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Metabolic rates of a hypogean and an epigean species of copepod in an alluvial aquifer

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Abstract:

Reduced metabolic rates of groundwater taxa, compared to those of surface water species, have long been inferred to be an adaptive trait where there is a low and discontinuous food supply and unpredictable shifts between hypoxic and normoxic conditions. However, there have been neither measurements of the respiratory rate of groundwater copepods nor a comparison of rates between closely related groundwater and surface water species.
We measured the metabolic rates of two species of Cyclopoida: Cyclopidae, the stygobiotic (hypogean) copepod *Diacyclops belgicus* and the epigean *Eucyclops serrulatus*, which co-occur in the same alluvial aquifer. We expected the metabolic rate of the hypogean to be lower than that of the epigean species, irrespective of the ontogenetic stage, which would be consistent with the hypothesis that there is a generally lower metabolic rate in groundwater species.
The metabolic rate of *D. belgicus* was significantly lower than that of the epigean *E. serrulatus*, irrespective of the ontogenetic stage. We found an allometric relationship between oxygen consumption and body mass for *E. serrulatus*, an isometric one for *D. belgicus* juveniles and a rate of oxygen consumption that apparently does not change systematically with body mass for *D. belgicus* adults.
The low metabolic rate of *D. belgicus* may be advantageous in oligotrophic groundwater habitats, where large fluctuations in oxygen availability occur. However, these physiological adaptations can put hypogean species at risk of replacement by more metabolically active epigean taxa, whenever the availability of organic matter increases, as happens with organic pollution. Moreover, the low metabolic rate of the hypogean species may entail an inability to cope with toxicants, rendering them more sensitive to pollutants. A higher metabolic rate in juvenile *D. belgicus* compared to that of adults allows copepodids to mature quickly when food is briefly abundant.

Keywords: alluvial aquifer, copepods, groundwater, metabolism, oxygen