# Groundwater fauna

**Author:**

Dr Bill Humphreys, Western Australian Museum

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Groundwater fauna, or stygofauna, comprise the animals that live in underground water. It is made up predominantly of many kinds of crustaceans but includes worms, snails, insects, other invertebrate groups, and, in Australia, two species of blind fish. Most species spend their entire lives in groundwater and are found nowhere else.

Stygofauna include a number of higher order taxa (e.g., the class Remipedia, the orders Spelaeogriphacea, Misophrioida and Thermosbaenacea, and family Pseudocyclopiidae, all crustaceans) that are found nowhere else n Australia, sometimes not even elsewhere in the Southern Hemisphere (Jaume et al 2001). The entire suborder Tainisopidea is restricted to karstic groundwater of the Kimberley and Pilbara (Wilson 2003). Groundwater communities typically comprise species that are found only in very small areas and so they are vulnerable to changes. The species are often closely related to those on other continents, a pattern of relationship indicating they had a common origin on the ancient supercontinents of Gondwana and Pangaea or in the Tethys ocean that eventually emerged from the east with the opening of the Atlantic Ocean about

*Halosbaena tulki* (a thermosbaenacean crustacean) belongs to a genus known only from near coastal groundwater in north-western Australia and from either side of the North Atlantic (Canary Islands and Caribbean).

Photo Douglas Elford, Western Australian Museum.

200 million years ago (Humphreys 2000c).

Owing to their requirement for permanent groundwater and their ancient origins, the presence of stygofauna may indicate the long-term presence of suitable groundwater. This is because many species belong to lineages that are entirely confined to groundwater and so their presence there is considered to predate the break-up of the super continents and to indicate the continuous presence of groundwater throughout the subsequent climatic oscillations (Humphreys 2000a). Even the more recent colonisers of groundwater, such as the plethora of subterranean diving beetles invaded the groundwater 8-5 million years ago (Leys et al 2003). Thus, their loss will serve to indicate that groundwater conditions have changed more or faster than in previous epochs.

Groundwater fauna contribute substantially to the biodiversity of Australia. In addition, they may be functionally important in aquifers and, especially, in hyporheic zones, that zone of interaction between river water and the groundwater present in the banks and beds of rivers (Boulton 2000; Hancock 2002). Water abstraction, artificial filling and contamination of aquifers (including the clogging of pore spaces by the mobilisation of fine sediments) are threats to stygofauna (Hancock et al 2005), especially where groundwater drawdown of great areal extent may affect the entire distribution of short-range endemics. In only a few areas is the presence of stygofauna documented and so they are ignored by land managers and regulatory agencies: the cumulative effect of this ignorance of the presence of stygofauna is probably the most significant current threat to stygofauna.

The significant contribution that the coastal stygofauna makes to Australia's biodiversity was recognised early (Poore & Humphreys 1992) but the broader significance of stygofauna to the nation's biodiversity was appreciated only later with the recognition that stygofauna is diverse and widespread on the western plateau of Australia (e.g. Wilson & Keable 1999; Humphreys 1999, 2001b; Harvey 1998; Watts & Humphreys 2004; Bradbury & Williams 1997; Karanovic, T. 2004; Karanovic & Marmonier 2003) and with the collating of data from south-east Australia (Thurgate 2001). While there is an increasing literature on the characteristics, origins and distribution of Australian stygofauna (see reference list), for most regions of Australia, no data are available. The data show that Australia has a diverse groundwater fauna, but the focus of knowledge is in the rangelands, particularly in Western Australia where subterranean fauna are routinely considered in the environmental review process. However, limited research elsewhere indicates that significant stygofauna occur elsewhere in WA (Jasinska et al 1996; Eberhard 2004) in NT, SA, TAS, QLD, NSW and Christmas Island. Typically, each new area examined has a unique fauna requiring large taxonomic effort; often couple with molecular work, to determine the nature and origins of the fauna.

As knowledge of the composition and distribution of stygofauna is only emerging there are few places where even baseline conditions are known from which to start assessing conditions in future. There is need to establish such baseline conditions at a number of locations throughout continental Australia and oceanic island territories.

The main foci of research on stygofauna and hyporheic systems have been, respectively, the Western Australian Museum and University of New England, but in recent years this has broadened considerably with collaborative and new research groups forming in agencies (SA Museum, WACALM, Qld. Natural Resources & Mines ), universities (Western Australia, Adelaide, Flinders) and consultancy bases. Some broad-scale work has been conducted in the Kimberley and Carnarvon

Blind gudgeon, *Milyeringa veritas*, which lives in groundwater on Cape Range and Barrow Island.

Photo Douglas Elford, Western Australian Museum.

Basin, Yilgarn and a regional survey is underway in the Pilbara. In WA, small programmes are undertaken associated with development projects, especially in the rangelands (e.g. Finston et al 2004). Foci of groundwater fauna research are present or developing in NSW and QLD, and in SA. Recent doctoral theses on groundwater, karst and hyporheic systems (respectively Schmidt 2005; Eberhard 2004; Hancock 2004) and current graduate students indicates that research into these issues is expanding.

A key problem arising from sampling is a shortage of taxonomic capacity, in terms of both expertise and numbers. There is also no common information pool to combine data that are gathered by numerous and disparate groups, including government instrumentalities, academic centres and consultants. With drying climate, salinisation of surface waters and increasing population, groundwater is becoming an increasingly important resource, one already over utilised in places. Stygofauna could be used in both monitoring and maintaining aquifer condition.

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