The effects of supersaturation on benthic invertebrates in two Norwegian rivers

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ABSTRACT: Gas supersaturation occurs when the total dissolved gases (TDG) in a body of water exceeds what is possible to dissolve given the current temperature and pressure. The TDG of natural rivers hovers around 100% and can reach supersaturated levels up to 110% TDG for short periods in waterfalls, during rapid temperature heating, and during periods of intensive photosynthesis. Hydropower production can create prolonged periods of supersaturation above 110% TDG and can cause spikes in saturation reaching over 200% TDG. Aquatic organisms exposed to supersaturation above 110% TDG can develop gas bubble trauma causing lethal and sublethal effects on the organism.

We have for the first time investigated how abundance, diversity, and community composition of benthic invertebrates are affected by gas supersaturation in field settings. We sampled benthic invertebrates in unaffected habitats upstream and affected habitats downstream of the power plants Skibotn and Brokke hydropower plants, which are known to produce supersaturation in the rivers Skibotnelva and Otra, respectively. In the year before sampling 123 days with a TDG above 110% were recorded in Otra compared to 32 above 110% TDG in Skibotnelva.

Environmental variables were measured at each site, invertebrates were sorted and identified to species in the lab, and the dry mass of each sample was weighed. The results indicate that the density, diversity, and dry mass of benthic invertebrates were significantly lower in habitats affected by supersaturation in Otra, whereas the density was significantly lower and diversity was significantly higher in affected habitats in Skibotnelva. Most taxa were absent or had drastic decreases in density at affected sites in Otra compared to unaffected sites. These differences were likely due to longer periods of supersaturation at high levels in Otra compared to Skibotnelva. Benthic invertebrates perform ecosystem functions that are crucial to stream integrity. Changes in diversity, biological production and community structure caused by gas supersaturation are therefore likely to reduce the resilience of the ecosystems and affect the whole ecosystem.