Multiple Responses of Benthic Invertebrates to Hydropeaking Waves

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Abstract

Sudden instream releases of hypolimnetic water from hydropower plants with high elevation storage reservoirs cause abrupt increases in discharge (i.e., hydropeaking) and can cause abrupt variations in temperature (i.e., thermopeaking), typically on a daily basis. The propagation of the discharge and thermal waves are asynchronous, causing the benthic community to undergo two distinct but consecutive impacts. Because in experiments conducted in natural conditions it is difficult to disentangle the multiple effects of hydropeaking and thermopeaking, our research group started a set of experiments on the effects of hydropeaking and thermopeaking on benthic macroinvertebrates in an experimental structure of five steel channels directly fed by the Fersina Stream (left tributary to the Adige River). One hydropeaking event was simulated in 2008 with two increases of flow: abrupt and gradual. Invertebrates responded to the sudden increases with stronger intensity than to the gradual increase, with an increase of active (catastrophic) drift. Two cold and two warm thermopeaking events were simulated in 2008-2009. Macroinvertebrates responded to the disturbance by increasing in drift, with temporal drift density trend inversely related to changes in water temperature. Although the achieved changes in temperature were within the tolerability range for benthic invertebrates, their drift increased and was probably behavioral, given the immediate responses of invertebrates which seek habitat patches which are within their temperature tolerance and/or preference levels. Catastrophic and behavioural drift can occur as distinct events in hydropeaking-impacted streams, thus we analysed the effects of a hydropeaking wave followed by a thermopeaking wave in the same flume system. We observed that the slight but abrupt increase in discharge caused an increase in drift but the abrupt decrease in temperature caused a stronger response. The long-term effects of thermopeaking are mixed and synergical with those due to hydropeaking and, on the long-term, may alter the longitudinal distribution of benthic communities.