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TITLE: INTERACTIONS BETWEEN HYDROPEAKING AND THERMOPEAKING WAVES AND THEIR EFFECT ON THE BENTHIC COMMUNITY IN FLUME SIMULATIONS

ABSTRACT BODY: M. C. Bruno1*, M. Carolli2, B. Maiolini1, A. Siviglia2, Zolezzi, G.2

1 Fondazione Edmund Mach, Research and Innovation Centre. S. Michele all'Adige, I-38010, Italy
2 Department of Civil, Environmental and Mechanical Engineering, University of Trento, I-38100, Trento, Italy
* cristina.bruno@fmach.it
In Alpine regions, hydroelectricity generation is a key power source and its ability to quickly respond to short-term changes in energy demand makes it an ideal source to meet the needs of the deregulated energy market. This economic need is reflected in the temporal patterns of dam operations with consequences for the water bodies that receive downstream releases in the form of 'hydropeaking', typically consisting of sharp water releases in river reaches below dams. The unsteadiness related to this highly intermittent phenomenon has cascading effects on both biotic and abiotic river resources. Regulation by dams may also significantly affect the thermal regime of riversespecially in mountain areas, where releases from high-elevation reservoirs are often characterized by a markedly different temperature from that of the receiving body, thus causing also sharp water temperature variations, named 'thermopeaking'. While interacting with external forcing, the hydrodynamic and thermal waves propagate downstream with different celerities and a first phase of mutual overlap is followed by a second phase in which the two waves proceed separately. The asynchronous propagation of the two waves produces two distinct but consecutive impacts on the benthic community. Because it is difficult to disentangle the multiple effects of hydropeaking and thermopeaking on benthic macroinvertebrates in experiments conducted in natural conditions, we conducted our studies in an experimental structure of five steel channels directly fed by an alpine stream, the Fersina, a tributary to the Adige River of northern Italy. We simulated two sets of cold and warm thermopeaking waves, and measured the induced responses on benthic macroinvertebrates, i.e., the active (behavioral) and passive (catastrophic) drift. Although the achieved changes in temperature were within the tolerability range for benthic invertebrates, their drift propensity increased threefold and fivefold, and twofold and fourfold in the two cold and two warm thermopeaking experiments, respectively. Drift was probably behavioral, given the immediate responses of invertebrates which seek habitat patches downstream, that are within their temperature tolerance and/or preference levels. Catastrophic and behavioral drift can occur as distinct events in hydropeaking-impacted streams, thus we analyzed the effects of a hydropeaking wave followed by a thermopeaking wave in the same flume. We observed that the slight but abrupt increase in discharge caused an increase in drift of elevenfold the basedrift, but the abrupt decrease in temperature caused a stronger response, of thirty-ninefold the basedrift. Our experimental results suggest that effects of thermopeaking are mixed and synergic with those due to hydropeaking, and in the long-term may alter the longitudinal distribution of benthic communities. Such complex responses should be taken into account in simulation studies, in modelling of aquatic ecosystems and in proposing remediation strategies to hydropeaking-impacted rivers.

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AUTHORS/INSTITUTIONS: M. Bruno, B. Maiolini, Research and Innovation Centre, Fondazione Edmund

Mach, San Michele all'Adige, ITALY;
M. Carolli, A. Siviglia, G. Zolezzi, Department of Civil, Environmental and Mechanical Engineering, University of Trento, Trento, ITALY;

CONTACT (E-MAIL ONLY): cristina.bruno@fmach.it

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