Subterranean Biodiversity: Ecology of a Chalk Aquifer

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INTRODUCTION

Groundwater is recognised as an internationally important resource for public water supply, agriculture and industry, but it also plays an essential role in the functioning of freshwater ecosystems. Despite supporting a diverse range of habitats and organisms, groundwater dependent ecosystems have received relatively little research attention and are rarely included in freshwater monitoring programmes.

STUDY METHODS AND RESULTS

This study surveyed the invertebrate communities inhabiting the aquifer and hyporheic zone of the Little Stour catchment (Kent, England) from 2009 until 2012 (n=377) to assess their distribution in relation to environmental gradients of water quality and flow permanence. More than one-hundred invertebrate taxa, including four stygofauna (groundwater-obligate species) and one previously undescribed amphipod, were recorded suggesting that these communities are an important component of overall catchment diversity. The distribution of these invertebrate communities was found to vary in response to environmental conditions and disturbance events, but that this response differed between habitats (Figure 1).

Invertebrate Communities within the Aquifer

The results suggest that the boreholes from which phreatic (aquifer) communities were sampled act as biological hotspots, providing habitat for a range of meiofauna, aquatic invertebrates and terrestrial invertebrates. However, only organisms displaying adaptations to the phreatic environment (such as a lack of pigmentation and reduced or absent eyes) were recorded from the aquifer .

The phreatic communities were found to respond to the hydrology of the surrounding catchment, increasing in abundance and diversity following periods of above average rainfall. Some species, such as *Niphargus kochianus kochianus* (left) were only recorded in boreholes, while others, such as *Crangonyx subterraneus* (right) were found in both boreholes and in the hyporheic zone of the nearby river, suggesting a continuum between these habitats.

The environment of the boreholes also provides a specialised habitat for species normally associated with caves (troglobites) such as *Folsomia candida* (below), an eyeless, terrestrial Springtail that was found on the inner walls of the boreholes throughout this study.

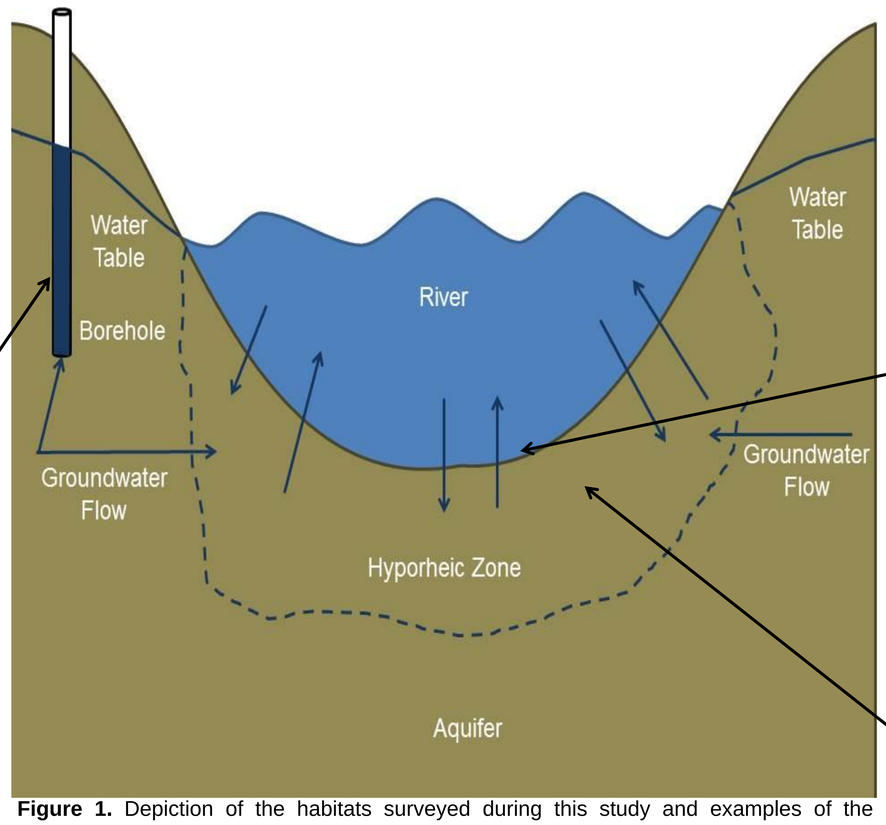

Figure 1. Depiction of the habitats surveyed during this study and examples of the ecological communities they support, including the boreholes drilled into the aquifer, the hyporheic zone and the benthic zone of the river bed.

Invertebrate Communities within the Hyporheic Zone

The hyporheic zone is the transitional interface between groundwater and surface water which provides a unique, highly oxygenated and thermally stable habitat. To better understand the organisms that inhabit the hyporheic zone, invertebrate communities from both the surface (benthos) and sub-surface (30cm) of the riverbed were sampled.

The results suggests that the benthic community declines in abundance and diversity during periods of environmental disturbance (such as drought and pollution incidents); however, some species, such as *Gammarus pulex* (below) were found to migrate into deeper sediments during such events.

The community recorded in the sediments below the riverbed was much less diverse than benthos; however, it was dominated juvenile benthic species and taxa adapted to this light and space-limited environment. Organisms occurring in the sub-surface, such as the Hydracarina (left) and *Niphargus fontanus* (right), have morphological adaptations that reflect their habitat - the small size of the Hydracarina facilitates its movement through small interstitial areas while the longer sensory appendages of *N. fontanus* allow it to thrive without eyes.

SUMMARY

This study demonstrates that groundwater supports a range of organisms both within the aquifer and the hyporheic zone which contribute to the complexity and diversity of lotic ecosystems. The results indicate that the phreatic, benthic and hyporheic communities respond differently to environmental disturbance, suggesting that all three should be assessed to determine the condition of the lotic ecosystem. A greater understanding of the distribution and response of these communities to environmental disturbance is essential for their conservation and improvement of integrated catchment management.

Further Information

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