Threatened **invertebrates** —our forgotten biodiversity

Invertebrates are the poor relations when it comes to allocating resources for conservation. A close look at some threatened Western Australian species reveals astonishing and varied lifestyles and adaptations—and that much more scientific study is needed to prevent many species from becoming extinct.

by Andrew Burbidge

Left facing page
The native Pemberton snail has not been found since 1955. It may be extinct because of predation by introduced snails.
Photo – Jiri Lochman

Above Five species of cave-dwelling spider-like schizomids, including this *Draculoides* sp., are found only at Cape Range and Barrow Island.
Photo – Douglas Elford/WA Museum

Invertebrates (animals without backbones) make up more than 95 per cent of all living animal species, with perhaps 10 to 30 million species in total. Australia has about 6,000 species of vertebrates and about 100,000 species of invertebrate animals known to science, with an additional 200,000 or more undescribed invertebrate species. Most Australian invertebrates occur nowhere else.

Despite the vast majority of Australian animal species being invertebrate, they have received relatively little conservation attention. This is partly because of a lack of information on their taxonomy, biology, ecology and population numbers, and partly because invertebrates are not as noticeable as larger vertebrates such as mammals and birds. However, it is becoming increasingly clear that invertebrates are the key components of most ecosystems. Many arid ecosystems in Australia, for example, would not support their inhabitants without the termites that recycle nutrients. In this environment, termites perform a similar ecological role as the large ungulates (such as antelopes) of African grasslands.

Six invertebrate species are currently listed as extinct in Western Australia, and 77 as threatened. But because knowledge about our native invertebrates is so limited, the true number in danger must be severely underestimated.

Major threats

Clearing (habitat destruction) is the main reason for the loss of invertebrates. Land degradation is another problem; striking changes in Rottnest Island's vegetation since European settlement, for instance, probably caused the extinction of the Rottnest bee (*Hesperocolletes douglasi*). Salinisation resulting from clearing is still dramatically changing habitats in the Wheatbelt. The Department of Conservation and Land Management's (CALM's) biogeographic survey of the Wheatbelt, part of the State Salinity Strategy, predicts the extinction of hundreds of species of freshwater and terrestrial invertebrates if salinity is not controlled.

Introduced invertebrates have probably had a significant effect on our native wildlife. Invasive invertebrate predators include a species of snail from Europe, *Oxychilus* sp., which has become established in the south-west and is eliminating many native snail species. Predation by *Oxychilus* is thought to be at least partly responsible for the extinction of the Albany snail (*Helicarion castanea*) and the Pemberton snail (*Occirhenea georgiana*), neither of which have been found since 1955.

Introduced ants, such as the Argentine ant (*Linepithema humilis*), Singapore ant (*Monomorium destructor*) and coastal brown ant (*Pheidole megacephala*), have wiped out native ants from much of metropolitan Perth and are now turning up in bushland areas. Introduced earthworms are probably eliminating native earthworms. Several slug species have been introduced unintentionally and their potential as predators is currently unknown.

Many insect species are predicted to do immense damage in the near future to WA's native wildlife (and, incidentally, to our way of life) if they become widespread. European wasps (*Vespula germanica*) are already found occasionally in Perth. They have bright yellow and black bodies and are slightly larger than bees, which happen to be one of their favourite foods among other native insects. The red imported fire ant (*Solenopsis invicta*) has become established in suburban Brisbane during the last few years and poses an enormous threat to the Australian environment. These aggressive ants will eat almost anything, including other insects and the plants they rely on. As a result, Brisbane's native ants have already decreased in numbers.

Above Bundera Sinkhole forms part of the karst landscape of the North West Cape. Karsts often support communities of threatened invertebrates.
Photo – Peter Kendrick/CALM

Subterranean invertebrates

Whole communities of amazing life forms survive beneath the ground in complete darkness. Animals that live underground and are totally adapted to life in the dark are called troglobites. They lack functional eyes and have usually lost all their body pigment, appearing white or translucent. The terms troglobite or troglofauna are usually restricted to terrestrial species, whereas similar animals that live in groundwater are known as stygobites or stygofauna.

WA has large areas of karst—terrain with special landforms and drainage characteristics due to the greater solubility of certain rocks (notably carbonate rocks such as limestone, dolomite or magnesite) in natural waters. In karst landscapes, caves and other underground cavities readily develop due to water infiltration and movement. Consequently, they often contain troglobite life. Karsts also often support large numbers of localised species of terrestrial molluscs. The Nullarbor region is the largest karst area in the world. Other significant karsts occur on the North West Cape peninsula (including Cape Range), at Barrow Island, at Millstream in the Pilbara and in the southern and eastern Kimberley, where ancient coral reefs now outcrop as Upper Devonian limestone ranges—the Napier, Oscar and associated ranges and the Ningbing Range.

Ancient riverbeds are also important limestone and calcrete regions in WA. They are mostly found in the arid interior and flowed when the climate was much wetter than it is now. Recent research by Dr Phil Playford suggests that many ancient rivers (palaeorivers) flowed in valleys carved out by glaciers in Permian times (between 290 and 248 million years ago). Research at the WA Museum has shown that groundwater (whether fresh, brackish or saline) within these features supports rich communities of stygofauna, and that communities in different palaeorivers may be very different from each other. Stygofauna is also found in groundwater beneath rivers that still run after heavy rain, in the Pilbara for example, and in groundwater and surface water in caves in the south-west.

While research into the State's subterranean fauna is at an early stage, enough is known about a few of the communities and species for them to have been listed as threatened.

Scintillating schizomids

Bamazomus and *Draculoides* are small spider-like schizomids. The Schizomida are a distinct group of arachnids and very few species occur in the southern hemisphere. Five species of cave-dwelling schizomids, that lack eyes and eye spots, are found only in the caves of Cape Range and Barrow Island. All five threatened schizomids inhabit caves on the North West Cape peninsula and one of them, the Barrow Island draculoides (*Draculoides bramstokeri*), probably has the most evocative scientific name of any invertebrate in the State. It has been located in two caves on North West Cape peninsula and in caves on Barrow Island. *Draculoides brooksi*, *D. julianneae* and *Bamazomus vespertinus* each occur in a single cave. *B. subsolanus* was found in a limestone quarry. The Barrow Island draculoides is vulnerable, while the other schizomids are endangered.

Nullarbor spiders

A number of troglobitic spiders inhabit caves on the Nullarbor Plain. Four species of *Tartarus* are each restricted to a single cave, indicated by their common names: the Mullamullang cave spider (*T. mullamullangensis*), the Murdoch Sink cave spider (*T. murdochensis*), the Nurina Cave spider (*T. nurinensis*) and the Thampanna Cave spider (*T. thampannensis*). They build broad funnel-like webs, within which the spider sits head down and motionless on the rock wall of the cave. It is thought that the web forms a snare that catches walking prey, probably arthropods such as beetles, cockroaches, centipedes and isopods that also live in the caves.

The Nullarbor cave trapdoor spider (*Troglodiplura lowryi*) is found in two caves north-east of Madura, and in a

Right Cape Range remipede (*Lasionectes exleyi*).

Below right A blind shrimp (*Stygiocaris stylifera*).

Bottom right The threatened Camerons Cave pseudoscorpion (*Hyella* sp.), found only in a single cave near Exmouth.
Photos - Douglas Elford/WA Museum

cave near the head of the Bight in South Australia. It is the only known cave-dwelling mygalomorph (primitive spiders that include the trapdoor spiders) in Australia. The Nullarbor cave trapdoor spider does not seem to make a web, but hunts prey while moving around the cave.

All these species are threatened because of the impact of people visiting the caves and because the Nullarbor Plain has suffered significant degradation—due to weed invasion and removal of vegetation by rabbits and stock—resulting in a harmful increase in the volume of silt-loaded water flowing into the caves.

Stygobites of Barrow Island

Barrow Island is made of limestone, with many caves and underground cavities, and has a rich underground fauna; new species are still being discovered. As well as the species listed as threatened, there are many other poorly sampled and poorly known species of stygofauna, including copepods and other crustaceans. At least 25 stygofauna species are found on the island, and probably many more.

Ten species of stygobitic amphipod crustaceans are found in a narrow lens of freshwater that sits above salt groundwater under Barrow Island (recent research by CALM scientists suggests that some of them may also occur on the adjacent mainland, which was joined to Barrow Island about 8,000 years ago). Their presence here may be supported by, or even dependent upon, the petroleum deposit below the island. The Barrow Fault, which reaches the surface towards the southern end of the island, releases hydrogen sulphide in vents at the surface and into the groundwater, where sulphur bacteria are likely to carry out chemoautotrophic energy production. (A chemoautotrophic organism obtains its nourishment through the oxidation of inorganic chemical compounds, as opposed to photosynthesis.)

The production of oil on Barrow Island since the 1960s has resulted in considerable pollution of the groundwater, as 'produced water' (saline water that is mixed with the oil and then separated from it) is disposed of underground even though it still contains traces of oil. There have also been accidental oil, chemical and salt water spills. In recent years, most 'produced water' has been injected deeper underground than previously. The effect of this pollution on Barrow's stygobites, if any, is not understood.

Above the ground

More 'conventional' invertebrates are also under threat. The short-tongued native bee (*Leioproctus douglasiellus*) has a black body about eight millimetres in length, greyish wings with dark brown veins, and reddish-yellow mouthparts. This small native bee has been collected only at Pearce and Forrestdale Lake, near Perth

on the Swan Coastal Plain. Its life history is not known, but it seems to be dependent on the flowers of *Goodenia filiformis*, a rare plant that occurs on the Swan Coastal Plain and on the south coast from Cape Riche west to near Manjimup. It has also been recorded feeding on *Anthotium junciforme*, which occurs from Perth south to Augusta. The main threat to this species, which is endangered, seems to be habitat clearing. Further searching and study is required before the conservation requirements of this species can be determined.

The graceful sunmoth (*Synemon gratiosa*) has been found at just 13 locations on the Swan Coastal Plain, from Neerabup, north of Perth, to Mandurah in the south. However, during the last decade, it has been recorded only from Neerabup, Whiteman Park and the Koondoola bushland. This medium-sized, day-time-flying moth has bright orange hindwings and clubbed antennae. The diet of graceful sunmoth larvae is not specifically known, but sunmoth larvae in general feed on the underground parts of plants, including *Lepidosperma* and *Lomandra* species. Members of these two plant genera are reasonably common near Perth, so it is likely these are required to sustain graceful sunmoth populations. Adults are thought to feed on flowers.

Graceful sunmoths are endangered and threatened by land clearing for urban development. CALM has supported a grant application by the Western Australian Insect Study Society to search for and study populations of this species.

Top left Introduced ants, such as these Argentine ants, have caused the disappearance of many species of native ants from the Perth metropolitan area.
Photo – Jiri Lochman

Centre left Graceful sunmoth (*Synemon gratiosa*).
Photo – Terry Houston/WA Museum

Left A froglobatic leaf hopper (*Phaconeura* sp.) from the Cape Range area.
Photo – Douglas Elford/WA Museum

Right A tree-stem trapdoor spider burrow entrance.
Photo – Barbara York Main

Below Female tree-stem trapdoor spiders live for 20 years or more and spend their entire lives in the same burrow.
Illustration – Brad Durrant

Trapdoor spiders

Endangered tree-stem trapdoor spiders (*Aganippe castellum*) are small: only about 12 millimetres long. They dig their burrows against the stems of shrubs or trees. A silk tube lining extends above the ground and attaches to the tree or shrub, always with the rim facing up the stem and the burrow door opening away from the stem. A fan of twigs is attached to the rim, and the free ends of these twigs hang down to the ground. This nest structure leads prey to the burrow and is unique among trapdoor spiders (see 'Endangered', *LANDSCOPE*, Spring 2003).

Tree-stem trapdoor spiders occur in the central, eastern and northern Wheatbelt. Like most other trapdoor spiders, they are remarkable in that females spend their entire lives—20 years or more—in the same burrow, while males leave their burrows only to search for mates following autumn thunderstorms. Clearing for agriculture has destroyed most of their habitat. The few, small populations that remain could easily be destroyed by road building, gravel extraction or hot fires. Recruitment is slow and dispersing juveniles cannot move between vegetation remnants.

The trapdoors built by Minnivale trapdoor spiders (*Teyl* sp.) are an adaptation against flooding. The vertical burrow is closed at the surface with a door, and has a side shaft that is also closed by a door. The burrow is deep (the first one excavated went down 33 centimetres) with a close-fitting, plug-shaped lid that is extremely difficult to observe when closed. Minnivale trapdoor spiders are active only in winter. Open holes are sealed with soil in the spring, and then remain closed until the following autumn/winter rains.

The Minnivale trapdoor spider is known from only two localities in the northern and central Wheatbelt of WA. The former distribution of the species is thought to have been over a narrow band, roughly between Minnivale and Mellanbye in 'perched' swamps on high terrain—an area that is now mostly cleared for agriculture. This species is critically endangered and may even be extinct. CALM prepared an Interim Recovery Plan for this spider in 1999. At that time, a single occupied burrow was known in an area of remnant vegetation near Minnivale. The plan's main actions were to protect this burrow and search for additional populations. Since then, the spider in the burrow has either died or, if it was a male, left the burrow during the mating season. Extensive searches in 1999 and 2001 did not uncover any new populations.

Invertebrate conservation

These are just some of the threatened invertebrates described in a book to be published by CALM in mid-2004. Because so little is known about our native invertebrates, it can only hint at these intriguing creatures and their lifestyles. At present, comparatively few resources target invertebrate conservation. Unless society directs more resources towards the study of invertebrate animals, we may never have the opportunity to describe and name many of these species, let alone appreciate their importance to our environment, before they are lost.

Andrew Burbidge is a Research Fellow at the Department of Conservation and Land Management's Wildlife Research Centre at Woodvale where he can be contacted via email (andrewb@calm.wa.gov.au). Andrew has been involved in the conservation of threatened species for more than 30 years.

Volume 19 Number 2 SUMMER 2003–04

contents

Regulars

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Marketing Estelle de San Miguel
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Subscription enquiries
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Prepress Colourbox Digital
Printing Lamb Print, Western Australia
© ISSN 0815-4465

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Published by the Department of Conservation and Land Management, 17 Dick Perry Avenue, Kensington, Western Australia.