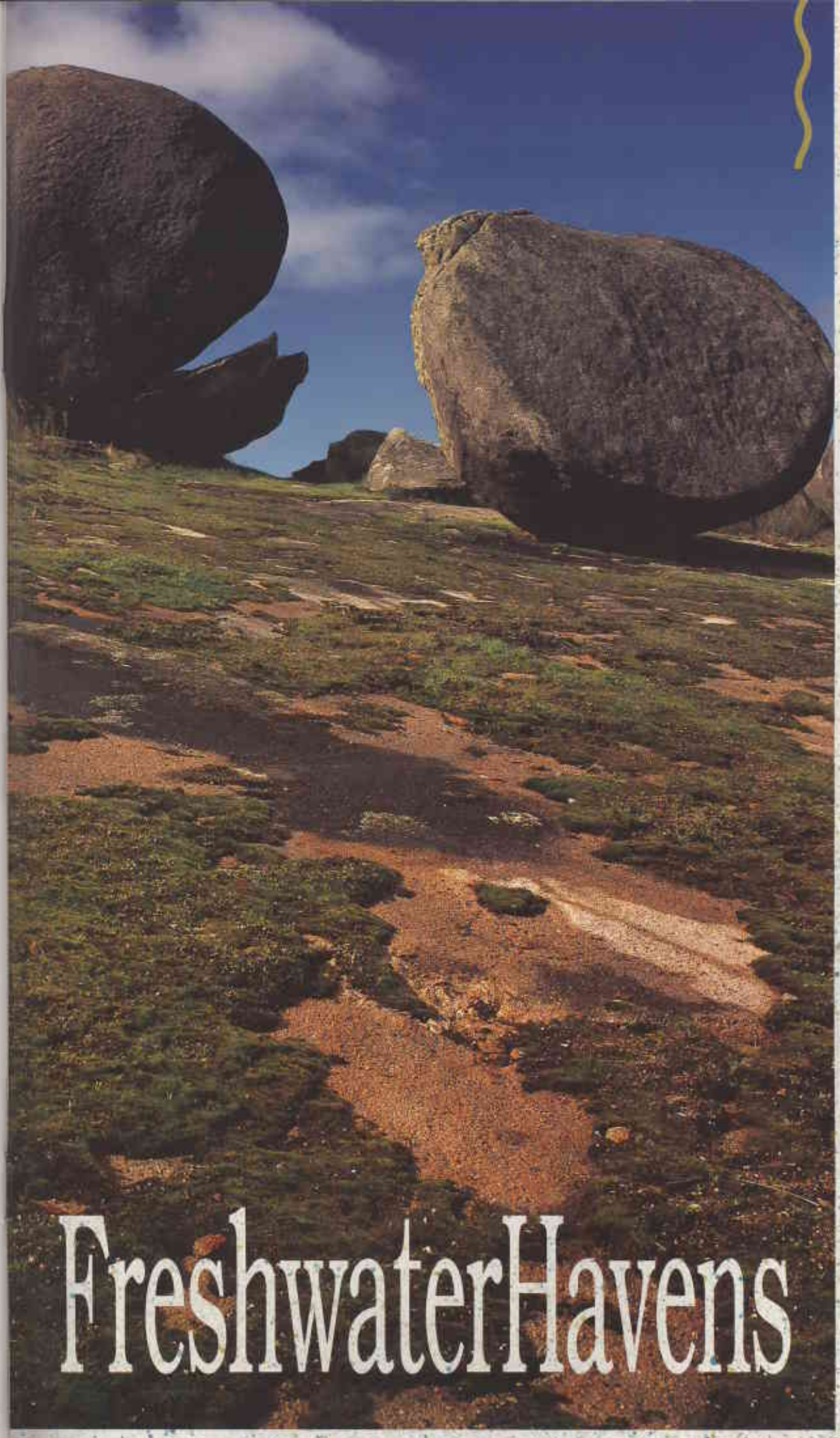


Freshwater Havens

In the south-west of Western Australia there are small, shallow, temporary pools teeming with micro-fauna and flora that are perched on top of ancient granite rocks. Ian Bayly, Reader in Zoology at Monash University, investigates these rocks and pools and argues that a balance should be struck between their use as water harvesters and their conservation values.

by
Ian Bayly

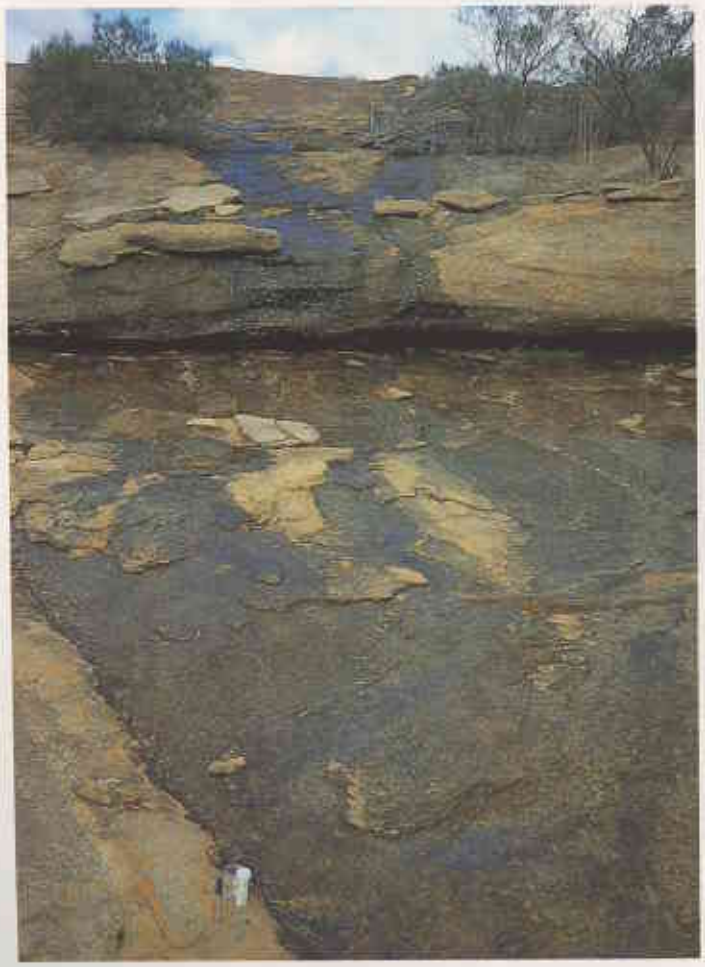
Much of Western Australia's South West consists of very ancient igneous rocks. Outcrops of resistant, elevated granites dot the landscape and are often the main features that add diversity and interest to an otherwise monotonous countryside. To many people living in the vicinity of these granite rocks, their main if not sole value is as impermeable surfaces and water harvesters - and on a continent as arid as Australia this is perfectly understandable. Harvesting is achieved by the construction of extensive, low walls to divert runoff into reservoirs. This is a common practice that represents one value of a granite outcrop, and the thoughtful and selective use of some rocks as water harvesters is unobjectionable. Another, often poorly appreciated, value of granite outcrops is as habitats for a wide range of freshwater flora and fauna.

My biological exploration of these granite inselbergs (literally 'island mountains'; hills that rise abruptly from the plains like islands from the sea) began in the winter of 1977, and they made a deep impression on me. Using a hut in Pemberton as a base, repeated visits were made to Mt Chudalup and Muirillup Rock, near Northcliffe, to sample the micro-fauna living in the temporary rock pools. Outstanding features were the lushness and extent of the moss beds on Muirillup Rock and the capacity of several small animals to flourish in the very small and shallow pools near the summit of Mt Chudalup. In these there occurred in great abundance a beetle-mite that had abandoned the terrestrial habits of nearly all its relatives and had opted for an aquatic mode of life. It was later described under the name *Chudalupia meridionalis*. (The nearest relatives of this animal occur in similar habitats in South Africa.) That winter a total of 19 pools, distributed between nine different granite outcrops, were sampled.

THIRTEEN YEARS ON

In the winter of 1990 I returned to Western Australia for a more extensive study of granite rock pools, including some of the most eastern examples. Travelling in from the east I turned south at Balladonia and headed towards Mt Ragged. With a sense of excitement I spotted Coragina Rock and pulled off the track. Walking to the low summit I saw what appeared to be a fine pool. Then to my dismay I realised that the level of the natural pool had been raised about 18 cm (the maximum depth was only 25 cm) - someone had cemented together some exfoliated pieces of granite to form a low dam.

After travelling almost 3 000 km it was disappointing and surprising to find that this apparently remote rock had suffered human modification. It was also difficult to understand, because there was a major dam at the base of the rock whose capacity was at least 1000 times greater than that of the shallow summit pool. What stood before me was not the pristine habitat I had travelled so far to study. Natural granite rock pools are always acidic, but the pH of this pool was 8.7 (the mean pH of 10 unmodified pools studied in 1977 was 5.3, while the mean for 32 such pools in 1990 was 6.1). The alkalinity was due to basic materials



Previous page:
Massive granite boulders atop Boulder Rock, in the jarrah forest on Albany Highway.
Photo - M and I Morcombe

Temporary stream on Yorkrakine Rock, north of Kellerberrin.
Photo - D.H. Edward

Northcliffe kennedya (*Kennedya glabrata*) is a declared endangered plant. Many rare plants and animals seek haven on granite outcrops throughout the State.
Photo - S.D. Hopper

Granite rocks are a major source of fresh water throughout the south-west. Frequently, exfoliated slabs are found cemented together to form low walls to direct runoff into dams and tanks, as seen here at Pingaring Rock.
Photo - S.D. Hopper

The shallow soils and mossfields on granite rocks are prone to erosion. Here a walkway has been built to avoid degradation of communities on Mt Chudalup.
Photo - S.D. Hopper

having been leached out of the cement mortar.

In the more populated wheatbelt regions of Western Australia some form of human modification of the hydrology and ecology of granite outcrops is more the rule than the exception. An extreme example of stone walling is to be found on Beringbooding Rock, to the north-east of Mukinbudin. Here, apart from the usual walling of the lower flanks of the rock, most of the patches of vegetation growing on the rock are completely encircled by cemented stones - in the manner of a formal garden on a suburban block! This work was done to assist water supplies for early settlers and steam locomotives. Such extensive works are today unnecessary; they contribute only very marginally, if at all, to the efficiency of water harvesting. Not surprisingly, the largest pool on Beringbooding Rock (outside of the main reservoir) was markedly alkaline with a pH of 8.8.

A large part of the natural inland aquatic environment in Western Australia is saline. Even before the advent of Europeans this was almost certainly the case. In the late Pleistocene, about 18 000 years ago, Australia suffered an intense period of aridity. Freshwater habitats were severely restricted and there was a great expansion of inland saline waters (mainly temporary). Despite some subsequent improvement, salt lakes still dominated much of Western Australia, especially in the vast arheic or riverless region that includes Salinaland around Kalgoorlie, at the time the Europeans arrived. Although the amount of fresh water in artificial impoundments has increased significantly during the past 100 years or so, land clearing for agriculture has resulted in a great increase in the salination of the natural aquatic environment (see 'The Last Lake', *LANDSCOPE*, Winter 1988). It is a commonplace that many Western Australian rivers that were formerly fresh are now saline. There are even rivers in which the salinity increases as you go upstream!

INSELBERGS: FRESHWATER HAVENS

The exceptions to this general trend are the granite inselbergs, which demonstrate an important value of granite outcrops: they provide refuge for strictly freshwater organisms within an otherwise highly saline area, and they are sometimes the only home for some very ancient and primitive organisms.

Being domed rather than funnel-shaped, these granite inselbergs are almost perfect exorheic systems (shedding rainwater and dissolved salts to the surrounding lowlands). In fact, they are like rock islands in a salty sea. For many organisms adapted to temporary fresh waters and with an intolerance of salt, granite rock pools must now represent one of their few habitats not under major threat.

An extremely primitive fly (Diptera) was discovered in Western Australia in 1967. It belonged to the family Chironomidae, which had always been regarded as lacking functional toothed mandibles (jawlike biting appendages) and which were commonly referred to as the non-biting midges. A very closely related family (the sandflies) which possessed functional toothed mandibles were distinguished as the biting midges (these insects are common near estuaries where they often inflict much misery on humans). The newly discovered Western Australian insect confounded this neat distinction; it was essentially a chironomid but it had functional jaws like its sandfly cousins. It was subsequently discovered that the larval stage of this fly (*Archaeochlus brundini*) occurred in freshwater seepages flowing from clumps of moss growing on granite hills. This species has been subject to intensive study by Dr Don Edward of the University of Western Australia, who recently discovered a second species in the same genus inhabiting the same habitat. This second species awaits description.

The granites of south-western Western Australia are ancient. Many of the habitats associated with them have had a continuous (even if seasonal) existence throughout vast periods of geological time. This is doubtless a key factor allowing *Archaeochlus* to persist to the present day; it is believed that the

Pre-Cambrian granites on which *Archaeochlus brundini* occurs have not been invaded by the sea since before the Triassic (that is, this type of habitat has been in existence for at least 240 million years). As with *Chudalupia*, the closest relatives to the Australian species of *Archaeochlus* occur in similar habitats in southern Africa. The explanation for this doubtless lies in the fact that 150 million years ago Australia and Africa were combined together as parts of one land mass - the supercontinent Gondwana.

Granite outcrops have figured prominently in the history of biological explorations in Western Australia. Yorkrakine Rock, north of Tammin, is the 'tor' in Main's (1967) book entitled *Between Wodjil and Tor* which is an elegant plea for the recognition of the high conservation values associated with remaining natural areas in the Wheatbelt. This rock and others have played a major role as field sites for ecological studies conducted over many years by biologists from the University of Western Australia. Yorkrakine Rock is the type locality for the frog *Crinia pseudinsignifera* Main, and for the mygalomorph spider *Kwonkan eboracum* Main. Professor Don Bradshaw of the University of Western Australia has made an extensive study of the ecology and physiology of the ornate dragon, *Amphibolurus ornatus*, on granite habitats.

The conspicuous fairy shrimp (*Branchinella longirostris*), the bright red calanoid copepod (*Boeckella opaqua*), and the black 'water flea' (cladoceran) *Daphnia jollyi* are not only characteristic inhabitants of pools on Western Australian granites, but all three species are known only from these habitats. Plants commonly found growing in silt on the floor of these rockpools include quillworts (*Isoetes* spp.), mudmats (*Glossostigma* spp.), crassulas (*Crassula* spp.), mudworts (*Limosella australis*) and the waterwort (*Elatine gratioloides*).

INSENSITIVITY - AND VANDALISM

Many of the rocks have strong aesthetic appeal. Some are positively awe-inspiring. In what is often a monotonous landscape one would think that the rocks might be revered for these qualities alone. Unhappily, insensitive placement of artificial structures effectively destroys or greatly impairs the beauty of many rocks. For example, a large and unsightly tank sits right on top of Nunegin Hill at Bruce Rock.

I had heard much about the famous Wave Rock at Hyden. But when I arrived there I found that even this wondrous formation had not escaped walling. Here was a masterpiece of nature surmounted by an artificial eyesore! Presumably the wall was built before tourism became important. Surely part at least of the potential catchment for the Hyden dam could now be foregone and the wall discreetly rerouted so that visitors, many of whom come from interstate and overseas, could stand at the base of the rock and have an untrammelled view of the masterpiece. More deliberate vandalism and impairment of aesthetic qualities is not uncommon. The gorge region of Yorkrakine Rock is plastered with graffiti.

On returning to Muirillip Rock in early July 1990, I was pleased to find that the Department of Conservation and

Right:
Archaeochlus brundini larva from temporary streams on granite outcrops.
Photo - D.H. Edward

Far right:
Sundews (*Drosera*) are tuberous plants found in the mossfields of granite rocks.
Photo - S.D. Hopper

Below:
Yorkrakine Rock, north of Kellerberrin.
Photo - Ian Bayly

Below right:
This ephemeral rock pool belies the searing summer heat waves that killed the shrubs left standing as grey skeletons.
Photo - Ashley de Prazier

Land Management (CALM) had now designated the area a conservation park. However, I was dismayed to find strips of moss torn away from the granite by trail-bikes and four-wheel-drive vehicles. Even the beautiful little moss-covered pool that had been first studied in 1977 had not been spared. Several weeks later I was as much amazed as annoyed to see a clear tyre imprint running right across the bottom sediments of a shallow pool that was within 15 metres of the summit cairn of Yorkrakine Rock. So much for the official designation of this rock as a 'limited access area'!

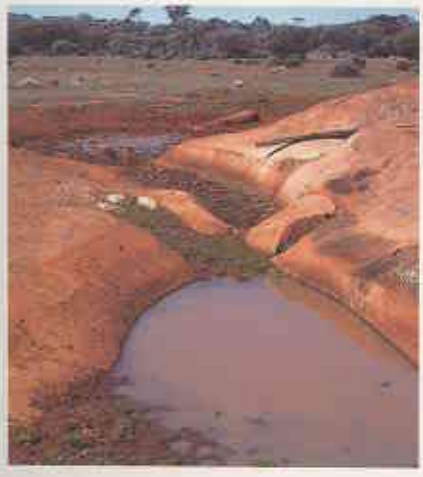
UNDERSTANDING THE VALUES

Although vandalism is all too prevalent, even at rocks officially designated as reserves, it is unreasonable to expect that officers of CALM should be the main agency in curtailing this. They can't be present at every rock, every day. In the long haul, a general heightening of community consciousness concerning the values of granite outcrops is required. The schools are the obvious place to start. There is enormous scope for capitalizing on the unique biological and geological features of the ancient granites in field studies associated with science education at both primary and secondary school levels. CALM is to be strongly commended for recently publishing an excellent booklet entitled *Exploring Granite Outcrops*. There is another useful CALM publication relating specifically to the Sanford [Sandford in the publication] Rocks north of Westonia. These are just some of the resources available to teachers keen to take up the challenge.

I have often walked past the ornamental pool alongside Winthrop Hall on the University of Western Australia campus and pondered over the inscription it bears: 'Verily by beauty it is that we come at wisdom'. This is an interesting proposition. I firmly believe that it is an appreciation of beauty in one or other of its diverse forms that is the primary driving force behind many human endeavours and achievements with which it may not be immediately associated. It was not the devotion of many years of my life to the scientific study of inland waters that awakened me to the aesthetic qualities of lakes, ponds and pools. Rather, I believe it was an acute sensitivity during adolescence to the beauty emanating from a landscape containing bodies of water that caused me to embark on the scientific study of inland waters. It has certainly been a personally rewarding preoccupation. It might even have imbued me with some wisdom, but that is not for me to judge.

My plea is for us all to acknowledge that the Western Australian archipelago of granite hills has values other than water harvesting (and trail-bike riding!). We should open our eyes to the way in which it beautifies and diversifies the landscape. The rest, the wise conservation of a goodly number of rocks, should follow naturally. ⊡

Ian A.E. Bayly is a Reader in Zoology at the Department of Ecology & Evolutionary Biology, Monash University. He is a joint author (with W.D. Williams) of the book *Inland Waters and their Ecology*, first published in 1973 and reprinted five times.



Far left:
A trailbike has caused erosion scars that will take decades to repair.

Left:
Use of ephemeral rock pools by cattle causes major damage to native animal and plant communities, and opens the way for weed invasion.

Below left:
The spider *Rebilus* hides in tiny spaces beneath slabs of exfoliated rock.

Below right:
Bold Rock Creek, Fitzgerald River National Park.

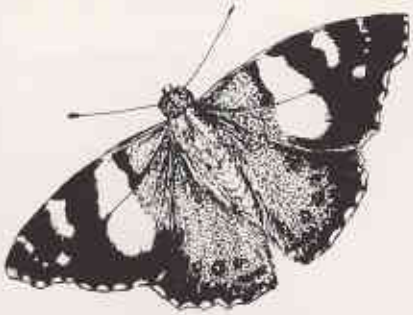
Photos - S.D. Hopper

You don't have to go far from Perth to enjoy the peace and quiet of the bush. The forest is right on our doorstep. See page 10.

The increase of births in captivity for cockatoos seemed promising, but was it related to the upsurge in 'birdnapping' in the wild? To Catch a Thief explains how forensic experts unravelled the mystery. See page 28.

LANDSCOPE

VOLUME SEVEN NO. 4 WINTER ISSUE 1992



Painted ladies, northern admirals, southern admirals and Western Australian skippers - not the stuff of a sailor's dream, but all members of the butterfly family. See page 23.

Our native animals are prey to introduced species. While baiting gives them a fighting chance, scientists are looking for more long-term, humane solutions. See page 16.

The bilby has many names, including ninu and dalgyte. Ninu Magic tells the story of this shy animal and its remarkable survival skills. See page 43.

FEATURES

REGULARS

COVER

The red-tailed black cockatoo (Calyptorhynchus magnificus) *is one of several cockatoos native to Western Australia. These spectacular birds nest in tree hollows and can be found in the woodlands and grasslands of the south-west of Western Australia.*

Illustration by Philippa Nikulinsky.

Managing Editor: Ron Kawalilak
Editor: David Gough
Contributing Editors: Verna Costello, Helenka Johnson, Tanyia Maxted, Carolyn Thomson
Scientific and technical advice: Andrew Burbidge, Roger Underwood
Design and production: Sue Marais, Stacey Strickland
Finished art: Gooitzen van der Meer
Advertising: Estelle de San Miguel ☎ (09) 389 8644 Fax: 389 8296
Illustration: Ian Dickinson, Sandra Mitchell
Colour Separation by Prepress Services
Printed in Western Australia by Lamb Print

Published by Dr S Shea, Executive Director
Department of Conservation and Land Management,
50 Hayman Road, Como, Western Australia 6152.