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Temporal scaling of high flow effects on benthic fauna: Insights from equatorial glacier-fed streams

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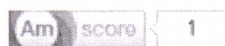
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Abstract

We used equatorial glacier-fed streams as a model system to investigate the relationships between flow fluctuation and benthic fauna at different temporal scales. Water level was measured at 30 min intervals over 29 months (942 d) and benthic macroinvertebrates were sampled 14 times over the study period. We performed wavelet analyses on water-level time series to identify temporal scales at which significant flow variation occurs, and calculated three indices: intensity, frequency and temporal clustering of the diurnal flow variation for periods from 2 d to 50 d. We determined the effect of temporal scaling (length of the periods considered) on relationships between benthic community dissimilarity (using Sørensen index) and differences in flow indices among the 14 sampling dates. Temporal scaling affected flow-variation frequency and temporal clustering and their subsequent relationships with benthic community dissimilarity. A time scale of 15 d before benthic sampling was relevant to the assessment of flow-biota relationships. Community dissimilarity significantly increased with increasing difference in flow-fluctuation intensity. This dissimilarity was associated with a decrease in the density of dominant taxa and a taxa turnover along the temporal gradient in flow-fluctuation intensity. Although

flow fluctuations are frequent and highly predictable in equatorial glacier-fed streams, macroinvertebrate communities exhibited a temporal variability in taxon assemblage, which was linked to the intensity of flow fluctuation. We explain these patterns by downstream displacement during high flow events and upstream displacement during low flow periods, thereby highlighting the need of considering temporal scaling effects on benthic fauna to understand the ecological dynamics of lotic systems.

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