FOOD-WEB DYNAMICS THROUGH COMPOUND-SPECIFIC ISOTOPE ANALYSIS (CSIA): A STUDY OF WESTERN AUSTRALIAN (WA) STYGOFAUNA

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During the last decade, Compound Specific Isotope Analysis (CSIA) of Carbon ($\delta^{13}C$) and Nitrogen ($\delta^{15}N$) has been increasingly used to study food web composition and energy flow patterns within ecosystems (Grice et al., 1998; Du et al., 2015).

As demonstrated in several studies (Steffan et al., 2013; Chikaraishi et al., 2009, 2011), by confining the isotopic analysis to select amino acids (AAs), it is possible to define the food web structure based on the metabolic pathway of amino groups, permitting a much deeper evaluation of trophic dynamics. To date, the $\delta^{13}C$ and $\delta^{15}N$ CSIA approach has been employed to unravel the food web position of consumer species in marine, freshwater and terrestrial ecosystems (Chikaraishi et al., 2007; McCarthy et al., 2013; Hussey et al., 2015). However, the study of the trophic interactions and associated geochemical patterns is still in its infancy in groundwaters (Bradford et al., 2014). Indeed, the magnitude of biodiversity and the importance of groundwater ecosystems has only been recognised recently (Gibert et al., 1994).

Australia hosts a huge array of these cryptic groundwater environments and associated faunas. The calcrete aquifers of the Yilgarn region (WA) - secondary sedimentary deposits formed from the precipitation of calcium carbonate in palaeo river channels - harbour a myriad of short-range endemic stygofaunal species, including the world's largest biodiversity of subterranean diving beetles (Coleoptera: Dytiscidae) (Humphreys, 2008). However, these ecosystems may be affected by an aridifying climate and human activity such as water extraction for mining. The impact of the potential loss of these ecosystems is significant, as subterranean fauna provide ecosystem services including the maintenance of groundwater quality. Although these habitats are quite well-studied in term of taxonomic identification and phylogeography (Miller & Bergsten, 2016), many of the functional aspects of the ecosystem are poorly understood. To fill this knowledge gap, a detailed understanding of the trophic relationships and energy fluxes within the system is needed.

This investigation aims to assess the biogeochemical patterns within the stygofaunal community of two aquifers (Sturt Meadows and Laverton Downs) in the Yilgarn region of WA, by focusing on two main objectives: identify the energy sources within the ecosystem via $\delta^{13}C$ of AAs, and recover quantified information about trophic position of various subterranean fauna via $\delta^{15}N$.

According to the preliminary biodiversity results, the calcretes contain 8 recoverable taxa: 1 copepod, identified to subclass level; 1 isopod, identified to genus; and 3 dytiscids and 2 amphipods, identifiable to species level. Isopods were present only at Laverton Downs aquifer, with the diversity for rest of the community being the same in both aquifers.

To analyse the isotopic composition of the AAs, collected stygofauna will be subjected to acid hydrolysis to recover the amino acids. For the dyticids, single individuals can be analysed, while for the smaller taxa, individuals will be combined to achieve an adequate analytical weight. For $\delta^{15}N$, isotopic values of Glutamic acid and Phenylalanine will be measured following the methodology reported by Chikaraishi et al., (2007; 2011) in order to delineate the trophic relationships between higher consumers.

Measurement of $\delta^{13}C$ has been carried out across a suite of essential and non-essential amino acids via Liquid Chromatography–Isotope Ratio Mass Spectrometry (LC–IRMS). This data will be processed via pairwise comparisons to identify the differing contributions of plant and microbial carbon to the system.

The geochemical analyses will allow us to accurately characterise interactions within the subterranean fauna found in WA groundwater. While the research is being initiated in the Yilgarn, it will serve as a model for hundreds of others sites in the same region and in the Northern Territory which have faunas of similar composition.The significant resolution of our geochemical data framework, integrated with taxonomic, microbiological and genetic studies, will bring a thorough understanding of the ecosystem function within groundwater environments, and will inform the future management of these systems for both ecological and social benefits.

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