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Studies on the impacts of hydropeaking on hyporheic invertebrates of an Alpine stream

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Changes in flow regime associated with sharp discharge fluctuations when water is released from the hydropower plants into the streams (hydropeaking) have cascading effects on the ecological integrity of riverine ecosystems. Hydropeaking modifies the specific composition and longitudinal zonation of invertebrate populations downstream of the power plants through direct impacts on the benthic fauna due to scouring, which removes the animals through drift (i.e. the downstream transport of aquatic organisms under the effect of current velocity) and indirect impacts on the hyporheic zone, i.e. clogging of the interstitial spaces. Clogging occurs due to the reduction of flow and extreme flood events and by deposition of the fine material transported by the release of hypolimnetic water. Clogging reduces the throughflow and the concomitant delivery of resources, as well as the usable pore space for interstitial fauna, impacting the colonization dynamics of interstitial animals.
While the impacts of hydropeaking on benthic organisms have been widely investigated so far those on hyporheic fauna have seldom been studied. In a previous research conducted in the same stations discussed here, we investigated the effects of one single hydropeaking event on benthic and hyporheic invertebrates, and assessed that the hyporheic habitat was used as a refuge to avoid drift by part of the benthic organisms, and that hydropeaking reduced hyporheic diversity and abundance in impacted sites, especially affecting the stygobites (specialised subterranean forms, obligatory hypogean), which were significantly more abundant at the non-impacted site. We continued the investigations by studying the spatial (downstream from the disturbance) and temporal effects of repeated hydropeaking events on hyporheic communities.
We focussed on the specialization level of the organisms to life in the groundwater, based on the assumption that a reduction of the available habitat for stygobite taxa due to colmation would reduce their abundance. On the other hand, in reaches where the effect of increased discharge is the removal of benthic invertebrates through catastrophic drift, the abundance of the stygoxenes in the hyporheic would increase, because such organisms use the hyporheic habitat as a refuge.
Thus, our study aimed to assess the following working hypotheses for aquatic invertebrate responses to repeated hydropeaking waves:
1. Repeated hydropeaking events alter and reduce the habitat available to hyporheic organisms impacting the hyporheic invertebrate communities
2. The hyporheic habitat represents a refuge for benthic taxa to avoid catastrophic drift;
3. The disturbance caused by the turbinated water releases propagates several kilometres downstream.

The impact of repeated hydropeaking events was assessed in the Alpine stream Noce Bianco. Three stations were selected, one upstream and two at 0.25 km and 6 km downstream from a hydropower plant which causes 7-fold discharge increases. We collected hyporheic invertebrates for two years. The results confirmed our hypotheses: hydropeaking reduced hyporheic diversity and abundance in impacted sites, especially affecting the stygobites, which were significantly more abundant at the non-impacted site. Stygoxene invertebrates were exponentially more abundant at the impacted sites, indicating that the hyporheic habitat was used as a refuge to avoid catastrophic drift by part of the benthic organisms. The results were possibly due to the colmation of the interstitial space downstream of the power plant, caused by the deposition of the fine sediment transported by the turbinated water and the absence of natural peak floods.