

Fish predators, food availability and diel vertical migration in *Daphnia*

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Abstract

Diel vertical migration of zooplankton is a highly variable and complex behaviour which apparently cannot be explained by any single factor. We determined the relative importance of fish predation, food availability and water depth in shaping the migratory behaviour of *Daphnia*. A modified 2×2×2 factorial experiment provided two levels of fish density (present/absent), food availability (ambient/high) and depth (4–10 m); shallow treatments with fish were excluded. Triplicate 1.2 m diameter enclosures for each of the six treatments were held in an 18 unit array in Peter Lake, Gogebic Co., MI, USA. Repeated measures ANOVA identified significant trends in daphnid density, migration and fitness (determined by lipid–ovary–egg index, LOE) as well as in chlorophyll *a* content of the water column for part of a 4-week experiment in July 1988. In deep enclosures with fish, *Daphnia* performed significantly more intense migrations than in fishless enclosures, save those in fishless ambient–food enclosures. *Daphnia* in deep fishless enclosures without abundant food at depth performed significantly reduced migrations. Daphnid LOE index was significantly influenced only by food content. Our results were consistent with the predator–avoidance hypothesis as well as with observations of greatest migrations where large vertical differences in food abundance exist. They support a hierarchical view of vertical migration, with presence of fish the primary factor, and food availability the secondary factor.