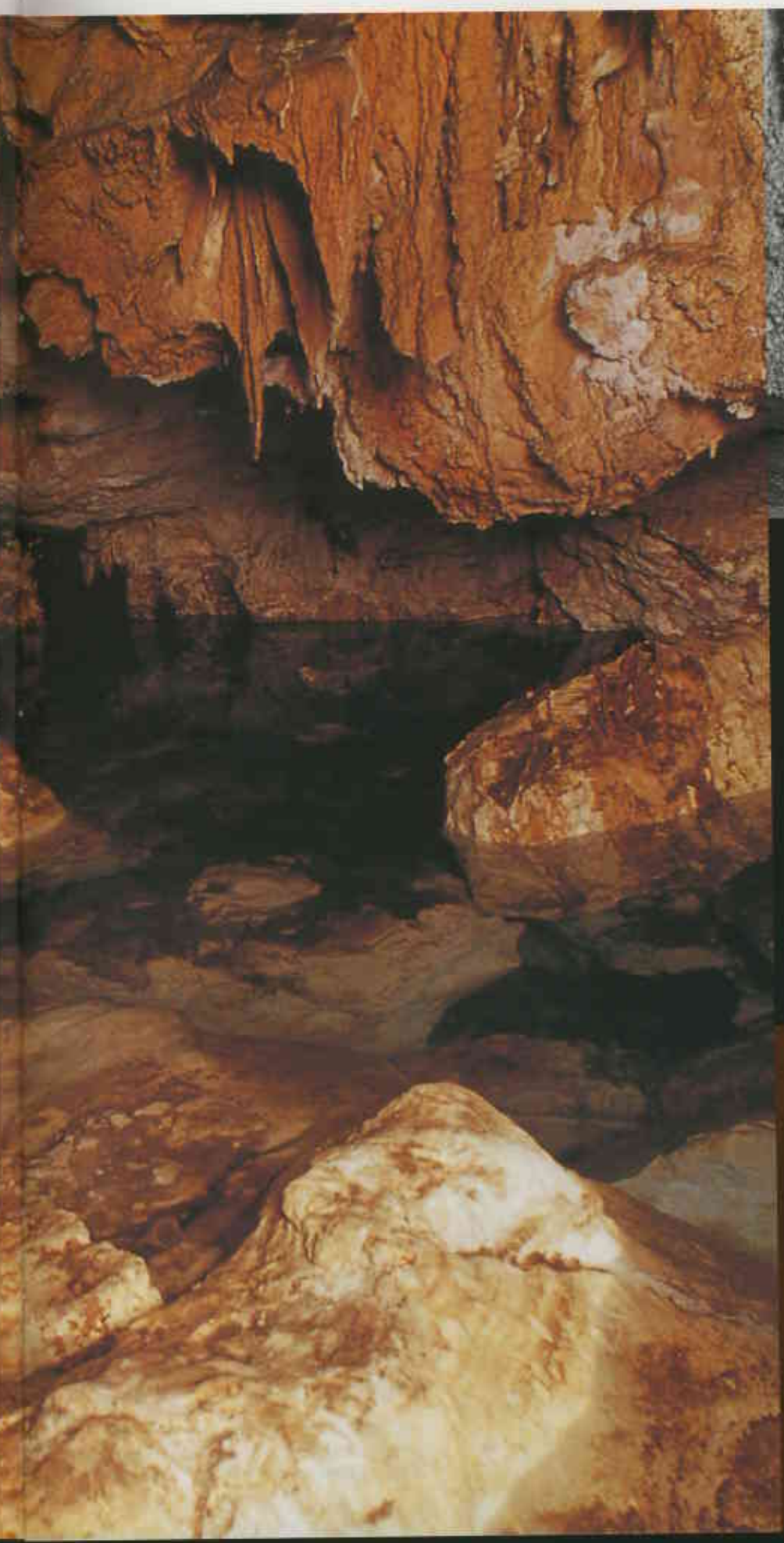
Threatened wildlife of the Yanchep caves



Beneath the Earth's surface, in the caves of Yanchep National Park, lives an amazing community of night fish, gilgies, leeches, beetles, mites, microscopic worms, snails and crustaceans. However, this unique underworld is seriously threatened by declining water levels caused by a range of factors. Can it be saved?

by John Blyth, Edyta Jasinska, Lyndon Mutter, Val English and Paul Tholen
Photographs by Michael James

Most dark zones of caves throughout the world are inhospitable places for animals to live in. This is mainly due to the lack of a reliable food source, because no plants will grow without light. Typically, all food must come from outside the caves in the form of washed-in debris, bat and cricket guano and dead animals. Known exceptions are caves in which bacteria use hydrogen sulphide as an energy source, and caves that contain tree roots.

In Western Australia, there are two areas (at Yanchep and on the Leeuwin-Naturaliste Ridge) that have relatively shallow caves containing mats of fine tree roots reaching down into streams and pools within the caves. These root-mats provide both food and shelter for numerous aquatic cave animals. Ancient species occur in the root-mats of both Yanchep and Leeuwin-Naturaliste cave waters (see 'Endangered', *LANDSCOPE*, Winter 1998). Edyta Jasinska and Brenton Knott, of The University of Western Australia (UWA), have studied these caves since the early 1980s.

The remarkable root-mat fauna consists mainly of invertebrates (animals without backbones), but night fish (*Bostockia porosa*) were also found in some of the Yanchep caves. A small number of ancient species are found only in a few (or just one!) of the Yanchep caves, and nowhere else. These caves are the only known location of at least six Gondwanan relicts—species whose ancestors existed when Australia was part of the supercontinent Gondwana, about 55–160 million years ago. None of these Gondwanan relicts would be able to survive the drying out of their habitat.

YANCHEP CAVE SYSTEM

The Yanchep caves occur at the junction of two ancient dune systems: the Tamala Limestone (Spearwood Dunes) and the silicon-rich sands of the Bassendean Dunes that underlie the Tamala Limestone in this area. The water in the caves comes from the Gnangara Mound—a shallow aquifer, held largely within the Bassendean dunes as if in a giant sponge (see key to landforms on page 37). In the area of Yanchep National Park, the water table coincides with the boundary between the surface limestone, five to 20 metres thick, and the underlying sands. This is also where an extensive development of caves occurs. The limestone and caves in the area formed between about 800,000 and 500,000 years ago.

Within the caves, the waters form a system of shallow streams, a number of them permanent and mostly only two centimetres deep. Channels up to 20 centimetres deep occur along the banks and in the narrowest sections of the streams. Being so shallow, these cave streams are extremely susceptible to changes in the level of the groundwater that feeds them, but 10 years ago groundwater levels varied very little. In fact, until the 1990s, all physical and chemical conditions of these cave stream waters were very stable, due to the substantial pressure and flow provided by the Gnangara Mound, with little direct contribution from rainfall. The freshness and low levels of ions in cave streams are typical of waters of the Gnangara Mound.

The fact that Gondwanan relicts occur in caves that were formed long after Gondwana broke up seems to be a paradox. However, it is believed that the animals, or their ancestors, lived in surface waters such as peatlands and springs on the ancient Darling Plateau.

Previous page
Main: Water Cave showing the current water level.
Inset: Close-up of the Crystal Cave crangonyctoid (*Hurleya* sp.).

Above left: The Crystal Cave crangonyctoid is critically endangered.
Photos – Edyta Jasinska

Left: Root-mat close up showing new growth (white shoots), Cabaret Cave.

During the last six million years, the permanently moist habitats of the Darling Plateau progressively dried and, about two million years ago, the Swan Coastal Plain emerged from the ocean. During later interglacial periods, the coastal climate was very wet and animals would have been flushed out of springs and wetlands down the Darling Scarp.

After the Yanchep caves began to form about 800,000 years ago, some of the animals would have been able to make their way to them through swamps and creeks. There, during the dry glacial periods, the animals would have moved into the caves seeking permanent water. They could have eventually come to live only in caves with permanent water and a reliable food source (the root-mats), having died out elsewhere as the permanent water on which they relied had virtually disappeared.

UNDERWORLD

The Western Australian Speleological Group has recorded more than 400 caves in Yanchep National Park, but only 10 to 15 contain permanent water, and only six of these are known to contain root-mats.

All of the roots that grow into the six caves at Yanchep belong to tuart trees (*Eucalyptus gomphocephala*). The root-mats in these caves provide a reliable food source, as well as shelter, and allow a complete and intricate miniature ecosystem to exist. The roots fringe the cave streams and form dense mats about 10 centimetres thick and 15 centimetres wide. A handful of the root-mats can contain about 500 animals. Microscopic fungi grow within the tissues of the fine roots and probably increase the nutritional value of the mats.

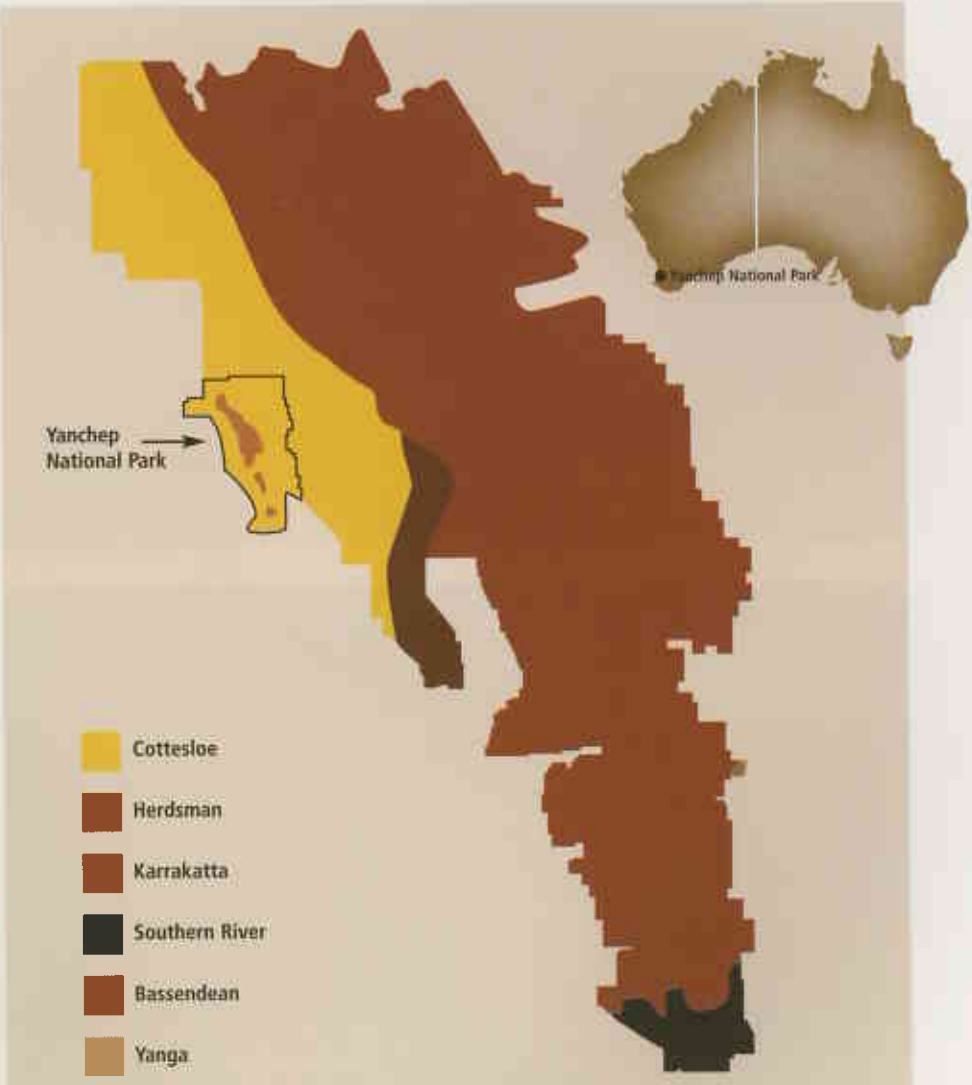
The cave fauna at Yanchep includes night fish, gilgies, leeches, beetles, mites, microscopic worms, snails and crustaceans. When first examined in detail, these six caves each contained 30 to 40 animal species. In total, about 100 species occur in the Yanchep caves. This is the greatest species richness known for aquatic cave habitat anywhere in the world (three to six species tends to be the norm for cave waters without root-mats). About a third of the 100 species are newly discovered, including the Gondwanan relicts.

Even though the caves that contain the root-mat community are only separated by distances of 100 to 1500 metres, and are fed by the same water mound, they all contain at least one species that is found in no other cave. Little movement of animals between different caves is known, and some animals appear to be still evolving.

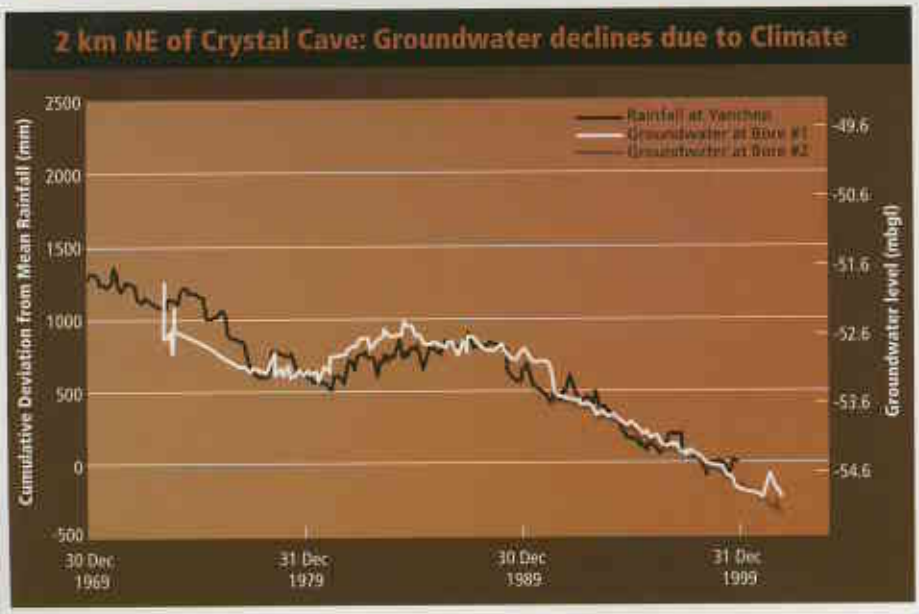
DECLINE OF WATER LEVELS

Since around 1976 the water level at the top of the Gnangara Mound has dropped by about five metres. Water and Rivers Commission analysis suggests that much of this decline has been caused by below-average rainfall between

Right: Paul Tholen, Ranger (Nature Conservation) at Yanchep National Park, standing next to a tuart tap root in Crystal Cave.



Key to landforms within the Gnangara Mound



then and now (see graph on page 38).

However, zoologists familiar with the cave community believe that climate cannot be solely responsible for the loss of the permanent streams in the Yanchep caves. During the last glacial period (around 17,000 years ago) the climate was much drier than at present, yet the Gondwanan relicts persisted in the caves. They could not have done this if the cave streams had dried out. This suggests that it is the combination of lower rainfall and increased use of water, by public and private water abstraction and pine plantations, that has been critical in the recent drying of cave streams.

The hydraulic pressure head maintaining the Yanchep cave streams is no longer sufficient to keep the streams flowing in summer. Clarification of the contributions of the various factors to declining water levels is needed and studies are continuing.

The graph shows the close correlation between rainfall and water levels close to the Yanchep caves. An upward slope in the rainfall graph indicates rainfall above the long-term average, and a downward slope indicates below-average rainfall.

The volume and speed of water movement in cave streams has also fallen. The water level in Crystal Cave, which contains a threatened Gondwanan relict called the Crystal Cave crangonyctoid (an amphipod crustacean) but has no root-mat community, dropped by 25 centimetres between 1987 and 1997. This cave is very close to two of the root-mat caves.

The stream in Gilgie Cave (originally one of six root-mat caves at Yanchep) dried out completely in 1996, for the

Top left: Cabaret Cave area showing the tuart forest surrounding limestone caves.

Centre left: This pond containing Crystal Cave crangonyctoids is regularly excavated to follow the declining groundwater table. The plastic surround holds back the sandy stream bed to minimise the chance of collapse

Left: Rainfall (black) and groundwater levels (white and brown) at Yanchep from 1969 to 2000 (from Yesertener, C, 2002, with permission).

first time recorded, and recording of cave stream levels began in the early 1900s. When flow returned to Gilgie Cave in spring 1996, none of the larger animals, including the Gondwanan relicts, had returned to the cave stream three months after it began flowing again. So it appears that one out of the six occurrences of the root-mat community has been lost.

Water levels have continued to drop. From 1998 onwards, more cave streams containing root-mats have stopped running in summer, and extra water has been pumped into them to prevent them drying out completely.

RECOVERY ACTIONS

The community was listed as Critically Endangered, a Recovery Team was established and a draft interim recovery plan was developed by the end of 1997. The Recovery Team recommends both emergency actions and ongoing management to help improve water levels in the caves in the longer term.

Many organisations need to be involved in helping to conserve the root-mat community. The Department of Conservation and Land Management manages the caves and their animals, the Water and Rivers Commission monitors and maintains the levels and water quality of the Gnangara Mound and regulates its use, and the Forest Products Commission manages the pine plantations that use Gnangara Mound water. The Recovery Team includes representatives from each organisation, as well as scientists and other interest groups, such as the Water Corporation and the Western Australian Speleological Group.

A number of long-term measures have been implemented. The pine plantations in the catchment for the caves—about 15,000 hectares—are being thinned to a density that uses a similar amount of water to that used by the original vegetation. This target is likely to be reached by the agreed date, in late 2002. Monitoring of root-mat animals in the Yanchep caves is undertaken each year. Brenton Knott and Andrew Storey of UWA carry out this work, funded by the Water and Rivers Commission. The results of this, and of the water level monitoring, are reported to the Recovery Team. Monitoring, analysis and modelling of water levels to allow better understanding of what is needed to maintain levels that will conserve the root-mat community will continue. Monitoring wells were established in 1995 and 1996, both in the caves and upstream of them.

In addition to the long-term measures, Yanchep National Park staff have undertaken a number of emergency actions.

Four of the five caves with living root-mat assemblages now have watering systems to prevent the pools and root-mats from completely drying out. These are made up of lined pools with water pumped into them from soak-wells installed in the base of the caves. A float switch maintains water levels in the root-mat pools. Monitoring of the pumping systems requires an average of three visits per week, with a greater frequency over summer. Upgrading of liners, pumps and batteries has continued for the last three years. Water level probes have been

Above: Monitoring groundwater levels, Crystal Cave.

Above right: Paul Tholen with remedial water pumping and trickle feed set up on a section of root-mat to maintain water flow at Cabaret Cave.

Right: Pine plantation south of Yanchep National Park.

installed in the most dangerous caves, so as to limit the number of visits required.

The November 2000 results of fauna monitoring suggested that the watering systems were keeping the original animals in root-mat caves alive. However, groundwater levels have continued to fall—2001 was a very dry year—and some streams did not run even through the winter. Results of the spring–summer 2001 monitoring indicate that the condition of the root-mats, and the abundance and species diversity of animals, in the remaining five root-mat caves had declined, despite the watering systems having kept water in the pools.

In response to the recent monitoring report, and with advice from a consultant hydrogeologist, Yanchep staff have upgraded the watering systems to supply more water and get at least some water flowing through the root-mat pools.

In addition, the department has committed new resources to investigate and implement even more robust systems that can be easily monitored to determine the health of cave pools. This money will be spent on Crystal Cave, to protect the Crystal Cave crangonyctoid, on Cabaret Cave, which originally contained more species of animals than other root-mat caves, and on Water Cave, which still contains water. The methods developed can then be applied to other caves.

Left: A yabby in Water Cave. These introduced crustaceans threaten the rare root-mat creatures.

Below: Paul Tholen in Water Cave, looking at bands of limestone showing various water levels in previous seasons.

THE FUTURE

Other threats to the root-mat community include the potential death of tuart trees that provide the root-mats, vandalism, cave collapses and introduced animals such as yabbies (*Cherax destructor*). Nevertheless, if the current upgrading of water supply systems is able to maintain the root-mat community in the five caves in which it still occurs, and if there is an eventual change back to higher rainfall, the prospects for this remarkable assemblage of invertebrates would be good. However, the longer the dry conditions last, the lower the water levels will become, and the more difficult it will be to keep the root-mat community alive.

The pine trees on the Gnangara Mound are an important resource to the State and worth many millions of dollars, as is the water for public and private use. Nevertheless, reduction in the water used by these two factors is likely to benefit the root-mat community. The recovery team is looking at how further reductions might be achieved. For instance, the pine plantations are now being harvested, and will eventually be largely replaced with different vegetation that will use less water. Speeding up that process could contribute to the recovery of the Yanchep root-mat community.

The pattern and management of future land developments, particularly to the east of the caves, may determine whether or not the quality and level of the cave streams can be maintained. Sustainable management of Gnangara Mound water will be crucial in determining the future of the root-mat community.

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LANDSCOPE

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An exciting range of recreational opportunities are being offered in some national parks, creating employment for locals. See page 28.

Native animals need tree hollows and people need wood. How are these conflicting uses managed? See page 20.

The search to find out the cause of a new tree killer known as Mundulla Yellows. See page 41.

Declining water levels threaten a remarkable community of cave-dwellers in Yanchep National Park. Turn to page 34.

Re-discovering the long-forgotten memoirs of a Kimberely pioneer. See page 48.

COVER

Leafy seadragons are occasionally seen in the seagrass around the Busselton Jetty (see page 10). They are in the same family as seahorses but, unlike seahorses, they have leafy appendages that make them almost invisible in their surroundings. The male carries the eggs in the skin beneath his tail. After hatching, the young swim off to fend for themselves.

Cover illustration by Philippa Nikulinksy

FEATURES

REGULARS

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