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A U S T R A L I A

# Nature

AUTUMN 1999

## FROGS



**IBIS**

**MOTHS**

**HUMANS &  
DINOSAURS**

**BANDICOOTS**

**RABBIT VIRUS**

**POSSUMS**

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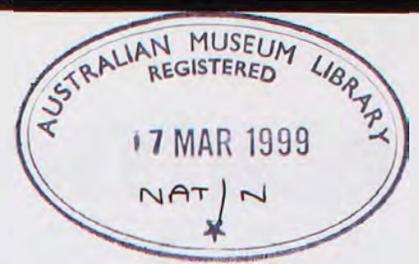
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# Up Front



**A**ustralian White Ibises have become a common sight in most of our urban parklands. These large, audacious and often grubby-looking birds are masters of opportunity and would think nothing of pinching a sandwich from your hand. But you've got to admire them. They are the only large wading bird that has managed to adapt to city life and therefore survive, perhaps even thrive, at a time when its normal habitat of forests and woodlands are being destroyed.



The Waldrapp (*Geronticus eremita*).

Unfortunately, the situation of ibises overseas is not as secure and many of these unusual and spectacular birds are fighting for survival. So sit back and read about these wonderful birds that were once revered and worshipped by the Egyptians.

Why do we look so different from Chimpanzees when we share 99 per cent of their genes? Just how much do humans and the king of dinosaurs, *Tyrannosaurus rex*, have in common? Are we the Peter Pan of the ape world or do we display Godzilla-like features too? Ken McNamara answers these questions and more as he takes us into the worlds of growth, development and evolution.

In "Rabbit Arrest: Life After Death?", Brian Cooke describes the hair-raising discovery of the escape of Rabbit Calicivirus Disease (RCD) from Wardang Island, South Australia. At the time it was big news and many people were understandably concerned—could the virus jump species, and what long-term effects would a sudden loss of Rabbits

have on other species? Four years down the track, the dust has now settled. The virus has remained within the Rabbit population and there appear to be major benefits coming to light. In fact, one such benefit occurred on Cabbage Tree island where, using a combination of traps, myxo, poison and RCD, land managers were able to achieve what was once thought impossible—removal of all the Rabbits from the island. David Priddel and Nicholas Carlile tell how Australia's rarest endemic seabird, Gould's Petrel,

ERWIN & PEGGY BAUER/AUSCAPE

was brought back from the brink of extinction.

The Green and Golden Bell Frog is a spectacular frog. Its good looks, however, did not stop it from being collected by the bucket load and used for dissection by university students. Those days may be over but the Green and Golden Bell Frog is still doing it tough, being considered endangered in New South Wales and vulnerable nationally. The Australian Museum's Graham Pyke explains his part in attempting to turn the tide for this popular frog.

In our regular features we have bandicoots with attitude, the saving of Mellblom's Spider-orchid, rampant paperbarks, exploding fossils out of rocks, a moth-infested Photoart and a larger-than-life poster of a Green and Golden Bell Frog. And finally, we are pleased to announce that Michael Archer, who you will be familiar with as the author of our regular column Views From the Fourth Dimension, has become the new Director of the Australian Museum.

—Jennifer Saunders

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**Front Cover**  
A Green and Golden Bell Frog (*Litoria aurea*) surveys its territory. These are relatively large tree frogs that prefer to spend most of their time close to the ground or in water rather than up trees.  
Photo by Pavel German.

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# LETTERS

The forum for readers to air their views about their concerns, past articles and interesting personal events.

## Common or Garden Snail

When a snail gets a gleam  
in its eye,  
It is not for itself it is  
yearning.  
Though hermaphrodite,  
some other guy  
Is the lover to whom it is  
turning.

They resolve that they see  
eye to eye,  
When swept on in a lather  
of lusting,  
As their tentacles feel up,  
whereby  
They nose out that the  
game's worth the  
thrusting.

First a pre-copulatory  
prick.  
Nickers off and removing  
the jock-strap,  
Then a three-hour-long  
lingering slick,

With a tickle and slow  
slimy slop-slap.  
Now they go their  
lugubrious way,  
Thus to lay up to fifty eggs  
(both, man),  
Mothered-fathered with  
fore and end play,  
After so slowly plighting  
their troth plan.

Why hermaphrodite, you  
may well rant,  
Why not hismaphrodite as  
an option?  
Well, the thundering  
feminist cant  
Won't allow this newspeak  
for adoption.

Still, unmindful of these  
sordid facts,  
Sexy snails, without one  
beg your pardon,  
Do unspeakable erotic acts  
In the secret confines of

your garden!

—Len Green  
Rose Bay, NSW

## Creation vs Evolution

I have read several issues of *Creation ex Nihilo* (Australian anti-evolutionist magazine) and one of *Nature Australia* (anti-creationist). I believe the editors of both magazines should take a stand against allowing authors to waste the readers' time and their own energy criticising authors of the opposite camp. The criticism is emotional and childish. I did not expect to find a professor of biology and geology in a prestigious university indulging in insults and name-calling to prove a point. It proves nothing except that the professor lacks the maturity to tolerate the opposing

views of a peer. I refer to Michael Archer's article on Koalas (*Nature Aust.* Summer 1997-98). Surely a man's religious beliefs are his own business, and will certainly not be altered by rudeness.

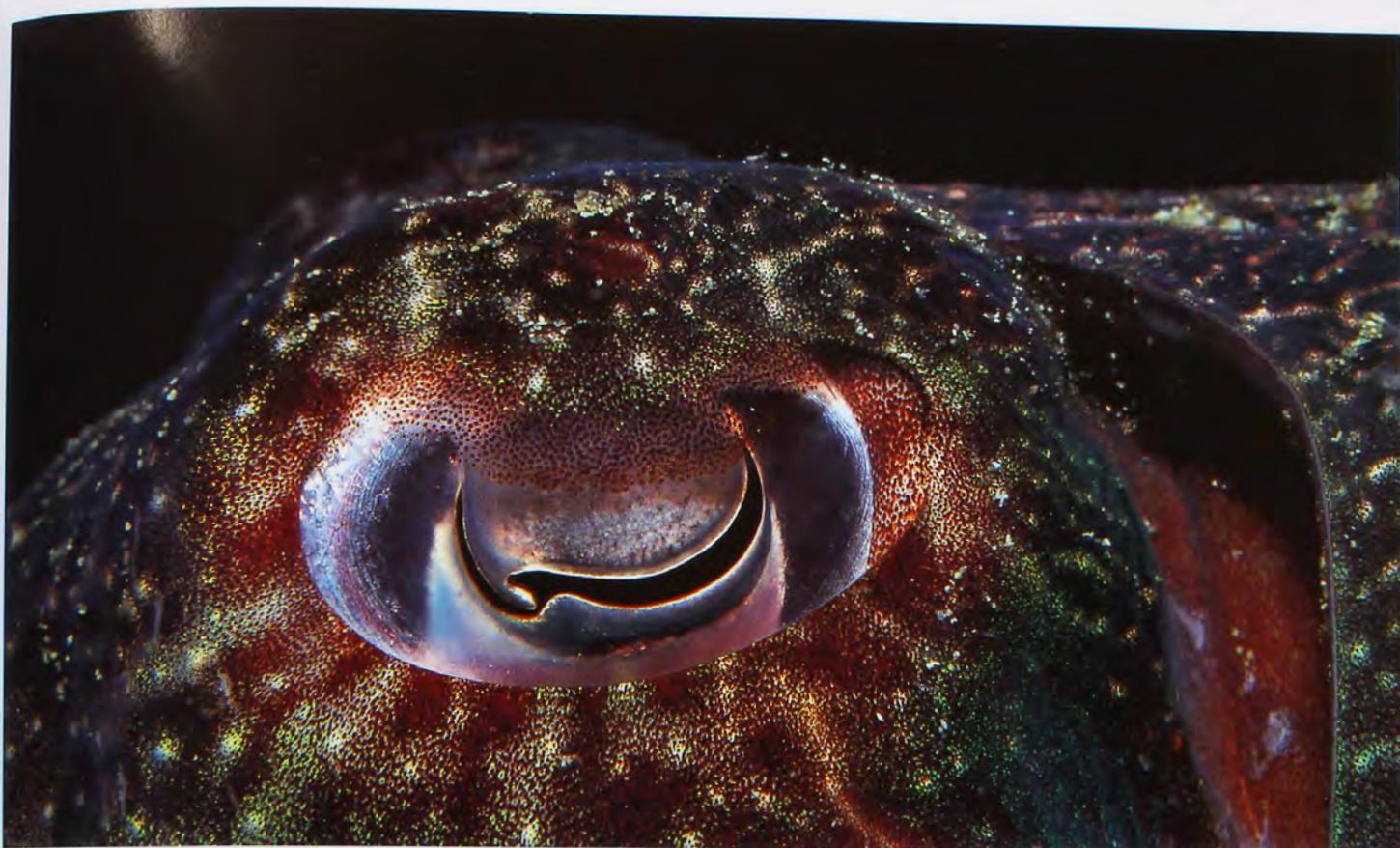
Australia is not a religious dictatorship. It has room for all shades of religious belief, both faith in evolution and faith in Creation and everything in between. Evolution is an unscientific dogma, which can never be proved. Creation also cannot be proved. The account of Creation in the Bible is not a scientific document. It tells what happened and who ordered it, but does not even attempt to tell us how it came about. The theory of evolution is a series of speculations about the how.

Most people are brought up with some sort of faith, and as they study and read and further educate themselves, they will either reject or be confirmed in the faith they were taught when young. It is a matter of one's own choice, in a free nation.

You have so much to share of your knowledge of the creatures native to Australia; please don't allow your contributors to indulge in speculation and sniping at fellow researchers. The photos are



A couple of Brown Garden Snails (*Helix aspersa*) doing what comes naturally.



KAREN GOWLETT-HOLMES/NATURE FOCUS

The complex eye of a cuttlefish (*Sepia apama*).

beautiful. Please ensure the text is of similar quality.

—Judith Petterson  
Waikanae, New Zealand

Congratulations for showing courage by printing those letters of complaint about Michael Archer's so-called 'scientific' reporting technique (*Nature Aust.* Spring 1998). I was wondering when someone was going to stand up to him. I'm sure many of your readers feel it is long due.

I am a student in the sciences, and recently received a Distinction for a detailed essay titled "The Desperation of Evolution". I couldn't resist but refer to his almost famous article "Koalas: Apostles vs Fossils" (*Nature Aust.* Summer 1997-98). The purpose of my essay was to show (with examples) how evolutionists become aggressive and insecure when they are unable to address challenges to their theory, hence displaying not a 'science' but a desperate clinging to faith. I should therefore thank Archer for his timely essay in which he ridicules the 'opposition' and attacks anything different

(did he vote for Hanson?). I concluded by stating that the 'science' of evolution is non-existent, just like the missing link they are going to find . . . one day.

—Adam Hughes

### Complex Eyes

I would like to take issue with John Brackenbury in his article "Insect Vision" (*Nature Aust.* Winter 1997). He states that "Throughout evolution, only two kinds of 'smart' eyes have ever been invented. One is the vertebrate eye . . . the other is the compound eye of insects and crustaceans . . .". What about cephalopods? I am under the impression (although I have not actually made a study of these molluscs) that the highly organised eyes of, say, octopuses, rivals the complexity and efficiency of the vertebrate eye, and has evolved separately. A small point perhaps but one not to be ignored.

—Anne Drover  
Wollstonecraft, NSW

*The cephalopod eye is remarkably similar in structure, development and func-*

*tion to that of vertebrates. It has eyelids, a cornea, an iris, a single lens and a retina. The retina has fewer photoreceptors than a vertebrate eye, so shape detection is poorer but still much better than in most other vertebrates. In all important respects it is a vertebrate-style eye, although evolved, as your reader correctly states, totally independently. The essential difference remains: an insect-style eye has many lenses, each ultimately forming a single 'pixel' of the image mosaic; a vertebrate-style (including cephalopod) eye has a single lens refracting a complex whole-field image onto the retina.*

—John Brackenbury  
University of Cambridge, UK

### Armchair Explorer

I just wanted to let you know how much I've enjoyed your magazine all these years. I can't quite remember if I started subscribing after my first trip to Australia in 1983 (for the First International Polychaete Conference, held at the Australian Museum) or a more 'touristy' venture in 1988.

Several of the posters have

come in handy. I have a part-time position with the city's Community Services (Recreation) Department Interpretive Outreach Program, which delivers classroom and field programs in natural and cultural history. When laminated, the posters are very attractive visual aids or backdrops for display items.

I've also enjoyed the bush foods articles, as one of my many interests is ethnobotany. Australia is a fascinating land, and I hope to visit again. But in the meantime, I'll be an armchair explorer, thanks to your wonderful magazine.

—Susan Williams  
Ventura, California, USA

**NATURE AUSTRALIA** welcomes letters for publication and requests that they be limited to 250 words and typed if possible. Please supply a daytime telephone number and type or print your name and address clearly on the letter. The best letter in this issue will receive a copy of *The diversity of life* by Edward O. Wilson plus an insect in resin key-ring from the Museum Shop. The winner this issue is Anne Drover.

# Nature Strips

COMPILED BY  
GEORGINA HICKEY

## Easter Island Rock Gardens

Easter Island, in the south-east Pacific, is perhaps best known for its huge stone statues, thought to have been erected as status symbols for the island's ruling elite. Such structures, and other large-scale dwellings, would indicate that the island once supported quite a significant population (8,000–10,000). To support these people, and to 'fund' the construction of elaborate statues and other structures, a surplus of food had to be produced. Until

now, though, the evidence of such large-scale production was missing.

In the central upland area of Easter Island, Chris Stevenson (Archaeological Services Consultants Group in Columbus, Ohio), along with Joan Wozniak (University of Oregon), came across some pretty sophisticated forms of agriculture, some of which may even provide lessons for land users today. These include large open-field plantations covered by surface stones, which Stevenson believes were placed there in order to retain soil moisture (rock mulch). The islanders would

have used this method to harvest sweet potatoes, as evidenced by plant remains beneath the stones. Uphill from one of the plantations, Stevenson excavated a straight alignment of stones, about 15 metres in length, that was probably used to redirect surface runoff to the field below. Other interesting horticultural features include stone 'planting circles' (probably nursery plots for trees), walled gardens, and circular stone enclosures that, once assumed to be small houses, are now thought by Stevenson to be large processing or storage pits.

These agricultural practices, however, were not enough to sustain the burgeoning population on Easter Island. Eventually civil war erupted, breaking down the hierarchical systems and the need for an overproduction of food, and agriculture reverted to subsistence farming on the coastal regions.

—Richard Fullagar  
Australian Museum

## Jet Lag Only Skin Deep

Resetting the body clock after a long-distance flight can often take days to adjust. We've known for some time now that jet lag cannot be slept off; rather it requires a good dose of sunlight to be cured (see *Nature Aust.\** Summer 1990–91). Previously it had been assumed that the light signals reach the brain via the eyes, but new research shows the secret to altering the body clock may lie under the skin.

Scott Campbell and Patricia Murphy of Cornell University Medical College have shown that shining light directly on



JEAN-PAUL FERRERO/AUSCAPE

Easter Island: large-scale agricultural practices would have been required to support the island's once complex hierarchical society.

Skippy the Dinosaur, as it would have appeared 113 million years ago.

the skin can change the body clock. In lab trials on humans, sleeping patients had a beam of light shone for three hours on the area behind their knees. By switching on the light just before the patient's temperature reached its lowest point, at about 5.30 in the morning, the body clock was set back by three hours. Conversely, turning the light on after the body reached its minimum temperature allowed the body clock to advance three hours.

How the skin transmits these messages to the brain is unclear. Dan Oren and Michael Terman, of Yale and Columbia Universities respectively, suggest that blood may be the messenger, as parts of haemoglobin are similar in structure to light-absorbing chlorophyll in plants. Alternatively, photoreceptors may exist within human skin. Recent findings in vinegar flies (*Drosophila*) support this idea, as photoreceptors controlling the body clock have been identified in the flies' wings and legs. Either way, further studies on the role skin plays in regulating body rhythms are guaranteed to be illuminating!

—K.H.

## Skippy the Baby Dinosaur

Scientific importance is not related to size. Palaeontologists had reason to be excited when Cristiano Dal Sasso (Museo Civico di Storia Naturale, Milan) and Marco Signore (Università degli Studi di Napoli, Naples) reported a new but quite diminutive theropod dinosaur from 113-million-year-old deposits in Italy. Christened *Scipionyx samniticus*, this two-legged meat-eater was quickly dubbed 'Skippy the Dinosaur' by Thomas Holtz of the University of Maryland.

The specimen is notable for several reasons. Not only is it the first dinosaur ever to be found in Italy, but its exquisitely detailed preservation rivals or exceeds that of any other dinosaur known. The

\*Previously ANH



Skippy's soft bits may hold clues to the origin of birds.

specimen has lost parts of its hind limbs and tail, but is otherwise complete. In addition to the skeleton, the fossil has retained much of the soft anatomy. The most obvious is the intestine, so well preserved that the fine surface detail is visible, and muscles can be recognised in several areas. From the relatively huge skull and the structure of its teeth, the researchers conclude that it was only a baby. Less than 24 centimetres long as preserved in the





FERRERO-LABAT/AUSCAPE

A cool approach to parenting is required by the sub-Saharan Crowned Plover.

limestone slab, 'Skippy' is estimated to have been about two metres long had it reached adulthood.

Further study of this specimen should assist in testing a recent challenge to the dinosaur origin of birds. Some scientists have interpreted apparent soft structures in another recently discovered fossil as indicating that dinosaurs had a lung/diaphragm organisation more like crocodiles than birds (see *Nature Aust.* Summer 1998-99). It will be interesting to see if the internal arrangement of 'Skippy' supports or refutes this idea. Watch this space!

—Walter E. Boles  
Australian Museum

## Cool Parents

**G**round-nesting birds in hot environments risk frying their eggs if they can't keep them cool. Many birds achieve this by soaking their breast feathers in water to wet the eggs, or covering them with a fine layer of sand. Yet for the sub-Saharan

Crowned Plover (*Vanellus coronatus*), which nests far from water on a hard shale surface, neither of these options is available. Instead the plover employs a simple tactic of shading the eggs by raising itself two to three centimetres above the nest.

Colleen Downs and David Ward, from the University of Natal, recently studied this shading behaviour and found an interesting twist to the bird's logic. Using a model plover (made from stuffing the skin of a frozen specimen with aluminium foil) and a plaster-of-paris egg, both of which share the thermal properties with the real things, the researchers measured their temperatures while in the incubation and shading positions. As expected, the model's temperature decreased when it was raised above the nest. But to their surprise the egg did not cool during shading; instead it became cooler when the model was sitting on it. This suggests that shading behaviour directly benefits the adult, but not the egg.

By crouching above the nest, the bird reduces the amount of contact with the hot surface and takes advantage of convective cooling by the breeze. Once the bird has cooled off sufficiently, it will sit back on the nest and this in turn cools the eggs. One may well ask whether the plover squats in the breeze purely for its own relief, or whether it is aware that a cool approach is needed for successful parenting.

—K.H.

## Embalming the Very Ancient

**T**he ancient Egyptians were experts at thwarting the natural ravages of decay. The precision with which they dried and conserved the bodies of their dead created mummies that have certainly stood the test of time.

To improve the drying process they used treatments of balsams and other naturally occurring antiseptics. Until recently, evidence of embalming was only known from the

period of ancient Egyptian history known as the Middle Kingdom, some 3,000 years ago, and onwards.

But new research by Johann Koller (Doerner-Institut in Germany) and colleagues suggests that the Egyptians used embalming techniques at least 1,000 years earlier. Embalming, it now appears, has a record that extends back to the period of Egyptian history known as the Old Kingdom.

The researchers recently analysed fragments of collar bone from the mummy of Idu II, known to be Secretary General of an Egyptian trade office around 2150BC. His tomb was discovered in 1914 at Giza.

No contamination by microbes was found. Traces of chemicals suggest that the bones were saturated with antiseptic sodium and wood tar compounds. These could only have come from pre-treatment with a preserving balm.

The extremely high level of sodium indicates the balm was applied directly to the

skeleton, indicating that the body of Idu II must have been partly de-fleshed during its preparation for burial.

There has been much debate among scientists about whether the Egyptians removed the flesh from bodies before embalming. The case of Idu II, however, suggests de-fleshing was in vogue in the Old Kingdom.

—K.McG.

## Hot Worms on Record

For those of us who think a 38° C day is unbearably hot, imagine life on the brink of a deep-sea hydrothermal vent where super-heated water, over 300° C, gushes into the surrounding sea. In this seemingly inhospitable environment, the tube-dwelling Pompeii Worm (*Alvinella pompejana*) colonises the outer wall of mineral 'chimneys' found around the vent openings. Here, the worms are continually flushed with 80° C water.

Although Pompeii Worms make regular visits into the

surrounding sea to feed on bacteria growing on the outside of the colony, they spend most of their time in their tube homes with gills and mouth structures extending into the sea. Craig Cary from the University of Delaware and colleagues placed temperature probes within inhabited tubes, and recorded a temperature gradient of up to 60° C along the length of the

worms (20° C at the tube opening and 80° C close to the vent). This makes the Pompeii Worm the most eurythermal (tolerant of a wide temperature range) complex multi-cellular organism (eukaryote) on record.

Temperatures of over 80° C at the worm's tail also make it the most thermo-tolerant eukaryote known, eclipsing the previous record set by the



The Pompeii Worm: hottest animal on Earth?

Saharan Desert or Silver Ant (*Cataglyphis bombycina*) at 54° C (see *Nature Aust.*\* Summer 1993-94).

Some highly specialised prokaryotes (simple-celled bacteria and blue-green algae) can grow in temperatures of more than 113° C, but eukaryotes do not seem to be as tolerant. The function of the complex structures within their cells seems to be limited by temperature, but just how the Pompeii Worm has adapted to overcome this problem is unclear.

—P.R.

COURTESY CRAIG CARY/UNIVERSITY OF DELAWARE

## Cetacean Battle Scars

Picture a heavyweight boxing champion. His cauliflower ears and disfigured nose might warn most men they'd come out second best from a punch-up with this guy. A similar rationale may reduce fighting among

\*Previously ANH

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A.C.N. No.007 867 521

Neanderthal flute or musical fluke?

males of some toothed whale and dolphin species, according to British researcher Colin MacLeod.

By reviewing the scientific literature and through personal communications with fellow cetacean researchers, MacLeod identified 18 species of whales and dolphins in which old battle scars may function as advertisements of male strength. It's a case of antagonists be warned! A competitor that has already survived a lot of fights—with the marks to prove it—might best be avoided.

Unlike most mammals, which are covered with hair, the smooth skin of cetaceans scars easily. However, as MacLeod points out, wounds don't heal in the same way in all whale and dolphin species. In the bottlenose dolphin *Tursiops truncatus*, for example, scars tend to fade relatively quickly. But in Risso's Dol-



phin (*Grampus griseus*), the Narwhal (*Monodon monoceros*), the Sperm Whale (*Physeter catodon*) and most of the beaked whales (family Ziphiidae), white or unpigmented marks persist and accumulate, providing a record of past injuries.

In these species, their diet has evolved to include mainly soft-bodied prey such as squid and octopus. Teeth are no longer important for feeding but have been retained,

and sometimes even become specially adapted, for use in male-to-male combat. These weapons can cause a lot of damage. MacLeod believes that healed wounds gradually became a signal of past conquests which worked to avoid costly fights. As a result, the repigmentation rate in the skin of these species declined so that scars could linger longer as indicators of strength.

—K.McG.

Neanderthals' Bone Flute?

Headlines were made when a perforated Cave Bear femur was discovered in 40,000–82,000-year-old cave deposits in western Slovenia. It had at least three holes along one side and was interpreted by its discoverers as a broken flute . . . and the world's oldest musical instrument.

Ivan Turk (from the Sloven-



A Sperm Whale's scars provide honest signals of strength.



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HELLIO-VAN INGENAUSCAPE

Male and female Blue Tits may look the same to us . . . but not to them.

ian Academy of Sciences) and colleagues found the 'flute' in sediments associated with Middle Palaeolithic artefacts, which are likely to have been the handiwork of Neanderthals. For many people this creates a problem. If indeed the bone is a flute, and Neanderthals made it, it would suggest that Neanderthals were more advanced intellectually than seems

otherwise likely.

Can you prove that a bone with holes is a flute? You can try to play a reconstructed version of it. This is just what Bob Fink, a musicologist from Saskatoon, USA, did . . . and he found that it worked. But that doesn't mean it was made for that purpose. Could a large carnivore have created the holes? To investigate this idea, Francesco d'Errico

(CNRS in France), Paola Villa (University of Bordeaux) and colleagues compared the holes in the 'flute' with known puncture marks in carnivore-chewed bear bones from other caves. According to these researchers, nothing about the 'flute' requires the work of Neanderthal craftsmen; they conclude that the most likely explanation for the holes is damage by carni-

vores.

But even if Neanderthals didn't make this 'flute', it doesn't mean they couldn't have played it. After a bit of experimentation with their lips and their fingers, they could well have discovered there was music in them bones!

—Richard Fullagar  
Australian Museum

## A Sight for UV Eyes

**M**ale and female Blue Tits (*Parus caeruleus*) may seem indistinguishable, but look again . . . this time under ultraviolet light. Two recent studies, led by Staffan Andersson (University of Göteborg, Sweden) and Sarah Hunt (Centre for Behavioural Biology, Bristol) respectively, have exposed this common European tit as the first bird known to be sexually dichromatic (that is, to have differently coloured males and females) under UV light.

Unlike birds, humans are UV-blind. Our eyes are not sensitive to near-ultraviolet wavelengths (300–400 nanometres), so what may seem like similar plumage patterns to us are strikingly different to a Blue Tit. This finding sheds enormous amounts of 'light' on such mysteries as how female Blue Tits choose mates or judge their quality.

Feathers on the Blue Tit's crown light up under UV light, with the males showing stronger colour than females. Their UV-sensitive vision maximises the contrast they see between crown feather colour and a dark forest background, suggesting the head's importance in communication. This coincides nicely with Blue Tit ecology—mate choice occurs in early spring when the deciduous habitat is still dominated by dark browns and greys (dead leaves from last year, and the trunks and branches), and male sexual displays involve head lunges and erection of neck feathers. The strength of UV head colouration, then, seems to be a key factor in distinguishing average male tits from more desirable ones.

In laboratory trials female tits consistently choose

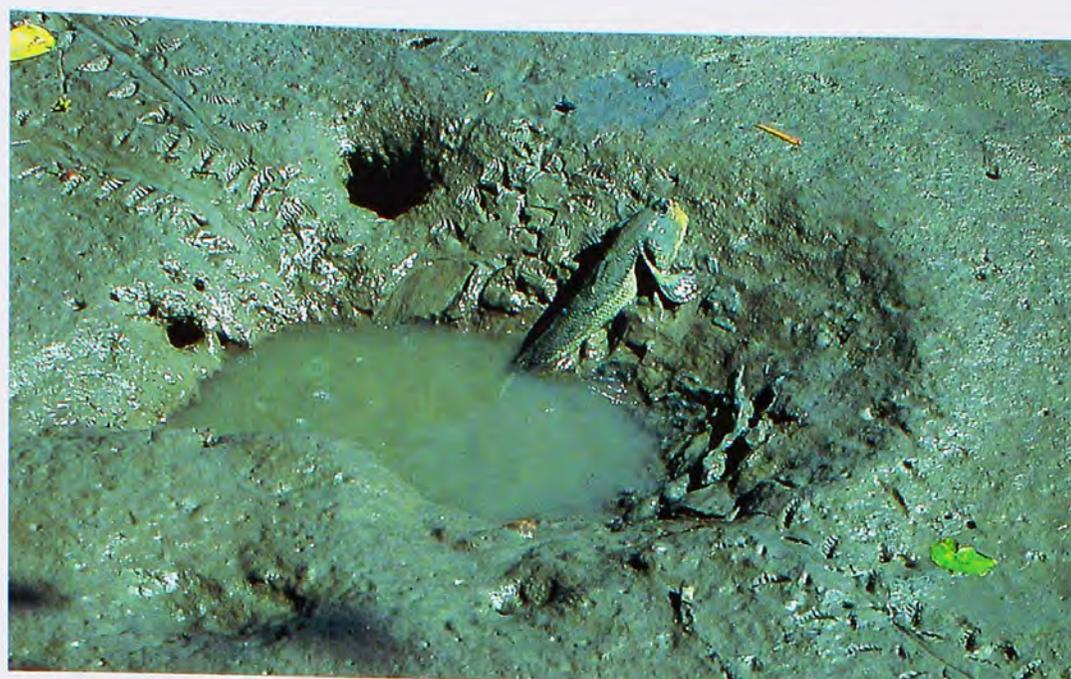
males with the brightest crown feathers. While they also use male song and body size to choose their partner, their ultimate decision may be based on that head patch we cannot see.

—Dafna Hopenstand & Leo Joseph  
Academy of Natural Sciences,  
Philadelphia

## Mudskippers: BYO Air

Deep inside an intertidal mudflat hardly seems the ideal place for a fish to raise its family. Mudskippers are a group of small fishes best known for their amphibious habits, but equally remarkable for their ability to live and reproduce in deep burrows filled with oxygen-depleted water. The burrow of one of the world's largest mudskippers, *Periophthalmodon schlosseri*, is about eight centimetres wide and extends down to about 125 centimetres. This vertical shaft is connected to one or more horizontal tunnels. The oxygen-starved depths of these muddy dwellings are a refuge during high tide, and a nursery for mudskipper eggs. But how do the eggs survive and develop in such an inhospitable environment?

Atsushi Ishimatsu (Naga-



FRITH/OTO

How do mudskippers manage in the oxygen-depleted depths of their burrows?

saki University, Japan) and his colleagues studied the behaviour of *P. schlosseri* on intertidal mudflats in Malaysia and literally stumbled across the solution. As they were walking around the mudflats, they noticed bubbles coming out of the mudskipper burrows. Apparently the action of their walking compressed the horizontal tunnels, forcing gas out of the vertical shafts. Analysis of the expelled air revealed that bur-

rows with signs of recent fish activity contained more oxygen and less carbon dioxide than 'inactive' burrows.

Field observations showed that *P. schlosseri* gulped air before entering their burrows, and looked deflated when they re-emerged. The mudskippers were clearly carrying air into their burrows, and sometimes spent up to 30 minutes shuttling air deep into their subterranean chambers. This behaviour

produces an oxygen reservoir deep in the mud that may be just what mudskipper eggs need to successfully complete their development.

—S.R.

## A Storm in the Platypus Brain

Platypuses only forage under water. It's usually at night, conditions are often murky, and their eyes and ears are closed all the time



D. PARER & E. PARER-COOK/AUSCAPE

While foraging, the Platypus processes tandem signals to judge the distance of its prey.



The shifting dunes at Dunhuang in China produce booming sounds that were once thought to be the work of demons.

they are submerged. And yet, so efficient are they at catching insects, molluscs, crustaceans and the occasional frog that they can consume up to almost half their body weight in prey in a single night.

It was confirmed over a decade ago that the secret to their hunting success is a 'sixth sense'—the Platypus bill can detect small electric currents emitted by prey. But it's much more than a matter of simple detection, as research by John Pettigrew and colleagues from the University of Queensland now shows.

The bill of the Platypus (*Ornithorhynchus anatinus*) contains two types of sensory receptors. There are some 60,000 electroreceptors and about 40,000 mechanoreceptors (or push rods). Each receptor sits inside its own mucous-filled pit. These close when the bill is exposed to the air. They open when the bill is submerged to allow the receptors within to contact

the surrounding water.

Pettigrew believes these two types of receptor work in tandem to tell a Platypus very precise information about potential prey. The nerves and muscles of a crayfish, for example, emit electrical signals that travel through water almost at the speed of light (like lightning in a storm) and are detected by the electroreceptors. A movement of the crayfish tail creates a wave of disturbance in the water that travels more slowly (like a thunder clap) and is detected by the push rods. Just as we can determine the distance of a lightning strike from the time between its flash and the arrival of its sound, the Platypus may be able to judge the distance (and shape) of its prey by measuring the time interval between the arrival of the electrical and mechanical sensations.

But does the Platypus have the brain to be able to process this sort of complex information? Pettigrew is

convinced it does. For three decades, he has been studying the visual cortex of primates, the extraordinarily complex section of the brain that supports binocular vision. Using modern staining techniques, a stripe-like structure showing a pattern of dark and light bands was revealed, which Pettigrew believes is related to the processing of two sets of information (one from each eye) and the basis for stereoscopic vision. Surprisingly, this same stripe-like structure is found in the section of the Platypus brain that receives sensations from the bill—light bands for processing information from the electroreceptors, interspersed with dark bands for processing mechanical sensations.

Perhaps the Platypus interprets the signals from the electroreceptors and push rods in the same stereoscopic way that we process and use information from our two eyes.

—K.McG.

## Musical Sands

Marco Polo blamed evil spirits playing musical instruments for the loud and mysterious sounds he heard while crossing the deserts of Asia. Charles Darwin was similarly fascinated by the strange and seemingly unearthly reverberations near large sand dunes. Today, such acoustic wonders are known as 'booming sands'. They occur mostly in large isolated desert dunes.

A less dramatic but more common phenomenon occurs when beach sand squeaks or whistles underfoot. Squeaking sand, however, produces high-frequency, short-lived musical peals. The sounds created by booming sands are of a much lower frequency and can resonate for as long as 15 minutes. They are also much louder and can be heard up to ten kilometres away.

Michael Bretz and Franco Nori from the University of Michigan believe that booms

tend to occur in sand where the grains are of a similar size, are uncommonly smooth and highly polished (although protrusions and irregularities also seem to be important in sound production), and conditions are dry.

When all these factors combine on the sheltered crest of a dune and wind creates an avalanche, large thin plates of sand are displaced and tend to shear across the underlying dune, like playing cards across a deck. The combined acoustic vibrations of the individual plates as they bounce up and down are a possible source of the booms.

Further research by Douglas Goldsack and colleagues at Laurentian University in Canada indicates that a silica-gel type of surface deposition on sand grains may also be important in sound production.

All researchers agree, however, that the explanation for 'musical sands' is far from complete and more study is needed to fully explain the mystery.

—K.McG.

## Baboons Fake It

It seems humans aren't the only females to fake an interest in sex; baboons do it too, but with a more serious agenda. By tricking males into thinking they're fertile they may be saving the lives of their young.

Many female primates advertise their sexual receptiveness by developing swollen pink bottoms to coincide with ovulation. In a paper presented at a recent conference on primate socio-ecology, Dietmar Zinner of the German Primate Centre in Göttingen related how females of his captive population of *Hamadryas* Baboons (*Papio hamadryas*) sometimes developed the swelling when they couldn't possibly be ovulating, such as when they were nursing an infant. Furthermore, he noticed that these out-of-season swellings occurred only after new males took control of the group, an event that occurred three times in the course of 14 years observation.

In each case, all six nursing mothers with infants under

five months old displayed swellings within a few weeks of the new male's appearance on the scene. In spite of this, they didn't fall pregnant, nor did the interval between births change, confirming that sexual swellings in females with nursing young have nothing to do with ovulation.

Approximately 60 per cent of infant deaths in baboon colonies are caused by male infanticide, because with the death of her young, a female will become sexually receptive within a matter of weeks instead of months. Zinner believes that, by seemingly offering the new males the 'come hither' sign, the mothers are giving their babies a chance at life.

—R.S.

## Further Reading

Andersson, S., Örnborg, J. & Andersson, M., 1998. Ultraviolet sexual dimorphism and assortative mating in blue tits. *Proc. R. Soc. Lond. B* 265: 445–450.

Campbell, S.S. & Murphy, P.J., 1998. Extraocular circadian phototransduction in humans. *Science* 279: 396–399.

Cary, S.C., Shank, T. & Stein, J., 1998. Worms bask in extreme temperatures. *Nature* 391: 545–546.

Dal Sasso, C. & Signore, M., 1998. Exceptional soft-tissue preservation in a theropod dinosaur from Italy. *Nature* 392: 383–387.

d'Errico, F., Villa, P., Llonca, A.C.P. & Idaraga, R.R., 1998. A Middle Palaeolithic origin of music? Using cave-bear bone accumulations to assess the Divje Babe I

bone 'flute'. *Antiquity* 72: 65–79.

Downs, C.T. & Ward, D., 1997. Does shading behavior of incubating shorebirds in hot environments cool the eggs or the adults? *The Auk* 114(4): 717–724.

Fink, B., 1997. Neanderthal flute . . . musicological analysis. <http://www.webster.sk.ca/greenwich/fl-compl.htm>

Goldsack, D.E., Leach, M.F. & Kilkenny, C., 1997. Natural and artificial 'singing' sands. *Nature* 386: 29.

Hunt, S., Bennett, A.T.D., Cuthill, I.C. & Griffiths, R., 1998. Blue tits are ultraviolet tits. *Proc. R. Soc. Lond. B* 265: 451–455.

Ishimatsu, A., Hishida, Y., Takita, T., Kanda, T., Oikawa, S., Takeda, T. & Huat, K.K., 1998. Mudskippers store air in their burrows. *Nature* 391: 237–238.

Koller, J., Baumer, U., Kaup, Y., Etspuler, H. & Weser, U., 1998. Embalming was used in Old Kingdom. *Nature* 391: 343–344.

MacLeod, C.D., 1998. Intraspecific scarring in odontocete cetaceans: an indicator of male 'quality' in aggressive social interactions? *J. Zool., Lond.* 244: 71–77.

Nori, F., Sholtz, P. & Bretz, M., 1997. Booming sand. *Sci. Amer.* Sept. 97: 64–69.

Oren, D.A. & Terman, M., 1998. Tweaking the human circadian clock with light. *Science* 279: 333–334.

Pettigrew, J.D., Manger, P.R. & Fine, S.L.B., 1998. The sensory world of the platypus. *Phil. Trans. R. Soc. Lond. B* 353: 1199–1210.

Stevenson, C.M., 1997. *Archaeological investigations on Easter Island. Maunga Tari: an upland agricultural complex.*

Bearsville Press and Cloud Mountain Press: Los Osos, California.

Turk, I. (ed.), 1997. *Mousterian bone flute and other finds from Divje Babe I cave site in Slovenia.* Institut za Arheologijo: Ljubljana, Slovenia.

## QUICK QUIZ

1. What is the name of the controversial uranium mine surrounded by Kakadu National Park?
2. Where does the world's heaviest and only flightless parrot live?
3. Do Lions purr?
4. What colour is the Pygmy Blue-tongue's tongue?
5. Which organisation owns the ships *The Rainbow Warrior*, *Moby Dick* and *Arctic Sunrise*?
6. What do folivores eat?
7. How many opposable 'thumbs' does a Koala have on each hand?
8. What type of animal is a pobblebonk?
9. Who is the author of the book *Throwim way leg* (1988)?
10. What is the name of Russia's orbiting space station?

(Answers in Q&A)

Karina Holden, Karen McGhee, Stephen Richards, Philippa Rowlands and Rachel Sullivan are regular contributors to Nature Strips.



A female *Hamadryas* Baboon. Pink and puffy 'turn-ons' aren't always what they seem.

COURTESY DIETMAR ZINNER

*Northern Brown Bandicoots never made it to the 21st century by being nice to anyone.*

## COOTS IN THE QUICK LANE

BY STEVE VAN DYCK

**N**OT LONG BEFORE WE received our eviction notice, the next-door neighbours asked us what actually went on inside the room from which all the dreadful screaming and huffing noises came at night. Our confession that we had turned a spare room over to rehabilitating half-electrocuted flying-foxes and Cat-wrested possums somehow filtered through to the landlord who sent word of an imminent visit.

Months earlier, we had raised three Northern Brown Bandicoots (*Isoodon macrourus*) from little more than squirming cheerios, and because rough-and-tumble life in the spare room was mostly stratified into the upper layer, the young bandicoots were quite safe running around on the floor. We'd covered the lino with newspaper and thrown in

truck loads of grass cuttings to make it more difficult for each bandicoot to find another's tail and bite it off.

The old rented house was a high-set 'Queenslander' so, to achieve an illusion of normality posthaste, we decided to chuck all the grass out the window, rake it up downstairs, then carefully dispose of it over the neighbours' fence. After a mammoth effort, Jane looked at a job well done considering the underlying motive was panic. All the floor now needed was a good sweep, being careful not to clobber the bandicoots that had been hiding all the time . . . under the grass . . . what grass? The shameful truth was that the 'babies' had gone out one-by-one with the bath water, liberated in billowing clouds of hay, and totally unnoticed by the hand that had launched them!

Knowing their weakness for Pal, I baited some cage traps in the yard at the fall-out site and after a few days managed to catch two of the coots. But our lasting memory of these consummate little ingrates was not of their toughness in the three-metre free fall or their now total indifference to our attentions, but

of the lacerations they left on our hands when we offered them a more dignified release in the bush. Perhaps they were only fastening their seat belts in preparation for another full toss, but their revenge hit a raw nerve, mainly because of the effort we'd put into raising them. Silly things us humans, always expecting gratitude for favours never asked for.

Northern Brown Bandicoots never made it to the 21st century by being nice to anyone. You don't get to be the only abundant terrestrial marsupial in the big smoke by sucking up. But muscles, a quick turn of speed, sharp teeth and more brawn than brains are not the only things that keep bandicoots a step ahead of Dogs, Cats and cars. The one thing that sets them apart is what they are capable of achieving with their reproductive bits.

They have a procreation potential so staggering it makes Rabbits look like Carmelites. For a start they have the shortest gestation period of any living mammal—an astonishing 12.5 days from hanky-panky to pinkies (compare this to the 18–21 days of a House Mouse, or the 30 of a Rabbit or kangaroo). Madame Bandi has scarcely had time to consider morning sickness when it's time to deliver enough 13-millimetre jelly babies to crawl up to the pouch and attach themselves to the eight maggot-like teats inside. Once there, the blistering pace of coot-pumping starts with their ingestion of a formula composed of around eight per cent milk solids. By the time they're poking their heads out at 45 days, they are drinking a 40 per cent milk-solid brew like warm runny Yak butter. The female then mates again, and 12.5 days later the 8.5-week-old Schwartzeneggers are evicted to make way for the new litter.



When their preferred diet of insects and larvae gets scarce, Northern Brown Bandicoots will eat snails, worms, berries and even the Dog's dinner.

(Brush-tail possums take six months from birth to independence, grey kangaroos 18 months.) In another one or two months the young bandicoots will be cruising for a mate themselves.

The frenetic pace does not end when the pouch drops down (like the backward-pointing loading ramp of a Caribou aircraft) and unloads them for the last time. Female Northern Brown Bandicoots live for only about 18 months and males might just make it to two years. In that time the young bandies pack a lot of food away and bulk up to a massive three kilograms in adult males and a more modest 1.7 kilograms in females.

It is in Autumn when the weather cools off that bandicoots are more frequently observed. At this time their naturally preferred food (insects and larvae) gets so scarce that the coots hunt for snails, worms, berries, Sugarcane and fruit. This search takes them closer to humans, houses and camp sites. They will soon be stealing any food left in the Dog's bowl, bursting their way under wire netting to get at laying mash inside the chook house, or digging small conical holes over the back lawn in their search for grubs and worms. In fact bandicoots are not averse to weeding your vegetable garden and turning your compost heap . . . but sadly they can't seem to distinguish between the two.

A male also spends a great deal of energy aggressively maintaining his rights to a five-hectare territory, sometimes chewing the tails off would-be rivals. In some areas whole bandicoot populations seem to lack tails, leading to reports of mini-wombats in places where they shouldn't be.

Given that it is theoretically possible for female bandis to breed all year round, producing a litter every two months and a total of 48 fast-growing young, it might seem strange that no-one has pounced on the bandicoot as a trendy table item like quail, pheasant or rabbit—there is no doubt they do taste deliciously like chicken. Perhaps their ferocious nature has had something to do with it. Handling them is like dealing with unexploded hand grenades—quiet bandicoots can go off in a blur of lashing hind claws, clods of flying skin and fur, flashing teeth and much blood. But that's nothing compared with the marketing challenge of dreaming up a more palatable name than 'bandicoot' to grace the menus of posh Australian restaurants.

In spite of all the mathematics of the maternity ward, the theory of their reproductive potential doesn't always match the practice. The average number of newly born pouch young in wild females is around four, and usually only three leave the pouch alive. Then of the actual 18 young a female produces in her one year of reproductive life, only six will ever survive to sexual maturity. While this recruitment rate sees them

maintain numbers in the suburbs, is it any wonder that other native species without such a procreative potential can't cope?

The Northern Brown Bandicoot is a survivor in an environment full of things that bark at it, bite it, burn it or squash it. From our perspective, its short life seems to be over before it's begun. But that's par for the course when you pump iron. This coot bulks up, struts around, and pushes off. No expensive steroids, no embarrassing urine tests. And, unlike in human has-beens, no-one gets to laugh at it because it never turns to flab.

Not bad going for something that's supposed to be thin on brains! ■

### Further Reading

Gordon, G., 1995. Northern Brown Bandicoot. Pp. 174–175 in *The mammals of Australia*, ed. by R. Strahan. Reed Books: Chatswood.

Seebeck, J.H., Brown, P.R., Wallis, R.L. & Kemper, C.M. (eds), 1990. *Bandicoots and bilbies*. Surrey Beatty & Sons: Sydney.

*Dr Steve Van Dyck is a Curator of Vertebrates at the Queensland Museum where he has worked since 1975.*



JEAN-PAUL FERRERO/ALSCAPE

## NORTHERN BROWN BANDICOOT

*Isoodon macrourus*

### Classification

Family Peramelidae (bandicoots and bilbies).

### Identification

Biscuit-brown with creamy white belly (very harsh dorsal fur is really a mix of straw-coloured hairs and dark-brown to black hairs); head–body length 400 mm; tail about 170 mm. Posture humped, snout long and very pointed, movements jerky. Forefeet with only 3 long-nailed toes. Tail sometimes absent (bitten off). Similar to Long-nosed Bandicoot (*Perameles nasuta*), which has soft fur, more pointed ears and a much larger gap between the 4th and 5th upper incisors.

### Distribution and Habitat

From northern WA, through northern NT, Gulf of Carpentaria, Cape York Peninsula, down the east 'coast' to Hawkesbury River near Sydney. Common in inner suburbs with protective daytime cover (long grass, vacant lots, rubbish piles). Outside cities/towns in dry and wet eucalypt forests and open paddocks.

### Behaviour

Nocturnal, non-climbing. Infamous for the small conical holes it digs in lawns. Heart-attack-inducing 'balloon-screech' call when disturbed from daytime 'nest' in long grass or dense vegetation. Becomes sexually mature at 3–4 months, average 4 young (from 8 nipples) per litter; gestation period 12.5 days; up to 6 litters per good year. Life span less than 2 years. Heavy tick infestations Jan.–May. Droppings like peanut pods.

### Diet

Omnivorous, but happy to supplement garden grubs and bush tucker with Pal and laying mash.

### Threats

Cats, Dogs, cars, whipper snippers and backyard tidiers.

*In a group known for its floral splendour, the flowers of Mellblom's Spider-orchid are magnificent.*

# MELLBLOM'S SPIDER-ORCHID

BY GEOFF W. CARR

**T**EMPERATE AUSTRALIA HAS the richest flora of ground orchids in the world. Over 800 species have been recognised, including 140 species of spider-orchids (genus *Caladenia*) from southern Australia.

Mellblom's Spider-orchid (*Caladenia hastata*) was first discovered in 1940 when a local plant enthusiast, Flora Mellblom, stumbled across a group of flowering plants at Point Danger (Portland, Victoria). After that it was only recorded from a few other locations and then it seemingly disappeared, until 1973 when about 300 plants were rediscovered at Point Danger, flowering prolifically after a fire had swept through the heath. Today almost all the species' original heath and heathy woodland habitat has been cleared; the Point Danger site is all that remains.

In 1980 an aluminium smelter was built on part of the Point Danger orchid site and Alcoa (Australia) Ltd commissioned studies that have continued until this day. Plants that would have been destroyed in the building process were collected for cultivation or relocation to a nearby coastal reserve, while the rest of the population was left untouched.

Mellblom's Spider-orchid is typical of spider-orchids in terms of its morphology, biology and ecology. Plants survive summer as a small tuber buried in the sandy soil. The single, hairy leaf, up to 12 centimetres long and 15 millimetres wide, appears in autumn and withers in late spring. Between September and November a 35-centimetre-long flower stem, bearing one and sometimes two flowers, appears. The flowers may last for six weeks. In a group known for its floral splendour, the flowers of Mellblom's Spider-orchid are magnificent with white, stiffly spreading sepals (up

to four centimetres long) and smaller petals. The central labellum (lip) is white with crimson markings, and it is hinged at the base so that it may be tilted forwards or backwards. Particularly striking are the narrow, maroon-coloured glandular 'clubs' (osmophores) at the end of the sepals and petals, which emit the floral fragrance (although undetectable to humans).

Like all Australian spider-orchids, Mellblom's Spider-orchid relies on an unusual method of pollination called pseudocopulation. Male flower wasps in the subfamily Thynninae are attracted by the flower's fragrance, which resembles the sexual pheromones produced by wingless female wasps. The enthusiastic but naive male is duped by olfactory, visual and tactile cues into believing the orchid labellum is a female wasp. He tries to seize the hinged but unyielding labellum to copulate with it and, in so doing, collects the orchid pollen on his back as he is tilted forward into the flower. In frustration he rushes off to another flower, there to deposit the pollen on its stigma, and pollination occurs.

Another extraordinary orchid relationship is their reliance on a mycor-

rhizal fungus, which invades the underground orchid stem or roots. The fungus supplies the orchid with necessary minerals in return for carbohydrates. Only orchid seeds that are infected with this fungus will germinate.

Fortunately stem tissue containing the mycorrhizal fungus is easy to isolate from spider-orchids and the fungus can be readily cultured on a nutrient medium under laboratory conditions. This allows horticulturalists to germinate the seeds on the fungus-infected medium, and young plants can later be transferred to soil and planted out in the wild.

Because of the lack of formal conservation plans, and various threatening processes (such as weed invasions and smelter emissions), the number of Mellblom's Spider-orchids has declined to around 20; more may exist but they are difficult to find unless flowering—a rare event except after fire.

However, the fortunes of the orchid are about to be reversed with the recent completion of a Recovery Plan, a collaborative effort between Environment Australia, Alcoa, the Victorian Department of Natural Resources and Environment, Kings Park Botanic Gardens in Perth, and Ecology Australia. This aims to ensure survival of wild plants by appropriate management, notably weed control and prescribed fire; to manage the plant-out site where orchids have survived for 17 years and select other planting sites; to maximise seed production by hand pollination; to raise seedlings using laboratory techniques (thousands have already germinated at Kings Park); and to survey the region for additional suitable spider-orchid habitat.

Single-species conservation programs have received criticism by concentrating on species rather than habitats. However, for successful management, we need both kinds of program; Mellblom's Spider-orchid cannot 'manage' itself. Furthermore, the lessons learned from managing Mellblom's Spider-orchid and its habitat are widely applicable to other endangered orchids, scores of which also need conservation management. Finally, the collaboration seen here between government agencies, botanic gardens, industry, conservation biologists and community groups is heartening and is sure to have far-reaching significance. ■

## Further Reading

Backhouse, G. & Jeanes, J., 1995. *The orchids of Victoria*. Melbourne University Press: Carlton.

Hill, J., Carr, G., Pritchard, A., Govanstone, A. & Backhouse, G., 1998. *Recovery Plan for Mellblom's Spider-orchid, Caladenia hastata, 1998–2002*. Portland Aluminium and Department of Natural Resources and Environment: Melbourne.

*Geoff W. Carr is a founder and director of Ecology Australia Pty Ltd, a Victorian-based flora and fauna consultancy.*





Seen through American eyes, Australia's Broad-leaved Paperbark is one heck of a tree.

# SUPERIOR CREATIONS

BY TIM LOW

**N**ATURALISTS IN THE 19th century thought that Australia was a backward land populated by the world's most primitive and inferior creatures. The fallacy of such thinking is obvious today when we look at how well Australia's species do as pests overseas.

Some of the world's major crop pests originated here, Cottony Cushion Scale (*Icerya purchasi*), Sugarcane Planthopper (*Perkinsiella saccharicida*) and Tobacco Blue Mould (*Peronospora tabacina*) for instance, and many of our shrubs and trees do exceptionally well as weeds.

The American book *Invasive plants* (1966) includes, among its selection of America's 24 weediest trees, six from Australia—a quarter of the total. In South Africa the proportion is much

higher—40 per cent of environmental weeds there are Australian, and in the winter rainfall zone the figure reaches 59 per cent for shrubs and trees (see *Nature Aust.* Spring 1997). These are astounding statistics, to say the least.

Australia's woody plants succeed so well overseas, I believe, because they evolved on an exceptionally harsh continent. They thrive in landscapes degraded by human misuse, where the topsoil has washed away, or in naturally difficult environments. The most compelling examples of the latter are the Australian trees invading Florida. In two of the most severe environments there—swamps and saline dunes—Aussie plants now dominate the land.

Seen through American eyes, Australia's Broad-leaved Paperbark (*Melaleuca quinquenervia*) is one heck of a tree. There are billions of them in southern Florida, infesting half a million hectares of swampland and taking over another six hectares every day. A single tree can drop 20 million seeds, a plant as young as three years old can set seed, and trees can flower five times a year. This is some superior weed! Its regenerative powers are amazing, with melaleuca fenceposts often sprouting into new trees. The trees use up to five times the water of the sawgrass prairies they replace, thus helping drain the



PHOTOS: TIM LOW

One of the newest of Australian plants to go feral is Tuckeroo. A popular street tree in California and Florida, it is spreading into littoral rainforests in southern Florida, its seeds dispersed by birds.



Paperbark forests in Florida often form gloomy thickets within which no other plants can grow. They provide shelter for raccoons and Bobcats.

Everglades' water supply, already overburdened by farm and city water-use. They also cause wildfires and asthma. The uncontrollable expansion of melaleuca has been described as one of the most serious ecological threats to south Florida's natural systems. According to Dan Thayer, an American weed expert, "the only areas they won't colonise are those covered in concrete".

The other Australian 'superweed' there is the 'Australian Pine' (not a true conifer), an astonishing hybrid of the River Oak (*Casuarina cunninghamiana*) and Coast Sheoak (*C. equisetifolia*), growing with the height of the first and salt-tolerance of the second. This fiendish creation has taken over shorelines and small islands, forming thickets so dark, and shedding leaf litter so toxic, that nothing can grow below. Believe it or not, of the several hundred exotic weed species infesting Florida today, these two trees rank among the top three, beside Brazilian Broad-leaved Peppertree (*Schinus terebinthifolius*).

Like most of the world's worst weeds, these trees were planted on purpose, as ornamentals, for bank stability and, in the case of the paperbarks, to drain the Everglades. (They drain them all right, but by claiming possession of the land.) Most of southern Florida was originally treeless and Australian trees have proved the ultimate colonisers of swampy or saline soil. You can drive

along highways for 20 minutes at a time seeing nothing but dense paperbark forests, apart from an occasional emergent 'pine'.

Paperbarks and 'pines' are not the only weeds we have donated to Florida. When I travelled there two years ago I saw stands of Earpod Wattles (*Acacia auriculiformis*), Weeping Bottlebrushes (*Callistemon viminalis*) and a few young Umbrella Trees (*Schefflera actinophylla*). Some American weed experts also took me out to see an infestation of 'Carrotwood' (*Cupaniopsis anacardioides*), the Australian rainforest tree we know as Tuckeroo. Imported to the States in 1968, this ornamental only became popular after 1980, when many homeowners planted it to replace trees damaged by Hurricane Andrew. As an invader it is so new that no wild trees have grown full size; there are only seedlings, sprouting in the hundreds, and scattered saplings. I was shown a site with a few saplings, only a few metres tall—nothing to worry about I thought, growing in forest not far from a towering 'Australian Pine' and some young Umbrella Trees. But these experts are trying to pick new problems more quickly (something we could learn from), to close gates before horses have bolted, and this Australian tree has them worried. One county has already banned 'Carrotwoods' from nurseries.

That night we ate takeaways and I showed them slides of Broad-leaved

Paperbark forests taken in Maroochy shire north of Brisbane, where I was conducting fieldwork on this fast-disappearing habitat. When I returned home I was dismayed to find that bulldozers had flattened much of the largest stand of these paperbarks remaining, one I had photographed for the Americans, and one I had recommended as a high priority for conservation. Paperbarks are the fastest-disappearing habitat in south-eastern Queensland. I trudged across the bulldozed fields, shaking my head in dismay, thinking back to my friends in Florida who would love to see a scene like this. What they want to get rid of, we want to save but can't. Paperbarks may be superior trees, but they are no match for gritty Australian determination to conquer the land. ■

#### Further Reading

Bodle, M.J., Ferriter, A.P. & Thayer, D.D., 1994. The biology, distribution and ecological consequences of *Melaleuca quinquenervia* in the Everglades. In *Everglades: the ecosystem and its restoration*, ed. by S.M. Davis and J.C. Ogden. St Lucie Press: Delray Beach, USA.

Randall, J.M. & Marinelli, J. (eds), 1996. *Invasive plants: weeds of the global garden*. Brooklyn Botanic Garden: New York.

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*We are separated from dinosaurs by the comforting cushion of 65 million years. And they are just so different from us in every way. Or are they?*

**I**N MOST MOVIES THERE IS OFTEN A particular scene or moment that lingers in the memory for a long time. In Steven Spielberg's "Jurassic Park", for me it was the one moment that brought the house down (or should I say up)—when the lawyer was plucked off the dunny by a rather cranky, and slightly peckish, *Tyrannosaurus rex*. Looked at dispassionately, the thought of any such interaction between humans and dinosaurs ever happening are on the remote side of non-existent. I mean, we are separated from dinosaurs by the comforting cushion of 65 million years. And they are just so different from us in every way. Or are they?

I would argue that there is a fundamental evolutionary similarity between humans and dinosaurs—and the result is that we both ended up as kings of our respective castles, especially in the great impact that we have had on our ecosystems. This similarity arose from the underlying mechanisms that fuelled our evolutionary histories.

Recently there has been a resurgence of interest in a facet of evolution that fell headlong into decline shortly after Darwin published his *Origin of species* in 1859. This concerns the relationship between development and

evolution. For more than half a century, evolution, to most people, has been synonymous with genetics and natural selection. Missing from the evolutionary equation is an appreciation of how genes act to produce changes in shape and size. After all, this is the basic raw material that natural selection feeds upon. Take humans and Chimpanzees, for example. About 99 per cent of our genes are identical—so why do we look so different?

**U**NDERSTANDING EVOLUTIONARY RELATIONSHIPS comes not only from comparing adults of different organisms. It also comes from looking at the entire developmental histories of organisms, from their moment of conception until the time they die. As we grow not only do we become bigger, but our proportions change. For instance, as babies we

FRANÇOIS GOMIER/AUSCAPE



have a relatively large head but, as we get older, our trunk, arms and legs become relatively larger. And as we and other animals evolved, the shapes and sizes of all our body parts have developed either more or less compared with our ancestors. Parts of our bodies may grow at relatively slower rates or for

# PETER PAN MEETS GODZILLA

BY KEN McNAMARA



shorter periods. Alternatively, they may grow faster or for longer. The result can be evolution down new and uncharted pathways, adapting to new niches. This change to the rate and timing of development is known as heterochrony.

If one or more features of an animal or species undergo less developmental

change than occurred in its parents or ancestors, it is said to retain ancestral juvenile features. These features grow less and remain stuck in a juvenile-like stage while the rest of the organism matures. I call this retention of ancestral juvenile features the 'Peter Pan syndrome'. Technically it is known as

*Tyrannosaurus rex*, like humans, had a mixture of 'Godzilla'- and 'Peter Pan'-like features. In *T. rex*'s case, the skull and hind legs grew faster for longer periods than in its ancestors, while other features, such as the arms, developed in the opposite direction.

paedomorphosis, meaning 'child-like shape'. This particular aspect of heterochrony has played a very important role in the evolution of domestic Dogs (*Canis familiaris*). The earliest Dogs found in archaeological sites look very similar to juvenile wolves. Moreover, juvenile wolf behaviour was also retained by adult domestic Dogs. It seems probable that selection, unwittingly or otherwise, focussed on these youthful behavioural traits. Small breeds of Dog, like Chihuahuas and King Charles Spaniels, are even more Peter Pan-like. Because Dogs change a lot in shape as they grow, any slight tinkering with the rates or duration of growth can

send the developmental trajectory way off course, producing a very different-looking Dog.

Evolution may also follow the opposite path to the Peter Pans of this world, with one or more features in the descendants changing more during their development. They may grow for relatively longer than in the ancestor, or at a faster rate. This is the 'Godzilla syndrome', named after a Japanese movie monster of the 1950s. Known more formally as peramorphosis (meaning 'beyond shape'), this process has been the driving force in dinosaur evolution. Take for instance our dinosaur with the taste for lawyers, *Tyrannosaurus rex*. The

adult has, obviously, a much larger body than the juvenile, but it also has a relatively more massive skull and huge hind legs. Recent research on dinosaur growth rates, based on the microstructure of their bone, indicates that these huge creatures grew very rapidly. They may also have delayed the point at which they reached maturity to allow for a long growing period. It is even likely that, as in living male African Elephants (*Loxodonta africana*), they may have continued growing throughout their lives. Many of the morphological features in *T. rex* and other large dinosaurs, such as hadrosaurs, ceratopsians and sauropods, are likely to have evolved from extended periods of rapid growth.

But what about the tiny, useless arms of *T. rex*? My research on heterochrony is showing that many animals are in fact a mixture of paedomorphic and peramorphic features. *Tyrannosaurus rex*'s tiny arms are paedomorphic evolutionary flotsam—unwanted, unused structures that arose as developmental trade-offs when selection pressure diverted energy and growth to other morphological features. A similar example is seen in the wings of flightless birds such as the Emu. Like *T. rex*, the trade-off was for large body size and massive legs.

WHILE SOME BIOLOGISTS AND anthropologists have suggested that humans are the Peter Pans of the ape world, because of a superficial resemblance of adult humans to baby Chimps, I would argue that we are, in many respects, quite the opposite—the Godzillas of the ape world—peramorphs that have developed beyond ancestral apes. But like *T. rex* we resonate with the distant echoes of Peter Pan.

During the 4.5 million years of human evolution, adult body weight and size more than doubled; brain volume more than trebled; and the hind limbs lengthened relative to the trunk. These changes led to our evolutionary success, for they bequeathed us our bipedal gait and our large cerebral cortex. Herein lies the seat of our conscious thought, our memory, our intelligence, and our speech. In these features we have developed beyond our ancestors and beyond all other primates.

However, the secret to our evolutionary success lies not in increases in our rate of growth, but in our life span. We live, on average, much longer than any other primate. What is special about human evolution is the extended duration of all our growth phases—embryonic, infantile, juvenile and adult. Each period of development has been stretched out. Like other animals we grow and develop faster earlier in our

It's the way in which this newborn develops, not just what it looks like as an adult, that is important to understanding the evolutionary history of the human race.



JEAN-MICHEL LABAT/AUSCAPE

Ninety nine per cent of a Chimpanzee's genes are the same as ours—so why do we look so different?



BERANGER-BSIP/AUSCAPE



DENNIS SAMSON/LOCHMAN TRANSPARENCIES

The retention of juvenile features or the 'Peter Pan Syndrome' has played an important role in the evolution of the domestic Dog.

development, particularly as embryos and infants. The evolutionary consequence is that in later hominid species features such as brain size, lower limbs and foot bones, as well as body size, developed 'beyond' the comparative stage in earlier species.

The impact of such stretching-out of hominid life histories on behaviour, social structure and diet would have been profound. Evidence from fossil teeth suggests that the earliest hominids, the australopithecines, were exclusively vegetarian. Members of the genus *Homo* that evolved about two million years ago incorporated more animal material into their diet. This change may be a consequence of the increase in brain size. But where did the energy come from in the first place to produce a more-than-three-fold increase in brain tissue? Recent research suggests that, like *T. rex*, there has been a developmental trade-off, with bigger brains traded for smaller guts. Our guts are relatively small, compared with other primates, whereas our metabolically hungry brains are larger than they should be. Small guts only function with high-quality, easily digested food, like meat. With selection so strongly favouring large brains that require a high energy input to grow, the major developmental trade-off was with the gut resulting in a change from a vegetarian to a more omnivorous diet. The behavioural sophistication that came with the larger brain included the ability to use tools to achieve this dietary change. The evolu-

tionary strategy of gut reduction was accompanied by a pedomorphic diminution in jaw and tooth size as later hominids were not constrained to chomping through a diet of coarse, abrasive vegetation.

The evolution of our extended childhood—much longer than in any other

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primate—has been tremendously significant, for this is when we learn most readily. Compared with our ancestors, our more complex brain stores and processes greater amounts of information; we articulate a sophisticated language; we can manufacture elaborate tools and engage in complex, social activity.

Even from the fossil record it is possible to infer that, during the course of hominid evolution, the extension of childhood has led to increasing behavioural complexity. The result was that *Homo habilis* used a simple, worked stone to obtain its food. Later species, like *Homo erectus*, used a slightly more complex, worked stone. Early *Homo*

*sapiens* crafted more intricate stone tools, or used other material like bone. Late *Homo sapiens* hops into a car and drives to the nearest McDonald's.

In Steven Spielberg's world, *Tyrannosaurus* and *Homo* could coexist. And as the lawyer stared in abject terror at the *T. rex*, he could be forgiven for not giving much thought to the parallels in their evolutionary heritage, both of which are dominated by the Godzilla syndrome (the biggest and meanest of their respective groups) with echoes of Peter Pan (tiny arms in *T. rex*, small jaw and teeth in *H. sapiens*). But in the real world, we can be comforted by the thought that no rampant *T. rex* will ever attack us because, as we know, dinosaurs are long extinct. Unless, of course, you subscribe to the view that, as birds evolved directly from dinosaurs, your cute little Budgie is really a dinosaur in feathered disguise . . . But that's another story. ■

**Further Reading**

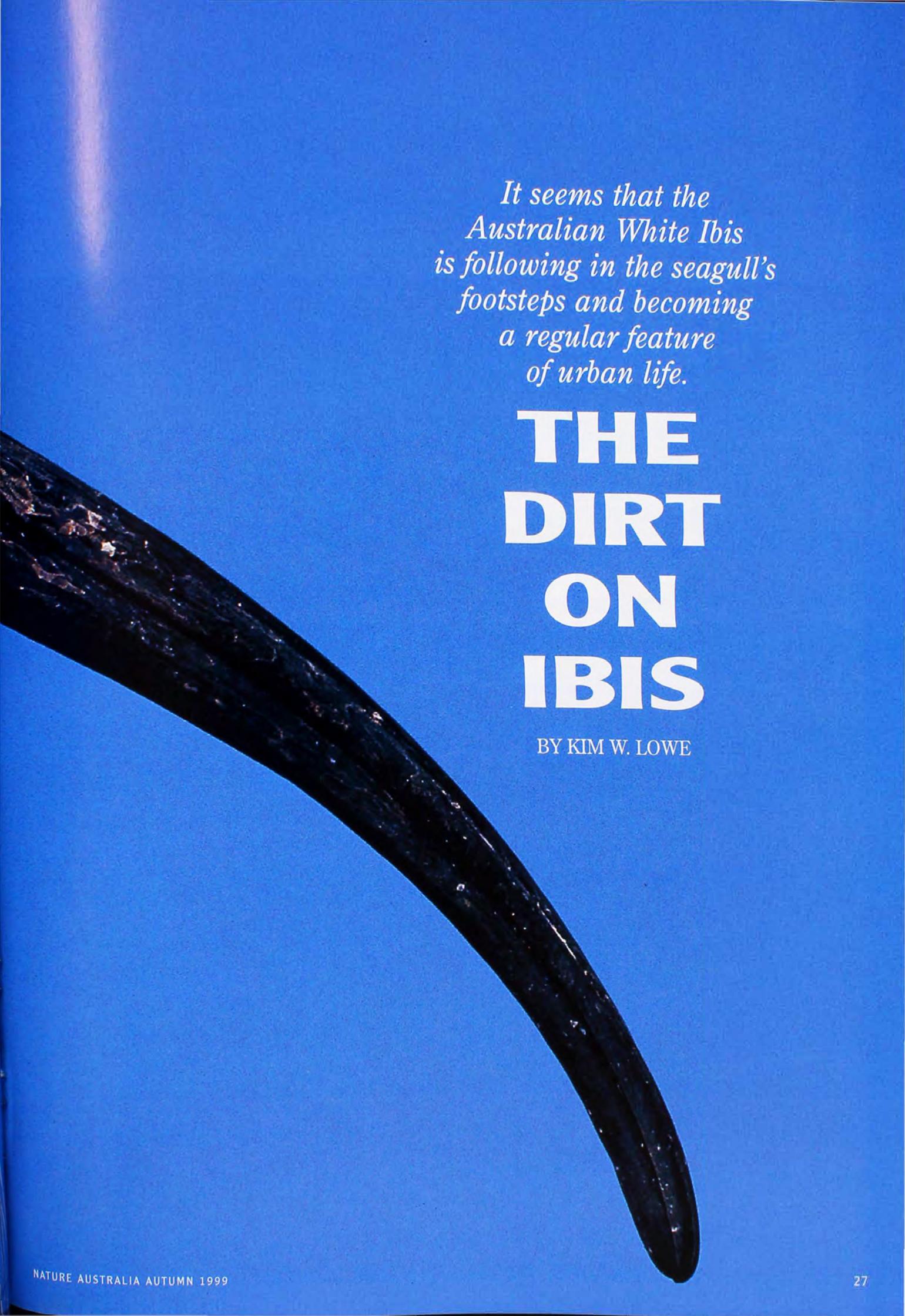
McNamara, K.J., 1997. *Shapes of time—the evolution of growth and development*. Johns Hopkins University Press: Baltimore.

McNamara, K.J. & Long, J.A., 1998. *The evolution revolution*. Wiley & Sons: Chichester, UK.

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An Australian White Ibis displays the characteristic sickle-shaped bill of ibises.



*It seems that the  
Australian White Ibis  
is following in the seagull's  
footsteps and becoming  
a regular feature  
of urban life.*

# THE DIRT ON IBIS

BY KIM W. LOWE

**W**HAT'S THAT FUNNY LOOKING white bird over there at third man?" queries the usually all-knowing Richie Benaud. The scene is the Sydney Cricket Ground during the recent test cricket match, and an Australian White Ibis (*Threskiornis molucca*) has landed on the playing field during a lull in the game. To just about anyone who has some contact with the natural world, the bird is immediately recognisable as an ibis because of the long downward-curved beak, perfect for pushing deep into water or muddy ground in search of its natural prey. It seems that the Australian White Ibis is following in the seagull's footsteps and becoming a regular feature of urban life.

There is no doubt that this species has become more common as a direct result of woodlands and forests being cleared for agriculture and settlement, creating many opportunities for yet another bird with catholic tastes. But its move into the cities is quite remarkable as it is the only large wading bird to have done so. The Australian White Ibis has lost the usual skittishness of wading birds and learnt to capitalise on the broad array of foods that our cities now provide. Not only can they feed on the larger insects at the cricket ground, but they also gleefully gobble up the leftovers from the cricket fans—the sickle-shaped bill certainly doesn't stop them from picking up a half-eaten meat pie. Likewise around tips and even rubbish bins in our parks,

the White Ibis easily finds plenty of things to eat.

So successful are White Ibises in our landscape that they roost at night in the trees in city parks, and this has almost inevitably led to the start of urban breeding colonies in most Australian capital cities. In Melbourne, for example, they have bred at the Westgate Park for many years. You'd think we'd be delighted that

**T**he Australian White Ibis has lost the usual skittishness of wading birds and learnt to capitalise on the broad array of foods that our cities now provide.

these wild creatures have overcome the man-made changes and adapted to our environments—surely a triumph for nature and reassurance that humans don't always upset the balance of nature. To many folks, yes, these birds are a welcome sight; but to others they are a headache.

At Healesville Sanctuary in Victoria, for example, White Ibises are a nuisance. People have been known to have their lunch snatched by the birds. Even more insulting, ibises roosting in the trees above seem to delight in aerially bombarding picnickers with their excrement. This sort of thing, and the dirt that they often pick up from sometimes-sordid foraging, not only spoils the ibis' image but also its clean white plumage. Some of them can look pretty grotty. But this is just one side of these multifaceted animals.

**W**HAT'S THIS ABOUT EGYPTIAN GODS? The well-travelled reader will almost certainly have seen statues and paintings of ibises in the great museums and galleries of the world. If you've wandered through the maze of halls at the British Museum in London, the Louvre in Paris or the Vatican in Rome, to name just three, you surely will have been attracted to their collections of Egyptian antiquities. And prominent among these collections are the images of ibises. The ancient Egyptians revered many gods and symbolised them with animals, and

**Superficially resembling Australia's White Ibis, the Sacred Ibis was worshipped by the Egyptians. The birds were kept in temples in their thousands and, after death, mummified and placed in animal necropolises. Unfortunately, the species is now extinct in Egypt due to habitat destruction but thrives elsewhere in Africa.**



The Australian White Ibis is the only large wading bird to have successfully moved into cities.





**The Waldrapp, from northern Africa and Turkey, is highly endangered. Ibises are specialised waders and, as a result, many of the species are vulnerable to human impacts.**

as a result the animals were worshipped as divinities. Among them was Thoth with the ibis head—the god of writing and wisdom. An important element for the ancient Egyptians, in the transfer into the next world, was the judgment of the deceased. A marvellous papyrus painting depicts the ibis-headed Thoth at the after-life ceremony where the heart of the deceased person is weighed. If the heart outweighed the feather of truth and justice, it would be devoured by the monster Ammit, a creature with the head of a crocodile, foreparts of a Cheetah and hind parts of a Hippopotamus. Thoth would record the result and report to the assessor gods. Fortunately the monster's services were never required, as all papyri

record a favourable verdict!

Live ibises were kept in temples, and were fed and tended until they died—a gigantic task given that there are reports of 60,000 live ibises being kept at one time. After death they were mummified and huge collections, sometimes numbering half a million birds, have been found in animal necropolises near the wetland breeding sites along the Nile River. Each bird had been carefully wrapped in intricate linen bandaging, and sealed into its own pottery jar. At other burial sites the ibises were contained in small wooden or stone coffins. These birds are from a closely related species of white ibis called the Sacred Ibis (*Threskiornis aethiopicus*), which is distinguished from the Australian form by several subtle plumage and anatomical differences. Unfortunately the Sacred Ibis' importance in human culture did not stop the species becoming extinct in Egypt by the mid-19th century

owing to destruction of its wetland habitat, although it thrives elsewhere in Africa.

Ibises occur on all continents except Antarctica, although the Buff-necked Ibis (*Theristicus caudatus*) nearly makes it there, being found near the tip of Tierra del Fuego, at the southern end of South America. There are 26 species of ibis in the family Threskiornithidae. This family also includes another six species of spoonbill.

Ibises seem to have fared worse than the other families of large wading birds, such as herons and storks. Although they have all suffered to some degree from the drainage of wetlands and pollution of waters, ibises have developed more specialised habits than the other waders, making them vulnerable to human impacts.

The title for the most endangered ibis is a toss-up between the Waldrapp (*Geronticus eremita*) found in only small

Each bird had been carefully wrapped in intricate linen bandaging, and sealed into its own pottery jar. At other burial sites the ibises were contained in small wooden or stone coffins.



## AUSTRALIAN IBISES

### Classification

Order Ciconiiformes, family Threskiornithidae. 3 Aust. spp.: Australian White Ibis (*Threskiornis molucca*), Straw-necked Ibis (*T. spinicollis*), Glossy Ibis (*Plegadis falcinellus*).

### Identification

Large robust birds with heavy sickle-shaped bills. White and Straw-necked have naked black heads, and stiff plumes on upper breast. Glossy more slender in build and lacks breast plumes.

### Habitat

Terrestrial wetlands, wet grasslands. White and Glossy also sheltered marine habitats; Straw-necked sometimes in dry agricultural lands; White in broad range of human settlements.

### Distribution

All 3 spp. found throughout Australia, but rare in the Centre, and occasionally in New Zealand. White and Straw-necked also in southern New Guinea, Glossy also throughout Africa, Asia and Europe.

### Breeding

In southern Aust., usually breed during spring and summer (although wild birds in Healesville Sanctuary have bred in every month of the year); in northern Aust., during wet season. Communal roosting. Generally serially monogamous, 2-4 (usually 3) eggs laid but only 1 tends to make it to fledging.

### Status

All common.

areas of northern Africa and Turkey, and the Oriental Crested Ibis (*Nipponia nippon*) from Japan and China. Both species are now known from only a few birds and their loss would be tragic, not only from a biodiversity perspective but because they are colourful, beautiful birds, much more spectacular than our White Ibis. Another species, the Bald Ibis (*G. calvus*) from South Africa, exemplifies the ecological radiation that ibises have undergone. It has adapted to a landscape where large trees are rare, because frequent lightning strikes have burnt out much of the native forest. This species now nests on sandstone cliffs, often beside waterfalls, that are inaccessible to predators. Another unusual adaptation for an ibis is shown by the Hadada (*Bostrychia hagedash*) from central Africa, which feeds and nests in dense forests that would normally not suit an ibis. But perhaps the most spectacular ibis is the aptly named

Scarlet Ibis (*Eudocimus ruber*) from South America. This bird is scarlet all over, except for black tips to the wing feathers and its dark eye. The Scarlet Ibis is now recognised as a subspecies of the American White Ibis (*E. albus*), which has scarlet only on the legs and part of the bill.

But back to our local ibises, of which there are actually three species. Similar looking in shape and size to the White Ibis is the Straw-necked Ibis (*Threskiornis spinicollis*), but which is predominantly black and has delightful straw-coloured plumes at its throat. The Glossy Ibis (*Plegadis falcinellus*), well named because of its shiny purple-brown plumage, is quite a different bird altogether, being smaller, slimmer and more graceful looking. The Glossy is also found throughout Africa, Asia and Europe, whereas the other two are found only within the Australasian Region.

Comparing the ecology of the three Australian species reveals some interesting variations. Straw-necks are the most terrestrial feeders, Glossies are almost entirely wetland feeders, and Whites use both wet and dry habitats. Accordingly their main foods differ: Straw-necks can feed happily on hordes of plague-locusts and field crickets, Glossies focus on worms and water bugs, and Whites take a wide range of food, including those meat pies at the cricket match.

**W**E KNOW A LOT ABOUT THE LOVE-LIFE of the White Ibis but virtually nothing for the other species. True to

their adaptable nature, Whites have been documented in all sorts of sexual encounters. Most birds seem to stick with serial monogamy, whereby the males are attentive to a single female for one breeding attempt, and then move on to another mate in the same season. It may be that the males are keen (and ready) for another breeding attempt but their partners are just slower at getting restarted. A few pairs stick together year in year out, but surprisingly this is not

**E**xtramarital affairs  
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**Most male Whites  
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reflected in any increase in the number of birds that survive to fledge. In a couple of cases, a male bird was thought to have simultaneously tended two nesting females, but the data for this are equivocal and the attempts were apparently unsuccessful.

Extramarital affairs are common and obvious. Most male Whites frequently initiate copulation with females from nearby nests—they take a short break

from their own brooding duty to 'socialise' with the neighbours, which are usually most willing to cooperate. Perhaps this type of behaviour creates some sort of group bond in the neighbourhood that makes them stick together when targeted by predators, or other White Ibises, which sometimes try to take over nest sites. Nevertheless the breeding success of Whites, like most ibises, is quite poor compared with other bird families. Of the three eggs that are normally laid, usually only one will make it past the fledging stage.

Wanderlust seems to be typical in ibises. After they fledge the nest, most young Whites and Straw-necks prepare for travels that are wide and far. Metal bands attached to the legs of these birds show that juveniles leave their natal sites in south-eastern Australia and journey as far afield as the Top End of the Northern Territory, Cape York and New Guinea. Straw-necks banded in the south-west of Australia have been recovered in New South Wales, and have probably travelled clockwise around the coast. The few banding data for Glossies show that these birds also move as juveniles from the Murray-Darling Basin to Cape York, and I suspect that they are regular travellers to New Guinea. Interestingly, most Straw-necks do not return to their natal area, whereas many Whites do.

Whites also seem to be stay-at-home types as adults. By observing adults with unique combinations of coloured plastic leg bands, we know that White Ibises at Phillip Island, Victoria, stick to a fairly



KATHIE ATRINSON

Of the three Australian species of ibis, the Straw-necked Ibis is the most terrestrial feeder and likes to eat plague-locusts and field crickets.



FRANÇOIS GOHIER/AUSCAPE

The Scarlet Ibis from South America, with its bright red plumage, is definitely the most spectacular of all the ibises.

regular routine over at least a three-year period (and probably for their entire adult life). In summer they feed on intertidal mudflats, often using the same patch day after day, taking crabs and small fish. In winter they move to nearby pastures and feed among cattle, picking up drowned earthworms and cockchafer (beetle) larvae in their wake. In spring they move into the local breeding sites and often fly to feeding grounds over 15 kilometres away. This seems to contradict the common image of Whites being nomadic and following the weather cycles; at least in the south of their range they are resident birds that get to know their local area pretty well. Presumably this gives them real advantages in finding food and avoiding predators. It may also help them keep in touch socially, with both their breeding partners and relatives.

Unfortunately we don't even have this snapshot of the lives of the other ibis species and we can only speculate about their antics. But back at the cricket ground, Mark Taylor has nicked a rising ball straight at the lone ibis, which has taken fright and flight. As it disappears out of sight we are left to wonder where it's going. Is it returning to its breeding site in nearby Hyde or Centennial Park, or is it continuing on wider travels, hav-



PETER COOK/AUSCAPE

The Glossy Ibis is a wetland feeder that prefers to eat worms and water bugs.

ing bred at the magnificent wetlands at Bool Lagoon near the Coonawarra wine district in South Australia and now making its way up the east coast of Australia into the steamy swamps of New Guinea? Perhaps ibises are a lot more interesting than we might have imagined. ■

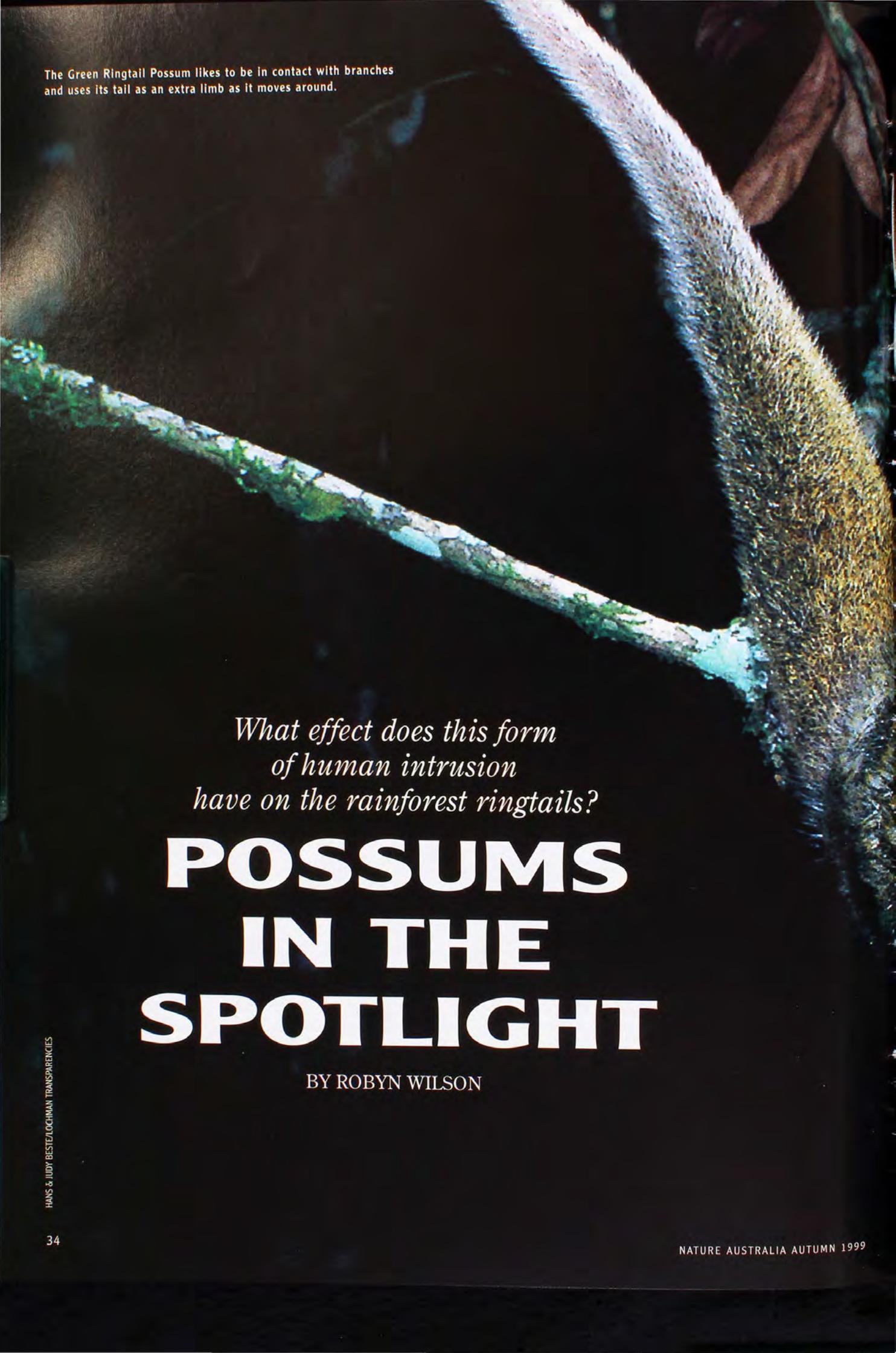
#### Further Reading

Hancock, J.A., Kushlan, J.A. & Kahl, M.P., 1992. *Storks, ibises and spoonbills of the world*. Academic

Press: London.

Spencer, A.J., 1982. *Death in ancient Egypt*. Penguin: Harmondsworth, UK.

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The Green Ringtail Possum likes to be in contact with branches and uses its tail as an extra limb as it moves around.

*What effect does this form  
of human intrusion  
have on the rainforest ringtails?*

# **POSSUMS IN THE SPOTLIGHT**

BY ROBYN WILSON



**A**CTORS AND POLITICIANS ARE not the only ones to find it stressful under the spotlight. New research in Queensland's northern upland rainforests indicate that ringtail possums also find the full force of the spotlight hard to take.

As part of a new ecotourism experience in the Wet Tropics of far northern Queensland, night-time spotlighting tours are increasingly being conducted to locate and watch our ringtail possums and other arboreal animals. Being nocturnal, they are not used to bright lights and the impact on the possums is thought to be comparable to our experience with flash photography or car headlights on full beam. A 55-watt limit has been set on the intensity of spotlights, but there is concern that this is still too bright for these nocturnal animals. Most spotlighting takes place from the roads that skirt the forest margins, because of the difficulty of seeing the animals deep within the forest. This means the same populations may be targeted night after night. Although there are restrictions on visiting some locations, other sites can be so inundated with eager observers (each with their own light) that the forest sometimes looks like a re-enactment of "Star Wars".

What effect does this form of human intrusion have on the rainforest ringtails? At some spotlighting locations a decline in the number of possums sight-

ed has been recorded. This could be due to a change in behaviour (they could be hiding or retreating farther into the forest) or a reduction in numbers.

Of concern is the fact that these possums occur naturally in low numbers and are sparsely distributed through their restricted range in the upland tropical rainforest. They are also small (less than a kilogram) leaf eaters, operating at the physiological lower size limit for this type of poor-quality diet. As a consequence they have limited energy available to cope with the challenges of daily life, making them particularly vulnerable to human disturbance. Any increased demands on their energy budget may lead to stress (that is, physiological changes) and it has been shown that stress in animals has long-term consequences for the overall fitness of the population. Research in the 1980s by Rick Speare and colleagues at James Cook University found stress was the major cause of disease and death in both wild and captive possums. Animals that are stressed are less likely to breed and are less able to cope with natural disturbance (such as predators or limited food), so the population risks going into decline.

We know nothing about the impact of spotlighting activity on the fitness of the rainforest ringtails. My PhD research is looking at how these animals cope with light and noise disturbance associated

with human visitation, and ways of minimising the impacts of this disturbance.

**M**OST OF THE NOCTURNAL ANIMALS are fairly easy to locate at night with a low-intensity spotlight, despite being dull brown, grey or black in colour. This is because these animals have a reflective layer (the tapetum lucidum) at the back of their retina that reflects light back to the observer. What the observer sees is a pair of eyes glowing in the dark. Once sighted, the animal can be held in the beam of light and watched with the aid of binoculars. Bright light, however, temporarily destroys an animal's night-adapted vision and it has been suggested that it takes half an hour for night vision to be fully restored once the light is removed. Many operators therefore use a red filter once the animal has been located, to lower the intensity of the light.

With some practice it is possible to tell the various species apart from the different colour and intensity of the eye-shine. Lemuroid Ringtail Possums (*Hemibelideus lemuroides*), for example, have a brilliant white eye-shine in contrast to the dull red eye-shine of the Herbert River Ringtail (*Pseudochirulus herbertensis*) and even duller red eye-shine of the Green Ringtail Possum (*Pseudochirops archeri*).

Apart from their eye-shine, animals can be located by listening for move-



A captured Lemuroid Ringtail Possum is measured and fitted with a radio-collar. After the effects of the anaesthetic wear off it will be released back into the forest.



GARY WILSON

A Lemuroid Ringtail Possum returns to the forest, having been fitted with a radio-collar so it can be tracked.

ment. Lemuroid Ringtails make frequent leaps of one to two metres between trees and sometimes drop two to three metres to foliage below. The other ringtail possums prefer to be in contact with a branch at all times and are more cautious in their movements. All ringtails use their prehensile tail as an extra limb while moving through the forest, often hanging by it as they stretch out for adjacent foliage. While feeding they often drop material and this noise may also alert observers to their presence.

Prior to commencing experiments to see how the rainforest ringtails respond to light and noise, I had to first understand how they behave in the absence of bright lights. For this, I captured and attached radio-collars onto several individuals of each of the three ringtail species in my study site. Over a period of several months, I monitored them to gain knowledge of their movements and home ranges, and watched them under infra-red light and low-intensity (ten-watt) light. From these observations I was able to build up a behavioural repertoire by which I could evaluate the behaviour of the possums in response to different treatments of light and noise.

The Lemuroid Ringtail Possum has a very small home range of about half a



JEAN-PAUL FERRERO/AUSCAPE

The brilliant white reflection from the eyes of this Herbert River Ringtail Possum demonstrates the function of the tapetum lucidum, which reflects light from the back of the eye and allows observers to locate animals while spotlighting.



C. ANDREW HENLEY/AUSCAPE

**A Herbert River Ringtail mother and young.**

hectare and is more gregarious than the other two ringtails. It frequently occurs in pairs, or groups of three consisting of male and female adults and a subadult. There is little overlap between the home range of neighbouring Lemuroids.

Green and Herbert River Ringtail Possums are usually solitary and have slightly larger home ranges than the Lemuroid Ringtails. The only times I saw Herbert River adults together was when a male was following a female, most probably in oestrous. The males made a clicking noise while pursuing the female, and once I heard a female snorting. I have never heard the other ringtail species vocalising, which is in marked contrast to the guttural noises produced by the other commonly sighted possum in the area—the Coppery Brushtail (*Trichosurus vulpecula johnstonii*).

My radio-tracking and observational studies suggest that the animals use the forest margins only for short periods (one to two days), so the same animals are not sighted every night. Possums with dens bordering the road may be sighted more frequently early in the evening but they tend to move back into the forest during the night. Because of permit restrictions, all my radio-tracking was undertaken in non-tourist areas. It would be interesting to carry out further radio-tracking studies in tourist areas to assess the full impact of human visitation.

For my spotlighting experiments I decided to observe the possums under two light treatments, a 30-watt lamp with and without a semi-opaque filter (which lowers the intensity by a quarter). I was able to show a marked difference in their response to the two light levels. Under the less intense light, the possums made fewer agitated movements and, compared with the bright light, I was able to watch them for a longer period of time before they moved off. I also saw nearly twice as many possums during routine surveys with the less intense light, which suggests that the possums were turning or moving away from the bright light.

Red filters are commonly used once possums are sighted, on the assumption that red light is tolerated better than white light. To test if different wavelengths of light were important in minimising the impact of spotlights, I compared the behaviour of the possums under red, green and a semi-opaque filter using a 30-watt lamp. All filters reduced the light intensity to a quarter of that of the 30-watt lamp, however I found little difference in the behaviour of the possums to different-coloured lights. These results show that the filters are useful in lowering light intensity but the colour does not appear to be important in lower-

HANS BUDY BESTE/LOC-HUMAIN TRANSPARENTES

**Left: A Lemuroid Ringtail Possum under the spotlight.**





CARY WILSON



HANS & JUDY BESTE/LOCHMAN TRANSPARENCIES

Herbivorous possums, like this Green Ringtail, have limited energy stores to cope with the stresses of daily life. So what impact does spotlighting have on the fitness of these rainforest animals?

The more trusting Coppery Brushtail Possum often comes to the ground and readily acclimatises to human activities. Many casual observers confuse it with the Lemuroid Possum but it can be distinguished by its large pointed ears and tapering tail.

ing the impact of the spotlight.

Interestingly, the coloured lights did attract the attention of some of the local community. I was stopped one night by a group of people looking for the source of strange lights in the sky. They were convinced we were being visited by UFOs!

I also carried out experiments to address the impact on the possums of repetitive spotlighting within the same night. The possums tended to move away from the road and higher up into the trees with each subsequent visit. In other words, they modified their behaviour even though they didn't appear to leave the area.

Next I monitored the behavioural response of the ringtail and brushtail possums to a selection of natural forest sounds and sounds associated with human visitation. Their main predator is the Rufous Owl (*Ninox rufa*) whose call is a low-frequency 'whooh whooh'. Most of the ringtails remained alert while I played a tape recording of its call. However, on three occasions Herbert River Ringtails continued to feed at the top of the canopy while a Rufous Owl (the real thing) called less than 25 metres away. All the possum species responded to animals moving and crashing through

the vegetation. They either turned towards the sound, alert and listening, or made a rapid departure in the opposite direction to the sound.

Sounds associated with human visitation that appeared to distress the animals most were scrunching gravel and, to a lesser extent, snapping twigs. The animals would rapidly retreat and defecate. Other sounds, such as the clicking of a microcassette or a camera, resulted in an intermediate response with the animals either assuming an alert posture, moving within the tree possibly to hide, or turning their back on the noise. The sound of passing traffic (cars, motor bikes and trucks) was ignored but engines running in close proximity resulted in the animals assuming an alert posture or moving away. Adult speaking voices were generally ignored by all species.

At one site where frequent spotlighting activity occurs the Coppery Brush-tail seems to have habituated to many of the sounds associated with human visitation (vehicle movements and sliding doors) and were even attracted to humans. In contrast to the rainforest ringtails, the brushtails will readily take any food offered by the tourists.

**O**THER TECHNIQUES THAT HAVE recently been used to monitor stress in animals are physiological telemetry, in which heart rate is measured at a distance, and the analysis of faecal steroids. I considered using heart-rate transmitters in this study, but decided against it as the transmitters currently available were too bulky for ringtails and had to be surgically implanted. The manufacturers also commented that the transmitters could be unreliable and would need to be monitored in captivity prior to releasing the animals. As attempts by other researchers to hold the Lemuroid Ringtail in captivity have failed, and the fact that this species is on the 'near-threatened' IUCN listing, I decided not to go down this track.

A non-intrusive technique that has been gaining popularity is to collect faecal droppings and analyse them for stress hormones (glucocorticosteroids). However, this technique needs to be verified as it has been found that a two-to-ten-fold change in the level of stress hormones can occur within individuals during the course of the day. Levels are also affected by gender and position of social dominance. At present, gaining a sample from an individual possum on cue, following a disturbance treatment in the rainforest, is considered too difficult. However, it may be possible to compare a collective sample of possum 'poo' from disturbed and undisturbed sites, to gain some general insight into the impact of human visitation on rainforest possums.

Spotlighting nocturnal rainforest animals is on the increase and it is important that methods to reduce the impact



CARY WILSON

**Lemuroid Ringtail Possums have forward-facing eyes and fine stereoscopic vision, allowing them to leap about in the rainforest canopy.**

on the animals are explored further if populations are to survive. My research has identified some aspects of human visitation that are disruptive to the rainforest ringtails, such as certain noises (scrunching gravel) and bright lights. In particular, the 55-watt limit currently in place is still too high. Although red filters are important in lowering the intensity of light, the colour does not appear to play a role in reducing the impact of the light on these possums. Therefore, with these animals it is probably better to use a semi-opaque filter so people can see the animals more readily and thus spend a shorter time searching for and observing them.

Although my studies suggest that ringtail possums move away from disturbance associated with spotlighting activities, we don't yet know whether this has an effect on possum numbers in frequently spotlighted areas. Rainforest possums can die from stress-related diseases, and we should aim to balance the negative impact of spotlighting against the benefit of allowing people access to the world of these fascinating animals. Studies that look at the impact of various spotlighting regimes, including commercial activity, on the behaviour, physiology and health of the animals will help determine what are the best practices with minimal impact on ringtails. In the meantime, to ensure our ringtail possums remain bright eyed and ready for viewing, we should use low-intensity lights (maximum of 30 watts), attach a semi-opaque filter once the animal has

been sighted, avoid noisy gravel surfaces and limit the number of times a site is visited in any one night. ■

### Further Reading

Bowles, A., 1995. Responses of wildlife to noise. Pp. 109–156 in *Wildlife and recreationists: coexistence through management and research*, ed. by R.L. Knight and K.J. Gutzwiller. Island Press: Washington, DC.

Creel, S., Creel, N.M. & Monfort, S.L., 1997. Radiocollaring and stress hormones in African wild dogs. *Conserv. Biol.* 11: 544–548.

Speare, R., Haffenden, A.T., Daniels, P.W., Thomas, A.D. & Seawright, C.D., 1984. Diseases of the Herbert River Ringtail, *Pseudocheirus herbertensis*, and other north Queensland rainforest possums. Pp. 283–302 in *Possums and gliders*, ed. by A.P. Smith and I.D. Hume. Surrey Beatty & Sons Pty Ltd: Sydney.

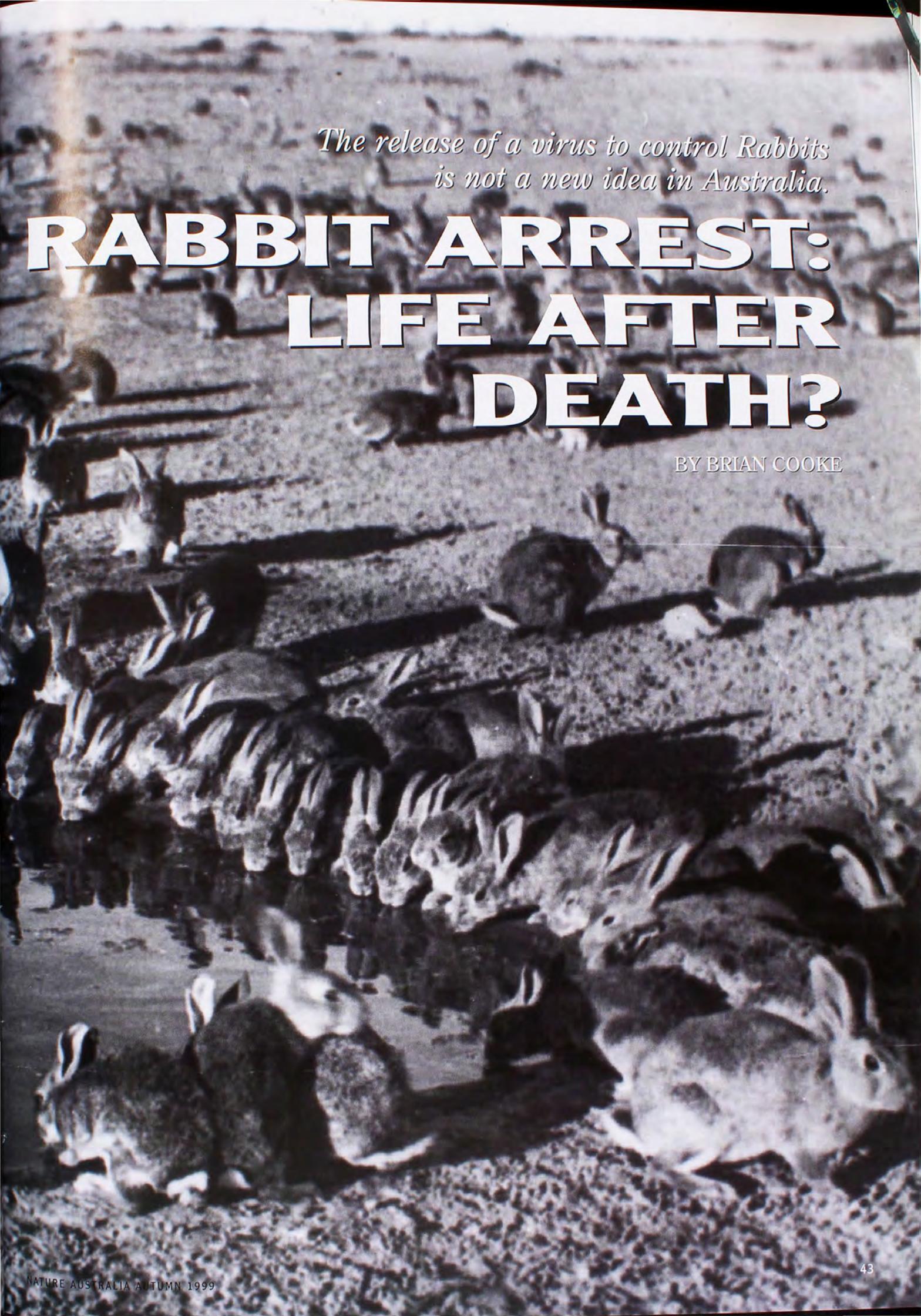
Winter, J., 1991. Mammals. Pp. 43–54 in *Rainforest animals. Kowari 1*, ed. by N.A. Nix and M.A. Switzer. Australian National Parks and Wildlife Service: Canberra.

Wingfield, J.C., Hunt, K., Creagh, B., Dunlap, K., Fowler, G.S., Freed, L. & Lepson, J., 1997. Environmental stress, field endocrinology and conservation biology. Pp. 95–131 in *Behavioural approaches to conservation in the wild*, ed. by J.R. Clemmons and R. Buchholz. Cambridge University Press: Cambridge, UK.

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Rabbits have plagued Australia for over 100 years and caused immeasurable damage to our native fauna and flora.

A black and white photograph showing a vast, dense population of rabbits in a dry, open landscape. The rabbits are scattered across the terrain, with many in the foreground and others extending into the distance. The ground is light-colored and appears to be a mix of dirt and sparse vegetation. The overall scene conveys a sense of a massive, uncontrolled population.

*The release of a virus to control Rabbits  
is not a new idea in Australia.*

# **RABBIT ARREST: LIFE AFTER DEATH?**

BY BRIAN COOKE

**T**HE TELEPHONE RANG. IT WAS Keith Murray from the Australian Animal Health Laboratory in Geelong. Rabbit Calicivirus Disease (RCD), being tested on wild Rabbits on Wardang Island, had escaped from one experimental pen and broken out in another that was being prepared for later work. Within hours I was on my way to the island in a Cessna, loaded with boxes of food and equipment needed by the field team. We flew from Adelaide, across St Vincent Gulf and Yorke Peninsula, and landed on Wardang Island, seven kilometres out into

Spencer Gulf.

When I got there, the Veterinary Officer on the island told me the virus had spread to more pens within the quarantine compound. The experiments were being shut down to stop further spread and a search party was combing the island on foot for signs of the disease outside the quarantine area.

My initial task on the island was to remove the last few Rabbits from the quarantine pens and, for a few days, all seemed well. But, one morning, members from the search party arrived breathless at the compound fence. A



**EUROPEAN RABBIT**  
*Oryctolagus cuniculus*

**Classification**  
Family Leporidae

**Identification**  
Agouti-coloured coat, belly white or grey, long ears and short tail, black above, conspicuous white fur below. Ears not black-tipped or as long as in Brown Hare (*Lepus capensis*). Domestic varieties, more variable in size and coat colour, are also widely kept.

**Habitat and Distribution**  
Originally the Iberian Peninsula (Spain and Portugal). It has since been introduced to much of western Europe and other countries including Australia (in 1859), New Zealand, Chile and Argentina. Favours Mediterranean-like climates but persists in sub-Antarctic islands and subtropics.

**Behaviour**  
A burrowing, largely nocturnal animal, feeds on grasses, herbage, browse and seeds. Coprophagy (reingestion of soft faeces) used as a means of recovering extra nutrients from poor, fibrous diet. Normal social group 2 males and 4 females in a well-defended territory. Mature at 3–4 months. Breeding corresponds to periods of pasture growth, with 4–6 young (born blind and naked) produced in successive litters at 28-day intervals. Up to 8 litters a year. May live 7 years in the wild. Major causes of mortality are predation by Foxes and Cats, and infection by myxomatosis and, now, RCD. Myxomatosis still kills about 50% of population. Rabbit populations of Australia's arid areas have periodically 'boomed and busted' with large increases following good rain and large die-offs due to starvation during drought.

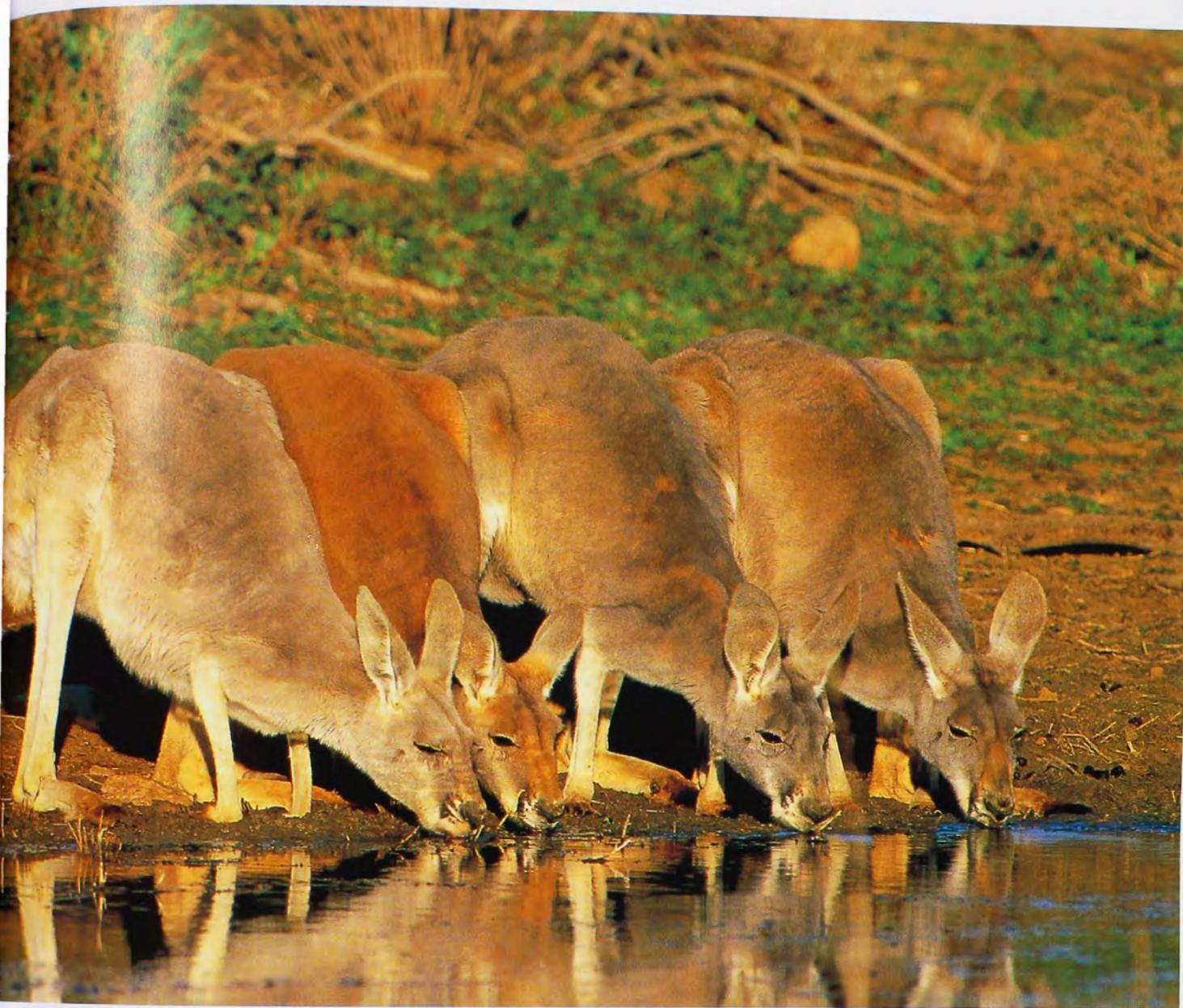


freshly dead Rabbit had been found! My worst fears were confirmed a day or so later when the test results came through.

More bad news followed; the walkers began seeing sick Rabbits over a wider area, so Rabbit eradication was stepped up to include the whole island. Our hopes eventually began to rise as the number of new cases of RCD dwindled, but then four weeks after the initial scare we discovered that the virus had slipped through the net and had appeared on the mainland at Point Pearce.

Leaving the island, on a fishing boat this time, and looking back at the jetty and red cliffs in the late sun, I realised that the carefully planned experimental work on Wardang was over. Another round of unrelenting work awaited as Point Pearce became the next campaign centre in this desperate attempt to stop the virus.

The Aboriginal people at Point Pearce were quick to help, offering support and suggesting how the area could be quarantined. They also protected me, where



JEAN-PAUL FERRERO/ALSCAPE

possible, from the growing media interest in the outbreak. This enabled our small team of CSIRO and District Council staff to start reducing Rabbit numbers and thus limit the spread of the virus until fresh teams of people from the State Animal and Plant Control Commission arrived to complete the work.

At that point, the stress of working 18 hours a day for weeks on end proved too much; my head ached and I felt shaky as I headed back to Adelaide to catch a flight home. It was a few days later when I learned that the virus had turned up hundreds of kilometres away near Yunta, north-east of Adelaide. At this stage all thought of its containment had to be abandoned.

**T**HE PREMATURE ESCAPE OF RCD WAS A great concern. This was not because its spread was considered dangerous, but simply because it took away the chance of having proper public debate about the proposal to release it. It also upset plans to maximise the effectiveness of any releases.

The use of RCD to control Rabbits had also become international news and drew criticism from some overseas scientists. Many of these concerns were extremely simplistic—a common assertion being that the virus might ‘mutate’ and ‘jump’ into species other than Rabbits. However, these easily absorbed word pictures hide the fact that there is far more to the process of viruses changing hosts than mutation alone.

All life forms can mutate and are genetically variable. Consequently, mutation of viruses is accepted without question. More important, however, is the immense natural selection against any aberrant viruses; few go on to infect the next host unless conforming to precise genetic templates. Although there are plenty of viruses that infect a range of different animals, there is no example of a virus suddenly switching to other hosts that have previously shown no susceptibility to it. As far as we know, RCD is host specific; extensive testing in Australia and overseas shows RCD only affects the European Rabbit (*Orycto-*

**With the demise of Rabbit populations came the return of many native grasses, and Red Kangaroos were quick to take advantage of this returning food supply.**

*lagus cuniculus*).

The release of a virus to control Rabbits is not a new idea in Australia. In 1950 the myxoma virus was responsible for alleviating the Rabbit problem in most of Australia’s farming areas. However, the sporadic impact of this disease in arid areas, which is tied to the appearance of the mosquito vectors after rain, has meant that it is not a completely effective method of Rabbit control. Other methods, such as warren-ripping and the use of poisons, have always been prohibitively expensive in inland Australia. Some other form of biological control seemed the only option.

Weighed against the nebulous possibility of RCD virus switching hosts is the stark certainty that Rabbits have caused enormous damage to Australia’s heartland. In the end, it is a question of whether introducing the calicivirus,

already present in over 40 countries around the world (see box), is a greater risk than leaving Rabbits uncontrolled.

RCD has now spread across mainland Australia and into Tasmania. It has even crossed the Tasman Sea into New Zealand, although this was an apparently deliberate but unauthorised introduction. The initial impact of RCD was particularly well documented in South Australia where Greg Mutze, Vicki Linton and David Powell (Department of Primary Industries, Adelaide) were already studying the effects of Rabbits on native vegetation in the Flinders Ranges National Park and the adjoining sheep station, "Gum Creek". These researchers had found that, where Rabbits were common, the number of Elegant Wattles (*Acacia victoriae*) increased very slowly and a large golden daisy (*Senecio magnificus*) was steadily disappearing. However, they also showed that, on removing Rabbits, wattle numbers increased more rapidly and the decline in daisies reversed.

The arrival of RCD on the study site totally disrupted the experiments. The three researchers could no longer work as planned, but they quickly saw the opportunity to measure the effects of RCD. Mutze estimated that in the Flinders Ranges National Park in South Australia more than a million Rabbits were killed within a few weeks. Rabbit

numbers in that area were reduced by over 95 per cent and two years (and two further bouts of RCD) later still remained at ten per cent of their original numbers.

Early measurements of the many changes in vegetation flowing from the reduction in Rabbits show a wide range

**R**abbit numbers  
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original numbers.

of regeneration, with wattles, saltbushes and wild flowers appearing in profusion.

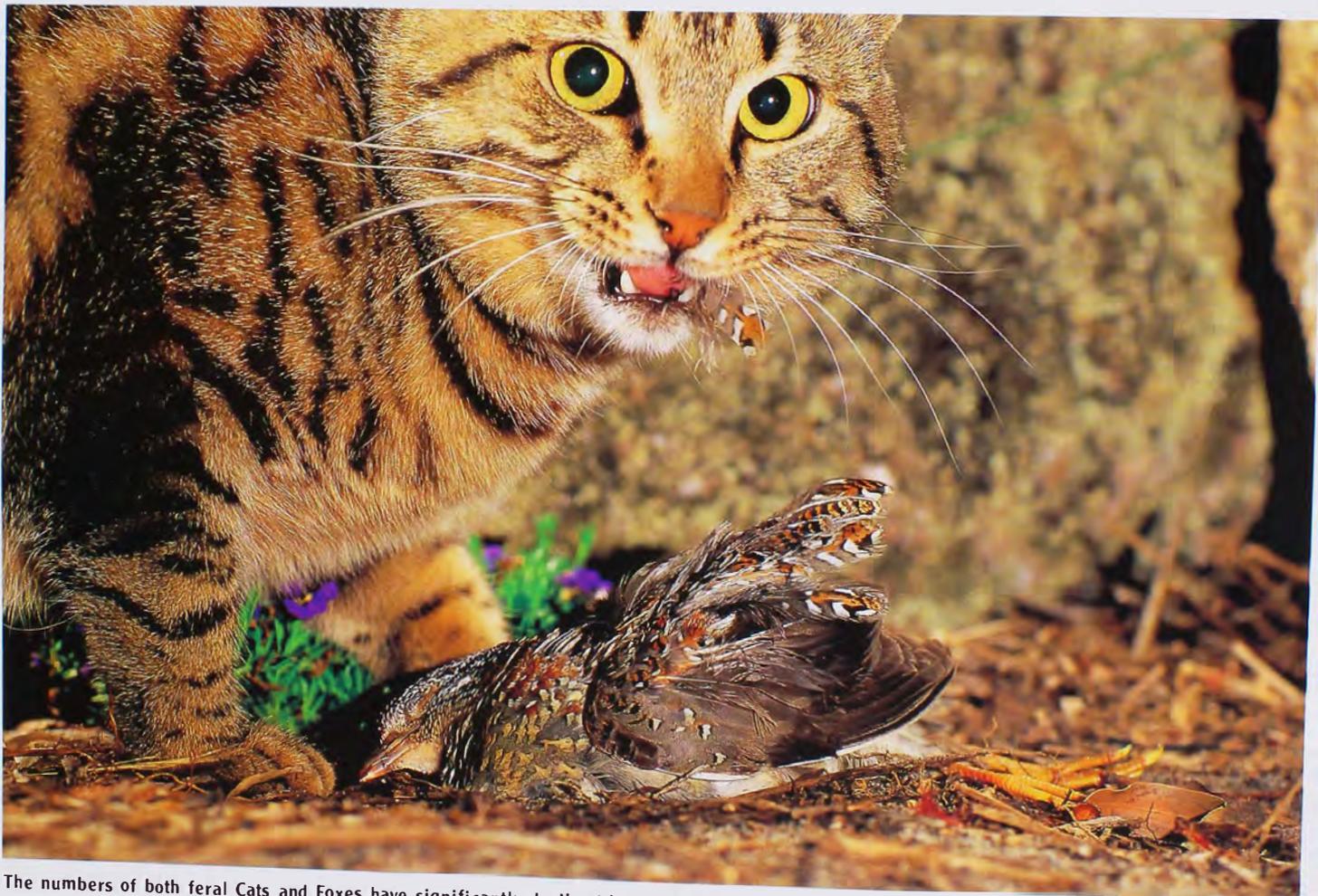
Twelve months after the initial spread of RCD, native perennial grasses were noticeably more abundant in the Flinders Ranges than usual. Normally, at that time of year, Rabbits nip off flower heads on native spear grasses (*Stipa* spp.), effectively stopping seed set. However, such damage is now limited to only a few sites near warrens where Rabbits

persist. The mauve fringe lily *Thysanotus* sp. was also unusually common but it is uncertain whether this followed from the reduction in Rabbits or whether favourable rainfall also helped.

As grasses recover, grazing animals will increase. In the Flinders Ranges, Red Kangaroos (*Macropus rufus*) and Common Wallaroos (*M. robustus*) quickly took advantage of the extra food on the experimental blocks where Rabbits were controlled by Mutze and his colleagues. In the immediate aftermath of RCD however, the kangaroos dispersed from those havens as food became more widely available.

Birds have also flourished as a result of RCD. In late 1996, Budgerigars (*Melopsittacus undulatus*) appeared in swirling, chattering flocks of iridescent green when a combination of good rain and low Rabbit numbers allowed prolific flowering of summer grasses.

The wattles now regenerating will soon provide food and shelter for birds and insects through their foliage, flowers and seed. But longer successional changes will take at least 20 years to become obvious. Mistletoes (*Amyena* spp.) spread by the Mistletoe Bird (*Dicaeum hirundinaceum*) and Spiny-cheeked Honeyeaters (*Acanthagenys rufogularis*) will colonise the maturing wattles and in turn provide food for the larvae of butterflies such as the Wood



The numbers of both feral Cats and Foxes have significantly declined in areas where RCD has been effective at killing Rabbits.



D. PARER & E. PARER-COOK/AUSCAPE

With Rabbit populations decimated, wattles are beginning to recover and will provide food and shelter for many species of birds and insects, including the larvae of butterflies such as this Wood White.

White (*Dilias aganippe*). This beautiful species, with white wings outlined in black and distinctive red spots on the hind wing, is heavily dependent on mistletoes.

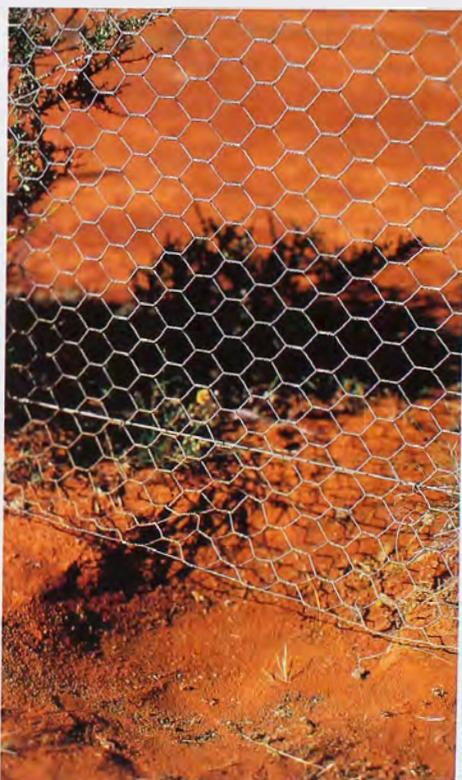
Not all the changes associated with falling Rabbit numbers are favourable. Foxes, Cats and native predators such as goannas and Wedge-tailed Eagles (*Aquila audax*) that rely on Rabbits have experienced food shortages, which have resulted in population declines and a wider range of prey being taken (prey-switching). This is a two-edged sword. While declines in Fox and Cat numbers are welcome, declines in native predators are not. Similarly, while prey-switching to a common species is not a concern, switching to a threatened species is less desirable.

While these concepts are easily understood, it is important to realise that it is a simplification of the real situation. Although a lack of Rabbits has affected Wedge-tailed Eagles, causing nesting failure in some areas, it cannot cause their extinction. Wedge-tailed Eagles are not confined to areas occupied by Rabbits, and a proportion of their population lives in parts of Australia where Rabbits

have never been present! Eagles are also adept at feeding on road kills or the offal left by kangaroo shooters, and they have recently been seen vigorously hunting young kangaroos. Nevertheless, rarer predators, such as the Black-breasted Buzzard (*Hamirostra melano-sternon*), have important breeding colonies within Rabbit-infested areas and their breeding success should be carefully monitored.

In the Flinders Ranges, Foxes have been forced to change their diet. Prior to RCD, Rabbits comprised about 80 per cent of food in the stomachs of shot Foxes, but since the release of RCD Rabbits only amount to 40 per cent of the diet. Lindsay Best from National Parks and Wildlife South Australia says that, although Rabbits are still important diet items, Foxes now eat more fruit and invertebrates, and scavenge on road kills. Cats seem less adaptable, relying heavily on the now-scarce Rabbits. This may account for a greater fall in the number of Cats than Foxes. However the abundance of both Cats and Foxes has declined significantly in areas where RCD is very effective.

In some situations, action by National Parks staff has alleviated the problem of



MARIE LOCHMAN/LOCHMAN TRANSPARENCIES

Over the years many techniques have been employed in an attempt to control Rabbits in Australia. Most have proved expensive and not all that effective—this 'Rabbit-proof' fence was simply burrowed under.



NICHOLAS BIRKS/AUSCAPE

**A Wedge-tailed Eagle dines on a Rabbit.** Although the decline in Rabbits has affected this native bird in some areas, it will not place the species in danger of extinction.

## RABBIT CALICIVIRUS

### Name

Official name is Rabbit Haemorrhagic Disease Virus; common name in Australia and New Zealand is Rabbit Calicivirus.

### Mode of Action

Incubation only 2 days, with Rabbits showing few external signs apart from lethargy over the last few hours. Death follows quickly with little struggle. The liver shows a characteristic, finely mottled (lobular) pattern, the spleen is enlarged and the lungs congested. Death caused by coagulation of blood in the circulatory system, and haemorrhages in the lungs and other organs appear as a result of blockage of blood circulation.

### History

Although the virus was first described in China in 1984, it probably had European origins. The virulent form of the virus spread through Europe, assisted by trade in domestic Rabbits. Its appearance in wild Rabbits in Spain prompted interest in its use for controlling wild Rabbits in Australia. After escaping from Wardang Island, SA, in Spring 1995, it has since spread across southern Australia. Natural spread has been supplemented by further deliberate releases. Today it occurs in over 40 countries in Europe, Asia, Africa, Australia and, most recently, New Zealand.

### Field Notes

Able to spread by both contact transmission and insect vectors (including at least 7 species of fly, 2 mosquitoes and 2 Rabbit fleas). Mostly noticed in autumn and spring. Low survival of the virus at high temperatures may explain its poor spread in summer. The disease kills up to 95% of adult wild Rabbits, although young Rabbits survive a little better. Surviving Rabbits have antibodies to the disease and young Rabbits temporarily carry maternal antibodies passed across the placenta.

### Use in Control

In most of Australia the virus persists as a self-sustaining, biological control, however the possibility of releasing more virus, applied to baits, is being investigated as a means of increasing its usefulness. It is recommended that such releases are made in autumn when there are few young Rabbits with natural resistance or protection from maternal antibodies. With the first autumn rains, and while the weather is still warm, released virus will have an opportunity for further spread by insect vectors.

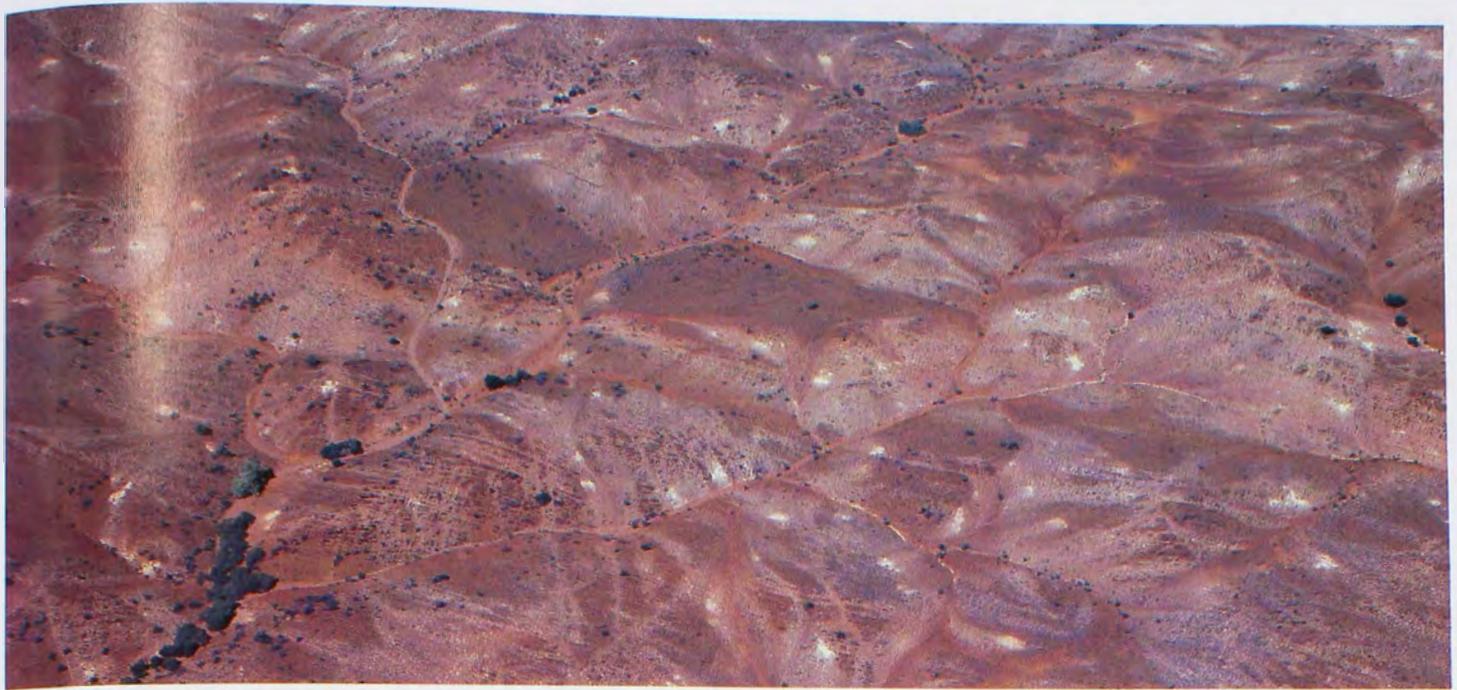
Cats and Foxes preying on the few remaining colonies of small native mammals. Foxes in the Flinders Ranges have been reduced by laying poisoned meat baits around colonies of Yellow-footed Rock-wallabies (*Petrogale xanthopus*). This reduction in predators, coupled with regeneration of grasses and shrubs, appears to be working. The wallabies are increasing in numbers quite rapidly and appear to be ranging well out from their rocky refuges to feed. The colonies of rock-wallabies that are not protected by Fox baiting have also survived well since RCD arrived, having increased more than expected from seasonal conditions alone.

We might expect other changes too. The Bilby (*Macrotis lagotis*) is considered to have been affected by Rabbits because its decline is strongly correlated with the spread of Rabbits across Australia. Today most Bilbies live beyond the northern limits of the Rabbit's distribution.

Travelling in south-western Queensland recently, my wife, Pam, and I checked one well-known colony of Bilbies, confirming its continued existence from the characteristic scratchings and burrows. As expected, there was no evidence of Rabbits at the site, but they had not been very far away. In the red sand hills, 70 kilometres south towards Birdsville, old weathered Rabbit dung and Rabbit bones were common but clearly Rabbit numbers had fallen sharply in recent times. Their warrens were collapsing and not a fresh Rabbit track or scratch was seen. Local people said that RCD had arrived in the previous autumn.

It is possible that RCD may cause Rabbits to contract from their northern limits reducing their interactions with rare species like the Bilby. Elsewhere along the northern limits of the Rabbit's distribution, there is additional evidence of the effectiveness of RCD. Will Dobbie from the Parks and Wildlife Commission of the Northern Territory informs me that Rabbits on "The Garden" cattle station, 100 kilometres north-east of Alice Springs, are at their lowest levels for many years and again Rabbit warrens are collapsing from disuse.

**A**T THIS STAGE THE LONG-TERM benefits of RCD for conservation can only be glimpsed at, but there are some extremely promising signs. The final outcome depends on RCD continuing to kill a high proportion of Rabbits without becoming attenuated or faltering because of increasing resistance in the Rabbits. Nevertheless, RCD is in Australia to stay and, added to myxomatosis, it can be expected to benefit arid-zone



D. PARER & E. PARER-COOK/AUSCAPE

This aerial view of the Flinders Ranges, South Australia gives an idea of the extent of the Rabbit problem. The white areas represent Rabbit warrens.

ecosystems for many years.

From a personal point of view there are obviously many things about the introduction of RCD that I wish had turned out differently. However, I have absolutely no regrets about the benefits now flowing on to ecosystems in inland Australia. The scale of the Rabbit problem in arid Australia warranted the use of another biological control, even though this was likely to be controversial.

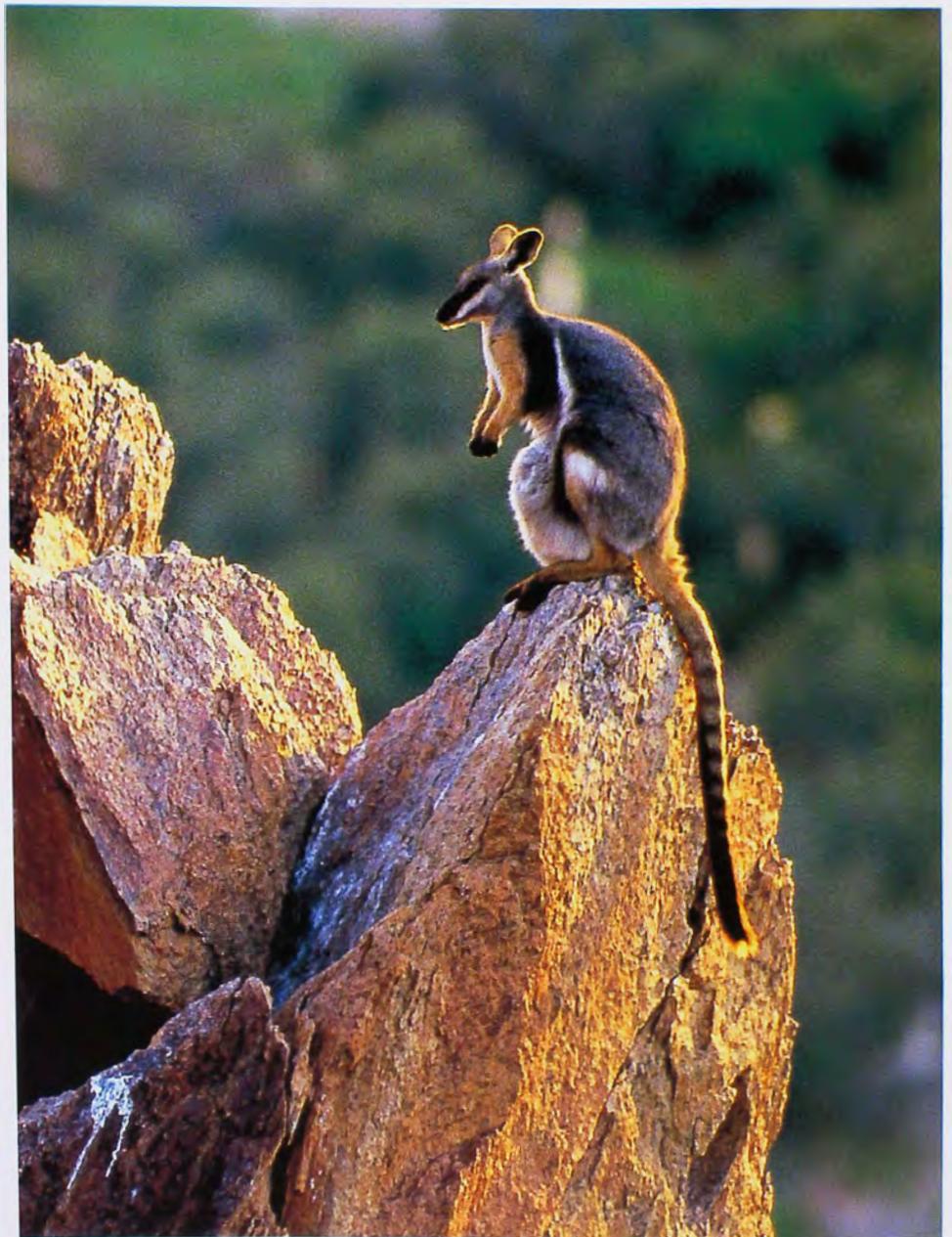
Whether RCD brings lasting ecological changes to the arid zone is yet to be seen. Nevertheless, the blueness of the juvenile leaves of freshly germinating *Acacia* seedlings, a sea of flowering summer grasses, and the sight of young kangaroos scrambling back into the pouch or racing ahead of the mob, show that significant changes are truly under way. ■

### Further Reading

Mutze, G., Cooke, B. & Alexander, P., 1998. Initial impact of rabbit hemorrhagic disease on European rabbit populations in South Australia. *J. Wildl. Diseases* 34(2): 221–227.

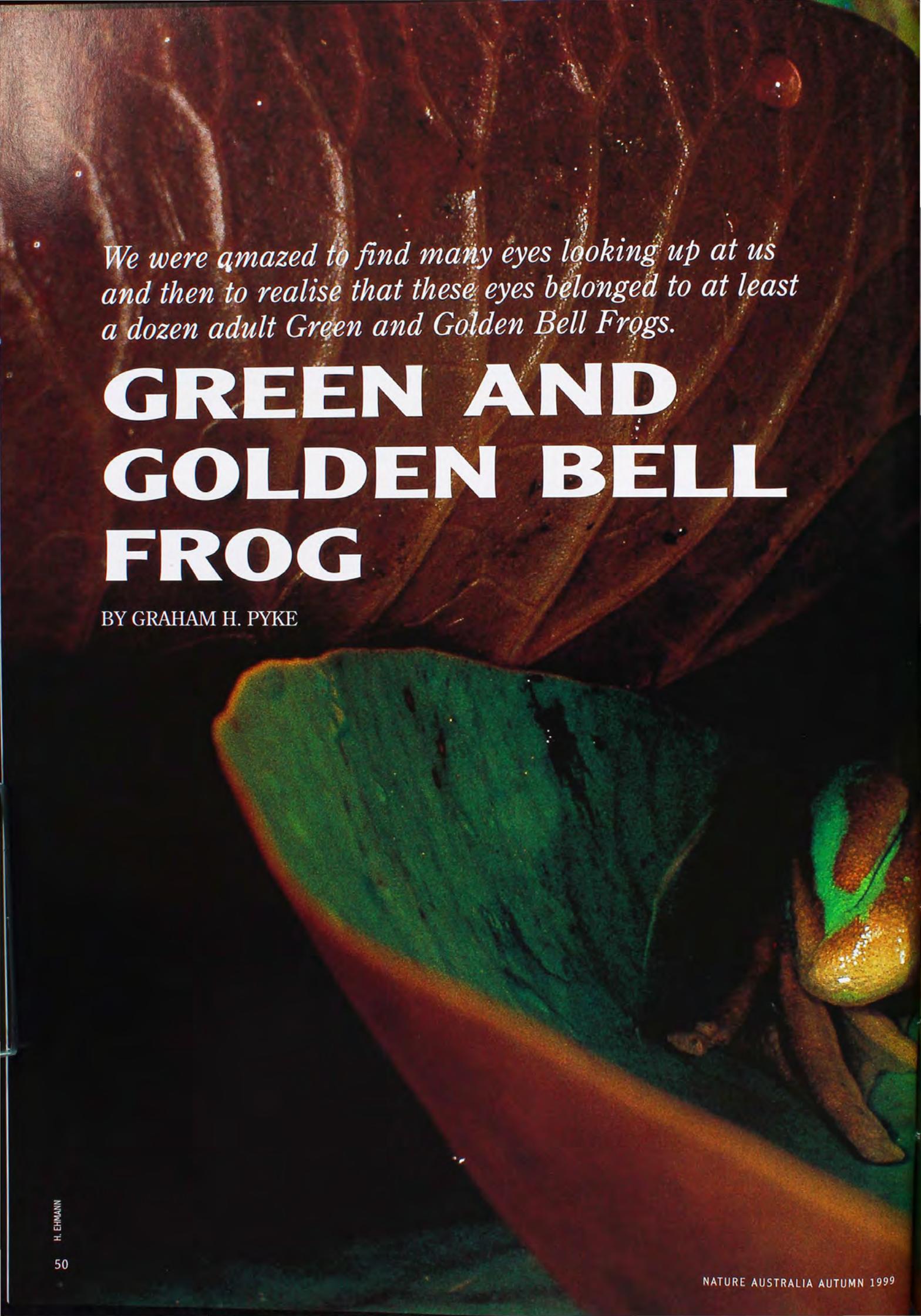
Mutze, G.J., Linton, V. & Powell, D., 1995. Changes in grazing patterns, range condition and soil erosion following rabbit control in South Australia. Pp. 203–206 in *10th Australian Vertebrate Pest Control Conference, Proceedings*. Dept Primary Industries and Fisheries: Hobart.

*Dr Brian Cooke is a Principal Research Scientist with CSIRO Wildlife and Ecology in Canberra. He has carried out field research on Rabbits for over 30 years, in Australia, Spain and France, and has assessed the impact of Rabbits on Australian ecosystems as well as developing more effective Rabbit control methods.*



NICHOLAS BIRKS/AUSCAPE

Despite prey-switching by Foxes, populations of the endangered Yellow-footed Rock-wallaby have increased as their food supply of grasses regenerates.



*We were amazed to find many eyes looking up at us  
and then to realise that these eyes belonged to at least  
a dozen adult Green and Golden Bell Frogs.*

# **GREEN AND GOLDEN BELL FROG**

BY GRAHAM H. PYKE



**W**HAT A BEAUTIFUL ANIMAL the Green and Golden Bell Frog is! When out basking in the daytime sun, its brilliant green and gold back, conspicuous pale racing stripe from nose to hind limbs, and bold blue-green groin and upper thighs distinguish it from other frogs. With these colours and its good athletic abilities, it is indeed a true Australian! And this acclaimed swimmer and high-jumper already has a connection with the Olympic Games! One of the largest known populations of the Green and Golden Bell Frog in New South Wales is found at Homebush Bay, which is also home to the new Olympic Stadium. Could this be a good omen for Australia's performance in the year 2000?

Sadly, like many other frogs in Australia and worldwide, the Green and Golden Bell Frog (*Litoria aurea*) has declined enormously in distribution and abundance. It was once one of the most commonly encountered frogs on the coast of south-eastern Australia. Indeed it was so common that it could be collected by the bucketful and was used as a standard animal for dissection by university students. Since then, however, it has disappeared completely from over 90 per cent of its range and, in New South Wales, is restricted to only about 30 locations, where most of its populations are small.

Although this situation is rather

gloomy, some positive actions have occurred. Governments, both Commonwealth and State, have drawn up lists of frogs (and plants and other animals) that are considered 'threatened' with extinction and have adopted legislation that requires the impacts of proposed human activities to be considered, and possibly ameliorated, before they get any approval. At present, the Green and

**It was so common  
that it could be collected  
by the bucketful and was  
used as a standard animal  
for dissection by  
university students.**

Golden Bell Frog is considered 'endangered' in New South Wales and 'vulnerable' nationally. (Both 'endangered' and 'vulnerable' are categories of 'threatened', the risk of extinction being greater for species in the 'endangered' category.)

There has also been a huge increase

**The Green and Golden Bell Frog can be distinguished from most other frogs by the pale racing stripe along the side of its body and the blue-green colour of the groin and thighs.**

in biological survey work, leading to a much improved knowledge of the patterns of distribution and abundance of frogs and other organisms. But there is still an urgent need for more research on frogs, especially in terms of the factors that control their distribution and abundance.

Along with Arthur White (Director of Biosphere Environmental Consultants and a Research Associate at the Australian Museum), we have been documenting the Green and Golden Bell Frog's past distribution, studying known locations where it still occurs, and investigating any reports that come our way of possible sightings. One of our earliest goals was to determine the frog's habitat requirements, especially in terms of breeding, as this should enable us to better manage the species through management of its habitat and to be more efficient at locating additional populations of the species through targeted habitat surveys. Our interest in the Green and Golden Bell Frog is shared with a number of our colleagues who are carrying out complementary research at various locations, including Homebush Bay.

At first glance, the Green and Golden

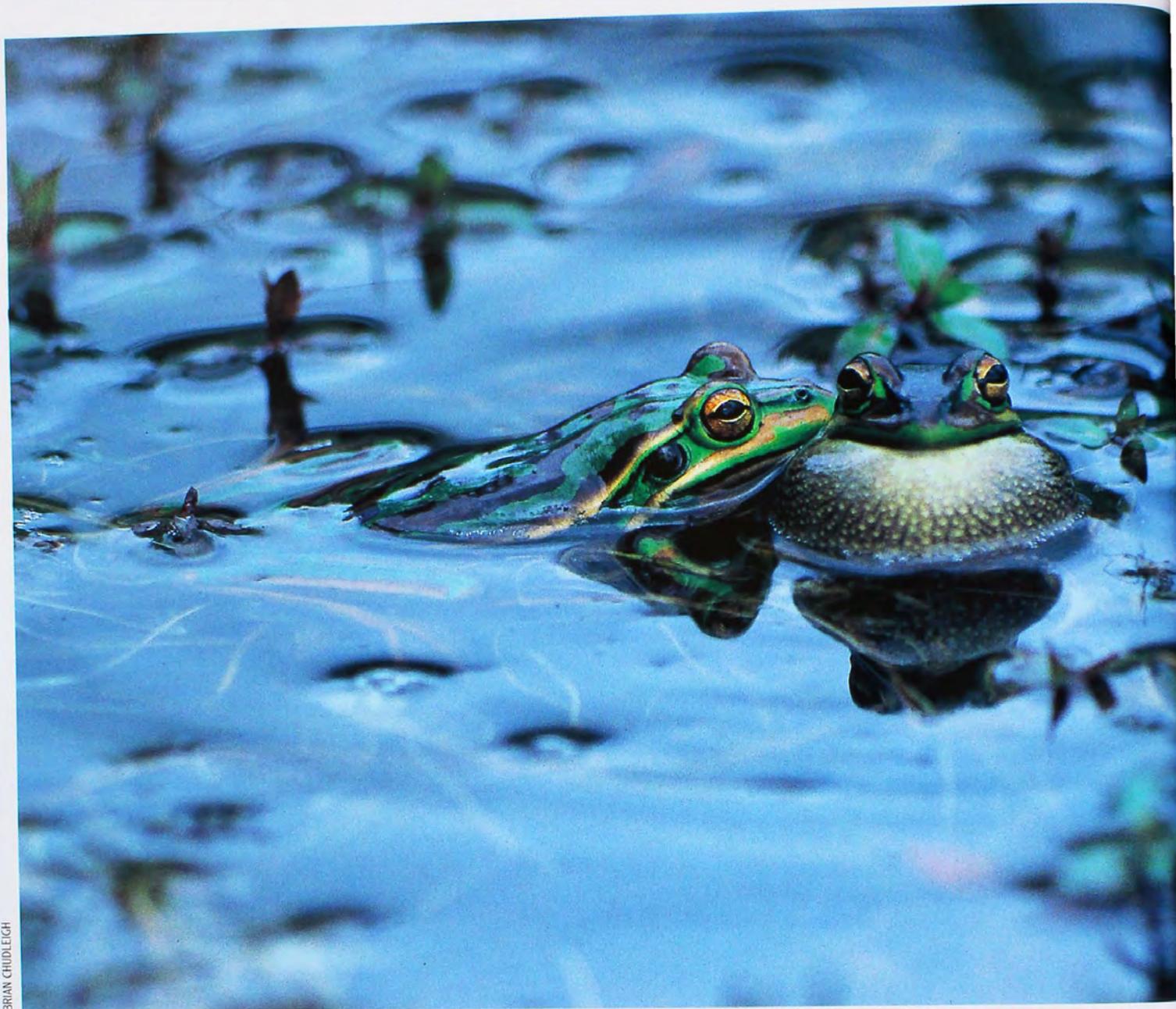


KEN GRIFITHS

The disused brick pit at the Homebush Bay—a useless hole to some, but it's home to the endangered Green and Golden Bell Frog.



PAVEL GERMAN



BRIAN CHUDDEIGH

Bell Frog occurs in an amazingly diverse array of seemingly different habitats. It has been found in a variety of natural swamps and ponds. It has also been found breeding in human-disturbed sites, including farm and garden ponds and water bodies created by mining activities. Indeed, some of the sites where the species occurs are completely human-made, which suggests that we should, if we can determine the correct recipe, be able to create new habitat for it in places where such habitat does not presently exist.

The common features of all these sites provide us with clues as to the actual habitat requirements of the Green and Golden Bell Frog. In general, the breeding sites of this species consist of water bodies that are unshaded, fresh (rather than saline or brackish), still or moving very slowly, free of the introduced Plague Minnow (*Gambusia holbrooki*) and other fish that eat the eggs and/or tadpoles of frogs, and that fluctuate significantly in water level (in accordance

with rainfall). These sites also generally contain places where the frogs can seek shelter (thick ground-level vegetation, rocks, timber or other suitable material), bask in the sun (suitable vegetation) and forage (nearby grass or other low vegetation).

These features and other aspects of the frog's biology suggest that what we are dealing with is essentially an endangered 'weed'. The Green and Golden Bell Frog is a relatively long-lived species (adults have been kept in captivity for over 15 years), with strong movement and dispersal abilities (individuals may travel about a kilometre a day while foraging and some have apparently traversed over 15 kilometres from one site to another) and a potentially enormous reproductive rate (usually 4,000–5,000 eggs per clutch). And, as described above, it seems to favour disturbed sites. These are typical characteristics of so-called 'weedy' species.

Armed with this knowledge of the apparent habitat requirements of the

Green and Golden Bell Frog, we have been searching for sites where it still occurs, as well as sites potentially suitable for its introduction. Serendipity has played a major role.

**I**N 1997 I LEARNT OF LONG REEF GOLF Course, in the Sydney suburb of Colaroy, as a potential site for introduction of the Green and Golden Bell Frog. I read an article in the local newspaper that described a program of wetland development on the golf course and wondered if it might be suitable for frogs in general and the Green and Golden Bell Frog in particular.

One thing led to another. A visit to Long Reef revealed to me that, in the process of developing a series of ponds, suitable habitat for the Green and Golden Bell Frog had inadvertently been created. Information about a wetland that occurred on the golf course up to about 1930, and nearby past records of the frog (which is believed to be extinct between the Parramatta and Hawkesbury



During the warmer months of the year, male Green and Golden Bell Frogs give out growl-like calls to attract females. They usually do this from the water and sometimes, as in this case, their calling will alert other males to their presence.

Rivers), also indicated the likelihood that the Green and Golden Bell Frog once occurred at this very site. So I approached the golf club with the suggestion that the course become a home, once again, for this frog, and also Taronga Zoo with a request that some of the progeny from its captive breeding colony be translocated to the golf course. This breeding colony is derived from a population of Green and Golden Bell Frogs at Rosebery, a suburb not far south of the centre of Sydney and a location closer to Long Reef than any other present location of the species. These ideas were enthusiastically adopted and resulted in the formation of a collaborative team, involving the Australian Museum, Long Reef Golf Club and Taronga



PATEL GERMAN

## GREEN AND GOLDEN BELL FROG

*Litoria aurea*

### Classification

Family Hylidae (tree frogs).

### Identification

Relatively large frog (adults 5–8 cm long) with varying amounts of green and copper-gold on the back, pale stripe along both sides of its body from nose to hind limbs, and a conspicuous area of blue–green around groin and upper thighs. Males generally smaller than females. Reproductively mature males have thumbs that are swollen through the development of nuptial pads.

### Distribution

Native to south-eastern Australia, mainly along coast from about Byron Bay (NSW) to Lakes Entrance (Vic.), but also throughout Southern Tablelands and adjacent Western Slopes. Now restricted to coastal locations in Aust. but has been introduced to New Zealand, New Caledonia and Vanuatu.

### Habitat

Generally requires water that is still or flowing slowly, unshaded, free of predatory fish, and that fluctuates significantly in water level. Also does best at sites that provide reeds, rushes or other emergent aquatic vegetation for basking and foraging, nearby grassy areas for foraging, and rocks or timber under which it can shelter.

### Biology

Although a member of the 'tree frog' family, it spends most of its time in the water, on the ground or on low reeds and other vegetation, and does not usually climb trees. Breeding occurs mostly in warmer months from about Oct.–Mar. Males generally call while partly submerged in water. Their call is rather growl-like. Females deposit 3,000–10,000 eggs in a floating gelatinous mat, which sinks after 6–12 hours. Tadpoles hatch in about 2 days, and about 2 months later may crawl out of water as immature frogs. Under some conditions, development can be much slower with animals remaining as tadpoles for several months or more.

### Diet

Tadpoles are believed to feed on algae, bacteria and organic detritus, while frogs are extremely catholic in their food habits, feeding on anything that moves, can be captured and can fit in the mouth. As adults they are known to eat insects such as crickets and cockroaches, as well as other frogs, including members of the same species.

### Status

'Endangered' in NSW; 'vulnerable' nationally.



C. PYKE

The creation of wetlands for water purification and irrigation at Long Reef Golf Course has created suitable habitat for the Green and Golden Bell Frog. Tadpoles were introduced to the site early in 1998 and so far appear to be doing well.

Zoo, and supported by Warringah Council (the council responsible for the golf course). A proposal was submitted to the New South Wales National Parks and Wildlife Service, resulting in the necessary licence to carry out the introduction; Long Reef Golf Club carried out further habitat enhancement for the benefit of the Green and Golden Bell Frog; and Taronga Zoo arranged for their frogs to breed and produce tadpoles that could be moved to the golf course.

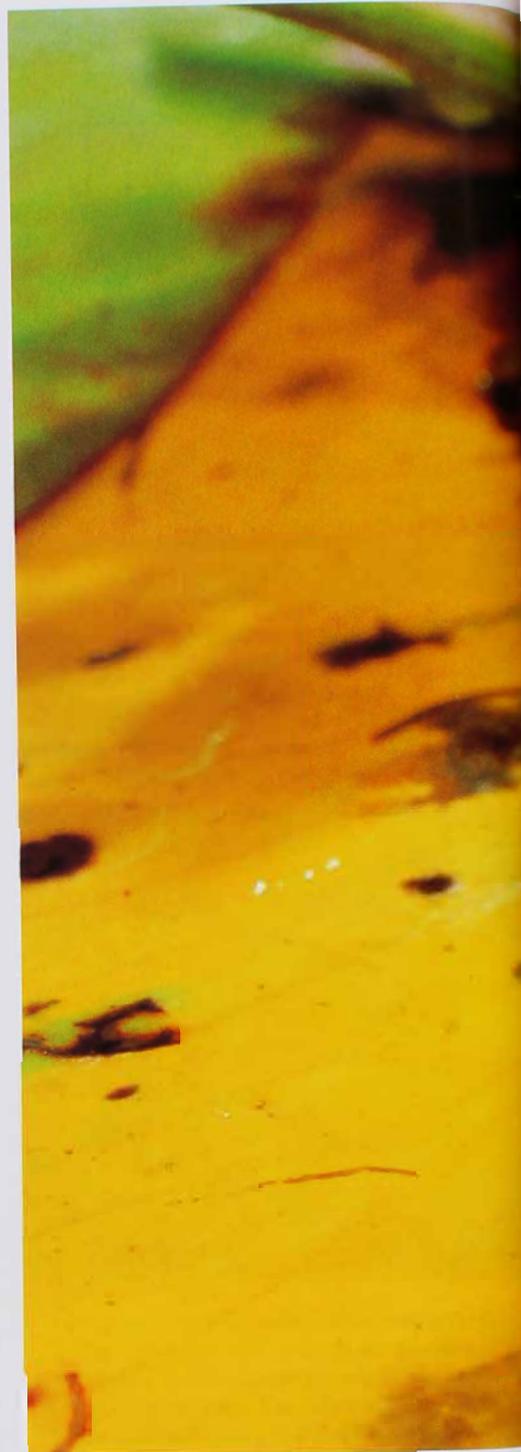
On 15 January 1998 we released 1,400 Green and Golden Bell Frog tadpoles into a total of six ponds on the course. We chose tadpoles rather than frogs because frogs that grow up and emerge from a pond are believed to be more likely to consider that pond and the surrounding area as 'home' than are individuals transplanted as frogs. We shall be testing this presently unverified idea by also releasing some frogs to the site and comparing their behaviour with that of the frogs transplanted as tadpoles.

As soon as we introduced the tadpoles to the golf course we began a monitoring program to follow their progress. During the day we look for frogs under artificial shelter boards that we placed around each pond, and sweep a net through the ponds to catch tadpoles; at night-time we search for active frogs. Any captured frogs or tadpoles are measured and weighed before being released at the same place they were captured. Frogs are also individually identified either by toe-clipping or insertion of an electronic microchip under the skin.

In the process of monitoring the Green and Golden Bell Frog we have also come across other naturally occurring frog species, including the Brown Striped Frog (*Limnodynastes peronii*), Peron's Tree Frog (*Litoria peronii*) and the Common Eastern Froglet (*Crinia signifera*). We hope to gain valuable information about these additional frog species, and determine the nature of any interactions between these species and the introduced Green and Golden Bell Frog. These other frogs may also provide food for the Green and Golden Bell Frogs, which are renowned for their willingness to eat virtually anything that moves, including members of their own species.

By mid-April, three months after the initial introduction, the tadpoles had passed their first milestone, with about 200 having successfully metamorphosed into three-centimetre-long immature frogs. Two of these frogs were found on golf course greens up to about 100 metres from the nearest pond. Another frog had moved about 600 metres from one pond to another. Although still young, some of these frogs have already reached adult length of five centimetres or more, and some of the males had begun to develop nuptial pads on their thumbs (used to clasp females during mating), a sign of advancing reproductive maturity. All signs so far indicate they are doing well in their new home!

By the time this article is published, the frogs should all have grown to reach their adult length of five to eight centimetres, with some possibly breeding



on the golf course. After that the population should increase until it reaches some roughly stable level. We shall follow the population through all these stages.

**R**ECENTLY WE HAVE ALSO HAD THE good fortune to find a large and previously unknown population of Green and Golden Bell Frogs on Broughton Island, about three kilometres off the coast of New South Wales just north of Hawks Nest. Broughton Island is only about 200 hectares and, if you were looking at it from a boat or helicopter, you wouldn't think it could harbour many frogs, let alone the endangered Green and Golden Bell Frog. Its coastline consists of a few sandy beaches, with rocky cliffs and intertidal areas along most of



HANS & JUDY BESTE/LOCHMAN TRANSPARENCIES

**The spectacular Green and Golden Bell Frog is endangered in New South Wales and is famous for its large population at the Olympic site at Homebush Bay.**

its circumference. There are no apparent creeks or swamps, and the vegetation generally indicates relatively dry conditions. Yet we knew Green and Golden Bell Frogs lived on the island, for Arthur White had found one on the southern side of the island in 1975, at a place where ground water seeped through to the surface and trickled down to the ocean. And when Ross Dixon (Kurri Kurri TAFE) and his family were walking in about the same area on the island in late 1997, a Green and Golden Bell Frog jumped out from wherever it was hiding and landed briefly on his daughter's leg! Ross also recalled seeing tadpoles in a small pond on the other side of the island.

Prompted by these sightings, Ross and I organised a trip to the island in Jan-

uary 1998. We first checked out the soak, but found no frogs. Then we walked across the island to the pond where Ross had first seen the tadpoles. It was about three metres in diameter with a moist drainage line leading into it. The water was almost completely covered by bulrushes (*Typha* sp.), which gave way to reeds (*Phragmites* sp.) and other plants with increasing distance up the drainage line.

We approached the pond, pushed aside some of the plant stems and peered inside and around the waterlogged vegetation. As soon as we did this, we were amazed to find many eyes looking up at us and then to realise that these eyes belonged to at least a dozen adult Green and Golden Bell Frogs. Sadly, such encounters have become

rare since the species began its precipitous decline in the 1960s.

Upon further investigation we found that the small areas of free water in the pond were absolutely thick with Green and Golden Bell Frog tadpoles. The tadpoles also occurred in several other nearby ponds, the largest of which was no more than five metres across. At one of these ponds we saw large numbers of advanced tadpoles and at least ten immature frogs. By now it was becoming apparent that these ponds supported a significant breeding population of the Green and Golden Bell Frog.



G. PYKE



G. PYKE

**Life on the edge at Broughton Island! Here a population of Green and Golden Bell Frogs manages to survive the occasional ocean wave, which would kill the tadpoles in the ponds. In between waves, the frogs do well in fresh water that seeps through the ground into the ponds.**

**The Green and Golden Bell Frog is unusual among frogs in that it often sits on reeds during the daytime and basks in the sun.**

The next two days gave us a good idea of just how many frogs lived in these ponds. With the help of everyone in our group we captured and marked 24 adults at the first pond. The following day we captured a similar 23 frogs, five of which had been marked the previous day. Using a simple calculation ( $23 \times 24/5$ ) we concluded there were about 110 adult Green and Golden Bell Frogs living around this pond. We also carried out similar mark and recapture techniques, from around all the ponds this time, and we calculated there must have been a total of about 166 adult Green and Golden Bell Frogs living at the site.

During this visit to Broughton Island we learnt of yet another site on the island where the Green and Golden Bell Frog is able to live and breed. Some passing bushwalkers told us how, about two weeks earlier, they had seen amplexing (mating) frogs in a small pond on the western side of the island. So we visited this site on our last day there and, although we saw no frogs, we did find large numbers of Green and Golden Bell Frog tadpoles. The amplexing frogs had apparently been successful!

Despite talking with many people who are extremely familiar with the island, we learnt of no other places where the Green and Golden Bell Frog seemed likely to occur. Assuming that some adult frogs were living around the pond at the second site, the total population on the island was probably somewhere in the range of 200–300.

Somewhat strangely, we found only one other frog species on Broughton Island. This was the Brown Striped Frog and it was relatively rare, accounting for just one per cent of all frogs. On the mainland, by contrast, it is one of the most commonly encountered frog species.

Broughton Island is different from the mainland in a number of other interesting respects. It has, for example, only one snake species, the Black-bellied Swamp Snake (*Hemiaspis signata*), which is known to feed on lizards and frogs, including presumably Green and Golden Bell Frogs. Mainland sites would generally have several snake species that would be significant predators of the Green and Golden Bell Frog. The ponds where the Green and Golden Bell Frog live are also uncharacteristically close to the ocean and would seem susceptible to occasional inundation with

**The ponds where the Green and Golden Bell Frog live are also uncharacteristically close to the ocean and would seem susceptible to occasional inundation with salt water during storms and rough seas.**

salt water during storms and rough seas. Such inundation would certainly kill any Green and Golden Bell Frog tadpoles.

There are so many important and exciting things still to do in terms of research on the Green and Golden Bell Frog. Using Long Reef and Broughton Island as our principal study sites, we plan, for example, to determine how population sizes of this frog vary from one time and place to another, and to explore the reasons behind this variation. We hope also to find additional sites that are potentially suitable for introduction and to learn of further places where the species still occurs naturally. Meanwhile other scientists will continue to monitor

the population at the Homebush Bay site. And as our Australian athletes strive for gold in the year 2000, they may take heart in the fact that they will be doing so alongside another green-and-gold battler, of the frog kind. ■

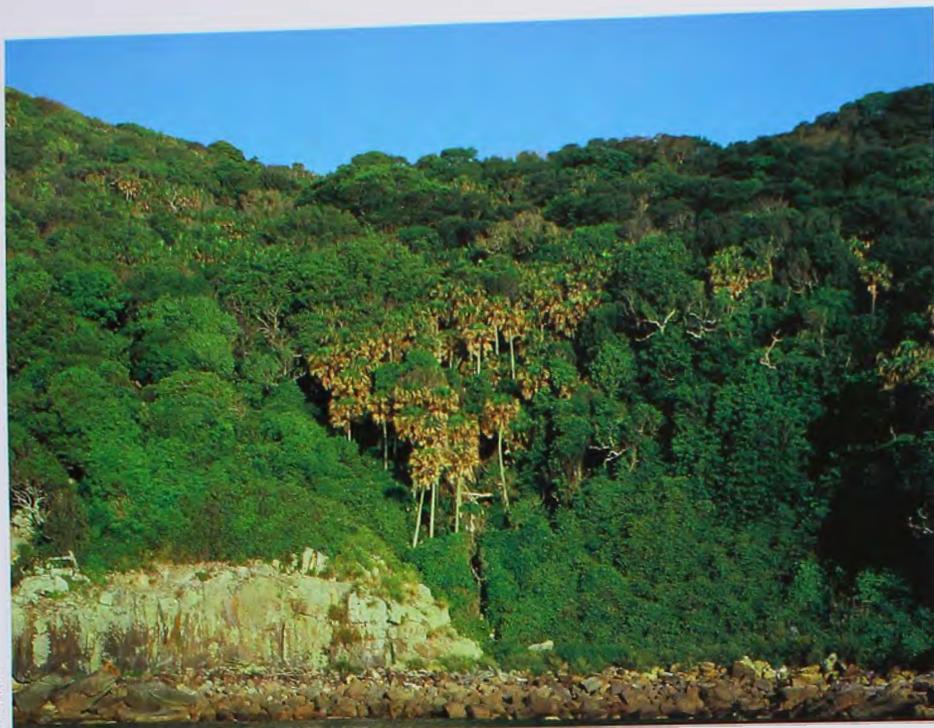
#### Further Reading

Pyke, G.H. & Osborne, W.S. (eds), 1996. The Green and Golden Bell Frog *Litoria aurea* biology and conservation. *Aust. Zool.* 30: 1–258.

*Dr Graham Pyke is a Principal Research Scientist at the Australian Museum. He and Dr Arthur White jointly coordinate the Museum's Frog Behaviour & Ecology Group.*



The back of the Green and Golden Bell Frog displays a mosaic of green and coppery-gold. The relative amounts of these two colours vary substantially and individuals can often be recognised by their particular colour patterns.



# RECLAIMING A PETREL'S PARADISE

BY DAVID PRIDDEL & NICK CARLILE

*In a world first, our research team has achieved on Cabbage Tree Island what many land managers on the mainland can only dream about.*

**A**S THE LAST OF 100 RABBIT traps were removed from Cabbage Tree Island, the clattering of metal on rock elicited an unmistakable call—that of a rare Gould's Petrel (*Pterodroma leucoptera leucoptera*) hidden among the rock scree. Woken from its daytime slumber, this bird was oblivious to the recent changes that had taken place on the island; changes that herald a new chapter in the struggle for survival by Australia's rarest endemic seabird.

For the last 90 years the diminutive Gould's Petrel, only 30 centimetres long and weighing less than 200 grams, has seen its principal breeding ground slowly destroyed by Rabbits. But an innovative and successful eradication campaign by the New South Wales National Parks and Wildlife Service (NPWS) has recent-



ly turned the tide. In a world first, our research team has combined the deadly calicivirus with a new type of poison to achieve on Cabbage Tree Island what many land managers on the mainland can only dream about.

Gould's Petrel, a critically endangered species, spends most of its 30–40 years of life at sea, soaring on the relentless winds of the southern oceans in search of small fish, squid and krill. Adults come ashore between September and April each year to breed on two small islands near the entrance to Port Stephens, New South Wales. Most of the population (about 500 breeding pairs) breed in rock cavities on the rugged slopes of Cabbage Tree Island; a dozen or so pairs breed on nearby Boondelbah Island. Gould's Petrel breeds nowhere else on Earth.

Cabbage Tree Island supports the most southerly offshore rainforest in Australia. Despite its remoteness, the



IRENE DENTON/NATURE FOCUS

island has not escaped the influence of humanity. Foremost among the disturbances has been the ill-advised introduction of Rabbits in 1906. Over the ensuing decades, these voracious herbivores have systematically devastated much of the island's subtropical rainforest. What remains is severely degraded, existing only as an ageing canopy with little or no understorey.

For the petrels, this change in vegetation structure has proven disastrous. The removal of the understorey has exposed nesting birds to predation by Pied Currawongs (*Strepera graculina*), and to entanglement in the sticky fruits of the native Bird-lime Tree (*Pisonia umbellifera*). By the early 1990s mortality and disturbance at their nesting ground had pushed Gould's Petrel to the brink of extinction. Each year, fewer than 250 pairs laid their single eggs, producing fewer than 50 fledglings. Mortality of

breeding adults exceeded the recruitment of young into the breeding population. Experimental action undertaken recently by the Threatened Fauna Ecology Unit within the NPWS, however, has achieved a dramatic recovery in breeding success. Nowadays, approximately 500 pairs lay eggs during November and December, and more than 300 fledglings depart the island around April each year.

This remarkable turnaround has been achieved through direct control of the currawongs and by removal of Bird-lime Trees from within the nesting habitat of the petrel. The underlying cause of these problems—the changes brought about by Rabbits—has not, until now, been addressed. The removal of Rabbits from Cabbage Tree Island has long been regarded as an impossible task. The difficulty of destroying each and every Rabbit is compounded by the ruggedness of the terrain and the difficulty of access to

**Top left:** Cabbage Tree Island's western shore is fringed by an impenetrable rainforest and this is home to Gould's Petrel. Above: adult Gould's Petrels only come ashore between the months of September and April to breed; the rest of the year is spent at sea.



A. ROGERS/NATURE FOCUS



N. GARLILE

**Gould's Petrel chicks must begin to fend for themselves less than a week after hatching.**

many parts of the island. The 30-hectare island sits atop a wedge of volcanic rock thrust up from the seabed. It measures just one kilometre long and 450 metres wide, but rises steeply to 125 metres above the swirling seas below. Just getting around this island requires enormous physical effort.

To eradicate the offending Rabbits we designed a program that called for the sequential application of several mortality agents, including both biological and conventional methods. The Rabbit population was first reduced by an epidemic of myxomatosis. The controlled introduction of calicivirus followed soon after. The survivors were then baited with grain-based pellets containing the poison brodifacoum, an anticoagulant that is toxic to all mammals. Although not used previously in Australia this bait, known commercially as 'Talon 20p', has been used with success to eradicate Rabbit and other mammalian pests from

**A Gould's Petrel nesting on the floor of Cabbage Tree Island's rainforest.**

islands in New Zealand. The absence of any native mammals on Cabbage Tree Island eliminated any potential risk to non-target species.

Eight weeks of intensive effort were needed before all Rabbits were dead. Monitoring continued for a further six months to verify our success. Within this time there was ample evidence of a dramatic increase in the emergence and growth of many plants. Monitoring sites had become engulfed in lush herbage, tracks were blocked by fast-growing vines and idle Rabbit traps became entwined with grasses and climbers.

We will continue to monitor vegetation for several years to fully document the recovery of the rainforest. After almost a century, Cabbage Tree Island is free from the ravages of Australia's most despised mammalian pest. As the last



N. CARLILE

**As the last Rabbit traps are removed, an atmosphere of tranquillity descends over the island; the serenity now broken only by Gould's Petrels returning from the ocean.**

Rabbit traps are removed, an atmosphere of tranquillity descends over the island; the serenity now broken only by the enigmatic Gould's Petrels returning from the vastness of the ocean to reclaim their island paradise. ■

### Further Reading

Priddel, D. & Carlile, N., 1998. Conservation of the endangered Gould's Petrel *Pterodroma leucoptera leucoptera*. *Pacific Conserv. Biol.* 3: 322-329.

Priddel, D. & Carlile, N., 1997. Boondelbah Island confirmed as a second breeding locality for Gould's Petrel *Pterodroma leucoptera leucoptera*. *Emu* 97: 245-248.

David Priddel is a Senior Research Scientist within the Threatened Fauna Ecology Unit, NPWS. He has been involved with Gould's Petrel for almost a decade. Nicholas Carlile is Project Manager for Gould's Petrel at NPWS and has spent much of the last five years living alongside these secretive seabirds. The Foundation for National Parks and Wildlife is raising much-needed funds for the conservation of Gould's Petrel (free call: 1300 656563).

### GOULD'S PETREL *Pterodroma leucoptera leucoptera*

#### Classification

Order Procellariiformes, family Procellariidae. Gould's Petrel is currently treated as a subspecies of the White-winged Petrel, with the other subspecies *P. l. caledonica* breeding in New Caledonia and *P. l. brevipes* in the Fiji, Cook and possibly Solomon Islands area.

#### Identification

Length 30 cm, wing span 75 cm, average weight 180 g. Black to sooty brown above and white below. Head with a dark hood and speckled forehead, and underwing with a distinctive dark diagonal stripe.

#### Distribution

Most often seen at sea beyond the edge of the continental shelf off south-eastern NSW. Thought to spend non-breeding period in the southern Tasman Sea.

#### Habitat

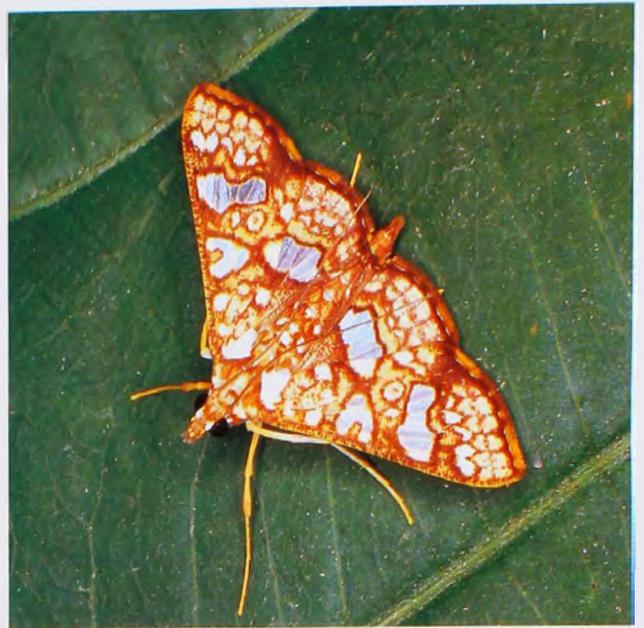
Breeds exclusively on two islands at the entrance to Port Stephens, NSW. Principal site is Cabbage Tree Island with a covering of subtropical rainforest over rock scree slopes. Nearby Boondelbah Island is a wind-swept location with only a few pairs limited to small areas of rock scree. Both islands are Nature Reserves with restricted public access.

#### Behaviour and Breeding

Nocturnal at its breeding locality, arriving and leaving under cover of darkness between September and May. Nest made in crevices among rock scree and fallen palm fronds. Birds return annually to the same nest site to lay a single white egg. Pair bonds appear to be for life and incubation is shared between sexes with individual shifts extending up to 21 days. Chicks hatch after 49 days incubation and are brooded for less than a week before fending for themselves between feeding visits from both parents. 500 breeding pairs produce 300 fledglings yearly.

#### Status

Endangered nationally, critically endangered internationally.



Pyralid moth, *Glyphodes canthusalis*, 20 mm across.



Geometrid moth, *Eumelea rosalia*, 40 mm across.



Noctuid fruit-piercing moth larva, *Othreis fullonia*, 30 mm long.

# MOTHS

BY PAUL ZBOROWSKI

Drepanid moth, *Hypsidia erythrospalis*, 26 mm long.





Choreutid metallic moth, *Sapha libanota*, 7 mm long.



Lasiocampid (snout) moth, *Eremaea zonaspila*, 15 mm long.



Arctiid (tiger) moth, 28 mm long.



Noctuid moth, *Cyclodes spectans*, 35 mm across.



Geometrid moth, *Uliocnemis partita*, 25 mm across.



Anthelid moth, *Anthela* sp., 32 mm across.

Whatever the nature of the skeletal beast that claws its way out of those blocks, it will soon find itself brought back to life.

# TIPPING AN AIR HEAD OUT OF A STONE BED

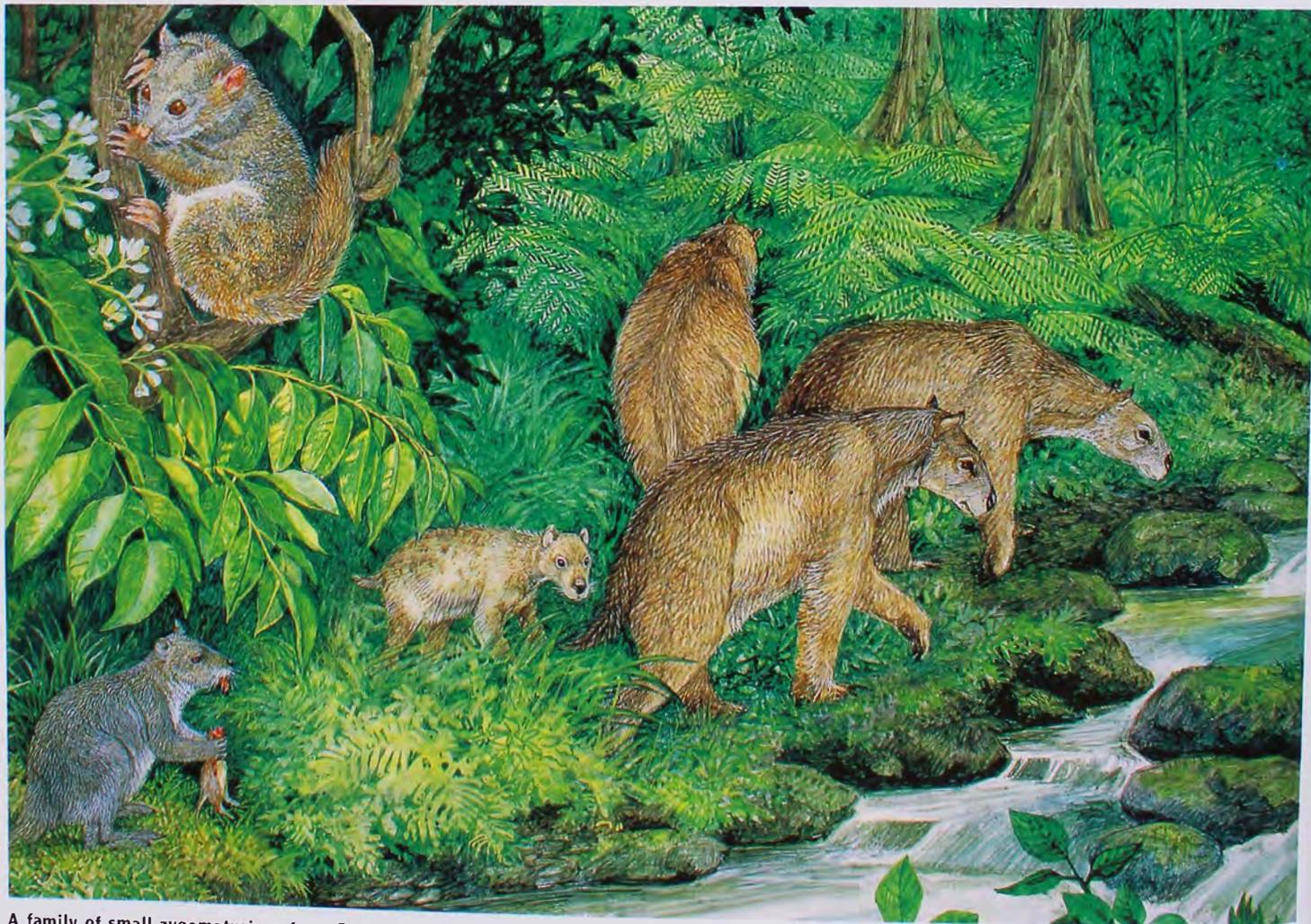
BY MICHAEL ARCHER

**T**HE LIMESTONE OF RIVERSLEIGH'S AL90 Site is harder than cement, as a legacy of blunted chisels, shattered sledge-hammers and damaged digits attest. To collect large blocks of this possibly 17-million-year-old bone-rich mater-

ial requires the skills of a master rock-cutter—which is exactly what our 1998 team of Earthwatch volunteers had in abundance. Chris ('Lizard') Cannell and Graham Hogan, from the mining company Pasmenco, caressed the quarry wall with their hands and eyes, much as a jeweller would study a rough diamond before risking the first cut. Eventually they determined the position for the drill holes that would be needed to crack the rock in the desired direction. After they had bored the holes with our electric rock drill, I inserted folds of the thin ICI

explosive called Red Cord. Twenty-two years of experience had taught us that, although Red Cord is normally used to link explosive charges so they go off simultaneously, it has in itself sufficient 'oomph' to cleanly pop limestone blocks from the wall. After clearing the area and checking the wires, I taped on the electric detonator and then waded through a sea of spinifex to join the others sheltering behind a tree. Checking again to see that everyone was accounted for, I shouted "Firing!", then counted down "Three, two, one" and on "zero" detonated the charge. There was a boom, a puff of smoke and a lot of intense curiosity about what might appear.

Looking down into the quarry, a 300-kilogram block lay on its side 20 centimetres from the wall. It was in perfect nick, having been carved away like a giant slice of Christmas pudding. When we rolled it over, the sun glinted off a beautiful set of shiny teeth jutting out from the base of an equally beautiful and complete skull. The teeth identified the creature as a species of *Nimbadon*, a diprotodontid genus previously named by Suzanne Hand (University of New South Wales) on the basis of a few jaws and teeth. These were calf-size plant-eating marsupials that are all now extinct. Diprotodontids included more than 20 kinds of wombat-like marsupials ranging



A family of small zygomatic marsupials from Riversleigh about to share an eternity in stone.

DOROTHY DUNPHY/COURTESY REED BOOKS 'RIVERSLEIGH'

from 24-million-year-old Dog-size leaf-eaters to rhinoceros-size giants like *Diprotodon* that died out 40,000 years ago. Sue concluded that *Nimbadon* species were among the most 'primitive' of the zygomatic diprotodontids and hence ought to reveal a great deal about their evolutionary relationships to other groups of marsupials. But to do this with confidence, far more than just tooth rows would have to be discovered. Enter the prehistoric treasury of AL90.

Because I was focused on the skull jutting out from the block, it took a 'hoi' from Lizard to draw my attention to the other end of the block where he had spotted what seemed to be both sides of a pelvis (the hip bones). "Very nice!" I thought, but the full significance of what we were looking at was slow to sink in. Not until I had examined another smaller block that'd been previously cut from the quarry wall did the hairs start to rise on my neck. Here, just visible and in a graceful arc, was a complete set of tail bones extending from the large vertebrae at the base of the tail to the tiniest ones at the tip. Rushing back to examine the edge of the main block, it was instantly clear that the smaller block with its set of tail bones had been attached to the point where the back of the pelvis was visible. Now the block had my total and undivided attention.

In front of the pelvis, I could just make out the ghostly outlines of the vertebrae of the lower back. Farther towards the skull, the sides of several ribs, all parallel to each other peeped, out from the rock's surface. Returning to the pelvis with growing excitement, I could now make out the thigh bones disappearing into the deeper mass of the block, a discovery suggesting that the rest of the legs and feet were tucked safely out of sight. Excitement spread quickly—the first complete and possibly articulated skeleton of a zygomatic had just been found at Riversleigh!

As the importance of this unexpected discovery sunk in, so did the despair about how we would get this monstrosity safely back to the lab in Sydney. Pasmenco came to the rescue. Early next morning a six-tonne truck sidled up to the edge of the quarry and a beautiful-to-behold hydraulic hoist stretched its powerful arm sideways to dangle chains above the treasure. To cheers and the overwhelming relief of back-weary Expedition members, the massive limestone sarcophagus was levitated out of the quarry and eased down onto the back of the truck for the first leg of its trip to Sydney. There, after the delicate ministrations of skilled preparators and thousands of litres of dilute acetic acid, this entombed beast of the Miocene would rise again.

Peter Murray (Northern Territory Museums & Art Galleries), who has spent years discovering equally fascinating but younger fossils from Bullock

Creek and Alcoota in the Northern Territory, described zygomatics as 'air heads' because much of the rear part of their skull was made up of hollow sinuses and other brainless spaces that together increased the outer area of the skull where the enormous muscles needed for chewing were attached. Karen Black (University of New South Wales), who has been studying Riversleigh diprotodontids as part of her PhD research, is now running her hands excitedly over the surface of these new AL90 blocks, anticipating the many mysteries they will resolve. What were the limb proportions of these ancient creatures? Could they use their hands to manipulate objects? Could they have climbed trees in search of leaves? Would they have been able to stand on their hind legs to reach titbits beyond the reach of smaller contemporary kangaroos? Would the base of the skull indicate relationships to wombats, koalas, marsupial lions or even stranger groups such as ilariids or wynyardiids? Here was the diprotodontids' book of revelations just waiting to be opened.

Whatever the nature of the skeletal beast that claws its way out of those blocks, it will soon find itself brought back to life alongside other rainforest creatures trapped millions of years ago in the cave that was to become AL90. In

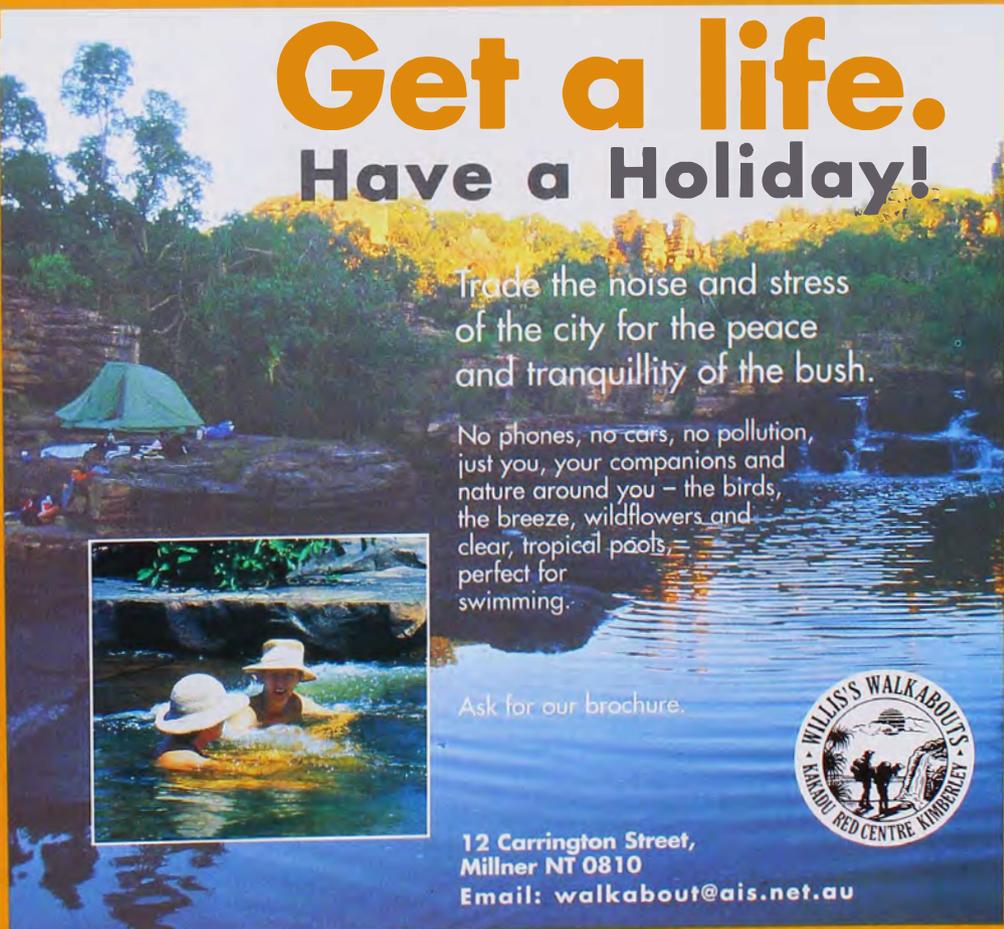
an exhibition that features the treasures of Riversleigh, to be completed by the Australian Museum and the Riversleigh Society in the year 2000, much of what has been recovered will go on public display. Here *Nimbadon* will be reunited with the beautiful fox-size *Nimbacinus* (an archaic 'marsupial wolf'), a powerfully muscled and bizarre kangaroo that galloped rather than hopped, an enormous flightless bird that stood almost three metres in height, a cleaver-headed crocodile that may have dragged its prey up trees, and many other creatures so far only known from the World Heritage area of Riversleigh. But the most fascinating of born-again beasts in this display may well be one that springs out at us next year as we continue to delve deeper into the catacombs sealed in stone below the spinifex. ■

### Further Reading

Archer, M., Hand, S.J. & Godthelp, H., 1994. *Riversleigh*. 2nd ed. Reed Books: Sydney.

*Memoirs of the Queensland Museum*, 1997. (Riversleigh discoveries) Volume 41 (Part 2).

*Michael Archer is the newly appointed Director of the Australian Museum, and Professor of Biological Science at the University of New South Wales. His major research interests are the fossil faunas of Riversleigh, north-western Queensland.*



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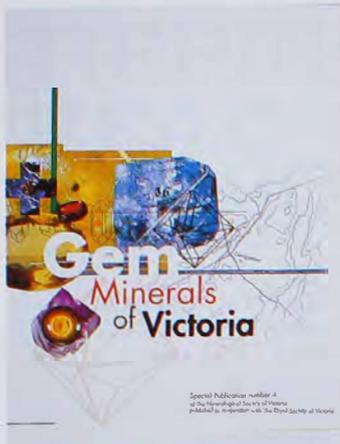
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# REVIEWS



## Gem Minerals of Victoria

By William D. Birch and Dermot A. Henry. Special Publication No. 4 of the Mineralogical Society of Victoria published in conjunction with The Royal Society of Victoria, 1997, 120pp, \$42.50rrp.

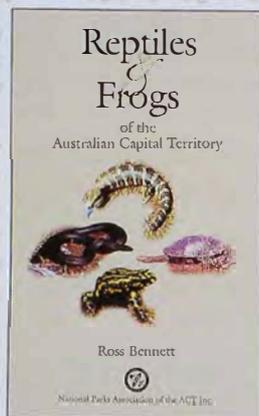
This book follows up the pioneer efforts of the Rev. John Bleasdale, an enthusiastic promoter of Victorian gemstones (and Victorian wine-growing capabilities) in the late 1800s. The book captures Bleasdale's spirit in its treatment of the little-known but diverse Victorian gemstone scene. It presents an engaging balance of historical background, field views, scientific illustrations and colour photographs of both rough and cut gemstones, all set within an informative script.

The book proceeds from the rarer, potentially more valuable, gemstones to the more abundant, less valuable, gem materials. It deals with, in order, the history of gem finds, geological setting, diamond, sapphire, ruby, zircon, olivine (peridot), anorthoclase (feldspar), topaz, tourmaline, beryl, garnet, quartz, agate and other gems. The writing is clear, straightforward, full of useful facts and laced with the odd humorous comment. It is illustrated by over 200 illustrations, with over 150 in colour and historical black-and-white pictures among the remainder.

The gemstone photos by Francesco Coffer and John Broomfield contribute to the

success of the book, although some pictures are too dark or dense to show details. The layout by two student designers, Paul Monkivitch and David Fox from Swinburn Design Centre, is fresh and appealing. Some of the content is repetitive and the book is most suitable for fossickers visiting the Victorian gem sites. However many can enjoy having the book on their shelves as a reminder of the beauty and diverse origins of those superior mineral varieties called gemstones. A recommended buy for the price.

—Lin Sutherland  
Australian Museum



## Reptiles & Frogs of the Australian Capital Territory

By Ross Bennett. National Parks Association of The Australian Capital Territory, ACT, 1998, 86pp. \$14.95rrp.

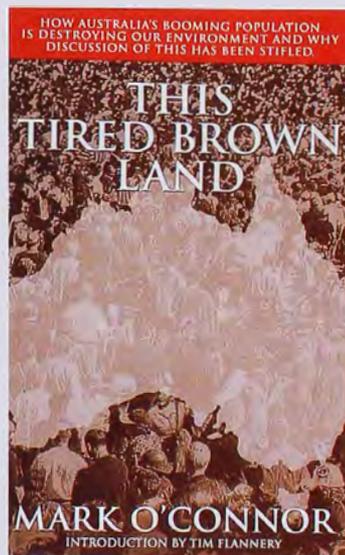
This is an excellent regional field guide for those living in or near the ACT. It covers all the reptiles and frogs most likely to be encountered in the area, as well as their conservation and the environment of the ACT. The book is well set out with a page and good colour photo for each species. The description for each species includes size, colour, distribution, and various other aspects of biology such as habitat and breeding notes. In the case of frogs there is also a written

description of the call. A very useful system of labelling the photos with important features of the animals goes a long way towards making identification easier. And there's a selected bibliography and index at the back too, for those who wish to look up more information.

But the book is not without its problems. Sometimes the language used is a little convoluted and the sentences a trifle long. Some of the definitions are a bit unclear, for example, "Reptiles are distinguished from all other life-forms by three features: a scaly skin, sex organs which permit internal fertilisation, and a dependence on external sources of warmth to allow bodily functions to continue"—if that's the case, there are several fish that qualify as reptiles including the mosquitofish, *Gambusia holbrooki*. Overall, however, the book is quite easily understood.

All in all, however, the book's good photos, ease of use and clever design make it a very useful addition to any nature library and will offset any of its problems.

—Martyn Robinson  
Australian Museum



## This Tired Brown Land

By Mark O'Connor. Duffy and Snellgrove, NSW, 1998, 335pp. \$16.95rrp.

This book addresses the pre-eminent issues of our times—ecological sustainability and population growth. In doing so it covers numerous related issues including the environment, demography, sociology, economics and morality. This intensely political mix is made all the more provocative by forthright discussion of political correctness and suppression of the population debate. The author is Mark O'Connor, a poet with a long-standing interest in ecologi-

**There are urgent environmental, economic and social reasons why Australia needs to slow its population growth.**

cal sustainability. The fact that he can weave these threads together is a testament to his breadth of knowledge, quite a polymath in fact.

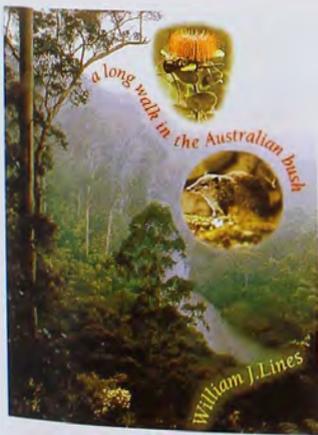
O'Connor's thesis is that "there are urgent environmental, economic and social reasons why Australia needs to slow its population growth". In Part One, he assembles facts and arguments to show that the planet and Australia are overpopulated and not ecologically sustainable. In sharp contrast to growth advocates, his conclusions have a scientific foundation. Indeed, he exposes various fallacies and spurious claims made to support a much larger population. Included here are economic analyses that reveal the large costs associated with immig-

ration. In Part Two, he deals with population growth, especially immigration-driven, and sets the scene for the third and largest section entitled "Suppressing the Debate".

In this third part, the ABC, the Federation of Ethnic Community Councils of Australia and the then Federal Bureau of Immigration Research are all vigorously attacked for bias and censorship concerning immigration and the multicultural industry. As well, the pro-growth lobby is exposed as having narrow, short-term self interest and excessive political influence, support for the John Ralston Saul thesis of corporatism overriding democracy. How else can large immigration intakes be explained against the wishes of over 60 per cent of Australians and the clear environmental evidence of overpopulation?

As always, the urgent (short-term economics and political advantage) drives out the important (long-term sustainability and quality of life). This book serves the nation by advancing a debate that must now be considered both important and urgent. As such, it deserves to be both widely read and influential.

—Alan Jones  
Australian Museum



### A Long Walk in the Australian Bush

By W.J. Lines. UNSW Press, NSW, 1998, 202pp. \$19.95rrp.

Karl Marx claimed that a waterfall has no value if not the product of human labour. This seemingly modest book takes to task not only Marx,

but also Adam Smith, Charles Darwin, Francis Bacon and Plato. It takes them out into the Australian bush to smell the wild flowers.

It is ostensibly an account of a 1993 walk along the Bibbulmun track, a 650-kilometre trail through the Jarrah and Karri forests of southern Western Australia. The author, however, is chiefly concerned with detailing the deliberate and disastrous impact of man on these once-magnificent forests, through almost 200 years of logging, milling, mining, farming, damming and dieback. This catalogue of shameful treatment is framed around the daily rhythm of the walk, sustained over five weeks, and is placed in the context of a broader ideological criticism of Western society. Lines argues against the human urge to 'manage' nature and harness the present for a future of economic growth. He tellingly deconstructs many ideas whose value we take for granted—such as environment, well-being, self-fulfilment and change—and puts forward an alternative view of our place in the world.

For some readers, Lines' humourless litany of criticism will not appeal. He draws a bleak picture, unapologetically leaving little room for hope or compromise. He is often too harsh or overly simplistic in condemning human endeavour, and consciously eschews any personal narrative that would have enlivened his account. But for me, the power and profound sense of Lines' thoughtful text won out over these distractions. I commend it to those seeking a provocative, troubling reflection on our relationship with nature, or to those who prefer simply to enjoy their Marx by a waterfall.

—Gareth Prosser  
University Technology, Sydney

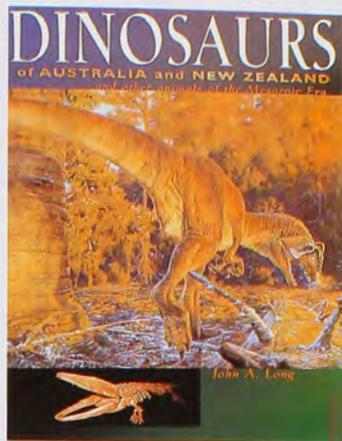
### Dinosaurs of Australia and New Zealand and Other Animals of the Mesozoic Era

By John A. Long. UNSW Press, NSW, 1998, 188pp. \$45.00rrp.

John Long's book is a definitive, up-to-date account of all dinosaurs known from Aus-

tralia and New Zealand. In fact, Long surveys the entire record of Mesozoic tetrapods—with amphibians, birds, mammals, turtles and marine reptiles all given pride of place along with *Minmi*, *Muttaburrasaurus* and many less familiar stablemates.

Long's attractive and enjoyable book should satisfy a wide audience—schoolkids,



science teachers, fossil buffs, and even professional palaeontologists. The most important fossils are illustrated with colour photographs and drawings of the bones; most species are reconstructed with line drawings or paintings, with a number of field photographs and historical accounts of discoveries. Introductory chapters explain geological time, how fossils are found, prepared and reconstructed, as well as basics about dinosaurs (their evolution, classification and theories about their extinction). A glossary helps the layperson understand even the more technical parts of the text, and the bibliography cites all scientific publications on Australasian Mesozoic tetrapods. Australian readers may be less familiar with recent discoveries in New Zealand, and should be intrigued by these accounts.

Twenty years ago a book on Australasian dinosaurs was scarcely conceivable, but the tenacity of a few persistent palaeontologists has turned up an impressive range of dinosaurian diversity, even if in many cases species are known from just a few tantalising bones. But, as Long shows, with big animals even a little goes a long way.

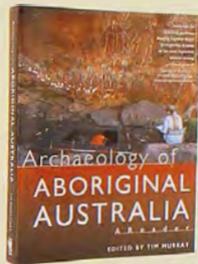
—Greg Edgecombe  
Australian Museum



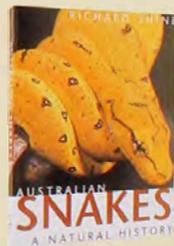
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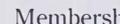
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### TAMS, The Australian Museum Society

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# Q & A

## Water Down the Gurgler

**Q:** *If cyclones in the southern hemisphere rotate in a clockwise direction, why does the water down my drainpipe rotate anticlockwise?*

—Mandy Masters  
Randwick, NSW

**A:** The wind blowing around cyclones is balanced by three main forces—the force due to the pressure gradient, the centrifugal force of circular motion, and a force due to the rotation of the Earth known as Coriolis. The direction of the Coriolis force changes as you move from one hemisphere to the other, falling to zero at the equator. This results in a clockwise flow around southern hemisphere cyclones and an anti-

Who's poo is this?

clockwise flow about those in the northern hemisphere.

This sense of rotation has been popularly attributed to all forms of natural rotation but the effect of Coriolis actually becomes insignificant as the scale of motion becomes small. This means that water flowing down a drainpipe can rotate in either direction in both hemispheres. What's important at this scale is any background sense of rotation, such as the motion of the water before the plug is pulled, and the shape and tilt of the basin itself. You can experiment with this by drawing your hand slowly around the basin before pulling the plug. The water should flow out with the same sense of rotation as your hand.

—Andrew Treloar  
Bureau of Meteorology, Sydney

## Mystery Poo

**Q:** *I enclose some droppings (pictured) that consistently appear on the floor of our wool shed, in the hope that someone can identify the creature responsible. These specimens have been observed over many months, mostly in one small square-metre area. The door to the shed is always locked, although it is a pretty draughty*

*building with a number of gaps in the walls and around the roof, but hardly large enough to admit a bird of any size. The local agricultural department has not been able to throw any light on the matter, nor have the shearers seen anything like them elsewhere.*

—W.N. Feathers  
Borenore, NSW

**A:** I think the scats are those of a large amphibian, as they closely resemble my reference samples of Cane Toad scats. I doubt if these pests have reached central New South Wales but perhaps there are some other large frogs or toads in the area. My only other suggestion is that they

come from a reptile because they also resemble some I have seen from large skinks. However skink scats are usually capped with some white uric acid and there was no sign of any white material in this sample. One thing is certain: they are not macropod scats as they are the wrong shape, content and smell!

—Barbara Triggs  
Genoa, Vic.

## Green Spiders

**Q:** *I found a beautiful green huntsman-like spider in my garage the other day. What kind of spider is this and is it rare?*

—Jennie Phillips  
Hornsby, NSW



A female green huntsman (*Neosparassus* sp.).

**A:** Some huntsman spiders are green when young but change to brown as they mature. Others may have green patches from time to time but these are more likely to be the remains of a semi-digested meal, which may be seen through certain translucent areas of the body wall, or green eggs which are produced by the females of some species. In these cases the colour change is gradual and the spider is never completely green. However, there is at least one unnamed species of huntsman spider, found in eastern Australia, that is green all over during all stages of its life. It is not common and would normally only be seen at night hunting on low shrubs, although sometimes wandering males venture into buildings during their search for a mate. The green huntsman is related to a group of spiders commonly referred to as 'badge huntsmen'.

—David Hirst  
S.A. Museum

### Herbivorous Carnivore

**Q:** Tom White's Letter on carnivorous herbivores (Nature Aust. Winter 1998) brought to mind my observation of an herbivorous carnivore. I once watched a jumping spider, one of the most carnivorous animals I thought, demolish a cake crumb on a picnic table. Is this an unusual observation or quite common?

—Eleanor Stodart  
Curtin, ACT

**A:** It is most unusual that a spider would eat a cake crumb. Some spiders, like huntsmen, have been known to eat recently dead prey (and can be hand-fed this), but there has been nothing recorded about spiders eating cake. It was probably trying to get the moisture out of the cake, and in so doing, the cake crumb disintegrated, giving the illusion that it was being eaten by the spider.

—Kate Lowe  
Australian Museum

Do jumping spiders eat cake?

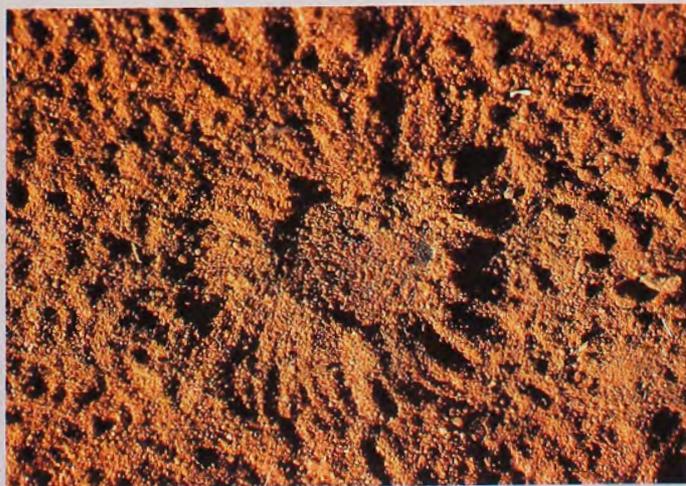


### Answers to Quiz in Nature Strips (page 15)

1. Jabiluka
2. New Zealand
3. No
4. Pink
5. Greenpeace
6. Leaves
7. Two
8. Frog
9. Tim Flannery
10. Mir

## P I C T E A S E R

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*We should not deceive ourselves by believing we are preserving a completely natural situation.*

# NATURE MANAGEMENT: HOW NATURAL IS IT?

BY ALLEN GREER



ONE OF THE PRIMARY goals of environmental management is to preserve as much of nature as close to its natural state as possible. The intention is to preserve both the current fundamental units of nature (species, populations and even genes) and the natural interactions among those units (their ecology and evolution). Although it is generally unstated, the degree to which the programs achieve a 'natural' outcome is measured by how far removed it is from human influence. The less human influence there is, the more natural the outcome.

Some people may believe that many of our environmental programs lead to very natural outcomes. This may appear so on the surface, but close examination of even our most conscientious environmental programs shows how far from completely natural most of these environmental initiatives are. Consider these examples.

Nature reserves are perhaps the most significant environmental management tool in use today. By creating reserves, we hope to fence off a piece of 'natural habitat' in which nature can 'take its course', relatively removed from the influences of humans. However, most reserves are little more than 'islands' and consequently are often very different from the once-continuous habitat from which they were carved. One of the biggest differences is that many of the plants and animals become permanently trapped on the 'islands', because they cannot cross the developed land surrounding them. Hence, when climate changes, as it inevitably will, the many species that cannot move to a more appropriate area will perish.

Another significant characteristic of reserves is that the land surrounding

them is often 'let go' to any manner of land use, and some of the consequences of this land use continually 'leak' into the reserve. A rampant weed species, a feral Cat, or a fire frequency different from the average natural frequency, can alter a natural community profoundly.

Rehabilitation programs are a major initiative to try and undo environmental damage. Most of these efforts involve the establishment of a few conspicuous species with little or no thought for other less conspicuous species, such as invertebrates. Yet in reality the least conspicuous species make up the bulk

**The inexperienced eye  
may see rehabilitated  
areas as natural;  
the informed eye sees a  
highly simplified  
and artificial community  
with only cosmetic  
changes.**

of any natural community. The inexperienced eye may see rehabilitated areas as seemingly more natural; the informed eye sees a still highly simplified and artificial community with only cosmetic changes.

Harvesting quotas for many animal species such as crustaceans and fishes are the preferred means of managing or 'sustaining' the resource. Many of these quotas include a size limit, the catch being restricted to individuals above a certain size. However, because it is usually the larger animals that have survived the process of natural selection and are the ones that do most of the

breeding, such quotas ensure that these extremely fit individuals are the ones that will be culled. This leaves the breeding to a smaller, less rigorously 'tested' group of animals. Indeed, our management practice may be a kind of artificial selection for animals to mature and breed at a smaller size, that is, before they are large enough to be caught. Because many other biological features of animals, such as the number of eggs or offspring produced, change with size, a 'simple' alteration in the average size of individuals within a population can have long-term effects.

Similarly, harvesting trees and other plants when they reach a certain size can also lead to highly 'unnatural' outcomes. A forest harvested on a 30-, 50- or even 100-year rotation may be 'sustainable' from a human point of view ("gee, look at all those trees"), but not from the point of view of the organisms that can only live in the forest after it has reached even greater maturity.

Consider, also, captive breeding programs—perhaps the most high-profile of all environmental management programs. Unfortunately, the individual organisms that humans select for breeding are not necessarily the ones nature would select. And the individual organisms that are suited for surviving the rigours of captivity prior to release 'back in the wild' are unlikely to be the ones that would be best suited to survive the rigours of nature. The same applies to frozen tissue programs (using sperm and eggs)—so highly touted in this high-tech age. A sperm that may be maximally suited to survive deep-freezing for several years may not necessarily have been the sperm that would have won the race to fertilise the egg in a natural situation.

Finally, many environmental programs involve the transportation of individuals to a new locality within the range of the species. However, such programs can affect local populations by disrupting established social structures, introducing parasites or diseases, and putting genes in places where they never occurred naturally.

Of course, almost all of our environmental programs can be defended on the basis that they are better than letting species go extinct, or better than bare ground. This may be true. But at the same time, we should not deceive ourselves by believing we are preserving a completely natural situation. All we are really preserving are disturbed plant and animal populations that are somewhat closer to nature than the unmanaged alternative.

*Dr Allen E. Greer is a Principal Research Scientist in the Herpetology Section of the Australian Museum.*

*The Last Word is an opinion piece and does not necessarily reflect the views of the Australian Museum.*

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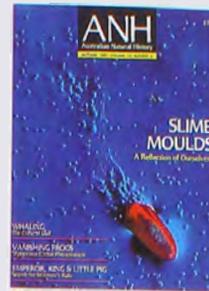
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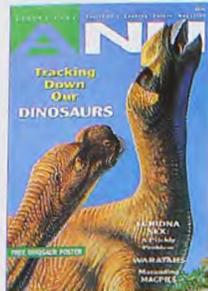
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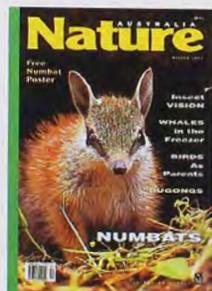
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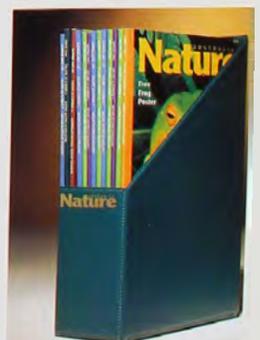


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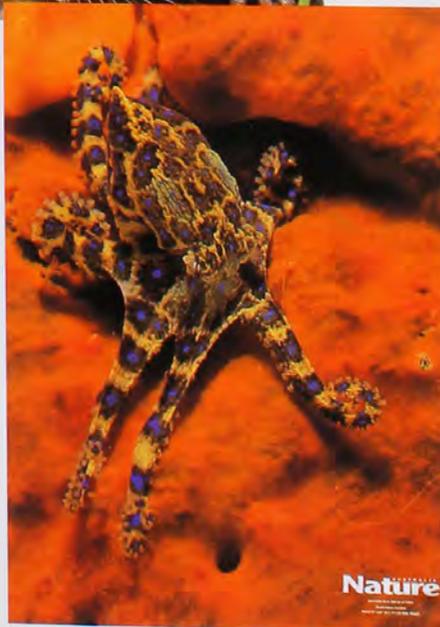


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