ECOLOGICAL RESPONSES TO AN EXPERIMENTAL INCREASE IN FLOW INTERMITTENCY IN AN ALPINE STREAM

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Abstract

More than one third of the world's rivers cease to flow and go dry on a periodic basis – so-called intermittent rivers. The frequency and duration of flow intermittency in running waters are increasing due to climate change and water demands for human use. Flow intermittency occurs naturally in alpine streams. However, changing rainfall patterns and glacier retreat are predicted to increase the occurrence of flow intermittency in alpine catchments, with largely unknown effects on ecosystem structure and function. Here, we continuously recorded water presence in 30 tributary streams and validated sensor performance with field-collected measures. Three different flow types of streams were found in the network: periodically intermittent, seasonally intermittent, and permanently flowing streams. Twenty-four streams (80% of recorded streams) dried at least once during the sampling period. To determine the effects of increased flow intermittency on aquatic communities and food webs, we conducted a flow manipulation experiment within a headwater stream of Val Roseg, a glacierized alpine catchment. We measured monthly changes in macroinvertebrate community composition, organic matter, and the trophic structure of macroinvertebrates. Compared with an adjacent reference channel, an increase in flow intermittency reduced macroinvertebrate density, taxa richness, and the proportion of rheophilic taxa. Density and richness remained lower in the manipulated channel after resumption of natural flow. Flow intermittency did not affect organic matter standing stocks, but increased assimilation of periphyton by aquatic macroinvertebrates. Predation on aquatic invertebrates by riparian spiders also increased. We attribute many of these patterns to the timing of drying, which likely excluded summer-growing cohorts of rheophilic, aerial dispersers. This study thus suggests that reductions in summer glacial melt and increasing flow intermittency could fundamentally change the diversity and function of alpine fluvial networks.

Keywords
Switzerland, glacial, macroinvertebrates, stable isotopes, food web, trophic structure