BARCHI Noah (2023): Seasonal pattern of benthic macroinvertebrate community structure and composition in a natural glacier-fed stream in the Swiss Alps

ABSTRACT

The few non-human-impacted Alpine river ecosystems are becoming increasingly precious hives of biodiversity and a valuable ecological resource for understanding the functioning of high mountain environments. Glacier-fed rivers, often wrongly regarded as unproductive habitats due to their perceived year-round harsh conditions, are actually important environments due to their unique spatio-temporal habitat template, providing a wide range of specific habitat conditions for Alpine benthic macroinvertebrate communities. Environmental characteristics within Alpine river systems change considerably in space and time, making the habitat network of the riverscape dynamic and heterogeneous. Consequently, the benthic communities inhabiting the Alpine watercourses show seasonal shifts in composition and spatial differences according to the specific properties of the habitat.

The dynamics of benthic macroinvertebrate community development in these environments are becoming better understood, yet systematic annual studies that address the seasonal pattern of macroinvertebrate structure and composition, and account for spatial heterogeneity of habitat conditions and suitability are rare.

To fill these gaps, the non-human-impacted glacier-fed mountain river Ova da Roseg (GR, Switzerland), fed by the Roseg Glacier and the Tschierva Glacier, and its tributaries were studied over a one-year period. The sampling campaign was conducted on a bimonthly basis, with a study design describing both the single communities of different alpine river habitats (i.e. kryal proglacial stream, kryal lake outlet stream, perennial krenal tributaries, temporary kryo-krenal tributary and kryal habitats in the floodplain) and the influence of tributaries on the glacial river.

Data showed a summer-winter reversal of the expected development and maintenance rhythms of macroinvertebrate communities in the glacier-fed river compared to lowland streams, with abundances, taxa richness and diversity indicating the presence of the window of opportunity for the development of benthic fauna during the cold season, with biodiversity peaking in mid-winter. Substantial spatial differences in macroinvertebrate community development were observed, reflecting the spatial heterogeneity of different river habitats and the different seasonal variations of environmental conditions between stream types. Glacial influence was found to be the main factor shaping the structure and composition of faunal assemblages throughout the year, with suspended sediments in water being the main environmental driver structuring the community and temperature playing a surprisingly secondary role, acting just as a filtering factor for community composition. Finally, this study revealed the importance of mitigating factors (e.g. proglacial lakes and tributaries) in maintaining biodiversity throughout the year, modifying the longitudinal continuum of the watercourse and stabilizing glacier-fed stream habitats. Even though tributaries did not appear to be a major mitigating factor, as significant direct colonization patterns of the glacial floodplain were not observed, they proved to be an important feature within the riverscape, providing refugia to macroinvertebrates during the harshest melting season and supporting the development of potential future colonists.