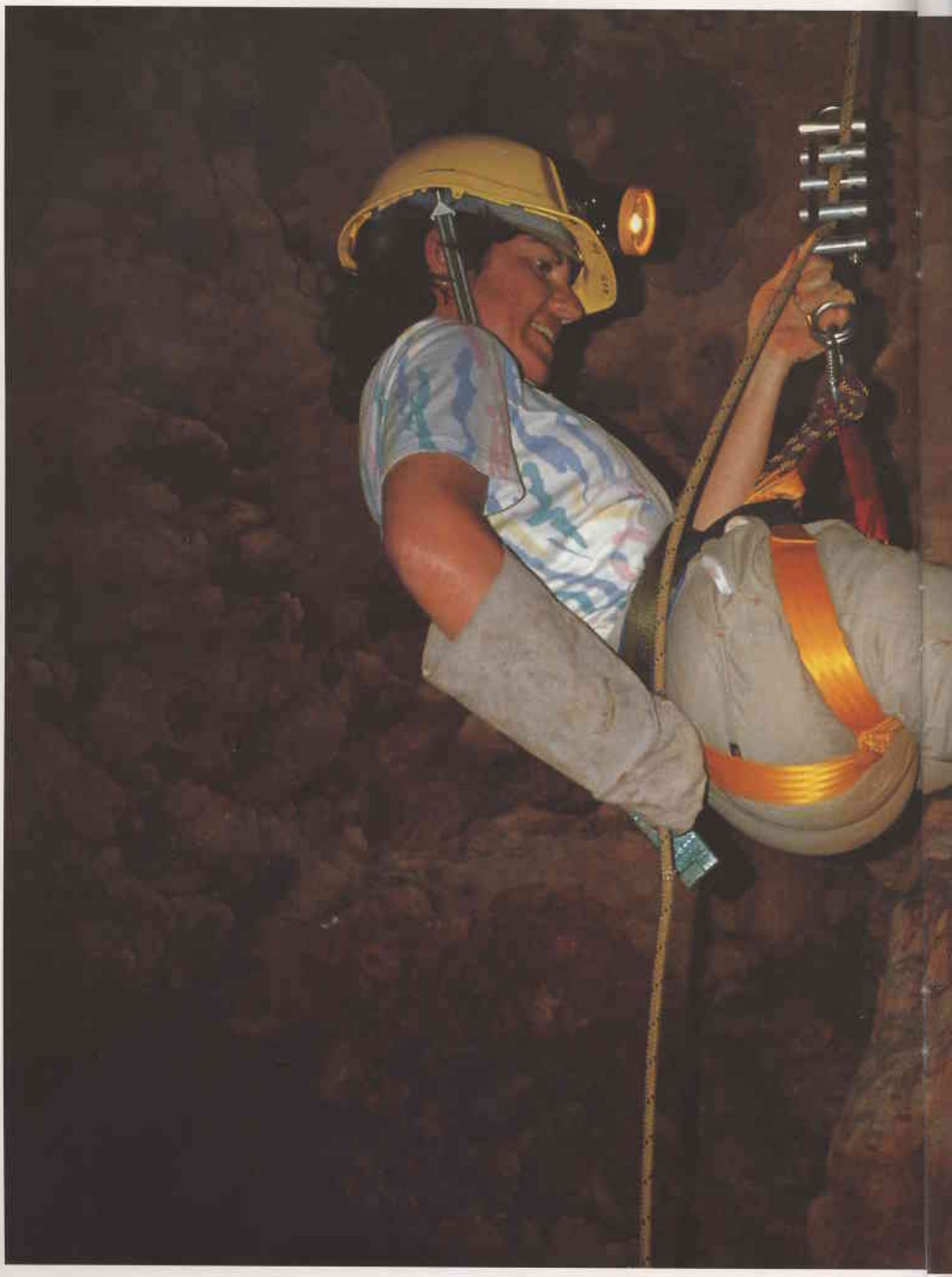
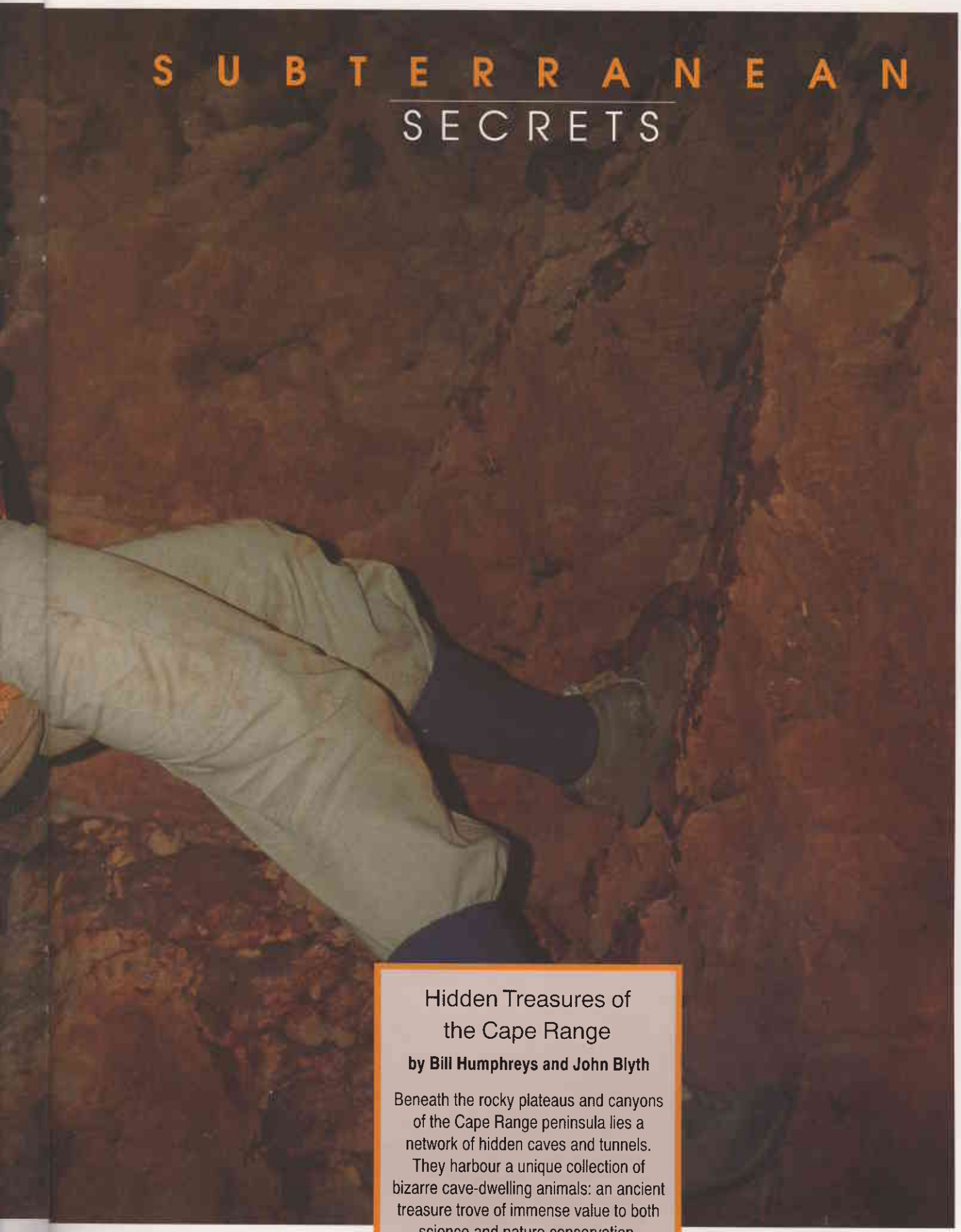


SUBTERRANEAN SECRETS



Hidden Treasures of the Cape Range

by Bill Humphreys and John Blyth

Beneath the rocky plateaus and canyons of the Cape Range peninsula lies a network of hidden caves and tunnels. They harbour a unique collection of bizarre cave-dwelling animals: an ancient treasure trove of immense value to both science and nature conservation.

The Cape Range forms the spine of the peninsula that stretches up towards North West Cape in the Gascoyne region of Western Australia. The impressive weathered limestone range, with plateaus of up to 330 metres in height, dominates the otherwise rather featureless terrain. The area is well known for the striking contrast between the clear blue seas, coral reefs and sandy beaches of Ningaloo Marine Park, and the rugged scenery of the Cape Range. But most visitors are unaware of the most remarkable features of the Cape Range, those that lie hidden deep beneath its surface.

The limestone that forms the range was laid down from marine sediments between 30 and 15 million years ago, when the whole area was covered by a warm shallow sea. Over time, the seabed was thrust upwards as the Earth's surface faulted and folded.

During some periods, much higher rainfall occurred there than does now. The surface results of that rainwater are easy to see; the Cape Range has been deeply eroded into weathered surfaces and steep gorges. But there have been equally dramatic changes beneath the surface.

Weathering and solution of the limestone have resulted in a massive system of more than 400 caves and other karst features (see 'Living Limestone, *LANDSCOPE*, Summer 1989-90), which lie under much of the peninsula.

Deep caves can maintain a stable temperature and high humidity, and can serve as refuges from changing climatic conditions. In consequence, they may contain creatures that are not typical of the current climate. The caverns and underground waters of the Cape Range have acted in exactly this way, providing refuge for an extraordinary collection of animals that are found nowhere else. They offer an intriguing vignette of a bygone era.

There are two main underground habitats on the Cape Range peninsula. The numerous caves within the range itself are often very humid, although few contain standing water, and the caverns and voids of the foothills and coastal plain contain fresh to saline water. These two habitats support quite different collections of animals.

CREATURES OF THE UNDERWORLD

Animals fully adapted to living in caves and totally dependent upon them for their survival are called troglobites. So far, 30 different species of troglobite (and a similar number of species less fully adapted to cave conditions but also restricted to the area) have been collected from the Cape Range. It is likely that many more remain to be found, because only a small portion of the range and its caves has been searched.

The cave fauna is derived from populations present in the area many millions of years ago. Although the area is now arid, the caves harbour the sorts of animals you would expect to find in the leaf mulch of wet temperate and tropical forests of the eastern Australian seaboard today. This remnant fauna provides the main evidence that wet and humid conditions, and the resulting rainforests, must have existed in this area within the past 20 million years. Because they have been isolated for so long, the species have now diverged from their original relatives. Most of the species, and at least nine genera, are endemic to the Cape Range, and many are known from only one or two caves there.

What strange-looking creatures inhabit this underworld? Caves are dark, and the more highly adapted cave-dwellers may lack eyes, body pigments, and, save for the male genitalia, hardened body parts. Their non-optic senses tend to be well developed and antennae and legs, if present, are elongated. They include spiders, micro-whipscorpions, pseudoscorpions, millipedes, woodlice, bugs, crickets and cockroaches.

Each cave is made unique by slightly different regimes of hydrology, humidity and temperature, and by differences in the availability and quantity of food resources. These factors are in turn influenced by the position of each cave, its shape and depth, and how nutrients reach it. Because of the absence of light, the whole cave ecosystem is dependent upon energy from organic material produced outside the cave. Animals that exploit the cave temporarily, such as bats, rats and woodlice, take some organic matter into the cave with them, but most is washed in with the inflow of water that is also essential for the maintenance of the humidity of the cave.

Because each cave provides a slightly different habitat, the troglobite communities vary along the length of the range and from cave to cave. Up to 10 species of highly adapted troglobite might occupy a single cave, along with many other species less adapted to cave life. In this sense, the Cape Range caves function rather like an archipelago of islands, or

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Museum volunteer Rae Young abseiling a 50-metre entrance pitch during the first exploration of this cave. Most caves in the Cape Range require rope climbing equipment.
Photo - Bill Humphreys

Above: Beneath this rugged gorge country of the Cape Range lies a mysterious subterranean fauna.
Photo - Geoff Taylor/Lochman Transparencies

Right: The eyeless miturgid spider (an undescribed genus) is the largest of the blind cave spiders found beneath the range.
Photo - Douglas Elford

Left: An undescribed genus of amphipod. The caves in the Cape Range are inhabited by different species to those of caves on the coastal plain. The populations may have become isolated from each other when the range was uplifted.
Photo - Bill Humphreys

Below: This cave-dwelling false scorpion belongs to a genus known only from two caves, one in the range and one on the coastal plain near Exmouth. It belongs to a sub-family otherwise found only in the Kimberley, India and Madagascar.
Photo - Douglas Elford

Far below: The blind cave eel only lives in the underground waters of the coastal plain, where it feeds on various blind crustaceans.
Photo - Gerry Allen

a chain of tall mountain peaks, inasmuch as they are separated from each other by greater or lesser distances and by habitats that are more or less inhospitable to the various potential occupants of each cave. This does not allow much mixing between populations in different caves.

There is exciting evidence from genetic studies that evolution is proceeding rapidly within the caves of the Cape Range. Isolated in their own caves and separated from other populations of their species, populations of animals are becoming more and more adapted to the specific conditions of their particular cave and less and less like their closest relatives.

LIFE IN THE GROUNDWATER

The groundwater underlying the coastal plain supports a rich aquatic fauna (known collectively as stygobites), including two species of fish, the blind gudgeon (*Milyeringa veritas*) and the blind cave eel (*Ophisternon candidum*). These are the only vertebrate animals known from Australasia that are restricted to either caves or groundwater, and they are declared as threatened fauna under the Western Australian Wildlife Conservation Act. There are also several crustaceans, including two in the genus *Stygiocaris*, which are in the same broad group (the order Decapoda) as the freshwater crayfish and are proposed to be listed as threatened fauna. Several other crustaceans from a wide variety of groups inhabit the groundwater system, and there are probably still many species left to discover because relatively little research has been done.

Whereas the troglobites of the Cape Range have relatives in other parts of Australia, the closest relatives of many of these stygobites are found in the Caribbean region and the Canary Islands. This extraordinary distribution suggests that the stygobites of the Cape Range are relicts from the Tethys Sea. This ancient sea formed with the break-up of the supercontinent Pangea, about 180 million years ago, and persisted until

about 40 million years ago. The north-west of the present continent of Australia formed part of its eastern shore.

LIVING TREASURES

The number of totally subterranean and other cave-using species that occur only on the Cape Range peninsula is known to exceed 40, and more species are continually being discovered. The fact that 56 per cent of the land snails in the area are endemic suggests that research into the crevice-living invertebrates of the Cape Range, which are largely unknown, should lead to the discovery of further biological treasures.

This small area contributes a disproportionate share of Australia's biological diversity. It contains one of the world's richest collections of troglobites, which attract scientists from around the world wishing to study their adaptations to the demands of a subterranean life.

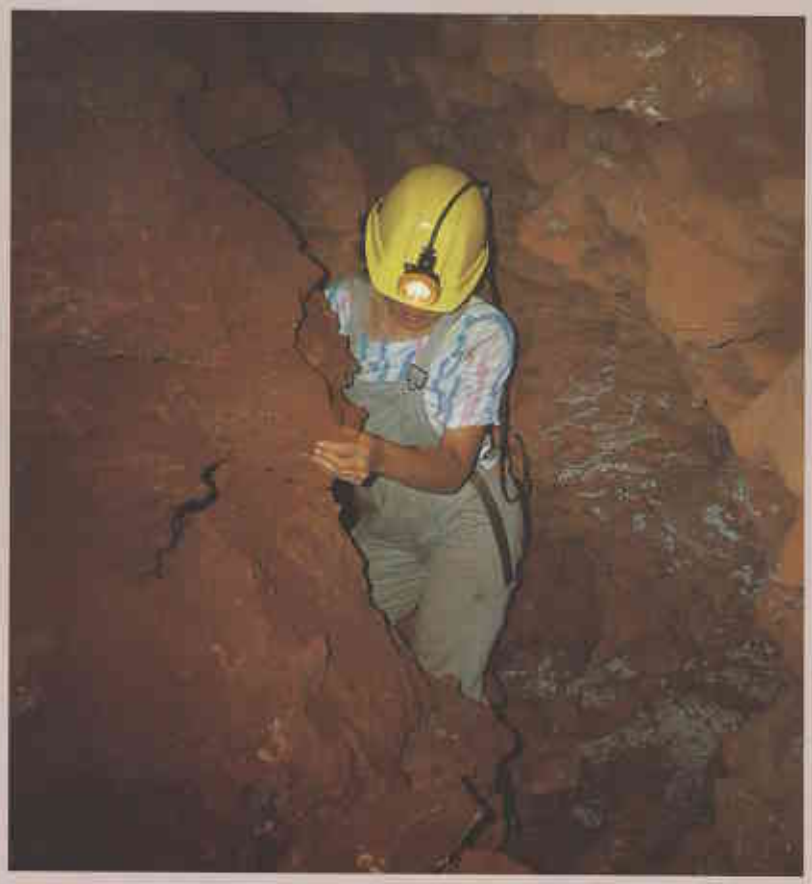
Although relatively little is known, it is already clear that the subterranean habitats of the Cape Range are also of international significance for biogeographical and evolutionary studies. They provide opportunities to understand the processes of dispersal and evolution in the same way as the Galapagos Islands, which have for many years provided a living example of the way evolution works.

CONSERVATION AND MANAGEMENT

Throughout the world, subterranean creatures, especially the aquatic species, are threatened by human activities. Indeed, the well-being of such creatures is a good indicator of the health of the groundwater itself. Caves are not closed systems, and changes to the catchment or cave entrance that alter inputs of water and organic material may have major effects on cave communities. Similarly, disturbances to the water table can be transmitted over long distances to affect the viability of troglobite populations; in fact, changes to water regimes are the prime threat to the viability of subterranean populations of both aquatic and terrestrial troglobites worldwide. There are several potential threats to the subterranean creatures of the Cape Range peninsula.

The very material that makes up the limestone formation of the eastern Cape Range, and that has permitted the development of a complex karst system, includes significant quantities of high-grade limestone that is suitable for a variety of industrial purposes. Such high-grade limestone located within 11 kilometres of deepwater access in the Exmouth Gulf constitutes a major economic resource. The Department of Minerals and Energy has recently completed a survey of the limestone resources of the Cape Range area and the report will be available shortly.

Within the Cape Range, most of the troglobites occur in caves that lie within a Temporary Limestone Reserve, in which quarrying could be permitted. The quarrying of limestone represents a threat because it can not only remove caves and their inhabitants directly, but also change the surface characteristics or drain the water critical to maintaining the high humidity within the caves.



CAVE EXPLORATION

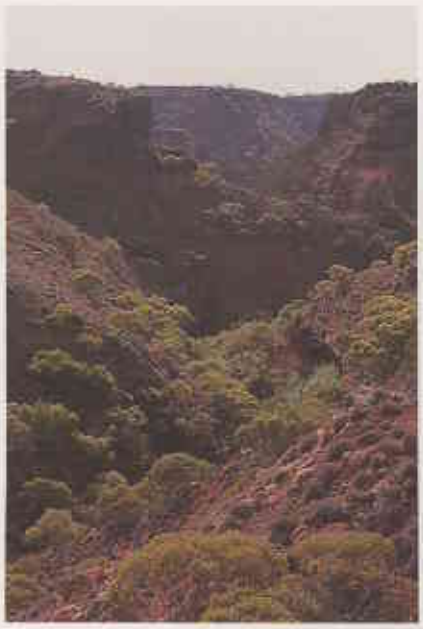
Some caves in the Cape Range were of cultural significance for Aboriginal people - as watering places, ceremonial sites and shelter - from 30 000 years ago until recent times.

Modern cave exploration started in 1962. Presently, more than 400 caves are known, and many more will be found as more of the area is examined. The caves are not big by world standards, being up to 100 metres deep. Few extend laterally for any great distance. However, one cave has low passages extending for more than five kilometres, and most of these can only be accessed by crawling.

Most of the recent discovery, exploration and recording of caves has been done by Exmouth-based members of the Western Australian Speleological Group, who have carefully recorded cave locations and surveyed many caves. Most of the caves in the Cape Range are vertical and require specialised roping skills to enable entry and exit. The caves are mostly dry, but many are unstable and contain dangerous concentrations of carbon dioxide.

Casual exploration is **not** permitted.

Photo - Bill Humphreys



Left: Looking up from one of the many sink holes found in the Cape Range.
Photo - Geoff Taylor/Lochman Transparencies

Right: The gorges of the Cape Range are unforgiving towards casual travellers. Their steep sides often have loose rocks and there is no water to be found.
Photo - Marie Lochman

Currently, about a third of the Cape Range peninsula is protected within the Cape Range National Park. Much of the area that supports troglobites lies to the north and east of the park, and is covered by the Temporary Limestone Reserve, as is about a quarter of the park itself. The current management plan for Cape Range National Park proposes adding to the park the area to its east. This would protect the catchments of the main streams of the range and take in much of the significant cavernous limestone of the area. However, if the cavernous limestone area to the north of the park could also be included, as was originally proposed, the full diversity of the cave fauna would be protected within the park.

Discussions are continuing between the Department of Minerals and Energy and the Department of Conservation and Land Management (CALM) about changes to the boundaries of the Cape Range National Park and other ways of protecting the caves and their inhabitants.

A less obvious potential threat to some caves is the construction of roads through the Cape Range for various purposes, including mineral exploration and tourism. Unless carefully sited and constructed, such roads could cause sediment and nutrients to leak into caves and change the water regimes within them. Any road-building within the range needs to be carefully planned, applying the best possible information about the position and catchments of caves.

The stygobites that live in the groundwaters of the coastal plain are potentially threatened by the development of Exmouth as a residential and tourist centre. In particular, the contamination of these waters by excessive nutrients, heavy metals or hydrocarbons would pose a threat to the survival of the aquatic species living there. Karst areas are extremely vulnerable, as contaminants can move widely through the underground system, a factor that places considerable restraint on the location and long-term management of waste dumps. Today, many groups of stygobites can still be found in the groundwater below Exmouth, a tribute to the deep sewers of the town. Careful planning in the future should minimise the threat to the groundwater and the creatures that live there.

WHAT LIES AHEAD?

Our knowledge of the ecological needs of the subterranean creatures of the Cape Range is rudimentary, perhaps comparable to our knowledge of mammals early last century. At the time of European occupation of Australia, the Cape Range peninsula supported at least 38 species of native mammal. There are now only 17 species found there.

Fortunately, none of these mammals was restricted to the peninsula, and although two of the 21 species lost from the area are now totally extinct, and two others are found only on offshore islands, many are still found in other parts of Australia.

In contrast, none of the species making up the subterranean fauna of the peninsula occurs anywhere else, and the loss of any of these species would mean its total extinction. However, some of the species known from the coastal plain also have populations on Barrow Island.

The subterranean creatures of the Cape Range offer scientists a remarkable living time capsule, whose composition provides echoes of past changes in sea level and climate, and of past connections with other parts of Australia, eastern Gondwana and even Pangea. The peninsula is comparable in importance, for both science and nature conservation, to the Galapagos Islands, the Australian wet tropics and the high mountains of equatorial Africa. It would be tragic if, unwittingly, anything were done that could result in losses of these fascinating creatures, of which we still have so much to learn.

With information now accumulating about the importance of the subterranean habitats of the Cape Range peninsula, we have a responsibility to maintain their biological diversity. By applying modern planning and management skills, we can ensure that any developments within the area do not degrade this invaluable biological resource.

Bill Humphreys is Senior Curator of Terrestrial Invertebrates at the WA Museum, Francis Street, Perth. He can be contacted on (09) 328 4411. John Blyth is a scientific adviser at CALM's Western Australian Threatened Species and Communities Unit (WATSCU) and can be contacted on (09) 405 5128.

LANDSCOPE

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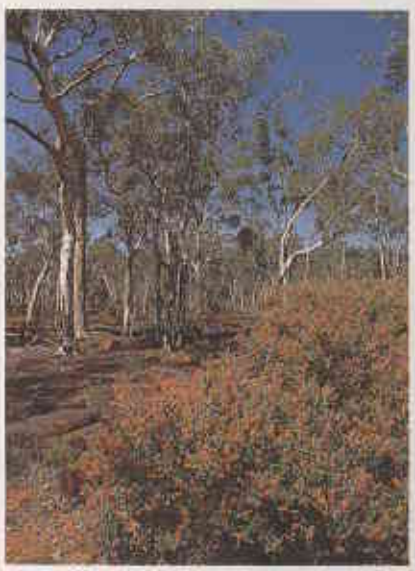
The hidden caves and tunnels of Cape Range National Park harbour several animals found nowhere else. Turn to page 22 to find out about these bizarre cave dwellers.



The characteristics that made WA inhospitable to the first Europeans are now helping us create new industries that can also repair the environment. See page 47.

The Pinnacles, in Nambung National Park, is one of the most photographed landscapes in the world. But there is another side to Nambung. See page 41.

Perth has at least 70 species of skinks, geckoes and other reptiles. Find out how to attract these fascinating creatures to your garden on page 28.

Devastation caused by the recent NSW bushfires has fuelled debate on the practice of prescribed burning. How do managers fight fire with fire? See page 35.

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COVER

The bobtail (*Tiliqua rugosa*) is sometimes incorrectly called the 'bobtail goanna' but is actually a very large skink. They are common around Perth and often seen in gardens. During hot weather they can be seen basking on footpaths, verges or roadways. See our story 'Reptiles in the Garden' on Page 30.
The illustration is by Philippa Nikulinsky.

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