Direct and indirect effects of glaciers on aquatic biodiversity in high Andean peatlands

Estefania Quenta Herrera*[1,2,3], Jorge Molina-Rodriguez[2], Karina Gonzales[2], François Rebaudo[3,4], Jérôme Casas[1], Dean Jacobsen[5,6], and Olivier Dangles[3,6]

[1]Institut de Recherche sur la Biologie de l'Insecte (IRBI), Université François-Rabelais, Tours, Tours 37200, France. – Institut de Recherche sur la Biologie de l'Insecte (IRBI), Université François-Rabelais, Tours, Tours 37200, France. – France

[2]Unidad de Limnología, Instituto de Ecología, Universidad Mayor San Andrés, La Paz, Bolivia. – Bolivia

[3]Institut de Recherche pour le Développement (IRD), UMR EGCE-UnivParisSud-CNRS-IRD-ParisSaclay, Gif-sur Yvette 91198, France – Institut de recherche pour le développement (IRD) – France

[4]Centro de Análisis Espacial, Instituto de Ecología, Universidad Mayor San Andrés, calle 27 Cota Cota, La Paz, Bolivia. – Bolivia

[5]Freshwater Biological Laboratory, Department of Biology, University of Copenhagen, Copenhagen, Denmark. – Denmark

[6]Pontificia Universidad Católica del Ecuador, Escuela de Ciencias Exactas y Naturales, 12 de Octubre, 1076 y Roca, Quito, Ecuador. – Ecuador

Abstract

The rapid melting of glacier cover is one of the most obvious impacts of climate change on alpine ecosystems and biodiversity. Our understanding of the impact of a decrease in glacier runoff on aquatic biodiversity is currently based on the "glacier-heterogeneity-diversity" paradigm, according to which, there is high α-diversity at intermediate levels of glacial influence due to the high environmental heterogeneity caused by glacier water. This α-diversity pattern generates high levels of between-site aquatic community variation (β-diversity) and increases regional diversity (γ-diversity).We investigated this paradigm by analyzing the different diversity patterns (α, β, and γ-diversity) of four aquatic groups (zooplankton, macroinvertebrates, algae and macrophytes) living in high-elevation peatlands ($>$ 4500 m above sea level). We sampled 200 pools from 20 peatlands along a glacier gradient in the Cordillera Real of Bolivia. We performed structural equation modeling (SEM) to analyze the potential mechanisms underlying the observed diversity patterns. Intermediate levels of glacial influence (15-20% cover) resulted in high heterogeneity, but α-diversity responded to glacial influence only for the zooplankton group (Cladocera). Our SEM analysis did not identify environmental heterogeneity as a significant variable explaining the relationship between glacier and α-diversity. Peatland area had a strong positive effect on heterogeneity and diversity. β-diversity was significantly associated with glacier gradient and 12.9% of the total regional diversity (γ-diversity) was restricted to peatlands with a high degree of glacial influence. These findings provide new insight into the potential effects of glacial retreat on the aquatic biodiversity in the peatlands of the tropical Andes.

*Speaker

Keywords: Glacial influence, aquatic biodiversity, high Andean peatlands, environmental heterogeneity, peatland area.