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Box 8.5 Exciting discoveries of new stygofauna

Finding new species or even new genera is always thrilling but when you record a whole new order, the excitement rises a notch! On my first aquatic collecting trip to the Pilbara for the Western Australian Museum in 1991, I sampled water in a cave at Cape Range, inland from Ningaloo, and found *Halosbaena*, representing the crustacean order Thermosbaenacea, a new record of this order for the Southern Hemisphere. This was just the first of many extraordinary findings that fellow collectors and I would make of a hitherto unexpected diversity of stygofauna (Humphreys 2008, 2012). Over the years, from various groundwater habitats, including the marine layer of Bundera Sinkhole (Box 8.4), we have found further higher taxa that were new records for the Southern Hemisphere, such as the class Remipedia, the order Misophrioida and the families Epacteriscidae and Ridgewayiidae. Later, using a special net hauled through the water in a borehole in the Fortescue Valley, WA, I collected a spelaeogriphacean, another crustacean order new for Australia and previously known only from caves in South Africa and Brazil, indicating a Gondwanan origin. Who knows what we'll find next?

Bill Humphreys, Western Australian Museum

Box 8.6 The biodiversity and uniqueness of Australian stygofauna

Drop a net down a well in some of the driest places in Australia and you have a good chance of sampling a new groundwater species. Stygofauna occur throughout arid Western Australia in various groundwater habitats such as calcrete aquifers and ancient fractured-rock aquifers. This region is a biodiversity hotspot for stygofauna, predicted to harbour over 4000 new and endemic species of which only about 10% are described (Guzik *et al.* 2011). In eastern Australia, groundwater habitats like the spectacular Jenolan Caves and alluvial habitats of rivers in the Great Dividing Range are also sites of stygofaunal biodiversity. Australia's stygofauna arose during a period of major climatic change. Inland Australia was once wet, but during the late Miocene/Pliocene (14–2 million years ago), much of the continent started to become increasingly arid. This process probably favoured groundwater organisms and appears to have driven an explosion in subterranean speciation. Interestingly, Australia's stygofauna also have direct faunal links to ancient Pangaea and Gondwana (e.g. Abrams *et al.* 2012). Such a long and complex evolutionary history has probably contributed greatly to the extraordinary biodiversity we see today.

Michelle Guzik, University of Adelaide

Box 8.4 Microorganisms in Bundera Sinkhole

Bundera Sinkhole, north-western Australia, is a groundwater ecosystem characterized by intense density stratification resulting from the subterranean intrusion of seawater from the coast. In addition to stratification by salinity, several other chemical and physical properties of Bundera Sinkhole are also stratified. This complex physicochemical profile influences and is influenced by the ecology of a diverse community of planktonic microorganisms. In the upper depths of the sinkhole, where light penetrates, phytoplankton photosynthesize and aerobic bacteria recycle organic matter. However, a few metres deeper, where light levels drop and oxygen is reduced, the microbial community shifts to one dominated by anaerobic and chemolithotrophic microbes, including sulfur-oxidizing, denitrifying and nitrifying bacteria. Each of these groups is spatially constrained within tight horizontal layers of the water column, resulting in discrete microbial niches, often separated by distances of only a few centimetres. Consequently, intense peaks in the abundance of specific microbial populations occur, sometimes evident as visible veils of organisms, including sulfur-oxidizing bacteria. The unique conditions within Bundera Sinkhole support and are supported by a rich and ecologically diverse microbial community, which ultimately underpins the productivity and function of this amazing ecosystem.

Justin Seymour, University of Technology, Sydney