Preface

Australia is unusual in having numerous habitat types with high levels of endemicity for invertebrates that have very restricted distributions. These are often referred to as short-range endemic taxa (*sensu* Harvey 2002, *Invertebrate Systematics* 16, 555–570). This phenomenon has previously been well-documented for high rainfall, isolated habitats such as oceanic islands and rainforest mountain tops, but it has generally been poorly studied for arid regions around the world. However, in recent years, several unique and very different habitats in the arid zone of Australia have been shown to have significant numbers of short-range endemic taxa associated with them, as outlined by Humphreys (this issue). These include: (1) mound springs of the Great Artesian Basin (GAB) – small isolated water bodies formed at the surface from water percolating through cracks under pressure from the GAB that contain numerous endemic invertebrates (see Gotch *et al*. – this issue) and fish; (2) calcrete aquifers of the Yilgarn and Pilbara regions of Western Australia and Ngalia Basin of the Northern Territory – semi-closed carbonate systems, isolated from each other and containing large numbers of endemic crustaceans, water beetles and other invertebrates (the so-called stygofauna) (see Allford *et al*., Cooper *et al*., Guzik *et al*. and Leys and Watts this issue); and (3) iron ore (pisolite) mesas of the Pilbara region – each of which comprises a large number of micro- and meso-caverns that contain large numbers of undescribed troglobitic arthropods (see Harvey *et al.* this issue). In addition, it is now emerging that Australia has a significant diversity of invertebrates associated with karst, fractured rock and alluvial aquifer systems (see Humphreys this issue), following recent discoveries in eastern (see Hancock *et al*. this issue) and southern Australia (R. Leys, pers. comm).

Although these systems are biologically very different from each other, it is apparent that they have numerous crucial environmental, scientific, economic and cultural attributes in common. For example:

- they are biological hotspots for high levels of endemicity;
- they represent very fragile ecosystems that in many cases are threatened by human activity such as mining or farming, either directly in the case of the iron ore mesas, or indirectly through the use of underground water by mining and pastoral operations;
- within the arid zone, they are habitats that have undoubtedly been shaped by past climatic change and are now isolated owing to aridification of the Australian continent;
- they serve as ideal models for the study of fundamental evolutionary and ecological processes, as has been shown for the calcrete aquifer biota (e.g. Leys *et al*. 2005, *Biology Letters of the Royal Society of London* 1, 496–499); and
- they are sites of significant cultural importance to aboriginal people.

In addition, the fauna associated with groundwater systems are likely to provide crucial ecosystem services to humans, such as water purification, bioremediation and maintenance of water flow (see Boulton *et al*. – this issue).

Given the importance of these habitats, the attributes they have in common and their intrinsic interest to a wide cross-section of the scientific and broader community, it is appropriate that the results of current research are brought together in one place. The idea of this special issue of *Invertebrate Systematics* was originally conceived during a meeting of the Working Group on The Diversity and Evolution of Troglobitic and Groundwater Ecosystems, funded through the Australian Research Council's (ARC) Research Network: Discovering the Past and Present to Shape the Future: Networking Environmental Sciences for Understanding and Managing Australian Biodiversity (Environmental Futures Network). As part of the activities of this group, we organised special sessions on troglobitic and groundwater biology at two conferences held during 2007: the 5th International Southern Connection Conference held in Adelaide in January and the Evolution 2007 Conference held in Christchurch in June, at which early versions of several of the papers here were presented**.**

The contents of this special issue cover a significant spectrum of research currently focused on these unique habitats and the fauna associated with them. We have grouped the papers by broad disciplines. The first deals with aspects of invertebrate diversity within ecosystems, their ecology and conservation – including one paper on the conservation implications for a group of cave spiders in Texas, the only study here with a non-Australian focus (Paquin *et al.* this issue). This section is followed by a series of studies that explore phylogenetic relationships and phylogeography for specific groups associated with three key habitats: mound springs in the southern Lake Eyre region of South Australia; iron ore mesas in the Pilbara region of Western Australia; and calcrete aquifers in Western Australia and the Northern Territory. The final group of papers deals with the systematics and biogeography of specific arachnid (Edward and Harvey, Platnick and Volschenk and Prendini this issue) and crustacean (Wilson this issue) groups in cave and groundwater systems. Significantly, one of these papers reports on the first record of an endemic member from the order Palpigradi for Australia (Barranco and Harvey this issue).

We hope that this special issue will foster a wider interest in these unique ecosystems, and that the research reported here makes a contribution to the management and conservation of their diverse and often highly unusual invertebrate fauna.

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