CASTELLI Aron (2023): The influence of physico-chemical conditions and food sources upon seasonal changes in the stability and persistence of benthic macroinvertebrate communities in a natural Alpine glacier-fed stream (Val Roseg, Swiss Alps)

ABSTRACT

Alpine streams are unique and important environments in high mountain settings, containing ecosystems with distinctive habitats and specific biotic communities. Instream environmental conditions are challenging for benthic fauna, mainly because physico-chemical attributes vary significantly across both spatial and temporal scales, resulting in complex abiotic mechanisms that control ecological processes in these rivers. The main purpose of this study was to assess the extent to which environmental factors influenced seasonal changes in the structure and composition of the macroinvertebrate community in a glacial floodplain, especially in relation to changes in the physico-chemical properties of the stream and the availability of food. This research aimed to define the most suitable period for the maximum development and maintenance of benthic macroinvertebrate communities, given the scarcity and imprecision of guidelines and theoretical models for the medium- to long-term ecological study of glacial rivers. Annual monitoring of seasonal benthic macroinvertebrate community dynamics was carried out by conducting bi-monthly sampling of chemical, physical and biological variables of a Swiss Alpine glacier-fed stream. indices of abundance, taxa richness, diversity, evenness and dissimilarity were calculated to characterise macroinvertebrate community structure. The multivariate statistical method of Principal Components Analysis (PCA) was used to characterise the physico-chemical environment of the stream and, together with correlation analysis, to distinguish seasonal habitat preferences of macroinvertebrate taxa. Carbon and nitrogen stable isotope analysis was conducted to investigate availability and sources of food and to assess variations in insect diets. Data analysis showed that winter to early spring was the time window of maximum development of the macroinvertebrate community. The stability of physico-chemical conditions of the winter flow, mainly due to groundwater contributions, and minimal glacial influence, in terms of turbidity and flow turbulence, were the main drivers of the high complexity and suitability of instream habitats for macroinvertebrates. Freezing winter water temperature was not a limiting factor, as excellent cold adaptation strategies were observed in most of the taxa. Isotopic analysis highlighted the importance of allochthonous organic matter inputs in the river system and the high feeding plasticity of benthic insects. The importance of allochthonous organic matter likely reflected low rates of instream winter photosynthesis and low rates of production and accumulation, due to flushing, of instream organic matter during summer months.