Experimental evidence of a low-oxygen refuge for large zooplankton

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ABSTRACT: We tested the hypothesis that hypoxic zones in the metalimnion and hypolimnion of lakes can provide a refuge against fish predation for large zooplankton. Experiments were run in a large indoor mesocosm system (Plön Plankton Towers). We compared mortality rates of *Daphnia pulicaria* due to free-ranging fish in mesocosms with either oxic or hypoxic hypolimnia. In the presence of fish *Daphnia* moved down below the thermocline. Under hypoxic conditions their distribution peaked in the upper hypolimnion at a concentration of approximately 1 mg O_2 L^{-1}. In oxygen-saturated hypolimnia *Daphnia* were distributed evenly. The mortality rate of *Daphnia* in the hypoxic treatment was only one third of that in the oxic treatment. The hypoxic habitat provided a refuge, as *Daphnia* tolerated lower oxygen concentrations than did fish. However, there may be demographic costs associated with living in low-oxygen conditions. Hence, the importance of a hypoxic refuge under natural conditions will most likely depend on the trade-off between predation risk and cost of living in hypoxic waters.

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