Can the Karaman-Chappuis method significantly enhance understanding of stygofauna ecology?

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Abstract

Comprehensive surveys on subterranean fauna are an emerging need for assessing species diversity patterns and for developing biodiversity conservation strategies considering anthropogenic changes to the environment (e.g., mineral and water extraction, climate change). Subterranean habitats comprise mainly terrestrial and aquatic aspects of caves and fissures, as well as interstitial waters. Sampling stygofauna in Northern Western Australia is different to other parts of the world due to the predominance of meso- and micro-caverns, and thus methods are largely constrained to net hauling or pumping of either drill holes or bores installed for mineral or groundwater exploration. Water is also encountered at shallower depths beneath water courses (the interstitial or hyporheic zone) and although it is known to share fauna with subterranean systems, is largely excluded in stygofauna studies. Interstitial fauna can be sampled with the well-known Karaman-Chappuis (KC) method, which involves digging a hole in saturated alluvial deposits, letting interstitial water accumulate, and use of a scoop net to collect invertebrates. However, the application of the KC as a standard complementary method for stygofauna surveys has to date been largely unexplored. In collaboration with Rio Tinto, we included the KC method alongside traditional subterranean fauna sampling at five study areas in the Hamersley Range of Pilbara region, Western Australia. We aimed to determine its utility to better understand the ecology of subterranean fauna recorded, and therefore improve conservation outcomes. Here, we summarise the faunal groups collected using the KC method (43 samples) from surveys conducted between 2016 and 2019. We found that the stygofaunal groups more frequently collected by the KC method were Ostracoda (30.4%), Cyclopoida (28.0%), Haplotaxida (12.5%) and Amphipoda (10.7%), but other groups – Harpacticoida, Syncarida, Aphanoneura, Isopoda, Enchytraeida and Trombidiformes – were also collected in lower frequency (total of 4.9% of the records). Notably, the KC method also collected troglofaunal groups as by catch. Pauropoda (28.1%), Symphyla (21.9%), Hemiptera (12.5%), Diplura (12.5%), Zygentoma (9.4%) and Chilopoda (6.3%) were the groups most frequently collected using the KC method, but Isopoda, Palpigradi and Polyxenida were also recorded (total of 9.3% of the records). Additionally, for one project where low level taxonomic data was available (based on morphological and molecular identification), we also assessed differences in species composition of stygofauna sampled with the KC method (10 samples) compared to the traditional haul net sampling method (139 samples). We found significant differences in stygofauna species composition between the KC and haul net methods, with 13 species (out of 78 species) collected exclusively with the KC method. However, there was also a considerable overlap of species collected by the two methods (11 species). Despite the current limited data, our findings demonstrate that the KC method could be complementary to traditional stygofauna sampling methods. It also allows sampling of potentially connected groundwater habitats to occur beyond the areas drilled for minerals or water. While this method usually targets stygofauna, the collection of troglofauna as by catch is significant and provides a potential way to evaluate the ecology of troglobitic taxa. Further study is needed to assess the KC method as a valuable addition to sampling methods aiming to produce comprehensive inventories of stygofauna that integrate species found in interstitial subterranean environments.

Keywords

subterranean fauna, stygofauna, troglofauna, Karaman-Chappuis method, haul net sampling, insterstitial water, hyporheic zone, subterranean habitat, Western Australia

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Conflicts of interest