

## Subterranean fauna of Barrow Island

### Regional context

The species density of fauna and flora on the exposed limestones of the Cape Range peninsula and Barrow Island is exceptionally high for the region owing to the geomorphological diversity of the area. The surface biota is, nonetheless, unexceptional being essentially an arid zone biota with little endemism (papers in Humphreys 1993a). By contrast the subterranean fauna is exceptional as the below ground habitats have been buffered from the major surface changes associated with the onset of aridity.

The humid caves contain species that represent what is essentially a rainforest fauna in this now arid area and comprising species that are specially adapted to living underground. All the cave fauna is endemic and there is an exceptional degree of generic endemism.

The groundwater contains many relict taxa otherwise known from congeneric species in the North Atlantic and which represents a very ancient fauna associated with the Tethys Sea. The area contains the only representatives known in the southern hemisphere of entire classes, orders, families and genera of animals.

Barrow Island contains a diverse fauna of obligatory inhabitants of the subterranean realm, some of which are related to those inhabiting the coastal plain of the Cape Range peninsula (Humphreys 1994), while others are known only from Barrow Island. The fauna has mostly been discovered recently and is very sparsely documented; no information on such fauna is available for the other islands of the North West Shelf.

### The subterranean aquatic fauna

Obligatory inhabitants of underground waters — stygofauna — are found on Barrow Island.

This fauna contains families, genera and species not otherwise represented in Australia, nor indeed in the southern hemisphere, and as such it makes a significant contribution to biodiversity in Australia. The following taxa have been recorded (Table 1).

**Table 1:** The composition of the stygofauna of Barrow Island a characterised by two short visits in 1991-2.  
\* Apparently endemic to Barrow Island.

Major taxon	Genus and species	
Decapoda: Atyidae	<sup>1</sup> <i>Stygiocaris stylifera</i> Holthuis	
Isopoda: Cirolanidae	<i>Haptolana pholeta</i> Bruce & Humphreys	
Thermosbaenacea	<i>Halosbaena tulki</i> Poore & Humphreys	
Amphipoda: Melitidae	*Gen. nov. sp. nov. 2	Bradbury & Williams ms
	*Gen. nov. sp. nov. 3	Bradbury & Williams ms
	*Gen. nov. sp. nov. 4	Bradbury & Williams ms
	*Gen. nov. sp. nov. 5	Bradbury & Williams ms
	*Gen. nov. sp. nov. 6	Bradbury & Williams ms
	*Gen. nov. sp. nov. 7	Bradbury & Williams ms
	*Gen. nov. sp. nov. 8	Bradbury & Williams ms
Amphipoda: Bogidiellidae	*Gen. nov. sp. nov.	Bradbury & Williams ms
Amphipoda: Hadziidae	* <i>Liagoceradocus</i> sp. nov. 1	Bradbury & Williams ms
Syncarida: Bathynellacea	* <i>Atopobathynella</i> n. sp.	Schminke pers. comm.
Copepoda:	Various undetermined <sup>2</sup>	
Micro-turbellaria	Undetermined	

<sup>1</sup> Listed on *Schedule 1* i.e. fauna which is rare or likely to become extinct, of the *Wildlife and Conservation (Specially Protected Fauna) Notice 1994*. <sup>2</sup> A number of new species have been described from Cape Range peninsula (Pesce, De Laurentiis and Humphreys, mss).

Karst development is likely to occur to more than 100 m below current sea level owing to changes in sea level during the Pleistocene. All this habitat is likely to be populated by stygofauna — some species only occur below haloclines in low oxygen areas deep in such caverns (not sampled on Barrow Island), e.g. the remiped *Lasionectes* sp. nov (Yager and Humphreys in press), a genus known elsewhere only from the Turks and Caicos Islands in the Caribbean.

There is great potential for even greater diversity of stygofauna on Barrow Island judging by the sampling results to date. For example 11 individual specimens of amphipod were collected from 7 subterranean sites; this collection comprises nine undescribed species belonging to three families of amphipod, one family previously unknown in Western Australia. Additional major taxa are likely to be discovered owing both to the presence of conspecific populations on the Cape Range peninsula, and from the composition of comparable North Atlantic communities — such predictions have previously been successful with other taxa (Humphreys 1993b; Poore and Humphreys 1992; Wagner 1994).

In addition to the undoubted stygofauna there are a number of other taxa which have been recovered from open water habitats that contain stygofaunal species but which are of uncertain stygal, or even taxonomic, affinity.

Table 2: The affinities of genera from the stygofauna of north west of Western Australia. T= Tethyan distribution, G= Gondwanan distribution. \* present on Barrow Island

Taxon	Genus	Tethyan?	Affinities
<b>Crustacea</b>			
*Syncarida: Bathynellacea	<i>Atopobathynella</i>	Pangean	SE Australia, New Zealand, Chile
*Thermosbaenacea	<i>Halosbaena</i>	T	West Indies, Columbia, Canary Is (Poore and Humphreys 1992)
*Amphipoda: Hadziidae	New gen. & sp.	T	Barnard & Williams, in press
*Amphipoda: Melitidae	New gen. & spp.	T	Williams and Bradbury, pers. comm. 1995
*Amphipoda: Bogidiellidae	New gen. & sp.	Pangean	Bradbury, pers. comm. 1995
*Isopoda: Cirolanidae	<i>Haptolana</i>	T	Cuba, Somalia (Bruce and Humphreys 1993)
*Decapoda: Atyidae	<i>Stygiocaris</i>	T	Madagascar (Banareescu 1990)
Ostracoda: Halocyprida	<i>Danielopolina</i>	T	West Indies, Canary Is, Galapagos, Atlantic abyssal
Remipedia: Nectiopoda	<i>Lasionectes</i> sp. nov	T	Turks & Caicos I. West Indies.
<b>Pisces</b>			
Perciformes: Eleotridae	<i>Milyeringa</i>	?	?
Synbranchiformes	<i>Ophisternon</i>	?	Circum tropical (Mexican caves)

Other significant notes:

- The first record of the genus *Liagoceradocus* (Hadziidae) in the Indian Ocean area.
- The first record of the family Bogidiellidae in W. Australia and the only member of the family with eyes (collected 50 m underground!).
- The only record for Australia of the family Olibrinidae (Crustacea: Isopoda) is from Wapet Camp beach (Dalens 1993).

**Subterranean terrestrial fauna**

The obligatory subterranean fauna inhabiting caves and smaller air spaces (troglobites) of Barrow Island has endemic species but also has elements in common with the fauna on the coastal plain of the Cape Range peninsula (e.g. Humphreys 1994; Harvey and Humphreys 1995), but not with Cape Range itself. The affinities of the terrestrial troglobitic fauna lie with the litter fauna of closed moist forests, both temperate and tropical, that are today typically found on the eastern seaboard of Australia. The fauna is considered to be relictual, isolated from similar taxa by the onset of aridity in the late Miocene or early Pliocene and it contains some very ancient elements with clear eastern Gondwanan affinities (papers in Humphreys 1993a).

The terrestrial troglobitic fauna of Barrow Island has been recognised only recently. By

analogy with the fauna on the Cape Range peninsula, this fauna is probably rich, containing troglobitic species from many orders (Table 3). In addition there are many species not obviously troglomorphic but whose presence in this arid region is dependent on the subterranean habitat (Appendix 1).

**Table 3.** Significant components of the terrestrial cave fauna of Barrow Island. All the species have been found since 1991.

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- Cixiidae (Hemiptera) nymph (?gen.) with reduced eyes. The only other cave cixiids from the region are from Cape Range itself.
  - \* Anobiidae: Ptininae gen. nov., sp. nov.
  - The world's first troglobitic spiroboloid millipedes, an apparently endemic genus, *Speleostrophus nesiotus* Hoffman 1994 (Spirobolida: Pachybolidae: Trioniulinae).
  - In humid caves are found *Draculoides bramstockeri* (Chelicerata: Schizomida), the only genus of Schizomida endemic to Australia.
  - The world's most cave adapted cockroach, *Nocticola* sp. nov. (Blattodea).
  - A cycloctenid spider was collected from cave B-2 in 1976 by D. Lowry and is the first record of this family in Western Australia—it is typically a family of humid forests of temperate to tropical eastern Australia and New Zealand (M.S. Harvey, pers. comm. 1990).
  - Apparently endemic genus of terrestrial isopod — *Barrowdillo pseudopyrgoniscus* Dalens 1993 (Armadillidae: Buddelundiinae).
  - In dry caves an undescribed species of pseudoscorpion, *Oratemnus* sp. nov. (Pseudoscorpionida: Atemnidae).
  - Undescribed genus and two species of spider (Ctenidae)
  - Undescribed genus and two species of spider (Pholcidae)
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### Conservation

The contamination of groundwaters is a major problem worldwide, especially in eroded limestone (karst) areas, such as Barrow Island. As some groundwater contamination is likely to occur associated with oilfield operations, then the lack of information about the groundwater hydrology on the island could usefully be addressed. Petroleum products can move large distances in fractured limestone (Wilber 1969) and will eliminate cave fauna wherever it spreads in the karst system. A thin layer of light oil on an exposed water surface is highly visible but is rapidly lost through both evaporation, photic and microbial action. Oil entering karst systems, while being invisible, is persistent (*New Scientist* No. 1786: 22-26 [1991]) as there is no photic and little microbial action and, as it

evaporates in confined spaces, it may accumulate to toxic levels in the caverns.

Cave faunae generally, and schizomids in particular, are vulnerable to change in the water table (Rowland and Reddell 1981). Some cave systems have animals which are halocline specialists, for example remipedes found on the Cape Range peninsula (Yager and Humphreys in press), which are lost when there is a breakdown of marked salinity stratification such as would result from the disposal of saline waste water into the superficial karst (e.g. Bahamas). In consequence it is undesirable that either pure saline water or oil be deposited into the superficial karst and the World Conservation Monitoring Centre has cautioned against the practice (*New Scientist* No. 1794: 6 [1991]).

### **Environmental monitoring**

Shallow bores are a major asset for environmental monitoring, both of the groundwater and the subterranean ecosystem. All shallow bores could be sampled prior to use, and maintained patent after use as sampling points to monitor the subterranean community.

Many uncertainties could be addressed through a program designed to monitor old and new bores to establish the background diversity and distributions so that if found necessary the baseline data will be available against which to audit a major component of the island's biodiversity.

### **Status of the north-west subterranean fauna province**

#### **Aquatic fauna**

The fauna is of high national estate and scientific significance, and of great conservation value, being endemic to the Cape Range Group and highly disjunct from related fauna (which, for the most part, occur only in the Canary Islands and the Caribbean region). The fauna comprises a relict community derived from the ancient Tethys Sea (Humphreys 1993b, 1993c; Knott 1993) that separated the continents of Gondwana and Laurasia and which persisted from the Triassic until the late Eocene (200-40 Ma). It may well have been separated from its relatives with the break-up of Pangea and dispersed by seafloor spreading—in either case the fauna is very ancient.

#### **Terrestrial fauna**

The affinities of the terrestrial troglobitic fauna lie with the litter fauna of

closed moist forests, both temperate and tropical, that are today typically found on the eastern seaboard of Australia. The fauna is considered to be relictual, isolated from similar taxa by the onset of aridity in the late Miocene or early Pliocene and it contains some very ancient elements with clear eastern Gondwanan affinities (papers in Humphreys 1993a; Humphreys 1993d).

The troglobite fauna is entirely comprised of endemic taxa, often at the generic level (plus one family), to the Cape Range Formation and as such it makes a significant contribution to biodiversity in Australia.

Troglobitic animals are found extensively in Cape Range proper. A related but discrete fauna is found on the coastal plain which has some species in common with Barrow Island. Barrow Island appears to have many endemic elements.

#### **Overall significance of the fauna**

The Cape Range peninsula and Barrow Island have a high species density and exceptional endemism in its subterranean component (papers in Humphreys 1993a). Of the described specialist underground fauna known from the worlds tropics, *c.* 6.5% are known only from this area which comprises only 0.07% of Western Australia (*ibid.*).

Subterranean amphipods are an exceptionally diverse group world wide. Yet, despite very sparse sampling, Barrow Island is already known to contain *ca* 1% of the world's subterranean amphipod species!

Appendix 1: Sundry selected invertebrates collected on Barrow Island. Where the material has been examined sufficiently the following information is given: \* New species; \*\* new genus; † known only from Barrow Island.

Location	Order/Family	Genus	species
**† Outside B2: litter sample	Anobiidae: Ptininae	gen. nov.	sp. nov.
F53	Araneidae	<i>Argiope</i>	<i>protensa</i>
WAPET camp lower	Armadillidae	<i>Buddelundia</i>	<i>labiata</i> (B.-L., 1912)
**†K17; Second genus in sub-family Armadillidae: Buddelundiinae		<i>Barrowdill</i>	<i>pseudopyrgoniscus</i> Dalens
*	Atemnidae	<i>Oratemnus</i>	sp. nov.
*†Outside B6: litter sample	Chthoniidae	<i>Tyrannochthonius</i>	sp.
*†	Cixiidae		
*†Malouet Cave	Ctenidae	<i>Janusia</i>	sp.3
* Ledge Cave top of upper chamber	Hubbardiidae	<i>Draculoides bramstockeri</i>	Harvey & Humphreys
*†litter, cave B.6	Lepismatidae	<i>Acrotelsella</i>	sp.
*†Outside B6: litter sample	Lepismatidae	<i>Anisolepisma?</i>	sp.
*†litter, cave B.6	Lepismatidae	<i>Heterolepisma</i>	sp.
WAPET camp beach beneath stones	Ligiidae	<i>Ligia exotica</i>	Roux
Camp	Miturgidae	<i>Miturga</i>	sp.
*† lower (mud) chamber	Nocticolidae	<i>Nocticola</i>	sp.
*WAPET camp beach FIRST OLIBRINIDAE IN PACIFIC AREA	Olibrinidae		<i>Olibrinus</i> sp
*Outside B6: litter sample	Olpiidae: Olpiinae	2 genera	
litter, cave B.6	Oonopidae	? <i>Opopaea</i>	sp.
*Anchialine pool 0.9mm mesh	Ostracoda	<i>Agelaiella</i>	Daday 1910 sp. nov. Wouters
**†Ledge Cave.	Pachybolidae: Trigoniulinae	<i>Speleostrophus nesiotes</i>	Hoffman 1994
Ledge Cave upper chamber	Philosciidae	<i>Laevophiloscia yalagoonensis</i>	Wahrberg 1922
*†F Cave"	Pholcidae	<i>Trichocyclus</i>	sp. nov.
litter, cave B.6	Polyxenidae		
*Ledge Cave.	Reduviidae: Emesinae	<i>Ploiaria</i>	sp.1
S74	Reduviidae: Emesinae	<i>Stenolemus</i>	<i>giraffa</i> Wygodzinsky
*S74. cf N. Qld caves	Reduviidae: Reduviinae	<i>Centrogonus</i>	sp.1
S67	Tenebrionidae	<i>Brises</i>	sp.
K17	Trogidae	<i>Omorgus</i>	<i>dilatocollis</i> (Macleay)
S87	Zodariidae	<i>Habronestes</i>	sp.

