An Eclectic Review of Subterranean Biology in Australian Waters

Dr Bill Humphreys

ABSTRACT

The last decade has seen a major shift in understanding of subterranean biodiversity in Australia. Two decades ago Australia was considered to be depauperate in subterranean fauna (cf Howarth 1988), a decade ago it was firmly established that the eastern seaboard, both tropical and temperate zones, had a rich subterranean fauna (Howarth 1988; Eberhard and Spate 1995; Eberhard et al 1995). It is now recognised that the arid zone and the "shield" regions of Australia also contain rich subterranean faunas, in both tradition (karst) and novel habitats.

Remarkable widely disjunct faunas inhabit salinity stratified near coastal aquifers (anchialine ecosystems) at Cape Range (Humphreys, 2000) and Christmas Island (Humphreys and Eberhard 2001), although the faunas themselves are quite distinct. The former-remiped community-has close affinities with anchialine habitats on either side of the North Atlantic while the latter-*Procaris* community-has affinities with the anchialine fauna of sea mounts (Bermuda, Ascension Island, Fiji, Hawaii).

Numerous subterranean communities comprising short-range endemic species are now known also from the "shield" regions (Pilbara, Yilgarn and Arunta Block) in arid Australia. However, these are found in areas not the traditional focus of biospeleological research in hyporheic (below river) groundwater and in groundwater calcretes in the palaeodrainage channels. The chains of salt lakes (playas) that form such a conspicuous component of the landscape of arid Australia are the surface expression of groundwater flows within the alluvial infill of ancient palaeochannels. Rainfall recharges the groundwater which flows towards the base level represented by the playa surface. The groundwater flowpath gradually comes closer to the ground surface and through which evaporation occurs. The resulting salinity gradient leads to CaCO3 precipitation (<3000mg L-1 TDS) near the groundwater surface and subsequently to gypsum deposition closer to the saltlake fringe. On a landscape scale this results in a series of isolated masses of limestone (calcrete) in the landscape immediately upflow of the playa (Humphreys 1999).

Groundwater calcretes are especially important in the Australian context as they form in arid climates (annual rainfall <200mm) with high potential evaporation (>3000mm per year), where rainfall is episodic and resulting in fluctuating groundwater levels. Thus groundwater calcretes are found throughout arid Australia and in Western Australian alone there are more than 200 major deposits (Humphreys 2001). These calcretes are widely referred to as karstic and the general models have them expanding, contracting and coalescing with changing climatic conditions.

Groundwater calcretes are the focus of considerable stygobite (obligate groundwater inhabitants) biodiversity and they have become a hot topic in the scientific and resource development area. Claims of a very speciose amphipod fauna in the Pilbara iron ore region (Bradbury 2000) are being disputed on the basis of allozyme data (Finston et al in press) in the same areas that new genera of ostracods are being described, each of which is known from only a single calcrete area. The calcrete fauna undoubtedly is best known in the Yilgarn where almost every discrete calcrete area examined have proven-based on both morphological and molecular evidence-to have a unique fauna (Cooper et al 2002). For example, these calcretes were invaded by numerous lineages of diving beetles at about the same time-molecular evidence indicates that this occurred in the middle Miocene-and within which subsequent speciation appears to have occurred (Leys et al 2002). There is a real need to obtain independent estimates of the age of groundwater calcretes but this seems to be an intractable problem.

Together, these faunas provide evidence for the past connections of Australia with Pangaea, Gondwana and Tethys and for the onset of aridity (Humphreys in press), and they make a major contribution to the biodiversity of Australia. They include a number of higher order taxa variously new to science (undescribed family of flabelliferan Isopoda), new to the southern hemisphere (Thermosbaenacea; Remipedia; Epacteriscidae; *Danielopolina* Thaumatocyprididae: Ostracoda), or new to Australia (Spelaeogriphacea; *Stygocyclopia*: Pseudocyclopiidae). In addition numerous new

genera and species of Amphipoda, Ostracoda, Copepoda and Coleoptera are being described by numerous researchers-particularly John Bradbury, Ivana Karanovic, Tom Karanovic, Chris Watts respectively-in an active process of investigation of these new and exciting stygal worlds.

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Contact details
Western Australian Museum, Francis Street, Perth WA 6000.