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Small ecosystem engineers as important regulators of lake's sediment respiration.

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Although shallow lakes are covering only about 1.5% of the land surface of the Earth, they are responsible for sequestration of carbon amounts similar or even larger than those sequestered in all marine sediments. One of the most important drivers of the carbon sequestration in lakes is sediment respiration. Especially in shallow lakes, bioturbation, i.e. the biogenic reworking of the sediment matrix and the transport of fluids within the sediment, severely impacts on sediment respiration. Widespread freshwater bioturbators such as chironomid larvae (Diptera, Chironomidae) are building tubes in the sediment and actively pump water through their burrows (ventilation). In the present work we study how different organism densities and temperatures (5-30°C) impact on respiration rates. In a microcosm experiment the bioreactive resazurin/resorufin smart tracer system was applied for quantifying the impacts of different densities of Chironomidae (Diptera) larvae (0, 1000, 2000 larvae/m2) on sediment respiration. Tracer transformation rates (and sediment respiration) were correlated with larval densities with highest transformation rates occurring in microcosms with highest larval densities. Respiration differences between defaunated sediment and sediment with 1000 and 2000 larvae per m2 was insignificant at 5 °C, and was progressively increasing with rising temperatures. At 30 °C respiration rates of sediment with 2000 larvae per m2 was 4.8 times higher than those of defaunated sediment. We interpret this as an effect of temperature on larval metabolic and locomotory activity. Furthermore, bacterial communities are benefiting from the combination of the high water temperatures and bioirrigation as bacterial community are able to maintain high metabolic rates due to oxygen supplied by bioirrigation. In the context of global climate change that means that chironomid ecosystem engineering activity will have a profound and increasing impact on lake sediment respiration and carbon sequestration due to a warming world.