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The ecological effects of thermopeaking in Alpine streams in flume simulations

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In Alpine areas, the temporal patterns of hydropower plants operations can have consequences for the water bodies which receive downstream releases in the form of "hydropeaking", typically consisting in sharp releases of turbinated water in the river reaches below dams. Hydropeaking may significantly affect also the thermal regime of rivers: typically power plants fed by hypolimnetic releases from large dams cause a reduction in summer temperature and an increase in winter temperatures for long distances downstream. Very few studies have addressed the effects of the short-term temperature fluctuations related to hydropeaking (i.e., thermopeaking) on aquatic fauna, although they can be a major cause of riverine habitat degradation posing serious threats to aquatic communities.

In the Adige River watershed, warm thermopeaking occurs from September to January and results in additional (up to 4°C) heating to the natural dial fluctuations; cold thermopeaking occurs from March to July and cools down the temperature (up to 6°C), in contrast with the natural trend that would result in heating during the day.

The biological effects of thermopeaking are difficult to study in nature, because they are associated with hydropeaking, which is known to cause a high catastrophic drift due to the increased intensity of bed scour. However, controlled simulations of thermopeaking events could be performed in artificial flumes. We used artificial flumes which had proved to perform discharge manipulations which simulate hydropeaking events, and conducted four simulations, two warm thermopeakings in early and late winter, and two cold-thermopeakings, in early and late summer, respectively. The impact of thermopeaking on benthic macroinvertebrates was assessed by collecting those organisms which are displaced from the substrate and drift in the water column. Displacement can be active (i.e., part of the behavioural repertoire of certain insect species), or passive (i.e., catastrophic and generated by any disturbance). Drifting invertebrates were collected at time intervals before the simulation, and at continuous, short-time intervals during the simulation in order to follow the changes in drift over a short time period during the simulation.

We assessed the effects of thermopreaking on the benthos community by answering to the following questions:

1) Do thermal alterations induce an increase in drift of benthic invertebrates?

3) Do a reduction or an increase in water temperature have different effects of invertebrate drift?

Benthic invertebrates responded more to the cold thermopeaking simulations, with differences among taxa with different life strategies and ecological requirements.