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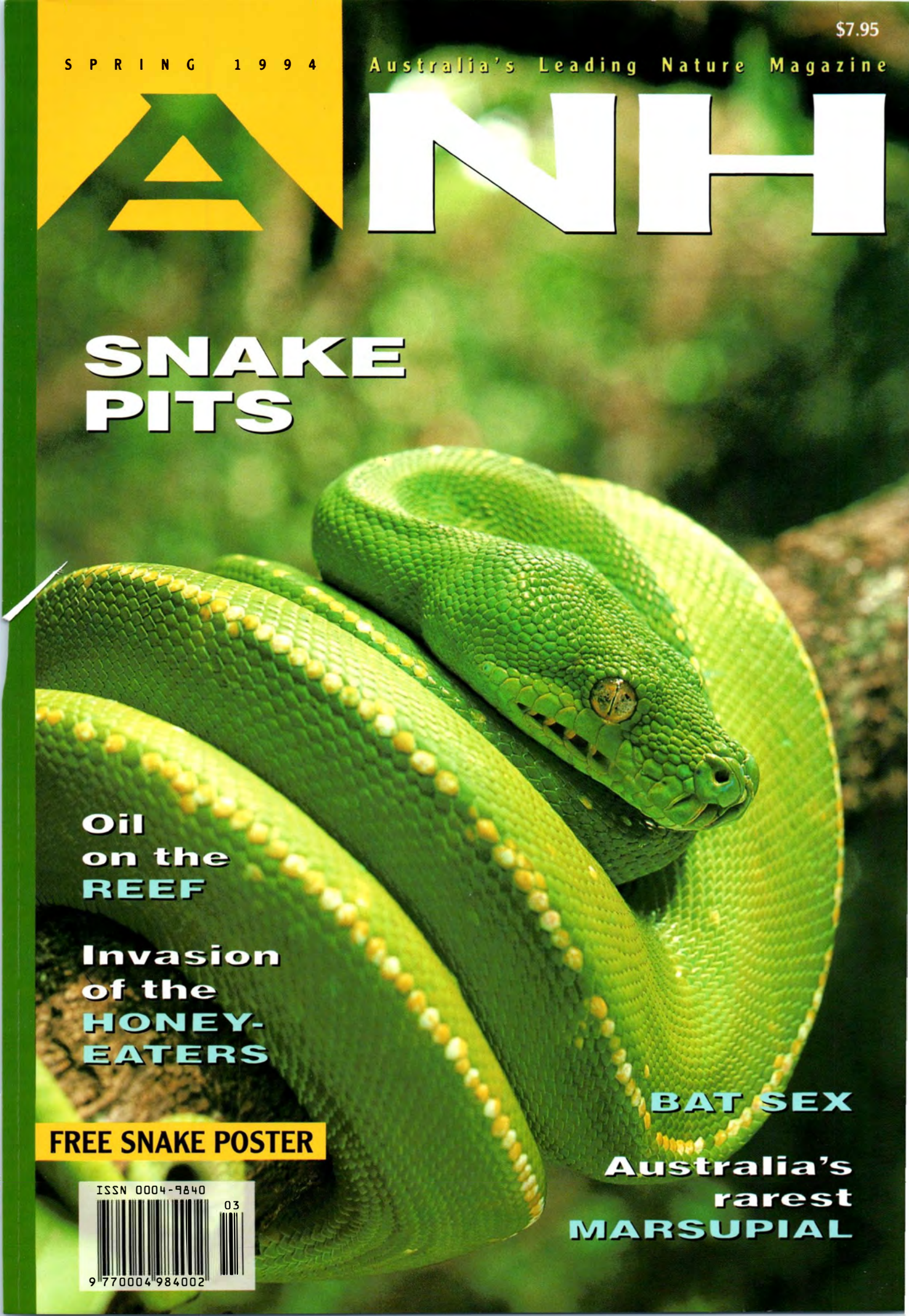

SNAKE PITS

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Invasion of the HONEY-EATERS

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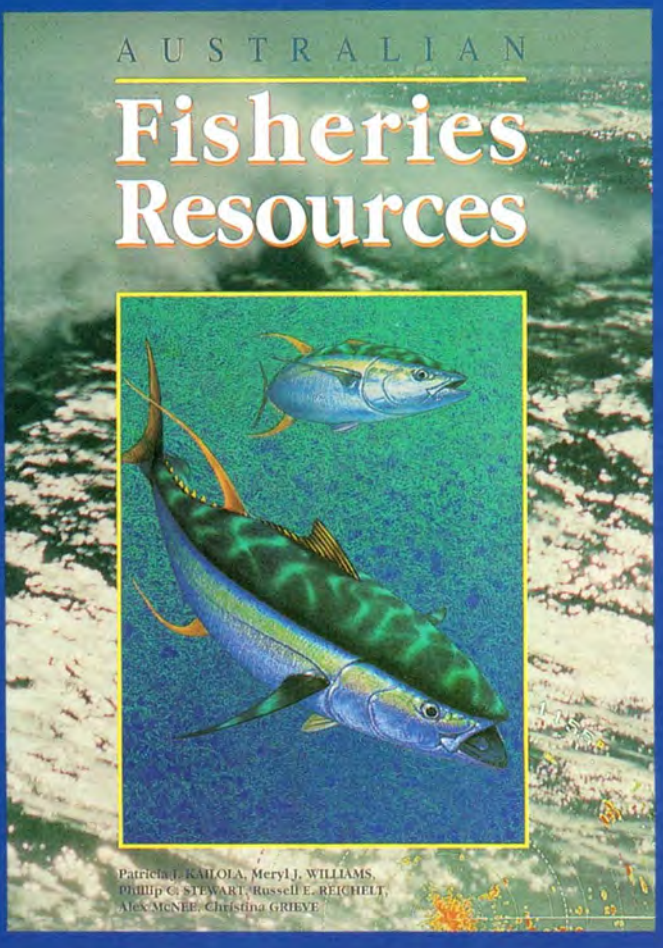

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Up Front

If you were to ask people what the world's most endangered animals were, they would probably reel off the names of large and magnificent beasts like tigers, elephants, gorillas and Humpbacks. Few would think of the Northern Hairy-nosed Wombat. Yet with only about 100 individuals left, this animal is one of the rarest large mammals in the world and is Australia's rarest marsupial. Despite these unfortunate titles, many Australians haven't even heard of the Northern Hairy-nosed Wombat, let alone its precarious state. In the hope of reversing this situation, we have dedicated one of our feature articles to this rare Queenslander. Dr Chris Johnson takes us into the field to meet this very secretive, highly suspicious and determined wombat.

C. ANDREW HENLEY/AUSCAPE INTERNATIONAL

Northern Hairy-nosed Wombat.

We also take a very different look at the Great Barrier Reef. Every year approximately 2,000 large ships ply the reef-studded waters. What if one were to have an accident and release its oil? How would the reef and other coastal environments cope? What plans are in place to deal with such a disaster, and what is being done to try and prevent it from happening in the first place? As the likelihood of such an event increases with each year, it is an issue we can no longer afford to ignore.

KEV DEACON/DIVE 2000

The Great Barrier Reef.

In other articles, Tim Low challenges us to face facts about how we have turned some of our endemic animals into native nightmares; Dr Uwe Proske takes us into the infra-red world of pythons and vampires; and Professor Michael Archer describes a land where nothing is as it seems.

—Jennifer Saunders

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Australian Natural History is proud winner of the 1987, '88, '89, '90 , '91, '92 & '93 Whitley Awards for Best Periodical.

Front Cover
Like all Australian pythons, this Green Python (*Chondropython viridis*) is able to hunt at night because of infrared receptors located in the pits around its mouth. Photo by C. & D. Frith/FrithFoto.

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SNAKE PITS
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With only about 100 individuals left, the Northern Hairy-nosed Wombat is Australia's rarest marsupial, and among the rarest large mammals in the world. But the future may not be all doom and gloom for this wonderful secretive wombat.
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What would happen if there was an oil spill on the Great Barrier Reef? What plans are in place to deal with such a disaster and what are the odds of it occurring anyway?
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ANH NEWS

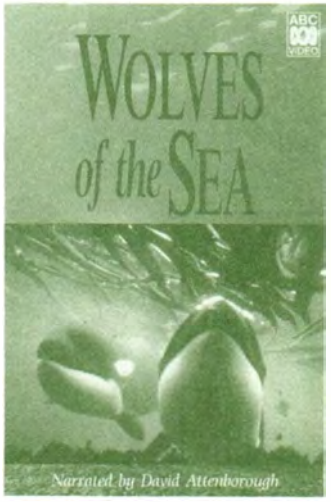
WOLVES OF THE SEA

Special offer

The sensational ABC documentary "Wolves of the Sea - A Natural History of the Killer Whale" has won enormous praise as well as a number of prestigious awards. It was produced by David Parer and Elizabeth Parer Cook who spent more than three years researching and filming Killer Whales in some of the remotest and wildest places on earth. The result, narrated by David Attenborough, is a fascinating portrait of the behaviour and hunting habits of one of the ocean's most feared creatures. Wolves of the Sea" was made by the ABC's Natural History Unit as a co-production with the National Geographic Society and Turner Broadcasting Productions.

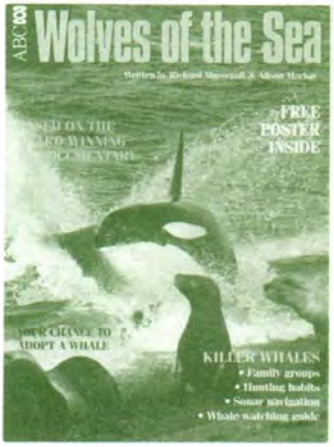
"Wolves of the Sea" is now available on video from ABC shops, ABC Centres, leading department stores and video retailers for $29.95 rrp.

And now there's a "Wolves of the Sea" book, based on the documentary, and written by Richard Morecroft and Alison Mackay. It's a complete and up-to-date guide to Orcas (Killer Whales), drawing on



the research of an international group of scientists. It's available from newsagents, ABC shops, ABC centres and selected bookstores for $9.95 rrp.

We have five copies of the "Wolves of the Sea" video to give away, courtesy of Roadshow Entertainment, and ten copies of the book, courtesy of ABC Enterprises. To win your own copy all you have to do is send a postcard or letter with your name and address to Wolves of the Sea Giveaway, ANH, Australian Museum, PO Box A285, Sydney South 2000 by Friday 21 October. The first fifteen names drawn on that date will receive a free copy of the video or book. ■



WINNERS

Mr James Rees of Doncaster, Victoria was the winner of our Winter pic teaser.

Frog Week 1994

Australian Frog Week 1994 takes place from 31 October to 7 November. Organised by the Frog and Tadpole Study Group (F.A.T.S.), its aim is to raise awareness of the crucial ecological role of frogs. There will be a range of community activities and publications promoting practical conservation strategies.

Frog Week also sees the launch of the **Australian Frog Count**, which aims to map the distribution of frogs by getting people to make tape recordings of frog choruses.

For further information regarding **Frog Week**, **Australian Frog Count** or contact names and numbers in your state or city phone 1800 636 744 (for the cost of a local phone call). ■

TAMS EVENTS

This Spring TAMS (The Australian Museum Society) is hosting a series of 8 lectures to coincide with the Museum's major new exhibition **"REDISCOVERING POMPEII"** (24 September to 11 December). The lectures are on Thursdays at 6.30 pm at the Australian Museum in Sydney.

Cost per lecture: Members $9.00, Non Members $12.00
Cost per series: Members $65.00, Non Members $80.00

Pompeii: History and Rediscovery - *Introduction & Overview* Prof. Jean-Paul Descoeudres - 20 October
Pompeiian Houses and Gardens Prof. Frank B Sear - 27 October
Human Skeletal Remains in Pompeii Estelle Lazer - 3 November
Vesuvius and Pompeii 79 AD and 1994 AD Dr Lin Sutherland - 10 November
The Roman Soldier and his World Dr Peter Brennan - 17 November
Theatre in Roman Society Prof. J Richard Green - 24 November
A Roman House and its Contents Dr Penelope Allison - 1 December
Pompeiian Wall Painting Prof. Jean-Paul Descoeudres - 8 December

As an ANH subscriber, you can enjoy all the benefits of being a TAMS member (including free admission, magazines, discounts and events) for only a small additional fee. For further information phone the Society's office on **(02) 339-8225.**

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Regular Features

Columns

LETTERS

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

Sex and Death

In the Summer 1993–94 issue of ANH, one of the QQC items reports on the post-mating male mortality in mammals. The first accounts of post-mating male mortality in Australian mammals appeared towards the end of the 1970s. Outside of Australia, however, the phenomenon may have been noted for the European vole *Microtus agrestis* as early as 1933, and accounts of its apparent presence in the South American marsupial *Monodelphis dimidiata* appeared as early as 1964. Subsequent work on *M. dimidiata* has tended to support the view that both sexes die at the end of their first (and only) reproductive season. Unpublished evidence is also now at hand that a New World marsupial of a second genus also shows post-reproductive mortality.

—Ronald H. Pine
Illinois Mathematics and Science Academy, USA

Healing Frogs

Your QQC piece (ANH Autumn 1994) about the University of Adelaide research on the anti-microbial activities of the skin secretions of the Magnificent Tree Frog illustrates well that there is still much to be learnt about the medicinal properties of 'natural products'. However, the article has produced some confusion by inferring that warts are caused by infection with the *Herpes simplex* virus (HSV). Warts are the result of infection of epithelial cells of the skin or mucous membranes by the Human Papilloma Virus. Infection of skin or mucous membranes by HSV usually causes vesicles (small blisters) or ulceration, known as herpes.

The use of frogs in different parts of the world to treat warts is intriguing, especially since folklore has it that handling frogs causes warts. However, from the information presented in the QQC piece, it seems premature to conclude that frog skin secretions might be used to treat herpes, even if a compound that can destroy HSV has been isolated from secretions. Nevertheless, the isolation of such a substance could be of great value and lead to the development of a new therapeutic agent for the treatment of herpes, a condition that affects so many people.

—Martyn French
Royal Perth Hospital, WA

Lumps and Bumps

In reply to Graeme Greenwood's letter "Understanding Cetaceans" that appeared in ANH Autumn 1994, we could possibly look at aviation for an explanation for the apparent anomaly with regard to power (or strength) available to, and speed produced by, some whales with a 'bumpy' skin.

In aviation, to reduce skin friction on the airfoils and fuselage, small bumps such as rivet heads are deliberately left on, rather than ground flat or countersunk, in an attempt to create small vortices in what is called the boundary layer. This is the layer of air immediately in contact with the surface. These small vortices reduce drag or skin friction without

JIRI LOCHMAN/LOCHMAN TRANSPARENCIES

The Magnificent Tree Frog (*Litoria splendida*) produces a number of chemical compounds new to science including antibiotics.

reducing lift. Thus it would appear to me that this is what nature has devised for these whales in order to produce extra speed from a certain amount of power. Congratulations on a wonderful collection of photographs and interesting articles.

—Robert Lee Royal
Flying Doctor Service Kalgoorlie, WA

Fridge Facts

It was fascinating to read the quip on environmentally friendly thermoacoustic fridges (ANH Autumn 1994). However, before we get too excited about how this may alleviate ozone layer depletion, we should have a look at what is really going on in the refrigerator manufacturing industry around the world.

The trend is not away from CFC refrigerators at all. In the most populous countries of the world it is full steam ahead to produce ozone-layer-depleting CFC refrigerators. For example, China has opened 12 factories to manufacture ozone-depleting CFCs for refrigerators for around 250 million households. India will build 300 million outdated CFC refrigerators by the year 2000. This information comes from a United Nations report cited in the *Sydney Morning Herald.*

While the affluent West (20 per cent of the world's population) gets excited by technological fixes that will reduce environmental damage, the reality is that multinational companies are selling outdated environmentally damaging technology to 80 per cent of the world's population.

—Stephen Taylor
O'Connor, ACT

Save Local Genes

In the Autumn 1994 issue of ANH, Martyn Robinson claims to support endangered species programs and asks whether it really matters if local gene pools are altered by the introduction of foreign genetic stock. I argue that it does matter.

An important aim of conservation is to maintain the evolutionary potential of a species. As part of the evolutionary process, substantial genetic differences may have built up among the populations of a given species. These differences between populations have the potential to play a central role in future evolutionary events. If we homogenised those different populations through translocation programs, we would in fact stifle evolution, thereby defeating our aim.

Martyn Robinson suggested that none of the original genes is lost following translocation of genetically different individuals into a population. This will not be true if the population is naturally small. Small populations lose genes through genetic drift. This occurs when all of the individuals that carried a particular gene happen to die at the same time. This is why small populations tend to have less genetic variation than large populations. If the original genome is diluted, then the probability of losing local variants will increase as the population shrinks back to its original size following the introduction.

I agree that endangered species programs are extremely valuable, both in ensuring the survival of the target species and in providing habitat for non-target species. However, this value can be severely compromised by translocation programs that do not take into account the genetic structure of the species. Captive breeding of local individuals followed by reintroduction is a far better option than simply introducing foreign individuals. If the latter course is taken, the very genome that we would like to maintain may be unnecessarily degraded, thereby threatening the long-term viability of the species.

—Don Driscoll
University of Western Australia

Shark Skin Sandpaper

Your QQC piece about the growing popularity of fish leather (ANH Winter 1993) reminds me of a 1984 visit to Colonial Williamsburg in Virginia, USA. This town is a wonderful as-close-as-possible replica of an early colonial American village.

While inspecting the carpenter's joinery, one of the carpenters recognised my Aussie accent and asked me a question I have yet to answer. It appears that the early colony of New South Wales had a small but apparently exclusive market with the American colonies selling shark skin, especially cured for use as sandpaper. This would have been sometime in the 1840s. The question put to me was could I find out how this skin was cured so they could replicate it for use in their joinery to be just that much more authentic.

I have asked many people and checked many sources to no avail. Even such mines of information as the late Gilbert Whitley and Tom Iredale, ichthyologist and malacologist of the Australian Museum for much of this century, could not help. Perhaps one of your readers might know?

—Phil Colman
Australian Museum

FRANÇOIS GOHIER/AUSCAPE INTERNATIONAL

For animals such as the California Condor (*Gymnogyps californianus*) an Endangered Species Program is all that stands between it and extinction.

Largest Living Organism?

When is a single organism not a single organism? And how can one really tell?

I have read with great interest reports of the 'largest living organism', as in QQC (ANH Summer 1993–94). It is, apparently, a fungus that has some enormous mass and is over 600 metres across.

I find particularly interesting the supposed confirmation of its status by 'genetic' tests. If this is indeed the case, then can I myself lay claim to possessing a much larger organism? Not bigger in bulk, but certainly much larger! A fuchsia growing in my garden in Adelaide started life as a cutting from a bush in Melbourne. According to any 'genetic tests' conceivably devisable, the two bushes are the same plant! So, is not my fuchsia 650 kilometres across?

The hyphae, mycelia or

TUI DE ROY/AUSCAPE INTERNATIONAL

To many, the Blue Whale (*Balaenoptera musculus*) is still the largest living organism.

rhizomorphs of fungi may indeed spread to cover large areas and, should one break and separate from its 'parent', both will continue to grow adjacently quite happily. However, even though they may abut each other and be identical in genetic make-up, are they not now two separate organisms? And do not asexual spores spread over the forest floor develop into genetically identical individuals? And may not their rhizomorphs intertwine inseparably? When are objects contiguous rather than continuous?

In the case of some otherwise identical objects, such separateness is undoubtedly self-evident. My childhood friend Robert, who still lives in Adelaide, is not part of a single organism stretching all the way to Canada, where his monozygous twin brother John now lives, but neither are they a single organism when they are shaking hands!

In the case of other objects, such separateness is much more difficult to determine. The fungi in question have lived for hundreds and possibly thousands of years, during which time many geological, environmental and otherwise disruptive events would have occurred. Vegetative or asexual reproduction via budding, sporulation and other methods would undoubtedly further spread genetically identical material.

It seems unlikely that anyone can ever prove continuity in the rhizomorphs of these fungi. How can we, therefore, possibly justify making such claims?

—A.G. Moskwa
University of South Australia

The QQC item "Largest Living Organism" (ANH Summer 1993–94) has left me a little confused about which criteria are being used to decide which species is awarded the title. The article stated that the mass of the *Armillaria bulbosa* fungus in Michigan was estimated as 100,000 kilograms, which equals 100 tonnes, while the Blue Whale reaches 200 tonnes. The giant Sequoia trees were apparently disqualified because their 6,000 tonne masses are composed mainly of dead wood.

Since fungal mycelium is well over 90 per cent water, the actual mass of organic matter in a 100 tonne fungus would not amount to more than 10 tonnes, while a 200 tonne Blue Whale would contain around 40 tonnes of organic matter. As for the Sequoia trees, the only 'living' parts are the epidermis and leaves, so it seems unlikely that the mass of organic matter remaining after the water is subtracted would exceed 40 tonnes.

I therefore do not find sufficient reason to dethrone the Blue Whale from its position as the largest living organism.

—Robert Hancock
Port Elliot, SA

A Tail of Woe

The grey-furred brush-tailed phascogale
Is rare and could be more so,
His black and fluffy bushy tail
Is bigger than his torso.

With large dark eyes, long pointed snout
And needle-like dentition,
This carnivore without a doubt
Has little recognition.

The populace in their ball parks
Would never come across 'em,
And that is why each one remarks:
"Oh yes, that's just a possum!"

A predator splendiferous,
Arboreal breadwinner,
Marsupial carnivorous
Has insects for his dinner.

The male alas is doomed to die
Soon after he has mated,
And researchers can verify
His death is stress related.

The female has three more good years
And rears her bobbysoxers,
Until they fall a prey, poor dears
To owls, stray cats and foxes.

With broods bred in captivity
Then let out in a hurry,
This phascogale declivity
May not be such a worry.

—Len Green,
Vaucluse, NSW

ANH 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 each issue will receive a $20.00 gift voucher from the Museum Shop catalogue. The winner this issue is A.G. Moskwa.

...struggling to survive in a land we don't understand...

Droughts that decimate the country's stock numbers, a merciless sun that gives Australians the highest skin cancer rate in the world, soils that are the poorest on earth—all conspire to remind the inhabitants of Australia that they are at odds with their land, that life in Australia is an eternal battle against a hostile natural order. How has that battle moulded life in Australia today? And who will win the conflict between Australia's inhabitants and its ecology in the future?

This land, so ideal for reptiles, is now being destroyed by the overexploitation of its human inhabitants—future eaters who are destabilising the land's ecosystems and limiting the options of their descendants.

The story of a people coming to understand and live within the unique ecological constraints of their southern home is often tragic, sometimes comic, but always heroic. Australians have historically paid a price for living in Australia. What price are we prepared to pay now for harmony between the land and its human inhabitants?

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QUOTES & CURIOS

QUIPS

COMPILED BY GEORGINA HICKEY

Heat-seeking Vampires

Few animals conjure up more feelings of fear and disgust than blood-sucking vampire bats. The stuff of horror stories and nightmares, vampires have now become the subject of scientific study because of their growing impact on the rural economies of some South American countries. As carriers of the dreaded paralysing rabies virus, they are not only responsible for large stock losses but they pose a direct threat to human life.

The most common and widely distributed species, the Common Vampire Bat (*Desmodus rotundus*), lives in the jungles that fringe cattle ranches. They roost in hollow trees or in caves during the day and emerge only during the darkest hours of the night. Their favourite prey is horses and cattle, although they may occasionally feed on pigs, goats, chickens or even humans. They seek out domestic stock after these have bedded down for the night and bite them on the neck, shoulder or legs.

Vampires use their razor-sharp incisors to make a three-millimetre-wide hole in their victim. Their saliva contains anticoagulants so they are able to suck blood freely until they have had their fill, usually 15–16 millilitres per animal. Once a wound has been made, up to a dozen other bats may feed from the same bite and so the prey may lose up to two litres of blood in a night. Other interesting observations are that vampires feeding on cattle show a preference for heifers in oestrus, and that this preference is lost during the rainy season. Also during the wet, vampires appear to inflict more bites, which suggests wounds are less frequently re-used.

Ludwig Kürten and Uwe Schmidt from the Zoological Institute of the University of Bonn have proposed that vampire bats may be able to detect the radiant heat emitted by their warm-blooded prey. Next to the vampire nose are three pits or depressions that are thought to contain nerve endings sensitive to radiant heat. The researchers pointed to the fact that the nose and pits are 9° C cooler than the adjacent skin. The thermal insulation of this region is achieved by a dense network of connective tissue and a sparse blood supply. A prerequisite for the detection of radiant heat is that the detecting surface must be at a temperature below that of the source.

To test for a radiant heat sense, a two-choice experiment was set up with captive vampires. Two heating elements—one at 33° C and the other at room temperature (23° C)—were set up above the floor of a chamber. The bats had to choose the warm element and received a food reward after each successful trial. They readily learned this task, picking the warmer element from a distance of up to 16 centimetres. The researchers concluded that the bat should be able to detect warm-blooded prey at similar distances.

It is known that certain snakes (boas, pythons and pit vipers) have pits on their lips and face with nerve endings sensitive to radiant heat. It enables the snakes to seek out warm-blooded prey at night and in burrows (see article in this issue). Reiji Kishida, from Japan's Yokohama City University, and colleagues have shown that in the brainstem of the Common Vampire Bat there is a nucleus (collection of nerve cells) that is homologous with a structure in the

OXFORD SCIENTIFIC FILMS/STEPHEN DALTON

Common Vampire Bats appear to have a radiant heat detection system for selection of bite sites at close range.

brains of snakes known to process radiant heat information. Non-blood-sucking bats appear to lack this nucleus.

While vampire bats probably rely on vision and echolocation to detect prey at a distance, the radiant heat detection system seems to be important at close range for selection of bite sites—regions of skin that are a little warmer because the blood is closer to the surface.

It occurred to me while reading this report that the two other aspects of vampire behaviour noted here could be explained by such a system. The preference for heifers in oestrus may simply reflect the fact that at this time the animals' body temperature is 1–2° C higher. The radiant heat detection system may also help locate an existing wound site that had warm blood oozing from it. In the rainy season when preference for oestrous heifers decreases and there is less re-use of the same bite, this may indicate a reduction in radiant heat emission from animals with skins soaked by rain. Water is known to effectively filter out radiant heat.

Experiments have yet to be carried out on the actual nerve endings in the facial pits of vampires. If they can be shown to be sensitive to radiant heat, then the Common Vampire Bat will be the first mammal known to be equipped with this special sense.

—Uwe Proske
Monash University, Vic.

Express Elevators to the Sky

OTTO ROGGE

Willy-willies can carry dust, dry grass and sometimes even birds hundreds of metres into the air.

A familiar occurrence on a warm afternoon is the willy-willy or dust devil, a small atmospheric vortex that may carry dust or dry grass hundreds of metres into the air. It seems that dust and grass are not the only things to be found circling in these whirlwinds; birds also make use of them, as recent observations by myself and others have shown.

The willy-willy is a common fair-weather phenomenon that forms over ground that gains more heat than its surroundings. Dark areas that absorb solar radiation, such as the dark soil of ploughed paddocks or bitumen roads, heat the air above them. This hot air forms a buoyant bubble that eventually breaks through the cooler air above and rises as a thermal, and air rushes in from the surrounding area to fill the region of slightly lower air pressure caused by the thermal's ascent. Sometimes this inrushing air has a slight amount of vorticity or spinning motion and, as in the familiar analogue of a spinning skater pulling her arms in, the rotation of the air increases as it nears the point of convergence. Thus formed, the willy-willy moves across the ground in the general direction of the surface wind. As long as there is a supply of warm air and the surface winds are not too turbulent, the willy-willy can continue, even across grassy areas that are cooler.

In the northern inland region of New South Wales, Galahs (*Cacatua roseicapilla*) have been seen to deliberately approach and fly into the base of a willy-willy and

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The infrasonic calls of elephants may explain how solitary bulls locate sexually receptive females to mate with.

ascend in the whirlwind while screeching loudly. If they are spat out of the vortex they re-enter it, and if they reach the top they fly down and re-enter at the base. This is similar to the 'playful' behaviour of Galahs where they screech loudly

One report tells of Galahs flying into a small tornado only to be spat out immediately.

and fly acrobatically around trees. Whether this use of willy-willies by Galahs is common across Australia is not clear as it has only been reported from the Coonabarabran and Tamworth districts.

More unusual is the occurrence of tornadoes. These differ from willy-willies in that they are formed in the environment of a severe thunderstorm and the winds involved are much greater—usually 100–200 kilometres per hour as opposed to 60 kilometres per hour for willy-willies. A Galah would probably only ever encounter one or two of these vastly more powerful vortices in a lifetime. One report from 1990 tells of a flock of Galahs flying into a small tornado only to be spat out immediately. No doubt the Galahs got a rude shock as the winds would have been so much more powerful than any previously encountered.

While the behaviour of Galahs can be identified as 'playful', as there would appear to be no survival benefits, raptors (birds of prey) also make use of willy-willies as an aid to their thermal soaring activities. The Australian Hobby (*Falco longipennis*), Australian Kestrel (*F. cenchroides*) and Wedge-tailed Eagle (*Aquila audax*) have all been reported to use these vortices to gain altitude rapidly, from as far afield as Kalgoorlie in Western Australia to Mount Surprise in northern Queensland to Loomberah near Tamworth in New South Wales. Any further reports of other species using these express elevators to the sky would be welcome.

—Gordon Garradd

Elephant Talk: The Sounds of Silence

The Qantas fleet's jumbos may have more in common with their pachyderm namesakes than just size. Sound-pressure levels around a calling elephant can be equivalent to those of a jet taking off less than 500 metres away. Yet noise-wise, a herd of elephants would be more preferable as neighbours than an international flightpath! To humans nearby, the elephant's call mentioned above would be detectable only as soft rumblings: weak overtones of a more powerful message emitted in infrasound, at frequencies below the 20-hertz audible limit of the human ear.

High-power, low-frequency sound can travel long distances and may be an important mode of communication for elephants. Infrasonic calling could explain why elephants spread over hundreds of metres will simultaneously change their behaviour with no apparent warning; why herds will disperse over several kilometres and later reassemble as if they've remained in constant contact; and why, when a sexually receptive female repeats certain distinctive calls only faintly detectable by humans, male elephants can travel great distances to find her.

The theory is supported by field research in Namibia by Cornell University bioacoustics researchers Bill Langbauer, Katy Payne and Russ Charif. They found that elephants four kilometres away responded to playbacks of pre-recorded infrasonic calls. In at least three instances bulls immediately left the waterhole they were drinking at and cut through scrub, ignoring the well-worn paths they normally use, towards a speaker box emitting the infrasonic lament of a sexually receptive female.

A better understanding of how these huge creatures communicate, particularly the way in which males and females locate each other, may be helpful to the success of management programs aimed at recovering elephant populations depleted by poachers.

—K.McG.

Wasps: Police for Plants

Imagine this. It is midnight. You're at home by yourself. You're in bed, asleep. Suddenly you are woken by a sound from elsewhere in the house. You hear a thud, then someone cursing under their breath. There is someone else in the house. What would you do?

You would probably call the police and hope they arrive before the intruder does too much damage. Corn seedlings do a similar thing with caterpillar intruders. The 'police' they call are a species of parasitic wasp, *Cotesia marginiventris*.

Ted Turlings and James Tumlinson of the US Department of Agriculture and their colleagues have been researching the way that corn seedlings summon wasps. They have discovered some very un-plant-like behaviour.

When corn seedlings are chewed by caterpillars, they produce and emit large amounts of chemicals called terpenoids. Terpenoids are released into the air by the whole plant, not just the part that's been attacked; and they are released only after a few hours have elapsed since the attack began. This suggests that the plant needs to get some kind of internal process going. Terpenoids are a signal, like a telephone call. What do they say?

COURTESY JAMES H. TUMLINSON

The corn seedling has summonsed a female parasitic wasp (*Cotesia marginiventris*) to attack and lay eggs in this hungry caterpillar.

Terpenoids signal that a plant is under attack. Like an SOS, they attract wasps—natural predators of the caterpillars—to help the plant under siege. Once at the plant, the wasps lay their eggs in the caterpillars, which become food for the developing wasp young.

Fighting off attackers (caterpillars) using their natural enemies (wasps) is an ideal defence mechanism for corn seedlings. It also helps wasps to find a host that is usually well hidden. Field studies suggest that a wasp could spend its whole life looking for one caterpillar if the search was left completely to chance. But the plants give the caterpillars' game away by 'telling' the wasps where they are.

Researchers are now trying to exploit this form of chemical communication for an environmentally friendly alternative to spraying crops for pests.

—C.B.

Honey, I Ate the Kids

COURTESY GUY HOELZER

A male Cortez Damselfish.

Social commentators say that today's fathers are more nurturing of their children than previous generations of fathers were. Cortez Damselfish fathers aren't quite so progressive. When they're left to mind the kids, they eat some.

When a male Cortez Damselfish (*Stegastes rectifraenum*) is left in charge of his brood, he eats up to five per cent of it, even when other food is nearby. While cannibalism can serve several functions, such as reducing competition, 'filial cannibalism' (when you eat your own progeny) doesn't seem to make evolutionary sense. Is it a 'tragic mistake' or a survival strategy? Guy Hoelzer of the University of Nevada has been investigating.

Hoelzer supplemented the diet of some male damselfish with damselfish embryos. If eating their young is a survival strategy, males fed embryos should eat less of their own young. If they eat their young by mistake, the rates of filial cannibalism should be unchanged. Hoelzer found that males fed embryos ate fewer of their young than those not fed embryos. So offspring-eating seems to be a survival strategy, but how does it work?

There could be a trade-off between sacrificing embryos and future reproductive success. When Hoelzer fed some male damselfish many more eggs than they would normally eat, he noticed that they spent more time courting females. He could not, however, detect any direct link between courting time and reproductive success.

Reproductive benefits may occur over a longer term. Damselfish spawn over several years, so eating their young may help males increase their body size and survive until the next breeding season. For male Cortez Damselfish, consuming a few of the kids every now and again may help produce more of them in one lifetime.

—C.B.

A STAR WITH A SIXTH SENSE?

DWIGHT R. KUHN

Looking up the snout of the Star-nosed Mole, it's not hard to see how it gets its name.

The snout of the Star-nosed Mole (*Condylura cristata*) is no ordinary appendage. Sporting a 'star' of 22 very mobile and fleshy rays at its tip—11 around each nostril—it is a nose of unique appearance, mobility and activity. And now scientists believe that the star also gives the nose remarkable sensory powers.

The Star-nosed Mole is a semi-aquatic, nearly blind, North American mammal. Despite its eyesight limitations it is an effective forager, commonly seizing prey such as earthworms and small crustaceans in muddy water. Researchers have speculated since the 1930s that the mole's star is an important tactile receptor. However until a team led by Edwin Gould, from the Washington National Zoo, recently investigated the sensory capabilities of the creature, no experiments had been conducted on the subject.

Through direct observations and videos of moles in aquaria, the researchers recorded the animals showing strong attractions for 1.5-volt penlight batteries during controlled experiments. In addition, the researchers recorded the location of mole bites on earthworms and the electric fields of earthworms. They found that the worms' electric fields varied along their length and that mole bites were concentrated at points producing the highest voltage, mainly the worms' reproductive regions.

This research is thought to be the first to suggest the use of electroreception by a placental mammal for prey detection. Previous unrelated research indicates that the Platypus, a monotreme mammal, has similar capabilities within its bill (see ANH Autumn 1990 and Spring 1992). If these two species do have electroreceptive powers, it may be significant that both occupy similar habitat niches, both have similar behaviour and poor eyesight, and the nerve that supplies the skin on the nose (star or bill) of each animal is enormous.

—K.McG.

JEAN-PAUL FERRERO/AUSCAPE INTERNATIONAL

A new method of extracting coconut oil is set to boost the South Pacific economies.

Oily Palms

The Coconut Palm (*Cocos nucifera*) is one of the few food plants that thrives in harsh atoll conditions. It lives about as long as a healthy person (60 to 70 years) and every month produces a new bunch of nuts, which fall from the tree when ripe. It is therefore not surprising that coconuts are the most widely distributed sustainable agricultural resource of the South Pacific.

For most of this century, thousands of small landholders throughout the wet tropical regions of the world have obtained their meagre cash needs by selling copra—chunks of dried coconut flesh. The copra is shipped overseas, chopped up finely and the oil extracted under high pressure. Because of contamination and ageing of the copra en route, the oil must be refined for edible use. The whole process from the farm to the refined product takes many months.

Unfortunately for coconut producers, the price of copra has declined on average by two per cent per year over the last 40 years. It has got so low that sometimes over half the coconut crop in many villages is left where it falls to sprout as virtual weeds. To make matters worse, farmers are faced with great uncertainty as the price for coconut oil fluctuates more than any other primary commodity on world markets.

An informal network of scientists from the Australian National University, CSIRO, the University of Wollongong and from private industry are excited by the prospect of enhancing the local use of coconuts by introducing a simple, robust, practical and economic system for producing a clean—spring-water clear—coconut oil at a village or household level. The by-product, which is an edible, high-protein, desiccated coconut, can also be used in food and for livestock feed.

We call the system the Direct Micro Process (DMP). The main difference from the current copra process is that the coconut flesh is shredded before being dried—and then only semi-dried. In this state only low pressure is needed to provide a constant daily flow of oil. To produce one litre of oil, only 15 to 20 coconuts are needed. Up to three batches of 40 nuts can be processed by a farm family each day. And the whole system is portable. The press, which is central to the process, weighs less than ten kilograms.

If local communities can gain access to the oil that 'rains' down daily, it will greatly empower them because the oil has so many uses. Apart from being a popular body and hair cosmetic, it is the foundation for soaps that will lather in hard water—even sea water. Coconut oil is also a stable cooking oil, a convenient fuel used in lamps, and it has excellent potential as a substitute for diesel.

This last application will probably be the most significant and create the largest local market for coconut oil. However, because of its high freezing point (24° C), it will have to be used in conjunction with diesel to start and shut down engines. This can be achieved using either a dual system, in which the engine is started cold on diesel, then run on warm coconut oil and switched back to diesel before turning off, or mixed fuel (such as 80 parts coconut oil to 20 parts diesel).

There is still much work to be done to prove and test the performance of the DMP. However, if successful, there will be a perception that poetic justice has been done. This is because the solution to the problems of the South Pacific coconut farmers originated in the tiny nation of Tuvalu—a remote cluster of Pacific Ocean atolls. It was here that a system of low-pressure oil extraction was first recorded in 1978, providing a vital clue to the possibility of a direct micro process.

—Dan Etherington
Australian National University

COURTESY GARY STROBEL

The Pacific Yew tree: source of the anti-cancer drug taxol.

Anti-cancer Fungus

Taxol has been the wonder drug of cancer research since the late 1980s, showing promise in the treatment of ovarian, breast, head and neck tumours. Unfortunately the primary source of taxol has been the inner bark of the Pacific Yew tree (*Taxus brevifolia*) and, in a classic case of demand outstripping supply, the drug has been rare and very expensive.

The Pacific Yew, which is endemic to the Pacific northwest of the United States, is a slow-growing tree, and natural stands are small and remote. All 11 known species of *Taxus* yield taxol but, compared to the size of the trees and taxol's projected market, only small amounts are produced.

Spurred on by the knowledge that fungi occasionally produce the same chemical compounds as their hosts, chemist Andrea Stierle (Montana State University) and colleagues set out to look for a fungal factory for taxol. Over 300 fungi from 25 different yew trees were collected, including one—a new species of fungus in a genus of its own (now known as *Taxomyces andreanae*)—that was found to produce the anti-cancer compound. It was isolated from a particular yew tree in Montana, the exact location of which remains secret for commercial reasons.

It was feared that, away from its host plant, the fungus would stop producing taxol. But tests revealed this is not the case—the fungus does produce taxol in isolation. Theoretically this means the drug can be produced in large quantities in the laboratory and so should become significantly cheaper in the near future.

—K.McG.

Spitting Turtles?

Turtle hatchlings would be an obvious fast-food choice for fish. Hatchlings are bite-sized, they are often conspicuously coloured or patterned, and arrive in great numbers after emerging en masse from their nest. Surprisingly, turtle hatchlings aren't often found in fishes' stomachs. Hatchlings somehow avoid being eaten. Carol Britson and William Gutzke of Memphis State University in Tennessee have been investigating how this might happen.

Earlier research showed that adult Largemouth Bass (*Micropterus salmoides*) eat dead turtle hatchlings but spit live ones out. What is it about live hatchlings that makes them unpleasant or harmful? The answer seems to be their behaviour.

Fish spit out the live hatchlings because the turtles claw and bite inside their mouths. During experiments, a bass made several attempts at swallowing a hatchling, spitting it out each time until eventually giving up. This experience doesn't harm the hatchling but it does teach the fish to avoid live hatchlings in future.

The fish seem to learn to associate aspects of the hatchlings' appearance with their behaviour. Perhaps the fish recognise the young turtles' distinctive bright colours and patterns, which are lost as the turtles grow and become less susceptible to predation. If true, this may be the first time that warning or 'aposematic' colouration has been linked with behaviour.

—C.B.

Traces of a Social Life

Trace fossils, such as dinosaur footprints and snail trails, don't preserve ancient animals; they preserve evidence of their activity. In fact, trace fossils can provide information about ancient animal behaviour that can't be obtained elsewhere. A fossilised termite mound found recently in Arizona, for example, shows that social behaviour among insects evolved at least 220 million years ago, about 150 million years earlier than previously thought.

The fossilised termite mound, discovered by Stephen Hasiotis and Russell Dubiel of the US Geological

Red-eared Slider (*Trachemys scripta*) hatchlings. Do fish learn to associate their distinctive patterns with their clawing, biting nature?

CAROL BRITSON

L. OATES

A brush with one of the front legs of *Diores termitophagus* means certain death for its termite prey.

Survey, is a complex multi-storey structure. It has lots of small chambers, probably for different purposes, joined by spiralling ramps, and there are galleries—tunnels about a centimetre wide—that connect the nests. Such a structure could only have been built communally, requiring a social caste system of labour such as that exhibited by modern-day termites.

Before this discovery, the earliest known evidence of termites was a 135-million-year-old wing fragment from England. Social behaviour was thought to have evolved much later—about 70 million years ago—with the evolution of flowering plants. Now it seems that termite social patterns evolved at the same time that termites did, much earlier than flowering plants. And trace fossils tell the story.

—C.B.

Death by Spider Leg

As a group, spiders have developed an astounding array of techniques to capture and immobilise their prey. Some pounce from behind trap doors or run down prey like wolves, while arachnid capture webs range from elaborate woven orbs to single strands of silk dotted with sticky glue and dangled mid-air like fishing line.

Now come reports of two new species from Africa, described by Rudy Jocqué (Koninklijk Museum voor Midden-Africa in Belgium) and Ansie Dippenaar-Schoeman (Plant Protection Institute in Pretoria), that appear to kill with the brush of a leg.

As its name implies, the South African *Diores termitophagus* feeds exclusively on termites. *Diores magicus* from Zimbabwe, named because of its seemingly magical way of killing prey without biting, has the same diet. By day they retreat to igloo-shaped shelters constructed from silk, coarse sand and pebbles. At night they emerge in search of prey.

Both are less than five millimetres long, about half the size of their termite prey, and both avoid confrontation by approaching termites from behind. A slight touch from the front leg of one of these spiders seems to be enough to start a termite shivering and twitching. Within a few seconds after contact, the termite will die and the spider will begin to feed.

The weapon that makes these spiders such effective hunters appears to be a small gland (the femoral gland) located on the leg. Its importance may be indicated by the fact that, while other spiders drop whole legs as a defensive ploy (known as autotomy), the new *Diores* species have a special breaking point at the 'knee'.

—K.McG.

C. SAGERS

This cigar-like structure not only provides shelter for its caterpillar builder, but disarms the leaf tissue that is kept in the dark.

Caterpillars Roll Their Own

Caterpillars in tropical and temperate regions often roll their own homes, turning and twisting leaves like loose, hollow cigars and binding them with silk. These simple but secure constructions probably offer some protection from desiccation and predators. But in the case of caterpillars from at least two moth families, Pyralidae and Ctenuchidae, found on the Panamanian Barro Colorado Island they appear to perform an even more sophisticated function.

These caterpillars cause extensive damage to a common shrub on the island, *Psychotria horizontalis*, by rolling older leaves around emerging buds and then feeding on the young leaf tissue within.

After observing that the behaviour cut out about 95 per cent of light to the new leaves, University of Utah biologist Cindy Sagers decided to investigate the physiological effects of leaf-rolling on the plants' tissues. Mimicking the caterpillars' activities, Sagers bound buds on *P. horizontalis* plants growing in the island's forests, and harvested them three weeks later to compare their properties with those of unbound leaves.

She found that, in contrast to exposed leaves, tissue that developed within a roll showed a marked reduction in toughness and tannin concentration. Yet their water and nitrogen levels, indicators of nutritional value, remained unchanged. In further tests, Sagers went on to establish that the caterpillars preferred to eat the leaves that had been kept shaded.

Herbivores display a wide range of tactics to overcome defences in plants. It seems that leaf-rolling has provided pyralid and ctenuchid caterpillars with a novel means of altering the microclimate around the leaves of their host, thereby disarming an otherwise successful defence strategy.

—K.McG.

Carrie Bengston (a science communicator for the CSIRO) and Karen McGhee (a freelance science writer living in Newcastle, NSW) are regular contributors to QQC.

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QUICK QUIZ

1. What term is given to the technique that uses forced air through pipes and computer wizardry to make animal models move realistically?
2. Name the only type of birds known to be toxic.
3. What does WIRES stand for?
4. An 'oasis' in Antarctica refers to what?
5. About how many billion stars are in the Milky Way?
6. Where is the Great Melbourne Telescope housed?
7. For Galahs, what obvious feature is used to distinguish adult females from males?
8. Who is the author of ANH's Wild Foods column?
9. For how many years must a species not be sighted before it can be considered extinct?
10. What is another name for tsunami?

(Answers in Q & A)

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AUSTRALIAN MADE

The origin of baby freshwater eels was, until about 60 years ago, a complete and genuine mystery.

SECRETS FROM OLD SLIPPERS

BY STEVE VAN DYCK

In 1980, Lynn ('Lightning') Millard won his third successive World Eel-skinning Championship at the Branxholme Bushwackers' Carnival. Mr Millard managed to skin two eels, gutting and preparing them in table condition, in just 50.6 seconds. Asked how he found the competition, 'Lightning' said "Everybody here's as keen as mustard...I reckon eel-skinning is about to really take off as a world sport".

But history tells us that the world was flicking eels long before the Bushwackers slipped into the sport.

Pliny wrote that the Romans used to skin eels and use the leather to whip naughty boys. And in the 16th century Rabelais wrote "...whereupon his master gave him such a sound lash with an Eel-skin, that his own skin would have been worth nothing to make bag-pipe bags of".

For all their familiarity with humble freshwater eels (*Anguilla* spp.), our ancestors were completely ignorant as to where any of the world's 15 species came from.

Aristotle said that eels sprang from "the entrails of the earth" (that is, worms), and Pliny thought that when an eel rubbed its body against stones, the small pieces of skin that were scraped off became baby eels. Today, some members of the Flat Earth Society still maintain that eels arise from horse hairs left to soak in water.

MICHAEL CERMAK

Freshwater eels migrate into the sea to spawn. Each female will lay between five and ten million eggs in waters up to 300 metres deep.

Land-locked Longfinned Eels can grow to over 1.5 metres in length and 20 kilograms in weight.

The conundrum concerning the origin of baby freshwater eels was, until about 60 years ago, a complete and genuine mystery. No-one ever saw pairs of eels spawning, their eggs were never seen, and eels smaller than about eight centimetres were unheard of in fresh water. Our four Australian species of freshwater eels, of which the Shortfinned (*Anguilla australis*) and Longfinned (*A. reinhardtii*) from the east coast are the most common, were no exception.

What some people had noticed, however, were two bizarre phenomena associated with eels.

One was that, about every three years in summer or autumn and after exceptional rain, large, fat, silver-coloured Shortfinned Eels around one metre long and three kilograms in weight would migrate downstream on a lemming-style push to the open sea. Hundreds of them might be seen swimming to within a few metres of a dam spillway, then suddenly turning around and sliding tail-first over the edge. As much as half a tonne of eels could be caught in less than a few hours.

The other more staggering phenomenon was a migration in the reverse direction, where millions of lead-pencil-sized eels, called elvers, would leave the ocean and swim on a desperate upstream invasion of freshwater streams, swamps and dams. Like a squirming mass of thick rice noodles, the elvers might climb near-vertical dam walls, 20-metre sheer waterfalls, rock faces and, if needs be, travel over open moist ground. Elvers and larger eels thus find their way into isolated dams, concrete water tanks and not uncommonly into electricity generating and pumping stations where they block pipes and dislocate the machinery.

The two migrations are part of the same slithery strategy. Adult eels that may have spent as long as 35 years in fresh water (up to 60 years in the New Zealand Longfinned Eel, *A. dieffenbachii*) swim out of our eastern rivers and migrate up to 3,000 kilometres to an area in the Coral Sea probably near New Caledonia, where they spawn. Females lay between five and ten million eggs and then, presumably, die.

The eggs, laid in waters up to 300 metres deep, hatch after two to ten days into minute ribbon-like larvae, which are carried southward by the East Australian Current for 12 to 18 months.

Near the Continental Shelf they change into a more cylindrical shape and, because of their see-through

GUNTHER SCHMIDA

appearance, are known as 'glass eels'. Finally they develop pigment, increase in size and, as elvers, migrate upstream in their millions. Those elvers that follow falling salinity and rising water temperatures into fresh water develop into females, while those that stay in the estuaries develop into males.

Like a squirming mass of thick rice noodles, the elvers might climb near-vertical dam walls, 20-metre sheer waterfalls and travel over open moist ground.

Land-locked Longfinned Eels which, because of protracted drought, miss out on their terminal trip to New Caledonia and remain isolated in deep lakes for many years, may reach monumental weights, growing thicker across the beam than a four-litre paint tin and over 1.5 metres in length and 20 kilograms in weight. Those that do manage to escape undergo dramatic changes to their bodies on the way downstream. They change colour from olive green or blotchy brown to grey-green above with silver-white bellies, their reproductive organs grow in anticipation of the great Coral Sea slip-and-tickle, and their stomachs degenerate so they can no longer feed. In the end, the anuses of such hell-bent eels close up as an insurance against water loss in the ocean.

The rest of the eel story is one of eat and be eaten. Adult freshwater eels are nature's consummate opportunists, eating insects, fish, molluscs and water plants, but (particularly Longfins) tackling anything from dead sheep, cats, rabbits, rats, rotten eggs and ducks to water dragons, crayfish and human toes. A memorable clip from the movie "The Tin Drum" showed a horse's head being used to catch eels. They are also not averse to eating their own elvers, or leaving the water to reach a tasty morsel.

On the other side of the coin, many say that an eel caught from a stony creek makes for one of the finest flavoured fish available. If it wasn't for their snake-like appearance and an unnerving habit of twisting and writhing in the pan hours after being cleaned and cut up, they would probably be thought of as more than just sport for boys playing truant.

For some, however, the sport has paid off, and 200–300 tonnes of Australian Shortfinned and Longfinned Eels, worth approximately $A3 million, are purged in fresh water, gutted and exported (mostly frozen to Europe, but live to South-East Asia) each year.

But according to Mr Pat Nash, postmaster and promotions officer of the Bushwackers' Carnival, "...other people like them boiled or baked. You can smoke them or jelly them. However you cook eels they taste lovely". ■

Further Reading

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The increasing use of estuaries by humans has led to the worldwide decline of Little Terns.

LITTLE TERN

BY ANDREW MURRAY

FEW HABITATS IN AUSTRALIA are more inhospitable than the exposed sandy environments found at the mouths of estuaries. Any bird that nests in this environment has to contend with extremes of weather, and the constant threat of inundation from high tides or from freshwater floods. On top of this, predators and scavengers abound. It is here—between the high-water mark and the coastal vegetation—that the Little Tern (*Sterna albifrons*) prefers to nest.

The Little Tern is a cosmopolitan seabird found in tropical and temperate coastal seas. The Australian subspecies, *S. a. sinsenis,* breeds in loose colonies along the eastern coast of Australia, from Tasmania and eastern Victoria through to eastern Northern Territory. The subspecies also breeds in South-East Asia, Japan and China. Fewer than 500 breeding pairs are currently found in Australia and, because of their limited numbers and fragile habitat, this bird is considered endangered.

Little Terns are migratory, arriving in south-eastern Australia in November, and breeding during the summer months. Most Little Terns migrate north (presumably to southern Asia) during the winter months, however around 70 Little Terns have been known to over-winter at Lake Wellington in the Gippsland Lakes, Victoria, during recent years. The Gulf of Carpentaria population is also thought to be resident, while the south-eastern Queensland birds are thought to be migratory from eastern Asia. Non-breeding Little Terns also migrate to Australia.

The nesting strategy of the Little Tern is based on maintaining a low profile. Nesting in such an exposed habitat makes the birds vulnerable to all manner of predators and scavengers, from goannas to Peregrine Falcons (*Falco peregrinus*). Little Terns construct an inconspicuous nest, consisting of a mere scrape in the sand, and lay highly camouflaged eggs. The chicks are also well-camouflaged and they innately seek cover not long after hatching. Colony cohesion is an important element in the nesting strategy of the Little Tern and, once a colony is established, members will readily mob aerial predators such as ravens or gulls. The colony will only abandon a nesting site if there is serious or prolonged provocation. The type of provocations that have caused colony abandonment in the past have included the attention from persistent foxes, falcons, dogs and people wandering through colonies.

With a lifespan of over 20 years, Little Terns would be well able to maintain their populations if they only had to cope with natural disturbances. The increasing use of estuaries by humans, however, has led to the worldwide decline of Little Terns. Little Terns leave the nest when approached by humans, exposing eggs and chicks to the extremes of temperature, and to predators such as gulls and ravens. Human activity on beaches also attracts scavengers such as dogs and foxes, and predation leading to complete failure of nesting colonies has been reported. The increased use of off-road vehicles is another cause of breeding failure.

Breeding populations of Little Terns have declined dramatically in New South Wales and Victoria over the last 30 years. Encouragingly, however, active management at a number of the breeding colonies in East Gippsland (Victoria) over the past seven years has seen a marked increase in the number of fledglings and breeding adult birds.

Conservation measures have included the regular monitoring of breeding colonies, and protection of those nesting sites vulnerable to human disturbance or terrestrial predators. Protection is achieved with the use of signs, educational material, fencing and wardening (much of it voluntary), and the control of feral dogs and foxes prior to the arrival of the terns each summer. Some sites have also had encroaching coastal vegetation removed in order to enhance the area as a breeding site. A banding program is being undertaken by the Department of Conservation and Natural Resources in Victoria, in an attempt to understand some of the migratory movements and breeding behaviour of Little Terns, and also to identify the important non-breeding habitats.

In eastern Victoria breeding success has dramatically improved since Little Terns were shifted intentionally onto specially created islands within estuaries, composed of dredge spoil. People are encouraged actively (via wardens) and passively (via signs) to avoid these islands, and terrestrial predators are also far less of a threat.

It seems that, without an ongoing commitment to the active management of Little Tern populations, the species will continue to decline in Australia. This commitment cannot, however, rest solely on the shoulders of government conservation agencies. Volunteer groups and local communities need to continue their involvement as stewards of the nesting sites.

Protecting estuarine environments for Little Terns will also ensure that many other shorebirds are protected. It is the conservation of this whole assemblage of birds that is important. After all, what is the seashore without its shorebirds? ■

Andrew Murray is a science officer with the Department of Conservation and Natural Resources in Orbost, Victoria.

LITTLE TERN

Sterna albifrons

Family
Laridae (terns and gulls). Closely related to Fairy Tern (*Sterna nereis*).

Identification
Smallest of the terns. Pale grey and white plumage. Black cap, black lores, yellow legs and yellow bill with black tip when in breeding plumage. In flight has dark wing tips. (Fairy Terns have white or pale wing tips.)

Diet
Small fish and possibly crustaceans.

Breeding
Australian subspecies breeds from November to February in colonies from the Gulf of Carpentaria to south-eastern Australia. Usually two or three eggs laid in a sandy or shingle scrape. Incubation about 18 days. Chicks fledge after about 19 days. Most birds migrate north following breeding season.

Threats
Breeding colonies threatened by human disturbance, aerial and terrestrial predators, inundation by tidal or flood waters, and industrial development.

Status
Vulnerable and possibly endangered. Appears to be recovering in Victoria.

TONY HOWARD

Mary was a socialist, feminist and Aboriginal activist long before these tags were fashionable.

THE SOCIALIST DAME ON THE $10 NOTE

BY TIM LOW

FOREIGN TOURISTS WILL TELL you Australia has colourful banknotes, but Australians are very ignorant about the 'famous' people on them. No-one seems to know much about Florey, Hardgrave and Clunies Ross.

With the release of the new $10 note, many will be saying the same of Dame Mary Gilmore. Who was she?

Born in a slab hut near Goulburn in 1865, Mary grew up in pioneering Australia, travelling widely in New South Wales with her father, a property manager and building contractor. She became a teacher and social activist, moved to Paraguay to help create Cosme, the utopian socialist settlement, then returned to Sydney to become a prominent writer of verse, essays, political essays and historical recollections. She died in 1962.

Mary was a socialist, feminist and Aboriginal activist long before these tags were fashionable. In her historical writings she wrote with great compassion about poor settlers, country women and Aborigines. She recorded the 'trivia' of bush life, documenting details about clothes and furniture, habits and fears. She wrote about kitchen plates cut from boards or bark, of bird wing fans, and of pioneering women so used to sitting on blocks of wood they felt unsafe on chairs.

The following passage is from her 1934 book of reminiscences *Old days: old ways*. A romantic blend of bush lore, herbalism and Aboriginal learning, it provides an insight into colonial use of wild plants.

"Up by the barns and cow-yards there were nettles for the blood, horehound for coughs and colds, and dock for poultices. But dock was used like horehound and nettles, for beer; sometimes it was wrapped round tough meat with the idea of making it tender. In the thick, unfelled bush above the horse-and-cattle yards were native hop, 'sarsparilla', the bottle-brush flower of the wild honeysuckle, together with geebungs, wild cherry, eucalypts, wattle, kurrajong, and pine. The wild hop made yeast; the 'sarsparilla' made naughty little boys good by clearing their 'over-crowded' blood; the bottle-brush soaked in soft water yielded syrup for sore throats and colds; the wattle-bark the aborigines had taught us to make into a tan lotion for unbroken burns and scalds; the eucalypts (also native teaching) made vapour in pits, or in bed, for chills and pains; the pine, too, was inhaled, and sometimes went as a flavouring into the home-made treacle beer."

The passage shows how colonists developed a unique herbal lore by blending ideas from different cultures. Horehound (*Marrubium vulgare*) and nettles (*Urtica* species) were European remedies. Sweet Sarsparilla (*Smilax glycophylla*) was discovered by First Fleet colonists (see ANH Summer 1987–88), and wattle bark and eucalypts were Aboriginal remedies. The "bottle-brush" was almost certainly a banksia (proba-

Hopbushes were so-named because the seed pods resemble those of true Hops (*Humulus lupulus*) and settlers found them to be an adequate substitute in beer brewing. Pictured is Large-leaf Hopbush (*Dodonaea triquetra*).

Common Centaury (*Centaurium erythraea*) was one of colonial Australia's most popular remedies, taken for dysentery, diarrhoea, indigestion, eczema, liver complaints and as a tonic.

PHOTOS: TIM LOW

bly *Banksia integrifolia*), and Mary's family was here utilising an Aboriginal food (the sweet nectar) as a medicine.

In *More recollections* (1935), Mary recalled other remedies—centaury (*Centaurium erythraea* or *C. spicatum*), native "camomile" and "stink-weed". The centaury was decocted for dysentery and made a slightly tonic beer; it was a popular remedy in New South Wales. The other herbs were unfortunately remembered in name only.

In another charming passage (in *Old days: old ways*) Mary told of harvesting cypress pine seeds (*Callitris* species) for a snack: "My black Mammy taught us to eat the tiny upright centre which was the seed. Old bushman, wandering hatters and shepherds, all collected and ate these as a concentrated stand-by for food, they also having learned their use from the natives".

She was full of praise for the "lean red meats of Australia—possums, kangaroo and wallaby", insisting that "many a time a child grew strong on well-sucked possum bones". Even after beef and mutton were widely available, many still hungered for the distinctive taste of possum.

Mary's reminiscences about Aborigines were written to combat the racism of her time. She emphasised skills that others claimed were lacking from native culture, like art, medicine, fauna conservation and agriculture.

Some of her anecdotes are remarkable. In *Old days: old ways* she devotes a chapter to "Native Sanctuaries", places where kangaroos, Emus (*Dromaius novaehollandiae*), water birds, fish, or other game were left to flourish, protected from hunting. For example: "Pregan Pregan Lagoon at North Wagga Wagga was a sanctuary for pelicans, swans and cranes; and the land between it and the Murrumbidgee was a curlew sanctuary". She tells of possums transported and released in new places to ensure future supply, and describes how Aboriginal women planted grass seeds and pollinated Sweet Quandong flowers (*Santalum acuminatum*).

Unfortunately, Mary's rhetorical strengths may also be her weakness. As a passionate poet and ideologist she may have sometimes been inclined to dress up and idealise her memories of long ago. In the preface to *Old days: old ways* she warns that errors will be found in her writings, that "Memory cannot hold everything".

Some of her recollections do seem questionable. One example: native pines contain not the single seed she describes but a series of small seeds. I also wonder about her recollection of quandong pollination by conveying flowering branches from one grove to another. In all my readings on Aboriginal culture I have found no other hint of Aborigines pollinating plants.

Coast Banksia (*Banksia integrifolia*), once known as 'Honeysuckle', was probably the cold remedy referred to by Mary Gilmore.

Hopefully Mary's new profile will encourage archaeologists and anthropologists to assess her work. She is an important voice from our recent past. I hope the general public discovers her as well; she writes evocatively and provocatively of pioneer life. But a word of warning: colonial Australians were unspeakably cruel to the Aborigines they displaced, and Mary was not one to gloss over the darker side of our past. ■

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Tim Low is a Brisbane-based environmental consultant and the prize-winning author of four books about Aboriginal foods and medicines, all published by Angus & Robertson. To assist his research on Mary Gilmore, readers are invited to send him new $10 notes!

The miner invasion raises questions about the way we are managing (or mismanaging) bushland and fauna.

INVASION OF THE SAVAGE HONEY-EATERS

BY TIM LOW

THE CHIMING CHORUS OF THE 'BELL-BIRD' (PROPERLY called the Bell Miner, *Manorina melanophrys*) is one of the prettier sounds of the Australian bush. Philosopher Archer Russell joyfully extolled the "jubilant, multitudinous carillon of silver bells". Poet Henry Kendall was moved to verse: "Softer than slumber and sweeter than singing, The notes of the bell-birds are running and ringing".

But although Bell Miners may gladden the human heart, they do not bring joy to the forest. Other birds learn to shun the 'silver bells' as a boding of terror; to the forest itself, the bells toll sickness and death.

N.N. BIRKS

Noisy Miners are remarkably aggressive birds that are invading much of temperate eastern Australia and they may be responsible for many local bird extinctions that are presently being laid at the feet of cats.

ANH

GARY WEBER

Because Bell Miners exclude other lerp-eating birds from their territories, eucalypts in these areas may suffer severe psyllid infestations and die. To the forest, the sweet song of the 'bell-bird' can be a death knell.

Bell Miners are savage birds. From communal territories in eucalypt forests they relentlessly bombard and drive away all other birds, even much larger ravens and Laughing Kookaburras (*Dacelo novaeguineae*), which they attack in groups. Only the smallest birds of the shrubby understorey, such as fairy-wrens and scrubwrens, are tolerated.

Bell Miners are olive-green honeyeaters (family Meliphagidae) that feed mainly upon lerps (sugary protective shields) and nymphs of psyllids, tiny sap-sucking bugs on eucalypt leaves. They harvest only a small proportion of the psyllids, and their hostility keeps away other lerp-eating birds like rosellas and pardalotes. As a result, eucalypts in Bell Miner colonies usually suffer severe psyllid infestation. Whole trees sometimes die. As bushmen and naturalists will tell you, Bell Miners live in 'sick' forests.

So remarkable is this association it was reported in the prestigious international journal *Science*. Richard Loyn and others from the Victorian Forests Commission concluded in 1983 that "The bell miners have developed their territoriality to an extent where its effects have a visible impact on the habitat". Loyn's team removed Bell Miners from a psyllid-infested forest near Melbourne, then watched as flocks of other forest birds moved in and removed the infestation.

The Bell Miner keeps to wetter eucalypt forests and gullies in south-eastern Australia, where it is limited by a need for permanent water. Unfortunately it has an aggressive relative that is not so constrained. The Noisy Miner (*Manorina melanocephala*), also called Micky Miner and Soldier Bird, has a less specialised diet, feeding on a wide variety of small insects as well as nectar. It lives in eucalypt woodlands across much of eastern Australia, where it is one of the commonest of birds. It is the main 'villain' of this story.

Queensland biologist Doug Dow reported Noisy Miner attacks on an amazing variety of birds, 65 in all. He observed: "Even the smallest, seemingly most innocuous, leaf-gleaning pardalotes *Pardalotus* spp are chased and driven from the area occupied by Miners. No discrimination is shown; large waterbirds (cormorants, herons, ducks and grebes) are harassed at the edges of lakes alongside colonies...Dogs, cats, foxes, cattle, horses, sheep, feral pigs, wallabies, bats and humans have all been attacked...".

This harassment is no empty threat. Dow watched two Noisy Miners slaughter a House Sparrow (*Passer domesticus*) by hammering the base of its skull. Another gang of five miners pecked the eyes and head of a Striated Pardalote (*Pardalotus striatus*) until it fell down dead.

The remarkable aggression of Bell and Noisy Miners is tied to their complex communal lifestyle. Colonies of as many as several hundred birds may occupy an area of up to 40 hectares. Both miners breed communally, with several males attending each female and helping feed her young. Noisy Miner females are promiscuous, and up to 22 males may visit one Noisy Miner nest (although most do not copulate). The males mob together when a hawk or goanna enters their domain. Noisy Miners even have a language identifying different kinds of intruders: the call

Noisy Miners even have a language identifying different kinds of intruders: the call for a tree snake is very different from that for a hawk.

for a tree snake is very different from that for a hawk.

Despite all the hostility, Noisy Miners do not oust all intruders. Medium-sized, strong-billed birds often withstand attack and can be tolerated within the colony. Noisy Miners often associate with butcherbirds, crows, rosellas, lorikeets and the Australian Magpie (*Gymnorhina tibicen*). Butcherbirds often join in Noisy Miner attacks, adding their loud calls to the cacophony, and striking savagely at the faces of startled possums or birds.

Noisy Miners are resident in my leafy Brisbane garden. (They are squawking incessantly as I write these lines, and just minutes ago launched a brief, unsuccessful attack on a Pale-headed Rosella, *Platycercus adscitus*.) Like other naturalists I keep an ear to their calls, for they alert me to unusual visitors. Yesterday it was a Pacific Baza (*Aviceda subcristata*), a couple of weeks ago a Green Tree Snake (*Dendrelaphis punctulata*) high in a neighbour's tree, and before that a Common Ringtail Possum (*Pseudocheirus peregrinus*) that had left its nest in the late afternoon. The bewildered possum had to be rescued from the combined savagery of the miners and Grey Butcherbirds (*Cracticus torquatus*).

NOISY MINERS THRIVE IN WELL-TREED gardens. A recent study by Sven Sewell of Griffith University found that, surprisingly, they do better in this artificial habitat than any other. Sewell found them at highest densities around Brisbane in suburban gardens retaining a eucalypt canopy, followed by suburbs planted with shrubs and trees, small forest remnants, and forest remnants lacking an understorey. His most surprising finding was that Noisy Miners do not live in undisturbed forest—he rarely found them in large forest remnants.

The implications of this are worrying. A highly aggressive bird is invading the Brisbane region, dominating habitats disturbed by development, driving away other birds. Two hundred years ago Brisbane was equivalent to a large forest remnant and, by implication, Noisy Miners were scarce. Now they are one of the most common birds. Older birdwatchers confirm they have exploded in numbers. (Bell Miners, by contrast, remain uncommon and restricted around Brisbane, which is near the northern limit of their range.)

The spread of Noisy Miners has been possible because they are woodland birds. They like a vegetation structure of tall trees in an open canopy, above a grassy understorey free of thick shrubbery. This allows them to harvest insects and nectar at all levels of vegetation, including the ground. They shun forests with a thick layer of shrubs, as this bars them feeding near the ground. It also protects small birds that would otherwise be driven away. But where thick forests are fragmented by clearing or roads they will live along the edges. In a recent study Carla Catterall and colleagues at Griffith University classified them as an edge species.

Human land use converts thick forests into fragmented woodland ideal for this bird. So many impacts are beneficial: partial clearing, logging, road and track construction, and loss of understorey from grazing, burning and mowing. The impacts are devastating for most forest birds, which suffer doubly from habitat disturbance and Noisy Miner attack.

The Noisy Miner invasion is proceeding throughout much of temperate east-

BARRY SLADE

Once Noisy Miners establish themselves in an area, many other birds are driven away. Medium-sized, strong-billed birds such as the Pale-headed Rosella can often withstand their attack.

ESTHER BEATON

This sort of woodland habitat, comprising a loose canopy of eucalypts over a grassy understorey devoid of shrubs, so favoured by humans, has allowed the populations of Noisy Miners to explode.

ern Australia. It was first alluded to over a century ago in Tasmania. The Royal Society of Van Diemen's Land was told in 1867 that Noisy Miners, previously unknown from Hobart, had suddenly appeared and bred in New Town and the Domain. They are dominant birds in the forested Domain park to this day.

The nature of the invasion has been recorded by only a few biologists, among them Richard Loyn, this time studying bushland remnants in Gippsland and Latrobe Valley in Victoria. Predictably, he found Noisy Miners were absent from large forest remnants, except on the edges, but common in small disturbed patches. Other insectivorous birds were excluded by miners from the patches, "all of which suffered dieback and defoliation by insects" as a consequence. Loyn found that in one four-hectare patch in Latrobe Valley with a healthy understorey, "noisy miners were initially resident on the edge and in nearby roadside trees. During a drought in late 1982 a few cattle were admitted to the patch and noisy miners encroached further, reducing populations of forest birds even where understorey remained intact. Thus a shifting balance was evident even in the short time-scale [two years and four months] of the study."

The evidence against the Noisy Miner is so compelling we should throw off our complacency and recognise that this bird has become a threat to other species. It is part of the much larger problem of forest clearing and fragmentation. Future land use will aid its spread, at the expense of most forest birds, especially fantails, whistlers, robins, thornbills, treecreepers and small honeyeaters.

The endangered Regent Honeyeater (*Xanthomyza phrygia*) may be especially threatened. Ornithologists fear that, because of forest fragmentation in south-eastern Australia, it is losing habitat to the Noisy Miner, and other aggressive honeyeaters.

The Bell Miner is also threatening an endangered bird, the Helmeted Honeyeater (*Lichenostomus melanops cassidix*). This honeyeater lingers precariously at a single site, Yellingbo State Nature Reserve near Melbourne. Everywhere else its surviving habitat has been invaded by Bell Miners. Its most recent demise was from Cardinia Creek in the Dandenongs, where biologists have postulated that dam construction and other disturbances upstream stressed the local eucalypts, allowing psyllid infestation and Bell Miner invasion. The dwindling honeyeater population at Yellingbo is also threatened by Bell Miners, and the recovery plan for the bird includes removal of selected Bell Miner colonies.

THE MINER INVASION RAISES QUESTIONS about the way we are managing (or mismanaging) bushland and fauna. It throws doubt upon, among other things, the breadth of the anti-cat campaign, the wisdom of planting flowers to attract birds, and the value of conserving narrow vegetation corridors, destined as they are to become dominated by Noisy Miners.

Many biologists, myself included, are concerned by the vehemence of some of the campaigns waged against cats. Cats are certainly very destructive

TIM LOW

Holly Flame Pea (*Chorizena iliafolium*).

WHAT TO PLANT

To avoid attracting Noisy Miners, plant your garden with shrubs, but not with species pollinated by birds. Noisy Miners are fond of nectar, and they like the nectar-rich flowers of grevilleas, banksias and other bird-pollinated natives. The gardener should instead plant native shrubs that have insect-pollinated flowers. These produce very small amounts of nectar, enough for insect pollinators, but not enough to attract birds. Examples of insect-pollinated native shrubs include wattles, Australian Blackthorn (*Bursaria spinosa*) and most native pea-flowers, such as hoveas (*Hovea* species), bush peas (*Pultenaea* species) and Dogwood (*Jacksonia scoparia*). Choose species native to your local area.

If Noisy Miners already inhabit your suburban garden, there is little you can do to discourage them, unless you and your neighbours are willing to forego lawns for the sake of a thick shrubby understorey.

towards some mammals and ground-dwelling birds, but it is dangerous to blame them (and foxes) every time bird numbers fall.

Anti-cat campaigners often live on the bushy fringes of cities, where they have witnessed a slow decline in the variety of native birds. "We used to see yellow robins here", they complain, "and golden whistlers, but cats wiped them all out". What they have not noticed is the rise in number of Noisy Miners with development of their bushy suburb. (Nor have they questioned how cats could eliminate such birds as whistlers that live high in trees.)

Cats are an easy target because they are an introduced species. So inured are Australians to love of native things, they have difficulty accepting that kangaroos can be pests, or that native garden plants can become weeds. This kind of prejudice distorts conservation thinking. The anti-cat campaign is sometimes fed more fuel than it deserves; the Noisy Miner problem goes ignored.

In a major consultancy project for Brisbane City Council, I rated the Noisy Miner a more serious pest of native birds than cats. I based this on interviews with ornithologists, on various studies showing that feral cats mainly eat small mammals (birds are only a minor food item), and on figures showing that suburban Brisbane has higher bird density (despite all those cats) than natural bushland.

The evidence against the Noisy Miner is so compelling we should throw off our complacency and recognise that this bird has become a threat to other species.

Cities support plenty of birds partly because of all the ornamental flowering shrubs and trees. Noisy Miners thrive on all the nectar, which they defend against other birds. Gardeners duped by gardening books into planting flowering banksias and grevilleas to attract birds achieve the opposite: they attract more and more Noisy Miners but fewer birds of other species.

This can be a real problem. Last year I wrote a booklet for Greening Australia about attracting wildlife to the garden, and included a warning against planting bird-attracting shrubs to attract birds wherever Noisy Miners are about. It seemed a controversial statement, but we all agreed it should be said.

The booklet emphasises the importance of vegetation structure. Landholders with Noisy Miners should plant up thick belts of shrubs to attract forest birds. The shrubs should have flowers pollinated by insects not birds (see box). Weedy shrubs like Lantana (*Lantana camara*) should not be removed unless replacement native shrubs, such as wattles (*Acacia* species) and native peas (Fabaceae), are ready for planting. Lantana protects birds like scrubwrens and fairy-wrens that would otherwise be driven away.

In bushland reserves the same kind of thinking should prevail. Clearings such as firebreaks, car tracks and picnic

Because of human impact, aggressive birds are on the rise and smaller forest birds, such as this Striated Pardalote, are declining.

N.N. BIRKS

All over eastern Australia open woodland and grassland birds are exploding in numbers as coastal forests become fragmented.

grounds should be kept to a minimum. Noisy Miners thrive in picnic and camp grounds if there is a woodland-like structure of widely spaced trees and mown lawns. Picnic spots should instead be bushy with ample tree cover.

Conservation authorities have scarcely noticed the dynamic changes taking place among Australian birds. The Noisy Miner invasion is just part of a much larger phenomenon that has gone largely unrecorded.

All over eastern Australia open woodland and grassland birds are exploding in numbers as coastal forests become fragmented. Dozens of birds are benefiting, including familiar farm and garden birds like the Australian Magpie, Willie Wagtail (*Rhipidura leucophrys*), Australian Magpie-lark (*Grallina cyanoleuca*) and butcherbirds. My Brisbane study identified no less than 37 woodland and grassland birds that have benefited from clearing in the region. I estimate about half these birds were present in the area before settlement, in small pockets of open country; the others have invaded from the west, mostly from beyond the Great Dividing Range. The latter group, which includes the Crested Pigeon (*Ocyphaps lophotes*), Galah (*Cacatua roseicapilla*), Cockatiel (*Nymphicus hollandicus*), Red-rumped Parrot (*Psephotus haemotonotus*) and Apostlebird (*Struthidea cinerea*), should be considered exotic to eastern Australia. These 'exotics' now inhabit many coastal national parks where their impacts are unknown.

Among the most successful of these invaders is the Crested Pigeon, often called the 'topknot'. Maps by the Royal Australasian Ornithologists Union show that last century it had not been recorded east of about Gunnedah and Goondiwindi, and not within hundreds of kilometres of Perth; it was an arid-zone bird. Now it is common in gardens and parks in Sydney, Brisbane and Perth, and in some coastal national parks where it may be undesirable.

Birds other than woodland birds are expanding. The Black Swan (*Cygnus atratus*) has moved into central and north-western Australia; the Little Egret (*Egretta garzetta*) has expanded dramatically to the south. While these movements may not matter very much, other changes do. The Pied Currawong (*Strepera graculina*) is an aggressive predatory bird that, while not increasing in range, is spreading into farmland and suburbia, abetted by plantings of fruiting trees. In New South Wales it may be a pest as serious as the Noisy Miner. The Bell Miner seems to be increasing in numbers, although only in forests close to permanent water. The Torresian Crow (*Corvus orru*) and Silver Gull (the common seagull *Larus novaehollandiae*) are other aggressive birds that seem to be increasing.

While many of these changes are not easy to interpret, one thing seems clear: because of human impacts, aggressive birds are on the rise, and smaller forest birds are declining. Blame for this should be placed squarely upon the humans who mismanage the land, not

N.N. BIRKS

Grey Butcherbirds often join in Noisy Miner attacks, helping to kill or drive off the other bird.

N.N. BIRKS

As coastal forests become fragmented, woodland and grassland birds are exploding in numbers. One of the most successful of these is the Crested Pigeon, which is an arid-zone bird now common in the gardens of Sydney, Brisbane and Perth.

upon the birds themselves, which are merely responding to suitable conditions. Unfortunately, the spread of aggressive birds is a trend that probably cannot be reversed, although through better land management it can be minimised. This is the challenge for conservationists and land managers. Unfortunately, the problem has yet to be properly recognised, much less acted upon. ■

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Tim Low is an environmental consultant and the author of four books about wild foods. Most of the research for this article was conducted as part of a consultancy project for the Environment Management Branch of the Brisbane City Council.

DAVE WATTS

The Northern Hairy-nosed Wombat is Australia's rarest marsupial with probably no more than 100 individuals alive today.

The fact that we so rarely see Northern Hairy-nosed Wombats is a sign that all is well with them.

STUDYING THE BEHAVIOUR OF THE Northern Hairy-nosed Wombat demands an effort of the imagination. Consider this: it is three o'clock in the morning, and I have spent the whole night watching a patch of wombat pasture in central Queensland's Epping Forest National Park. The long dry grass is silver-grey in the moonlight, the dust of the previous day has settled out of the air, and I can clearly see in silhouette the tops of several burrow-mounds, each beneath its own little patch of dark, scrubby trees. I know there are ten wombats living in this area, all wearing radio-collars. Every half hour, I scan through their transmitter frequencies, but so far my receiver has been silent—all ten have stayed deep underground.

THE INVISIBLE WOMBAT

BY CHRIS JOHNSON

CHRIS JOHNSON

Because Northern Hairy-nosed Wombats are so secretive and difficult to observe, scientists monitor the remaining individuals by attaching radio-collars.

At last I pick up a signal, faint at first but growing stronger as an animal climbs up towards the surface. The signal cuts in and out for a while, and I imagine the wombat moving in and out of its burrow, perhaps clearing loose sand away from the entrance. Then the signal settles into a steady pattern of regular beeps, with just a few minor fluctuations in strength—my mental image now is of the wombat raising and lowering its head as it grazes. I can see the trees that stand over this wombat's burrow, about 100 metres from where I am sitting, but it stays out of sight in the long grass. After two hours of activity and just before dawn, the signal falls silent again as the wombat climbs back down its burrow.

In two years radio-tracking Northern Hairy-nosed Wombats (*Lasorhinus krefftii*), this is as close as I came to observing their behaviour, except for one memorable night when a radio-signal suddenly became very strong and, looking up, I made out a wombat-shape ambling out of the grass about ten metres in front of me. I sat up straight in excitement, the wombat turned and galloped back towards its burrow, and the beeps faded rapidly to silence.

I made out a wombat-shape ambling out of the grass about ten metres in front of me.

At first I found this intensely frustrating. But the more time I spent in the field with these animals, scarcely ever seeing them but listening by radio to their brief nightly emergences, the more fascinated I became. Radio-tracking was at least providing some solid figures: the average Northern Hairy-nosed Wombat was spending as little as two hours above ground each night, and during this time it rarely moved far from its burrow. By having several assistants radio-tracking simultaneously, and plotting the bearing each person took on the same wombat, I was able to map the wombat's feeding ranges. Most of each animal's feeding was done within an area of only two or three hectares, which meant they rarely moved more than 100 metres from their burrows. Sometimes one would go on a longer trip to visit burrows 200–300 metres away, but when travelling as far as this would stay on well-defined paths linking adjacent burrows.

I am not the first person to have been intrigued by the extremely restricted movements and activity of this species. The existence of the Epping Forest wombat population was brought to the attention of the wider world in 1937 by the naturalists Charles and Greensill Barnard. Following up rumours of wombats in the Clermont district west of Emerald in central Queensland, they visited Epping Forest Station, were shown the wombat colony, and managed to shoot a wombat for the Queensland Museum. The Barnards found many burrows on "...sandy ridges in fairly well-timbered country, but carrying very poor grass..." but could find

Northern Hairy-nosed Wombats are quite large, weighing up to 38 kilograms and growing up to 1.1 metres in length.

DAVE WATTS

NORTHERN HAIRY-NOSED WOMBAT

Lasiorhinus krefftii

Identification

A large wombat with silky grey fur and black eye-rings. Appearance is similar to the Southern Hairy-nosed Wombat, but the northern species has a much broader muzzle and is larger (body weight up to 38 kilograms and total length up to 1.1 metres). Both hairy-nosed wombats differ from the Common Wombat in having finer fur, longer ears, longer muzzles, and hair over the snout. Females tend to be larger than males but males have thicker necks. Both sexes have very powerful forearms and broad forepaws.

Biology

Nocturnal, feeds on grasses and sedges. Each individual uses 3–4 burrows, and burrow use of different individuals overlaps. Social behaviour largely unknown. Individuals are mostly solitary but burrows are arranged in groups, which may be occupied by families of wombats. Females are more likely to move between groups than males. Females give birth mainly in late spring and early summer.

Distribution

Now restricted to Epping Forest National Park, 110 kilometres west of Clermont in central Queensland. Formerly recorded from St George in southern Queensland and Deniliquin in New South Wales, with unconfirmed reports from other parts of central and southern Queensland.

Habitat

Open woodland and grassland on sandy soil. The Epping Forest population lives in Bloodwood and Moreton Bay Ash woodland with pastures of native perennial grasses on deep alluvial sands.

Status

Endangered


QUEENSLAND
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SERVICE

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Northern Hairy-nosed Wombats are accomplished diggers and each individual wombat makes use of three to four burrows within its home range.

very few tracks and saw only three animals (including the one subsequently donated to the Museum). Charles Barnard wrote that "We could see no trace of them feeding out anywhere..." and concluded that they did most of their feeding underground, on roots.

This is a marvellous suggestion, but untrue. The Northern Hairy-nosed Wombat feeds entirely above ground, mostly on grasses. Other large grazers are obliged to spend many hours each day feeding, and use large feeding ranges. They do this because grass is a very low-quality food, high in fibre and low in nutrients. The only way a large mammal can extract sufficient nutrients from a grass diet is to process as much of it as possible, and this means spending most of each day eating.

This problem of low food quality should be especially severe for the Northern Hairy-nosed Wombat because it lives in such an unproductive environment. Most of Epping Forest National Park is covered by Brigalow (*Acacia harpophylla*) and Gidgee (*A. cambagei*) trees, which form a scrub so dense that very little grass grows beneath it. The wombats occur in a section of the Park where a ribbon of deep sandy soil supports an open Bloodwood (*Eucalyptus polycarpa*) and Morton Bay Ash (*E. tessellaris*) woodland, with an understorey of native perennial grasses. The wombats dig their burrows in the sandy soils and feed out over the grass pastures. But the sands are extremely infertile and the grasses have very low nutritional value, being probably too poor to support kangaroos or cattle. To make matters worse, Epping Forest is in the wet-dry tropics. Most of the yearly rain falls in a short wet season in late summer,

What caused this prehistoric decline is anybody's guess, but the recent and nearly fatal decline is clearly due to the impact of European settlement.

A typical Northern Hairy-nosed Wombat burrow in Epping Forest National Park. The weight of cattle resting under trees where burrows are located would often cause the burrows to collapse, killing the wombats inside. The Park has since been fenced and cleared of cattle.

C. ANDREW HENLEY/AUSCAPE INTERNATIONAL

and for the rest of the year the area is dry and grass growth is minimal. Even the wet season is erratic, so that periods of summer drought are common. How can an animal as large as a wombat survive in such a poor environment, while feeding so little?

THE QUESTION OF SURVIVAL OF THE Northern Hairy-nosed Wombat in Epping Forest National Park is important because this is the last known population of the species. The Park itself is small, only about 3,000 hectares, and of this area only 300 hectares are occupied by wombats. The Northern Hairy-nosed Wombat is Australia's rarest marsupial, and is among the rarest large mammals in the world.

Only two other living populations of Northern Hairy-nosed Wombats have ever been documented; one near Deniliquin in southern New South Wales and the other near St George in southern Queensland. Both went extinct early this century, well before the Barnard brothers confirmed that there was a third population. There have been rumours of wombats in other places in southern and central Queensland, particularly around Tambo, Injune and the Carnarvon area, but none has been confirmed.

The species was evidently very widespread during the Pleistocene—fossils have been found at Wellington and Menindee in New South Wales, and east of Clermont and on the Darling Downs in Queensland—but must have contracted to a few isolated populations before Europeans reached Australia. What caused this prehistoric decline is anybody's guess, but the recent and nearly fatal decline is clearly due to the impact of European settlement. Land clearing affected all three populations, and the demise of the Deniliquin animals was hastened by the gassing and filling of burrows (to eradicate rabbits). Wombat numbers have fallen dramatically at Epping Forest. Local people tell us that there were two distinct populations of wombats on adjacent properties early this century; one has disappeared entirely and the other now covers a fraction of its former range. Evidently, cattle-grazing in combination with drought is to blame for this. Surveys of the area during the 1970s showed that wombat numbers were greatest where cattle-grazing was least heavy, and landholders recall that the wombats declined in a series of steps, each associated with a severe drought, when the effects of cattle-grazing were most severe. Cattle probably affected wombat numbers not only by depleting their food, but also by physically disturbing burrows. Cattle often rested under trees where burrows were located and their weight caused collapse of some burrow entrances. Epping Forest National Park was fenced and cleared of cattle in 1981, and the population has since increased steadily.

Because Northern Hairy-nosed Wombats are so difficult to observe, trends in the population can be monitored only by recording tracks around burrows, and dung piles or urine splashes (by which the animals mark their burrows) in burrow entrances. The actual size of the population is very difficult to judge from this information. In the 1970s it was estimated that there may have been as few as 20 or as many as 100 wombats in the population. Of more concern, it was impossible to be sure how many juveniles there were and what proportion of the adult females was breeding. In a long-lived mammal like a wombat (some animals may live 30 years or more), it is possible that a population of largely non-breeding adults might persist for many years, only to collapse as the animals die of old age and are not replaced.

Doug Crossman of the Queensland Department of Environment and Heritage came to grips with this problem (and his first wombat) in 1985. Trapping a Northern Hairy-nosed Wombat is a vast undertaking. The other two species of wombats—the Southern Hairy-nosed Wombat (*L. latifrons*) and the Common Wombat (*Vombatus ursinus*)—can be caught by pushing cage traps into burrow entrances, but Northern Hairy-nosed Wombats are deeply suspicious of traps, and the sandy soil at Epping Forest is

DAVE WATTS

Northern Hairy-nosed Wombats are deeply suspicious of traps, so anyone wanting to study them must go to elaborate lengths in order to catch them. Scientists are shown here assembling a tunnel-trap, designed especially for these wombats, in front of a burrow entrance.

DAVE WATTS

Northern Hairy-nosed Wombats spend as little as two hours above ground feeding each night, venturing rarely more than 100 metres from their burrows.

so soft that they easily dig around them. The Crossman technique involves building a small fence around each burrow, leaving an opening over the path normally used by the wombat to enter and leave, and placing a large tunnel-trap in this opening. The trap is left open for several weeks while the wombat gets used to passing through; then it is set with a trip-line inside the trap. In the latest version of this system, the trap trigger switches on a radio-transmitter, which in turn sets off an alarm in camp so that animals can be handled and released as soon as they are caught.

THE ANSWER TO THIS SEEMS TO BE THAT the Northern Hairy-nosed Wombat is extremely efficient in its use of energy and water. This efficiency is achieved in two ways. First, by minimising the time they spend out of their burrows, they reduce their expenditure of energy and water. At all times of the year, my radio-collared wombats timed their emergencies from burrows to coincide with the most comfortable conditions, avoiding both low and high temperatures. This meant that they must have had little need to expend extra energy on maintaining body temperature in winter, and would have lost very little water in summer.

Second, wombats in general appear to have very low food requirements, as shown by Dr Perry Barboza while working at the University of New England. Wombats have very efficient digestive systems, with an expanded region along the hindgut where micro-organisms break down fibrous plant material. The capacity of this expanded region is greater in wombats than in other grazing mammals of similar size; this allows them to hold food in the gut for long periods for maximally efficient digestion. In addition, wombats appear to have very low metabolic rates. So, by combining the digestive capacities of a larger mammal with the food requirements of a smaller one, their daily food

The many hours not spent feeding can be devoted to peaceful, thorough digestion of food, and energy-conserving sleep in the burrow.

This system works well, although the sensitivity of the animals and their astonishing ability to stay down their burrows for long periods (sometimes more than a week) makes the process of censusing the population extremely slow. Doug and I trapped intensively between 1985 and 1989, and our efforts brought to light a total of 65 wombats. Allowing for some incompleteness in the results, we estimate there were probably only 70 animals alive in 1989. Happily, many of these were young, the adults were healthy and in good condition, and all but one of the females were breeding. More encouraging still, the animals appeared able to maintain good condition during the dry season, and a significant proportion of the females still bred in the driest years of trapping. So, the Epping Forest population appears healthy and capable of increasing, but this brings up, again, the question: how can they do it while feeding so little, and on such poor food?

A Northern Hairy-nosed Wombat caught inside a tunnel-trap as it leaves its burrow. Despite being extremely rare, all the present signs seem to indicate that the species is no longer heading towards extinction.

requirements are very low indeed. The many hours not spent feeding can be devoted to peaceful, thorough digestion of food, and energy-conserving sleep in the burrow. The fact that we so rarely see Northern Hairy-nosed Wombats is a sign that all is well with them.

The key requirement for the wombats is that plenty of grass is available close to their burrows, so they can do their daily feeding in the minimum of time and with as little travelling as possible. The removal of cattle from Epping Forest National Park has had this effect. The grassy patches on which the wombats feed are now very stable and abundant, even during drought, and all the signs suggest the population is in the early stage of recovery. This wonderful, lazy creature has been heading towards extinction for a long time. But now it may be on its way back. ■

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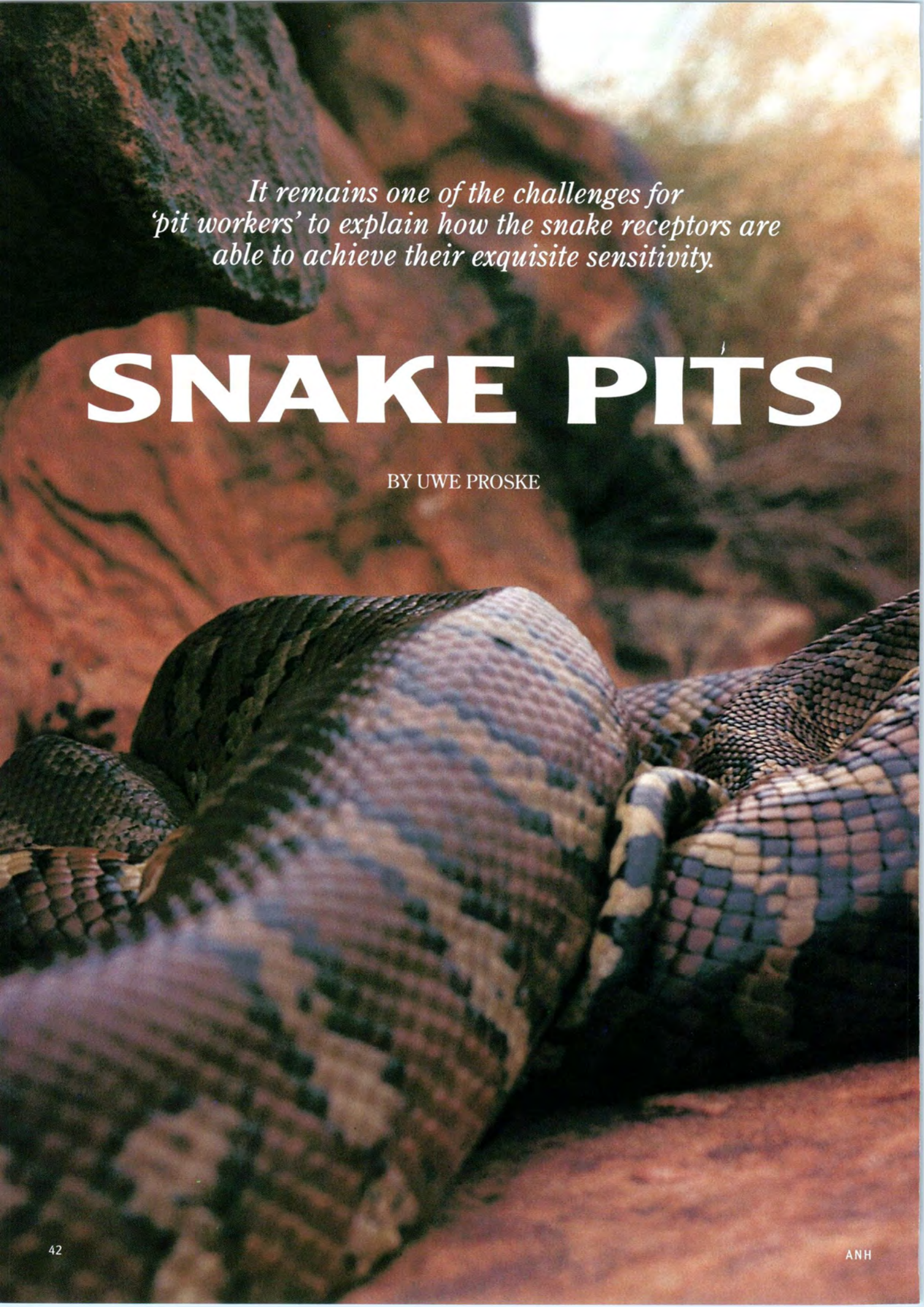
Dr Chris Johnson is a lecturer in ecology with the Department of Zoology, James Cook University, Townsville. He studied Northern Hairy-nosed Wombats while working for the Queensland Department of Environment and Heritage.

D. WATTS/NPIAW

It remains one of the challenges for 'pit workers' to explain how the snake receptors are able to achieve their exquisite sensitivity.

SNAKE PITS

BY UWE PROSKE



A characteristic feature of some boas and pythons is a series of depressions running along their upper and lower lips. These pits are particularly prominent in Australia's Carpet Python.

HARRY EHMANN

MICHAEL CERMAK

How do pythons like this Green Python (*Chondropython viridis*) hunt in the dark? The answer, as researchers have discovered, is on their lips.

IF, LIKE MYSELF, YOU ARE AN ENTHUSIastic bushwalker, you may have reflected on the fact that rarely in southern Australia do you encounter snakes after dusk. There are the exceptions of course, especially on warm balmy evenings, but generally speaking the threat of snake bite recedes in the dying hours of the day. This is because the majority of southern snakes are diurnal, feeding during the day and returning to their nesting place at night. However, the same is not true for the tropical regions of Australia. There it is not unusual to encounter snakes, especially pythons, while they hunt for their prey at night. Often they may be seen climbing trees, searching for birds roosting for the night.

Pythons belong to the family Boidae (the boas and pythons). In this group are some of the largest snakes known, the Anaconda (*Eunectes murinus*) of South America and the Reticulated Python (*Python reticulatus*) of South-East Asia. Adult boids typically feed on birds and mammals, killing their prey by constriction and then swallowing it whole by unhinging their jaws. In Australia we don't have any boas but we do have a number of pythons, the best known of which is the Carpet Python (*Morelia spilota variegata*). Carpet Pythons live in hollow logs or animal burrows and are generally nocturnal or crepuscular (active in twilight). But how do they locate their prey, which is mainly small mammals, at night?

A CHARACTERISTIC FEATURE OF SOME boids is that they have a series of depressions or pits along the upper and lower lips, typically about 20. The pits are particularly prominent in the Carpet Python. In order to determine the possible function of these pits and to see if they were involved in any way with the python's ability for night 'vision', Jim Warren (Monash University) and I carried out a study of their nerve supply. We found that the skin of each pit was supplied with a dense array of elaborately branching nerve endings and that these nerves were absent from the adjacent skin. What could be the function of the nerve endings, and how might they help the snake hunt at night?

Nerve endings in our own skin are concerned with the senses of touch, temperature and pain. Each ending is selectively sensitive to a particular type of stimulus, so temperature endings, for example, will not normally respond to touch. The function of a nerve ending is determined experimentally by listening to the electric pulses it produces in response to different stimuli (touch, local warming, cooling etc.). Each nerve ending converts the stimulus into pulses, which are the code of the nervous system. What we actually feel is generated in the brain, which interprets the pulses and converts them into a sensation.

We decided to listen to the nerve pulses generated by the pit endings in

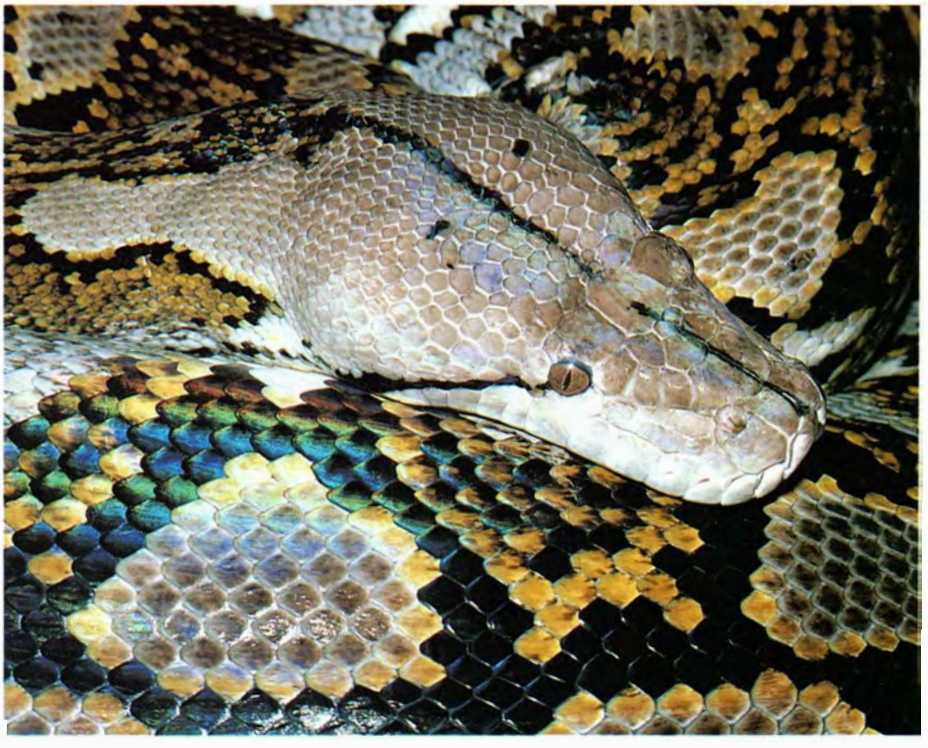
The overriding impression was that they were responding to the light itself, but what kind of light can be filtered out by water? And what kind of 'light' does a human hand generate?

an anaesthetised Carpet Python. To do this we had to record the pulses with an electrode, amplify them and then play them through a loudspeaker. The first thing we found was that many nerve endings in the pits were continuously active, discharging impulses even in the absence of a stimulus. But the real surprise came when we moved our hands across the front of the snake's head. Activity increased dramatically, generating a deafening roar on the loudspeaker. If instead of a hand we used the light from a microscope lamp, that too evoked a powerful discharge. But if a glass of water was placed in the light path, although the light still struck the pits, stimulation was no longer effective. We could move the glass rapidly into and out of the light beam, and each time the light travelled through the water before striking the pits, the discharge abruptly fell silent. If the glass was emptied and the light passed through glass only, it was still able to stimulate the pits. So it was the water that was absorbing the stimulating property of the light. When we tried moving a piece of ice past the pits, the ongoing activity coming from them again abruptly stopped. These responses were so rapid that it could not be the warming or cooling of the air that was stimulating the pit sensors. The overriding impression was that they were responding to the light itself, but what kind of light can be filtered out by water? And what kind of 'light' does a human hand generate?

The effective stimulus for these pit sensors was, of course, radiant heat. Heat can be transmitted by conduction (touching a warm object), convection (movement of air warmed by an object) and by radiation. In nature, radiant heat can be emitted by a very high temperature source (for example, the sun), in which case it lies in the visible part of the spectrum. It is also emitted by ordinary warm objects, but within the infrared region, which is invisible to us. All bodies, including our own, absorb as well as transmit radiant heat. Since our bodies are at 37° C, which is normally well above that of our surroundings, we are a constant source of appreciable infrared radiation. The same applies to all warm-blooded animals. And here we begin to understand how a python crawling about at night locates its prey: it relies on the specialised nerve endings in the pits on its face to detect the radiant heat energy emitted by its warm-bodied prey.

Having established that python pits contain nerve endings sensitive to radiant heat, we wondered whether the endings were responding to local warming of the skin by the radiation, much like our own warm-sensitive nerve endings, or whether a different process was involved. Here we had in mind the possibility that the infrared light was directly stimulating the nerve endings in much the same way that visible light stimulates the photoreceptors in our eyes.

Although we cannot be sure, there are several reasons why we think it is unlikely that the infrared is stimulating nerve endings directly. First, there are no photochemical reactions known that involve infrared light. Second, light in the infrared range is readily absorbed,



Reticulated Pythons are among the world's largest snakes, growing up to ten metres long. They mainly feed on birds and mammals and, like Australia's pythons, are able to hunt their prey at night because of the infrared receptors around their lips.

PAVEL GERMAN

particularly by water. We saw earlier that water in a beaker effectively filtered out any infrared contained in the light shone on the pits. Similarly infrared striking the surface of the pit would be absorbed very quickly so that it would be unable to penetrate beyond the uppermost layers and therefore would probably never reach the nerve endings below.

Current opinion favours the notion that the python pit receptors are not photoreceptors but specialised warm-sensitive receptors. One experiment that supports this idea involves rapidly filling the pits with water at different temperatures. Raising the temperatures of the water stimulates the receptors just as effectively as does radiant heat. But the pit receptors must be something more than simple warm-sensitive receptors. All of the sensors in vertebrate animals that are known to respond to warm stimuli are supplied by small nerve fibres that end in a simple branched structure. The pit endings, on the other hand, are supplied by large nerve fibres that terminate in an elaborate bulb-like expansion from which fine branches reach into the uppermost layers of the skin. It seems that pit receptors are much more specialised than ordinary thermoreceptors and a separate group of nerve fibres has evolved to supply them. The unique sensitivity of the pit receptors is demonstrated by the fact that they can be stimulated by the warmth of our hand held at a distance of 50 centimetres and calculated to produce only about 0.02° C rise in temperature at the skin surface. Certainly our own warm-sensitive receptors remain unresponsive to a hand held even quite close to the skin. It remains one of the challenges for 'pit workers' to explain how the snake receptors are able to achieve their exquisite sensitivity. The suggestion that the pit nerve endings are more sensitive because they lie closer to the skin surface seems, at best, to be only part of the explanation.

It has been calculated that a rattlesnake can detect a live mouse at more than twice the distance that a python can.

OUR IDEA OF FACIAL SKIN DEPRESSIONS as sensors for 'night vision' was, of course, not entirely original. Some years previously American scientists had shown that in pit vipers (family Crotalidae—the group that includes rattlesnakes) there is a single depression between each eye and nostril that contains a membrane densely packed with nerve endings. Experiments revealed that these nerve endings were sensitive to radiant heat and that they enabled the snakes to track down warm-blooded prey in burrows or at night. More recently a wide variety of snakes has been surveyed for the presence of infrared sensors. But only the boids and crotalids have been found to have them. Tests carried out on elapid snakes, the group that includes the majority of Australian venomous snakes, have not detected any infrared sensors. It remains an open question why infrared reception has appeared in only two rather disparate groups of snakes. Herpetologists believe that the boas and pythons comprise a primitive group, while the pit vipers are much more highly evolved. It has been suggested

STEVE PERKINS

All warm-blooded animals like this mouse emit infrared radiation that enables pythons such as this Carpet Python to track them down in the dark.

PAVEL GERMAN

A python's pit receptors are extremely sensitive to infrared heat. This juvenile Green Python (*Chondropython viridis*), for example, would be able to detect the warmth generated by a human hand at a distance of 50 centimetres.

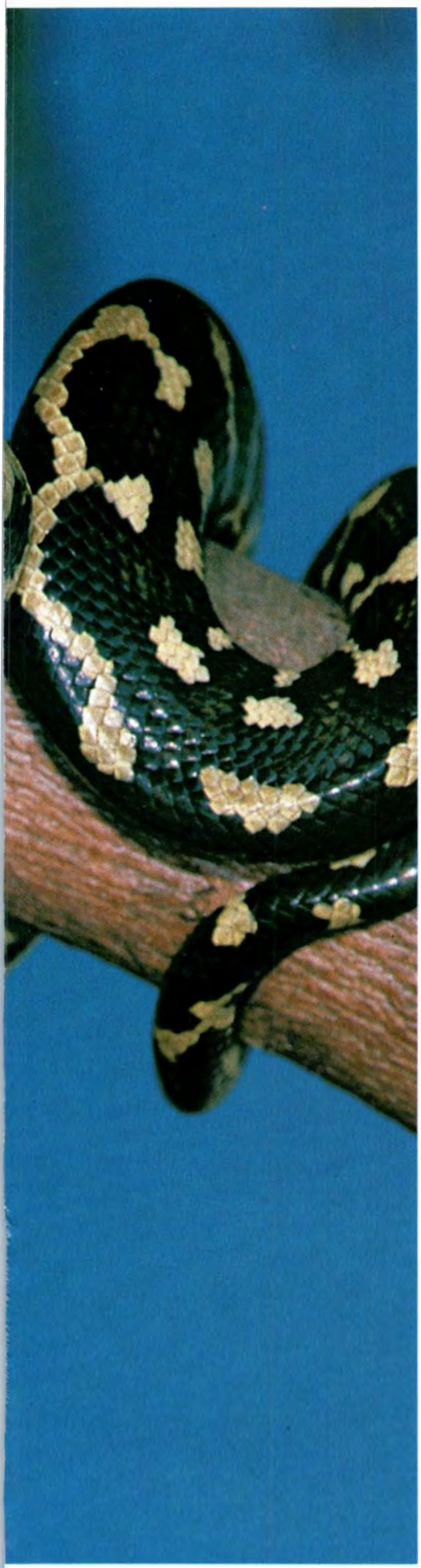
that the pit receptors evolved independently in these two groups, reaching a much more sophisticated form in the pit vipers. The pit receptors in crotalids are, on average, three to five times as sensitive as those in boids. It has been calculated that a rattlesnake can detect a live mouse at more than twice the distance that a python can.

Within the Boidae there also appears to be quite a lot of variation in receptor sensitivity. Some boas like the Anaconda don't possess any specialised facial pits, yet in the region of skin normally occupied by the pits infrared-sensitive nerve endings are present. A survey of the boids has shown that, when pits are not present, the infrared sense appears to be less well developed. For the Anaconda this is consistent with its largely aquatic habit, spending its time in swamps and rivers catching cold-blooded prey like fish and amphibians. In the future more studies should be directed at comparing receptor sensitivity with feeding behaviour in a variety of snakes equipped with an infrared sense.

If some boids don't have them, then what might be the significance of the actual pits themselves? There are probably two answers to this question. The first is that nerve endings located in a depression in the skin will be more protected from everyday wear and tear than those in adjacent skin. The second and probably more important point is that infrared radiation, like visible light, is able to cast shadows. The shadows cast by the walls of the pit allow the snake to localise the source of the infrared, and to establish how far away it is and whether or not it is moving.

It has been speculated that a pit functions like a simple pinhole camera, the diffraction patterns created by the edges of the pit allowing formation of a crude image of the infrared source on the floor of the pit. Our own eyes function like a camera but here light is focused by the lens. Using a lens to focus infrared would not work, of course, because the tissue of the lens would absorb the infrared.

As mentioned before, signals generated by sensors in the skin are sent to the brain where, as a result of complex processing, a sensation is generated. Recordings made from the brain of an animal often give an indication of the importance to the animal of a particular



JOHN WEIGEL

Pit vipers like this Red Diamondback Rattlesnake (*Crotalus ruber*) have a single radiant heat-sensing pit between each eye and nostril that enables them to detect prey up to one metre away. By using this sense they can hunt prey in burrows.

sense. Physiologists have recently been able to map the brains of rattlesnakes and pythons for the distribution of nerve cells that were receiving signals coming from the pits. Infrared coming from in front of the animal and striking the back of the pits stimulated nerve endings whose fibres projected to the frontal regions of the brain. Conversely, infrared from the side and rear of the animal striking the front of the pits led to signals that projected to regions lying further back. It was found that the infrared-sensitive brain cells lay adjacent to cells that received signals coming from the eyes. The spatial distribution of the visual cells was much like that of the infrared cells, those excited by light that was coming from in front of the animal lying further forward. In addition there were some cells that responded equally well to infrared and to visible light. All this suggests that the infrared sense and vision work together. Thus when a snake turns its head to look at a mouse, the visual impression is powerfully reinforced by the infrared signal. But if infrared sensors are designed for hunting at night, when levels of visible light are likely to be very low, what purpose would be served by such a cooperative action? The answer is that even a night-hunter relies to some extent on vision. The python creeping about at night may detect an infrared source, but it will need a confirmatory visual signal for the final strike.

It is interesting to reflect on the fact that snakes have a sense that we don't have. In fact, as far as we know, they are the only group of animals equipped with this unusual sense. (An exception may be the blood-sucking vampire bat *Desmodus rotundus*; see QQC this issue.) More generally, our view of the world is limited by the array of sensory receptors with which we are born. We cannot hear the supersonic whistle to which dogs respond. We don't have nerve endings in our skin that respond to weak electric currents as does the Platypus. Nor can we sense the Earth's magnetic field by which birds navigate. Of course we get around many of these shortcomings by using state-of-the-art technology to supplement our limited faculties, like the modern-day soldier who detects an approaching enemy by looking through his infrared night scope. Still, I am left with the impression that we see our world through a narrow window and that, despite all our knowledge, much of what we do is determined by our particular view. I wonder what everything would look like if we could see infrared? ■

When a Carpet Python hunts, both its infrared sense and normal vision work t ogether, one reinforcing the other and giving the snake a very clear picture of its intended victim.

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Dr Uwe Proske is a reader in physiology at Monash University in Melbourne. He has been working for many years on the properties of sensory receptors but the mainstream of his research is concerned with receptors found in our limb muscles and how these help to regulate posture and movement. His work on infrared receptors, like that on Platypus electroreceptors (ANH Autumn 1990), remains a fascinating sideline.

KEN GRIFFITHS

The decision to not actively 'treat' an oil slick will always attract strong criticism from those who demand action but know little about the issue.

THE SPOILS OF OIL

BY STEVE RAAYMAKERS

IMAGINE AN UNDERWATER WONDERland of kaleidoscopic colours and never-ending movement; a dazzling variety of fishes and other marine creatures abounding amongst sponge beds, seagrass meadows, kelp forests and coral gardens; thundering surf pounding rugged headlands, and tranquil lagoons reflecting the southern sun. This is Australia's marine environment, a beautiful and bountiful treasure stretching from the icy waters of Antarctica to the steaming mangrove forests of the Northern Territory. Holding a special place in the hearts and minds of predominantly coastal Australians, our marine and coastal environments are also a source of significant wealth and economic activity.

ACTION PRESS

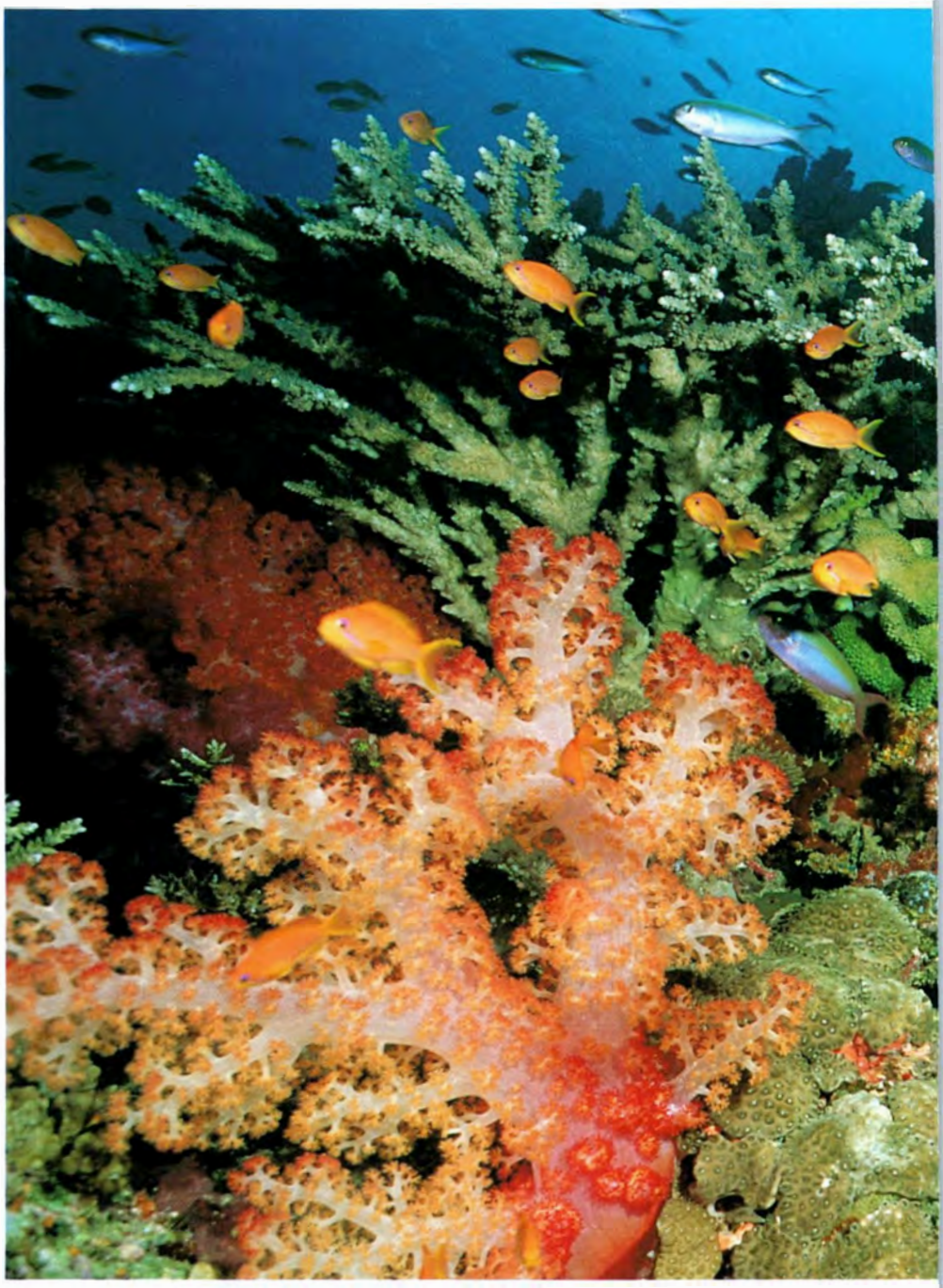
Western society's dependence on oil often extracts a high price that is not always paid by humans.

ANH

As an island nation, Australia is dependent on shipping for trade and other activities essential to survival in a technological age. As a result over 12,000 ships ply our waters each year, and these have long forsaken the freedom of the wind and the romance of sail for the power, speed and reliability of engines.

Unfortunately the advent of mechanical power, which has brought so many benefits to our shipping transport system and to our society in general, has also brought new threats to our environment. Cargo ships now carry thousands of tonnes of oil to feed their great churning propellers, and many of the ships are tankers, some carrying as their cargo tens of thousands of tonnes of oil for our energy-hungry society. Should one of these ships be involved in an accident in which all or even part of its fuel or cargo is spilt, the effects on marine and coastal environments can be severe.

The probability of a major oil spill in Australian waters could be as much as 49 per cent in the next five years.



Although Australia's relatively small population has not yet generated sufficient shipping activity to produce serious sea-lane congestion, the weather and navigational hazards of particular parts of our coastline create a very real risk. In 1991 a study by the Bureau of Transport and Communications Economics (BTCE) concluded that the probability of a major oil spill (over 1,370 tonnes) in Australian waters could be as much as 49 per cent in the next five years and 84 per cent in the next 20 years. The report also found that the highest risk areas are Bass Strait and more generally the area between Brisbane and Adelaide. But an area of particular concern is the Great Barrier Reef, where about 2,000 large ships cross reef-studded waters each year and where the BTCE reports shipping accident rates per unit shipping to be the highest in Australia.

Fortunately, so far Australia has not experienced any headline-grabbing mega-spills. Australia's biggest spill to date was the *Kirki* off Western Australia in July 1991. Serious environmental impacts and damage to the lucrative lobster fishery were narrowly averted when wind and currents caused 17,280 tonnes (equivalent to over 10 olympic-sized swimming pools) of crude oil to be carried offshore into open water, where it evaporated and broke down naturally, probably forming tar balls that can float around the oceans for a long time and eventually come ashore.

In relation to recent major oil spills worldwide, the *Kirki* compares with 38,000 tonnes spilt by the *Exxon Valdez* (Alaska, 1989), 70,000 tonnes by the *Aegean Sea* (off Spain, 1992) and 84,000 tonnes by the *Braer* (off the Shetland Islands, 1993). The largest marine spill in history was the 816,000 tonnes, or more than 500 olympic-sized swimming pools, of crude oil discharged into the Arabian Gulf during the Gulf War in 1991.

However, Australia has experienced numerous smaller spills in recent years, many of which have resulted in localised environmental damage. The extent of damage does not always reflect the amount of oil spilt. For example, while the 17,280 tonnes spilt by the *Kirki* resulted in no measurable damage, a smaller spill of only 700 tonnes from the *Sanko Harvest*, off Esperance in southern Western Australia only five months earlier, resulted in 200 fur-seals becoming oiled (13 of which died), many dead oiled birds being recovered, and over 100 kilometres of coastline, much of it pristine national park, becoming oiled.

IT IS NEVER POSSIBLE TO ACCURATELY predict the extent of environmental damage that will be caused by an oil spill. This will depend on a large number of factors prevailing at the time, such as the type and amount of oil, the distance from sensitive areas, and the

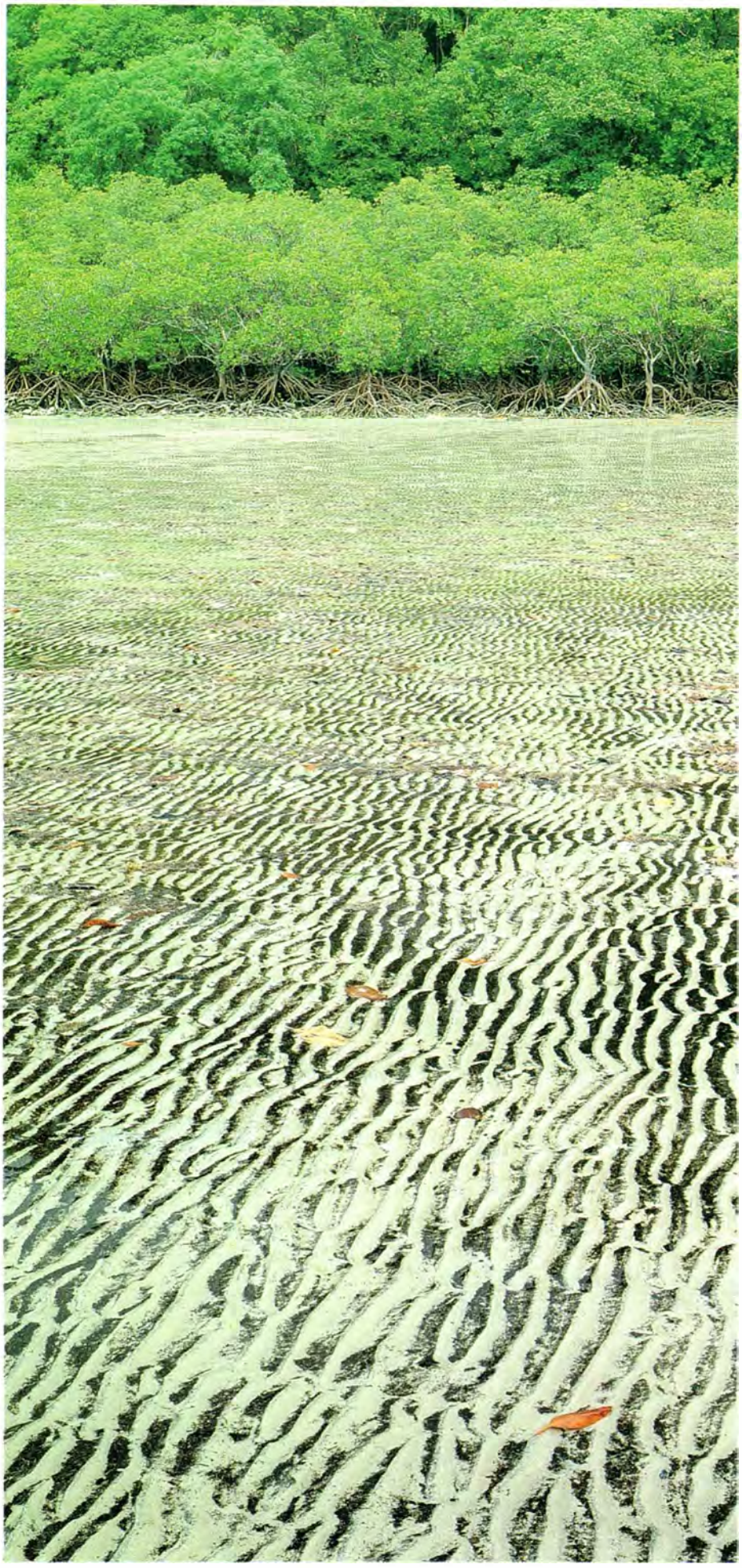
KEV DEACON/DIVE 2000

The Great Barrier Reef is one of the wonders of the natural world—a region treasured by all Australians, yet 2,000 oil-bearing ships cross its reef-studded waters every year. What would happen if an oil spill occurred in these waters?

prevailing winds and currents. In a worst-case scenario, such as 40,000 tonnes of oil being spilt on the Great Barrier Reef, it is possible that coral reefs, seagrass beds, mangrove forests, bird and turtle feeding, mating, nesting and nursery areas, commercial and recreational fisheries, and tourism and recreational resources would all become oiled. The economic cost of the ensuing damage might be measured in billions of dollars, with the potential ecological impacts defying valuation in what is the world's richest marine ecosystem. However, it is also possible that the very same spill, should the prevailing conditions carry the oil offshore into open water, would cause relatively little impact.

It is important to remember that oil is a natural, organic product that starts to undergo physical, chemical and biological degradation as soon as it is spilt onto the sea. High temperatures and winds will cause much of the oil to evaporate, wave action will break the oil up, and bacteria in the ocean that feed on oil will begin to attack it. Damage caused to marine life results from the smothering effect of the oil and the toxic effect of the lighter fractions. It is also possible for these toxic components of oil to enter the food chain, causing mutations and diseases in invertebrates and fish, and accumulating up the food chain in a process known as bio-magnification.

Experience with oil spills on coral reefs in other parts of the world has shown that, if corals come into direct contact with oil, the lighter components will damage the surface tissues by rupturing cell membranes. Those that do



FERRERO/LABAT/AUSCAPE INTERNATIONAL

Mangrove forests are a primary source of food and energy for marine life and are particularly vulnerable to the threat of an oil spill. If such an event were to occur, its effect in these sensitive areas could last for several decades.

not die from this may suffer stress and become more susceptible to disease or be less successful in producing offspring. The abundance of marine creatures such as crabs, shrimps and shellfish that live amongst the corals can also be severely affected.

However there is some evidence to suggest that the effects of oil on coral reefs are relatively short-term and that they may be able to recover in about ten years. Of greater concern is the effect of oil on other environments, such as mangrove forests and seagrass beds. Mangroves and seagrasses are very valuable in that they are important nursery grounds for many of the commercial species of prawns and fishes, and are a primary source of food and energy for much of the marine life found in Australia's seas. Should large areas of mangroves be destroyed by an oil spill, the myriad plants and animals that rely on that habitat for food and shelter will also be severely affected. The effects of oil on these areas can last for several decades.

Tourism and recreation can also suffer if resorts, marinas and beaches become oiled. Infrastructure and industrial facilities are another resource that may require protection from a spill, as was shown graphically during the Gulf War when every effort was made to protect desalination facilities, which supply the majority of Saudi Arabia's fresh water.

SUCH SCENARIOS CAN PRESENT DIFFICULT decisions for oil spill response managers who, due to limited resources, may have to choose to protect one area at the expense of another. Political pressure from special-interest groups can force authorities to take action that may not necessarily yield the best results for the environment. For example, a wealthy prawn farmer or a politically connected resort owner may be able to force authorities to protect their resource at the expense of an adjacent mangrove forest. Unfortunately, should the mangrove forest become oiled, it may be impossible to clean it up and recovery may take up to 50 years, whereas an oiled resort would only take a few days or weeks to restore.

Australian authorities try to prevent such problems occurring by pre-designating priorities in oil-spill contingency plans. Under Australia's National Plan to Combat Pollution of the Sea by Oil (the National Plan), the priorities for protection from oil spills are clearly identified as human life and safety first, followed by natural habitats and ecosys-

JOHN E. SWEDBERG/ARDEA

When the *Exxon Valdez* spilt 38,000 tonnes of oil in Alaska a massive and expensive clean-up campaign was put into place. Despite all their efforts, most of the clean-up work was done by nature.

tems, then rare and endangered species, other species, and finally commerce, culture and amenities.

The impacts of oil on wildlife is of concern. Seabirds are particularly vulnerable, potentially becoming oiled if diving through slicks to feed, or if islands and coastline become oiled. Turtle hatchlings, which have to cross beaches to enter the sea, are also vulnerable if the beach is oiled. In addition, turtles often feed along windrows, where oil and tar balls accumulate, and they may attempt to eat the tar balls, mistaking them for food. Overall responsibility for the National Plan rests with the Australian Maritime Safety Authority (AMSA), a Commonwealth Government body responsible for shipping safety and marine pollution.

Under the National Plan stockpiles of oil-spill equipment are located at strategic centres around the country. In addition, the Australian Marine Oil Spill Centre (AMOSC) located in Geelong, Victoria, which is owned and operated by the oil industry, represents a major $8 million stockpile of oil-spill equipment and a pool of highly trained personnel that can be deployed rapidly by air to assist a government response anywhere in the country.

Response to an oil spill under the National Plan is based on the philosophy that, if the oil remains in open water and does not threaten sensitive resources, the most environmentally sound option is to leave the oil alone and let it degrade naturally. Constant monitoring of the slick is maintained using surveillance aircraft, and predictions of the slick's likely movements are made using sophisticated computer models. It is only when the slick threat-

Should a mangrove forest become oiled, recovery may take up to 50 years, whereas an oiled resort would only take a few weeks to restore.

AUSTRALIAN PICTURE LIBRARY/VOLVOX

Twelve thousand ships ply Australian waters each year and each one carries with it the potential for a significant oil spill.

ens to come ashore that action is taken to deal with it.

The decision to not actively 'treat' an oil slick in open water, despite being based on sound scientific understanding of the problem, will always attract strong public and political criticism from those who demand action but who know very little about the issue. As with the wealthy prawn farmer and politically connected resort owner, such pressures can force oil-spill responders to take very expensive yet ineffective and unnecessary action. It is therefore vital that the general public is educated about the realities, practicalities and limitations of oil-spill response.

Should a spill threaten sensitive resources, then a variety of response options are available. The backbone of our oil-spill 'armoury' is the use of chemical dispersants to break the oil up and hasten its degradation before it comes ashore. The use of dispersants is often subject to much controversy and criticism, due to the fact that such chemicals are toxic pollutants in themselves, and can actually increase the toxicity of oil for a short period. However there are many misconceptions about dispersants. Modern dispersants have been developed over a period of decades and those currently available are considered less toxic than the original formulations. Dispersants do not cause the oil to sink to any great depth, as is commonly feared. Maximum penetration of chemically dispersed oil will only be a few metres, depending on sea conditions.

Dispersants can be a very effective tool for preventing oil from coming ashore and thereby minimising damage to sensitive coastal resources. When deciding whether or not to use dispersants, oil-spill responders must be prepared to accept impacts on one area in order to reduce impacts on a more valuable or sensitive area. The wholesale use of dispersants in any oil-spill situation, without appropriate scientific advice, should never be allowed.

In addition to dispersants, booms can be used to deflect small quantities of oil away from specific sites, and to contain oil in sheltered bays where it can be recovered using floating skimming devices and other equipment.

However the reality is that, due to the nature of oil on water, and the practical limitations of booms and other equipment, even the best oil-spill contingency plans in the world cannot guarantee protection of the environment. Unless the weather and sea conditions are merciful, response operations will always consist largely of cleaning up shorelines, rescuing and treating wildlife after it has become oiled, and rehabilitating damaged sites after the spill.

When you consider that a single milk carton (one litre) of oil can spread to form a slick larger than a football field (5,000 square metres), you can imagine the difficulty of containing and cleaning up 40,000 tonnes (more than 40 million milk cartons) of spreading oil from a grounded tanker in 30-knot winds, 20 kilometres out from the mainland on the Great Barrier Reef.

IT HAS BEEN CLAIMED THAT $3 BILLION OR more spent in the huge clean-up of the *Exxon Valdez* spill in Alaska had virtually no effect on the oil, and that the vast majority of the clean-up was effected by natural processes such as wind and waves. For $3 billion, Exxon could have rebuilt its entire tanker fleet to include double hulls for increased protection, and implemented other measures that would improve the preven-

tion of similar spills in the future. This would seem to be a far more sensible way to spend such huge sums of money. Indeed prevention of oil spills is really where both government and industry should be putting the most effort.

The Australian Commonwealth and State Governments recognise this and have various measures in place to help prevent major oil spills. Compulsory pilotage legislation for the Great Barrier Reef, for example, requires all loaded tankers and large ships to carry a pilot who is familiar with Reef waters. Shipping routes around the country are well defined and navigation aids are provided to help vessels travel safely. Navigation charts are continually being upgraded and new, safer technologies developed. The design of vessels is also continually being improved, with all tankers built after July 1993 now being required to have double hulls or equivalent protection. In addition, foreign vessels entering Australian ports are subject to inspection by the AMSA. However, only about 25 per cent of ships are inspected and inspections are fairly superficial. For example, the *Kirki*, which lost its bow off Western Australia in 1991, was inspected only a few months prior to the incident.

A single milk carton of oil can spread to form a slick larger than a football field, so imagine the difficulty of containing up to 40,000 tonnes of oil.

Unfortunately, the fact that shipping is an international industry and extremely difficult to regulate, combined with the existence of 'flags of convenience' (countries that will certify and register ships even though they do not comply with the proper standards), has resulted in many substandard and poorly operated ships plying the world's oceans.

Under International Conventions and Australian legislation, the discharge of oil from ships is strictly controlled, including a total ban on all discharges of oil within the Great Barrier Reef and fines of up to $1 million. However, despite this legislation and enforcement efforts, the chances of polluters being caught are small; of being caught and prosecuted even smaller. Even if polluters are prosecuted, the chances of being found guilty are low and, if found guilty, fines are not likely to be the maximum applicable. Much needs to be done to improve surveillance and enforcement efforts if legislation is going to be effective in preventing oil pollution.

Apart from oil spills from shipping accidents, another significant source of oil in the marine environment is run-off from the land. Rainwater running over roads and other urban surfaces washes a film of oil into drains and eventually into the sea, and 'backyard mechanics' often dispose of waste oil into drains.

In the United States it has been reported that in one year approximately 350 million gallons of used oil are disposed of improperly in drains and waterways, representing 32 times the amount of oil spilled by the *Exxon Valdez* in Alaska. Crankcase oil drainings have been reported to account for more than 40 per cent of the total oil pollution of US harbours and waterways. Although such figures would be considerably less for Australia, back-

LEROUX/AUSCAPE INTERNATIONAL

When the *Braer* ran aground off the Shetland Islands in 1993, 84,000 tonnes of oil were released into the ocean. So far, Australia has not experienced a mega-spill such as this, however many experts believe it may only be a matter of time.

yard mechanics abound and terrestrial sources of oil pollution are a concern. This problem can be expected to increase as Australian cities grow and urbanisation continues to creep along the coast.

What can we do? Obviously the ultimate solution would be for our society to stop using oil, thus removing the problem completely. But equally obvious is that this is not a realistic proposition overnight. However there are many ways that we can reduce our consumption of oil and help make the move to alternative, environmentally friendly energy sources. After the introduction of Government-backed measures to reduce oil consumption in Japan in 1973, it took only 12 years for Japan to become 51 per cent more efficient in its use of oil. However in Australia, energy consumption per person has doubled in the last 30 years! By adopting a more energy-conscious lifestyle, and putting pressure on governments and industry to provide incentives for change, we can all help reduce our need for oil and thus reduce pollution of the environment. ■

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Steve Raaymakers has worked on shipping and port issues at the Great Barrier Reef Marine Park Authority, Townsville since 1990. He was responsible for managing the Authority's role under Reefplan (a sub-plan of the National Plan), other ship-sourced pollution issues such as ballast water, and the environmental management of port activities such as dredging and dredge spoil disposal in the Great Barrier Reef region. He is now Environment Manager for the Queensland Ports Corporation, where he is working towards ecologically sustainable management of Queensland's port system.

LIZARD ISLAND

COMPETITION

GUESS THE TIME OF CORAL SPAWNING & WIN A GREAT BARRIER REEF CRUISE

Guess the time of this year's mass coral spawning on the Great Barrier Reef and you could **win** a fabulous 4 night Captain Cook Cruise for two aboard the luxurious **Reef Escape**.

Cruise from Cairns along the Great Barrier Reef to Lizard Island. Fly First Class from Sydney or Brisbane. Prizes courtesy of Captain Cook Cruises, Qantas and Coles Myer.

All funds raised support the Lizard Island Research Station, a facility of the Australian Museum.

Coral "*Acropora*" spawning on the Great Barrier Reef. Photo courtesy of Jamie Oliver.

Coral Spawning

On one night every year, in late spring or early summer, the Great Barrier Reef begins a breathtaking ritual. Masses of tiny coral polyps release their egg and sperm bundles into the water creating a "snow storm" of spawn. This lasts for a couple of days. In previous years, the spawning has taken place within a few days of the full moon in November. This year, November might again be the month but no-one really knows the exact day and time when the spawning event will reach its peak. Now you can have a chance to predict when this will be and win a wonderful prize, all whilst supporting Lizard Island Reef Research Station. Entering the Coral Spawning Sweepstakes is easy.

How to enter

You can receive as many sweepstakes entry cards as you like by completing the coupon on this page and returning it to the address shown. Full competition details will accompany your card.

Coral Spawning Sweepstakes

- Guess the time of peak coral spawning within the immediate vicinity of the Lizard Island Research Station, as determined by the Station's Directors
- Each guess costs $10, all funds raised support Lizard Island Research Station
- Each card has a provision for up to 5 guesses
- The cards will be read by a computer
- The winner will be the person who guesses the correct time within one half hour
- In the event of more than one correct entry, the winner will be drawn by ballot
- If there are no correct winners, the closest guess will be declared the winner
- Closing date for the competition is 15 October 1994
- The winner will be notified by mail and published in the Autumn issue of ANH
- The prize is transferable but not cash redeemable

☐ YES! I would like the chance to enter the Coral Spawning Sweepstakes

Please send me (number)____ Sweepstakes cards

Name _____

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Address _____

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Send to Coral Spawning
Australian Museum
PO Box A285
Sydney South NSW 2000

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This competition is an initiative of the Lizard Island Reef Research Foundation

A myriad of egg and sperm bundles are released from a brain coral colony (*Favites chinensis*). Photo courtesy of Peter Harrison, Southern Cross University.

Black Kennedia ***(Kennedia nigricans)***.

Featherflower *(Verticordia insignis).*

Preiss' Kunzea *(Kunzea preissiana).*

WESTERN BLOOMS

BY GREG HAROLD

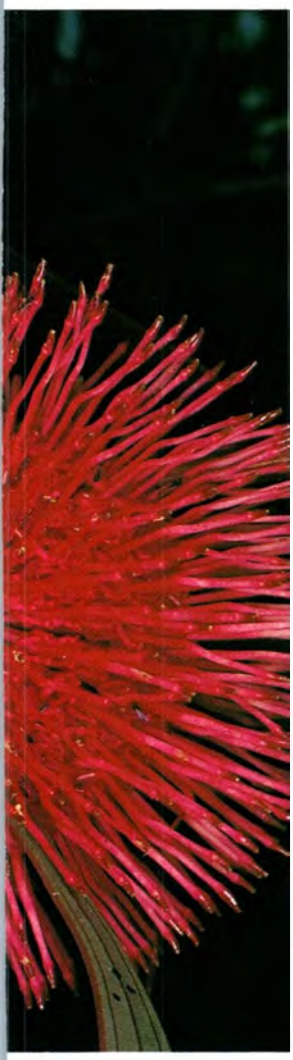
THE SOUTH-WEST OF WESTERN AUSTRALIA contains an impressive array of flowering plants and one of the most outstanding areas is the 329,000-hectare Fitzgerald River National Park on the south coast. So far about 1,800 species have been identified from the park. This represents 20 per cent of the total number of named and unnamed plant species from Western Australia. There are also 75 species restricted to the park, many isolated on the various peaks and ranges that were once islands about 40 million years ago.

Being primarily a reptile photographer I initially thought that taking pictures of unmoving subjects would be relatively simple. Little did I realise that the flowering season is also rather windy and sometimes the only parts of the plant that don't move are the roots. In the end patience has paid off and the pursuit of the many varied and splendid blooms has been an enjoyable learning experience.

Pincushion Hakea *(Hakea laurina)*.

WESTERN BLOOMS

Purple Starflower *(Calytrix leschenaultii)*.



Common Donkey Orchid *(Diuris corymbosa)*.

Red Lechenaultia *(Lechenaultia formosa* var. *oblata)*.

WESTERN BLOOMS

Box Poison *(Oxylobium parviflorum)*.

Red Toothbrush (*Grevillea hookerania*).

MEAT MARKETS AND CHASTITY BELTS

BY CHRIS TIDEMANN

It is a combination of their small size and seasonally limited food supply that has dictated these bats' extraordinary sex lives.

THE MATING SYSTEM OF SOME BATS has been likened to disco sex, where males and females mate with multiple sexual partners after a perfunctory or non-existent courtship. Some male bats are bisexual and there seems to be a premium on penis size. There are other similarities to humans as well, but there's one major difference, which some readers may find difficult to credit. At certain times of the year there are 'boys' nights out', when male bats inseminate whichever females they can find, and the females have absolutely no say in the process at all. To add further insult these 'cowboys' leave behind the biological equivalent of a chastity belt, which means that subsequent suitors cannot have their 'wicked way'.

The bats referred to here belong to the group known as microbats (order Microchiroptera) because of their small size. Indeed the smallest of Australia's 60 odd species weighs about the same as an empty matchbox. Compared to megabats (order Megachiroptera), which include the much larger flying-foxes and which eat fruit, nectar and pollen, microbats eat mainly insects. It is a combination of their small size and seasonally limited food supply that has dictated these bats' extraordinary sex lives.

Food shortage or low temperatures can spell certain death for small mammals that need food to maintain a body temperature around 37° C, and some insectivorous bats live right at the treeline in cold climates. They solve this problem in cold areas and at high latitudes by dropping their body temperature to near the ambient temperature and going into torpor or hibernation for up to several months. In this state they can make tiny squeaks and move with almost painful slowness, but not much more. The small amount of energy needed to survive in torpor comes from fat reserves accumulated in summer when insects are plentiful.

Much mating happens in autumn before torpor sets in, and this is when the 'disco' or 'meat-market' mating scene ensues, at least with some species. Fertilisation, however, does not happen until spring. Female microbats (all except a few species) can store sperm for long periods—up to six or seven months if necessary. This is common enough in insects, but in most other mammals, if a female is to conceive, fertilisation must occur soon after copulation, for sperm does not usually survive long in the female reproductive tract. Sperm quickly run out of energy and, like any other foreign material, are engulfed and destroyed by white cells or leucocytes. Maximum survival time in humans is about five days, but is often less. Female microbats, however, can mate in autumn and then draw on their sperm stores when they ovulate in spring without further recourse to male

A lactating female Gould's Long-eared Bat *(Nyctophilus gouldii)*.

PAVEL GERMAN

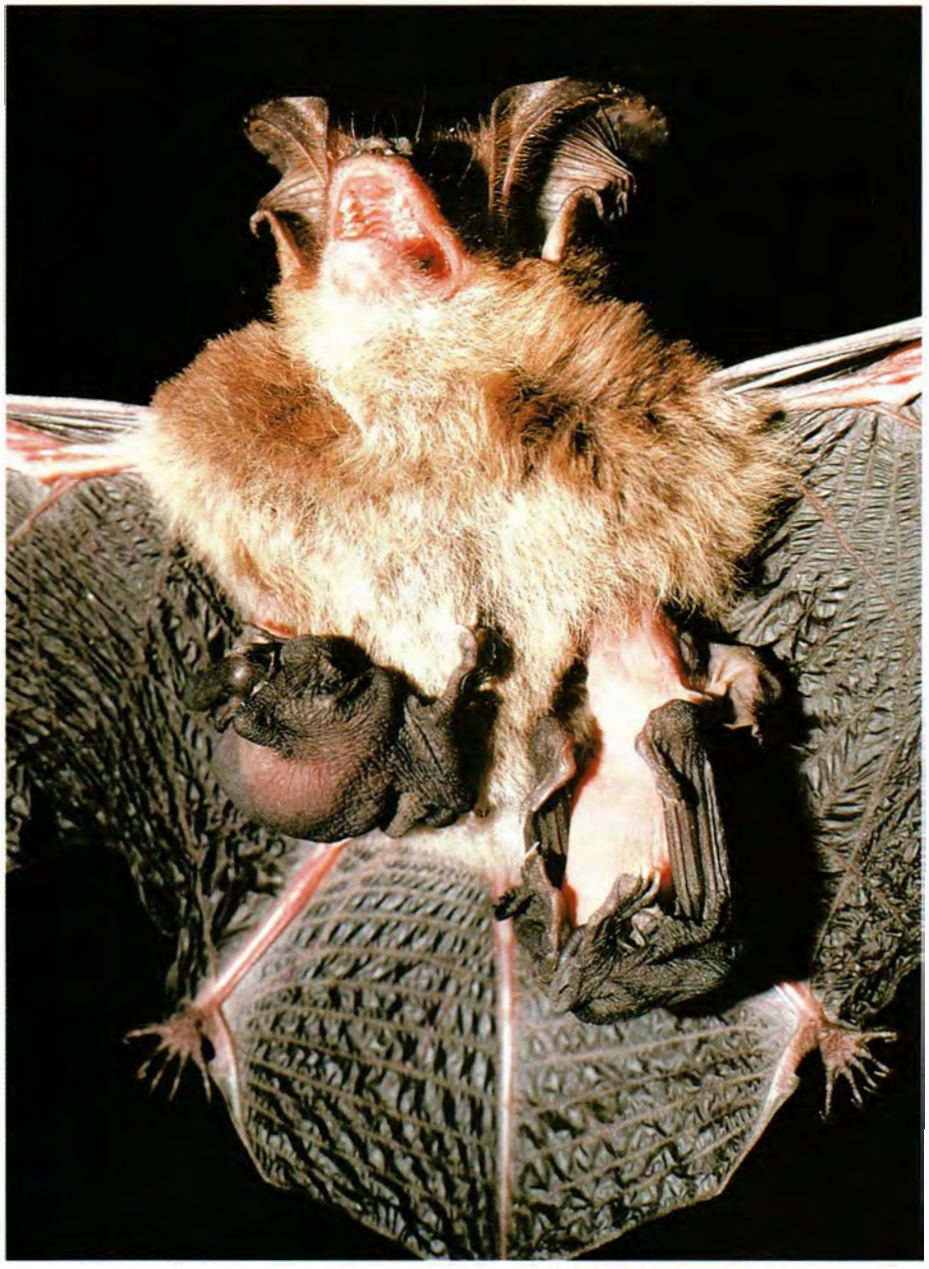
contact. This mechanism is referred to as delayed ovulation or delayed fertilisation.

Male microbats, one might expect, would hibernate after their autumn mating session, secure in the knowledge that their genetic input was destined to bear fruit in spring without further action on their part. Some species, although not the promiscuous disco lot, actually guard against being cuckolded by the formation of a copulatory plug in the vagina of the female at the time of insemination. This 'chastity belt' occludes the vagina and prevents further insemination. The story doesn't end here, though, for male bats have been observed mating with inert females (and occasionally other males) during the depths of winter. We now know that both males and females arouse from torpor periodically, but males do so much more often than females.

When females arouse from torpor their sperm stores are subject to leucocyte removal and their copulatory plugs are often voided as well. This means that they are once again sexual targets for passing males, at least those that are quick enough to get in before the copulatory plugs of others are installed. Males that take advantage of these opportunities must be treading a thin tightrope, balancing the needs of the reproductive imperative on the one hand, with the need to conserve energy to survive the winter on the other. No doubt some must perish in the process. Perhaps only the very finest are able to survive these 'boys' nights out' and these animals may, in fact, be passing a far more rigorous test than that imposed by females of any other species during courtship.

A few species of microbats, one African flying-fox and many marsupials use delayed implantation, rather than delayed fertilisation, to get around the problem of low food availability during winter or at other times. In this case fertilisation occurs at the time of mating, but development of the embryo is arrested until the food supply improves. Young microbats are usually born in early summer, or early in the wet season in tropical species, after a gestation period of about three months. As one more safeguard against a hostile and unpredictable environment, the gestation period of microbats is quite variable and is dependent on temperature. Most microbats give birth to one young at a time and the baby is commonly about a third of its mother's weight.

It is only recently that we have come to fully appreciate the amazing adaptations that these tiny animals have developed in order to survive. While their use of ultrasound to navigate is legendary, other features are of more than academic note for they provide clues that may help to improve the quality of human existence. Specialised physiological mechanisms have evolved to allow sperm storage in microbats and these are of particular interest to those who study organ transplants and conception problems in humans. Microbats also live far longer than any other mammals of the same body size. Some live more than 30 years, in contrast to mice, which are lucky to see out 12 months. How microbats do this may even suggest avenues for retarding the ageing process in humans. ■



KATHIE ATKINSON

Raising twins is not a rare event for Gould's Long-eared Bats. Here the young are shown attached to the female's nipples.

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Dr Chris Tidemann is a lecturer in the School of Resource and Environmental Management at the Australian National University. In addition to studying bats he also has an interest in cats and rats.

If there is one predictable attribute about most of Australia's modern environments, it is their unpredictability.

OPPORTUNISM AND THE GIZZARDS OF OZ

BY MICHAEL ARCHER

IT WAS A SIGHT ALMOST TOO UNNERVing to recall. There in the darkening corner of the room, hunkered down and growling with teeth bared, the 'thing' that had moments before been my beloved Swamp Wallaby prepared to defend her right-by-possession to the cooked chook clutched tightly in her paws. I made one bold attempt to retrieve the purloined bird but she lunged at me, claws outstretched, and sank her pearly whites into my arm. That was quite enough; the chicken rescue mission was promptly aborted. I beat a hasty retreat to the top of the kitchen table from where I watched in confusion as my normally placid, plant-eating pet savagely dismembered and consumed my dinner.

As a result of that event, I lost all confidence in textbook statements about the diets of Australian mammals. It quite clearly said in my reference book that Swamp Wallabies (*Wallabia bicolor*) were herbivores—eaters of plants. Indeed, normally she did consume copious quantities of lush greenery. But her schizoid conversion that evening by the incandescent light of the fridge suggested there was something wrong either with this simple wallaby or my simple book or both.

As the evening wore on, her gut proved to be a less capable co-conspirator in carnivory than her mouth. While it was clear that chook could readily be gobbled at the biting end, what came out the other end, in a surprisingly short space of time considering her elongate herbivore's gut, made chocolate milk seem solid. Such diarrhoea! But then anal spray-painting for a depressingly wide range of reasons was one of the really big down sides of raising Swamp Wallabies indoors. She had, for example, a problem with mirrors. If she spied a reflection of so much as her own tail tip, baroom! Even after all mirrors were covered with pieces of taped-on cardboard, her obsession ruled. She knew where those phantom wallabies were and would tear away the cardboard until she was suddenly staring one in the face—instant carpet catastrophe. Those were times when the phrase 'house-proud' came to have little meaning.

But back to the point of this essay. Culinary 'perversions' in Australian mammals are not restricted to Swamp Wallabies. A similar confounding occurred with a 'domesticated' Western Quoll (*Dasyurus geoffroii*). While a textbook example of an efficient marsupial carnivore, he had an inordinate fondness for things green. Often I would haul him out of the garbage bin to find a chunk of decomposing cucumber possessively clamped in his mouth. Meredith Smith (South Australian Museum) once told me that she watched one of her indescribably cute, nectar-loving Sugar Gliders (*Petaurus breviceps*) pounce on and savage an adult House Mouse (*Mus musculus*) that had strayed into the glider enclosure chasing bits of dropped fruit. Are these abnormal behaviours caused by captivity, or could they be expressions of a feeding strategy singularly well adapted to this continent—opportunistic omnivory?

If there is one predictable attribute about most of Australia's modern environments, it is their unpredictability. When the great, wet, biologically diverse forests of the Miocene with

STEVE THOMAS

The diet of many Australian mammals, like this Swamp Wallaby, may not be as simple as the textbooks state.

their predictable rainfall began to shrivel in the Centre, perhaps ten to six million years ago, they were replaced by a far more stressful environment—stressful, not because it was simply drier and hotter, but because its life-support systems were less stable and less dependable. Droughts and floods came unexpectedly and stayed unpredictably. Animals and plants that required a particular food resource, whether red fruit or flesh, were in jeopardy here. It was risky business to have a search image for soft berries if you had to wait a year or two or three for your next meal.

From the top of my kitchen table I watched in confusion as my normally placid, plant-eating pet savagely dismembered and consumed my dinner.

Hence there would have been a powerful selection pressure on all lineages to become less fussy about food—that is, to become opportunistic omnivores, willing and capable of taking advantage of serendipitously provided nutrients in a wide range of wrappings, be they animal or vegetable. If a kangaroo found it could turn a blind tastebud to the flavour of grasshopper on the stem it was eating, or a predatory antechinus found the taste of flower nectar surprisingly palatable, then these opportunists could smile as they let their belt out a further notch before going to bed.

In fact, there are few Australian mammals that seem to specialise on a limited range of foods. Most of these, such as the Greater Glider (*Petauroides volans,* which I have never managed to persuade to take even the most innocuous insect), occupy remnants of wet forests along the eastern edge of the continent. As one joins dinner tables farther and farther into the 'desert' country, the Gizzard of Oz becomes extraordinarily tolerant.

From this point of view, it was predictable that the first humans in Australia would have been well pleased with the place. The human species is one of the world's unfussiest omnivores. We delight in raw oysters, decomposing fish, dried blood, bird spit, squirming grubs, writhing tapeworms, thinking monkey brains, heaving haggis, toxin-laced mushrooms and chemically noxious chillies. In fact, there is very little we won't covet given enough time to acclimatise to the taste or effect. In terms of survival value, Australia's first humans could survive any season by being willing to consume almost anything that had food value.

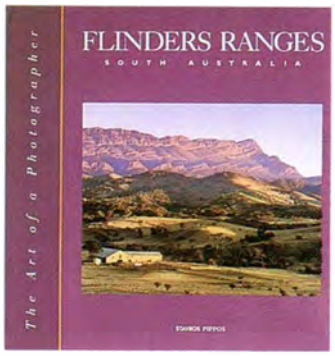
Unfortunately, many of the mammals we introduced to Australia, such as the Red Fox (*Vulpes vulpes*), are masters of opportunism. This predator has been a particularly awful disaster because of its opportunistic feeding behaviour. Whereas a specialised carnivore's numbers would be controlled by the numbers of its prey, when small Australian mammals become scarce, either through predation or seasonal declines, foxes simply shift to centipedes and beetles and hence are able to maintain their own high numbers and their unrelenting levels of predation on the declining small mammal populations. Foxes in their native European homeland have no special advantage because of the stable, predictable environment that favours specialist feeding strategies. In Australia, where regular, dependable seasons are rare, opportunistic foxes have done appallingly well.

Days after the chicken-ripper experience, and my Swamp Wallaby had returned to some delicate state of intestinal balance, she came up to me looking for all the world like she wanted to kiss and make up. But as her rubbery black lips sought what I thought were mine, her nose began to twitch uncontrollably. It didn't take a French chef to work out that she was really interested in what I had in my mouth—chewing gum. Its menthol bouquet had lured her all the way across the room. Why not, I thought? Without hesitation she accepted the offer and sat back on her haunches, chewing like a champ. And chewing. And chewing. Then within that minimally sufficient brain something began to dawn—this stuff wasn't breaking up so it couldn't be swallowed. Curious, she reached into her mouth and pulled a long strand out in front of her face. After staring at it for a moment, she chewed it back in and continued to chew until I couldn't stand the sight of the futile exercise any longer. Much to her annoyance and with some misgivings for the fate of my finger, I retrieved the well-exercised wad for the bin.

Australia might be the unpredictable land of culinary opportunism, particularly if you have the guts for it, but it was a relief to know that there are at least some things that even a chicken-ripping Swamp Wallaby couldn't consume. ■

Professor Michael Archer lectures in biology and geology at the University of New South Wales. Most of his non-teaching hours are devoted to the study of the fossil faunas of Riversleigh.

REVIEWS



Flinders Ranges, South Australia. The Art of a Photographer

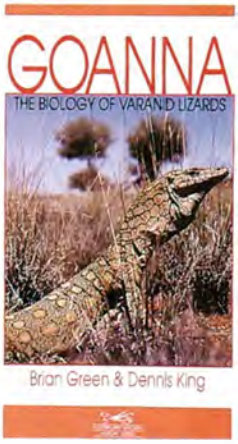
By Stavros Pippos. Endeavour Publishing, SA, 1993, 80pp. $39.95rrp.

This is more than a coffee-table book of beautiful landscapes—it is a book of history. The photographer Stavros Pippos and historian Hans Mincham, who wrote the introduction, combine to tell some of the stories of European exploration and settlement in the Flinders region of South Australia.

A detailed map makes it easy to follow the travels of explorer Edward John Eyre as he ventured into unknown country beyond the head of Spencer Gulf. By 1846 it was the pastoralists, in search of permanent water, who carried out the detailed exploration. Urged on by the government, they pushed north with their settlements, many of them heading for a life of hard work, poverty and despair. They had crossed the line, Goyder's Line. They broke their backs trying to tame country where recurring drought was the norm. Stavros' images of the ruins at Mount Deception and the 'Vintage Wagon Montefiore' remind us that Australia will always be a land of droughts, fire and flooding rains.

But this is not a book of despair and broken dreams; it is a celebration of the beauty of a special place—the Flinders Ranges. Stavros Pippos is a skilled landscape photographer. For me, his bold images and interesting text capture the spirit of the place. Many photographers find the mood of the Flinders landscapes frustratingly elusive, usually because we do not spend enough time in the area. Stavros has succeeded. Since his first visit in 1982 he has been exploring and photographing remote and rugged corners of the region, backpacking heavy camera equipment when the roads ran out. He set himself quite a task when he decided "to cover the entire region photographically, and then to publish my completed work". I am glad he has taken a breather to produce this first book and share his passion with us, because he now admits the project will take years to complete. Not too many I hope.

—Kathie Atkinson



Goanna: The Biology of Varanid Lizards

By Brian Green and Dennis King. New South Wales University Press, NSW, 1993, 102pp. $19.95rrp.

Goanna, varanid, monitor—these names have all been applied to a group of lizards that occurs widely throughout Africa, Asia and Australasia and includes the largest living lizard, the Komodo Dragon (*Varanus komodoensis*) of Indonesia. The richest variety of varanids is found in Australia, which has more than 25 species, ranging from the formidable two-metre Perentie (*V. giganteus*) to the 25-centimetre-long Pygmy Goanna (*V. brevicauda*). Varanids share the common body form of long neck, strong legs and tail, and sharp claws and teeth. Their splay-legged swagger and flickering forked tongues suggest a primitive and even sinister nature that has won them a special place in Australian folklore.

Folklore, however, is definitely not the subject of this book. According to authors Brian Green and Dennis King, it was written in order to summarise scientific information on the biology of varanid lizards in an easily readable form for students and naturalists. Brian and Dennis have studied goannas for many years and some of the most entertaining passages in the book relate to their observations on a large terrestrial species, *Varanus rosenbergi*, on Kangaroo Island.

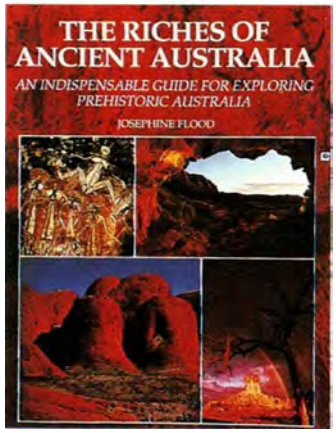
The book's introduction covers general characteristics, relationships and distribution of varanids, and is followed by a summary of their taxonomy and phylogeny. There are chapters on feeding, breeding, general behaviour, thermal biology, respiration, water use, and energy and food. The book closes with a chapter on conservation and management, comparing the status of varanids in Australia, Asia and Africa. Each chapter is supported by a reading list of scientific publications.

The text is complemented by many clear, simple line drawings and tables, and 15 colour plates illustrate the diversity of body form and colouration. The index is comprehensive and easy to read, and the text itself is cross-referenced. I have one gripe with the book's design, however, and that is the margins are very wide, resulting in large expanses of blank paper.

My other criticisms are also minor. The text is sometimes poorly integrated, resulting in repetition (a relative of the varanids is described in almost identical words on consecutive pages) and subject matter is sometimes fragmented (the use of burrows is discussed in both Chapters 5 "General Behaviour" and 6 "Thermal Biology"). It would have been nice if more information could have been included as there are tantalising references to phenomena that beg for further explanation. What is the function of the hemipenis-like structure in female Rosenberg's Goannas (*V. rosenbergi*), for example, and why is *Varanus acanthurus* generally captured at its shelter sites while most other species are encountered when they are active?

These niggles aside, I think the book achieves its stated aim and also provides a useful introduction to the physiology of reptiles.

—L. Cameron
Australian Museum



The Riches of Ancient Australia: An Indispensable Guide for Exploring Prehistoric Australia

By Josephine Flood. University of Queensland Press, Qld, 1993, 373pp. $29.95rrp.

One of the dilemmas facing cultural heritage managers is whether or not to advertise the whereabouts of a site to the public for educational or tourism purposes. Will such advertisement lead to greater destruction or dis-

turbance of the site? It is a shame that the wrongful actions of a few can lead to heritage sites being hidden away. Yet, if some sites are not advertised, people will not know what their value is and why they should be preserved.

At least some Aboriginal sites should be open to the public and interpreted for the non-specialist so that people can learn to recognise such sites and avoid activities that may lead to their disturbance or destruction. Done in an appropriate management context and with appropriate information, a more positive attitude to Aboriginal sites and culture can be generated.

Josephine Flood's book, *The riches of ancient Australia*, sets out to guide people to some of the heritage sites in Australia. As stated in the foreword, this book is for people "...who wish to know more about Australia's prehistoric heritage without having to grapple with technical terms, and to help people recognise, appreciate and visit important prehistoric places throughout Australia". It also aims to ensure that people who visit these places treat them with respect.

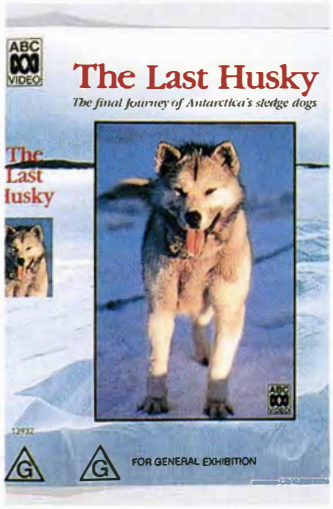
The book, written in an easy-to-understand style (there is a glossary for some of the technical terms), provides an excellent context with which to visit Aboriginal sites. The first chapter, "Do the Right Thing!", provides information on the do's and don'ts of visiting sites. The various State and Federal legislation that protects Aboriginal sites and their contents is briefly described. The second and third chapters furnish the reader with an overview of Australian prehistory and rock art respectively.

Information on the sites is provided in 17 chapters, each of which covers a different region. The physical environment of the region is outlined at the beginning of each chapter as well as a general overview of the sites and archaeology of the region, and then details of selected sites that are open to the public are given. How to get to the sites and whether special permission is required from land owners or Aboriginal custodians is also provided. It is also recommended, however, that intending visitors check with the local site authorities beforehand in case access conditions have changed since the book was written.

Given the size of the area covered and the number of sites included in the book, only a small amount of information is provided for each site...just enough to whet one's appetite and to decide whether or not to visit the site. A list of references is provided in the end notes to each chapter as well as further reading at the end of the book.

This is an excellent book. Although aimed at the traveller, it will also make informative reading for those who are interested in Aboriginal culture and archaeology.

—Val Attenbrow
Australian Museum



The Last Husky: The Final Journey of Antarctica's Sledge Dogs

Co-produced by the National Geographic Society and the Australian Broadcasting Corporation, 1993, 54 min. $29.95rrp.

This video presents the story of the sledge dogs at Mawson Station and their deportation to their new home in the United States. The Madrid Protocol stipulated that all introduced species except humans must be removed from Antarctica, so the Huskies had to go.

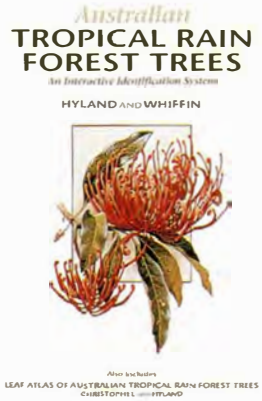
The story starts with one of the last dog-sled expeditions in Antarctica. This involved two teams on a 630-kilometre return trip, travelling 45–50 kilometres a day, to inspect penguin rookeries. The preparation, events during the journey and hardship encountered are all well documented. The expedition took 33 days and eight of them were spent pinned down by blizzards and temperatures down to –40° C. There is remarkable footage of the dogs sleeping in very high winds and nearly covered with snow. An interesting part of documenting the expedition is the historic flashbacks of the 100-year partnership of dogs and humans in Antarctica. There were excerpts of Scott's, Amundsen's and Shackleton's expeditions, illustrating their success or lack thereof in using dogs. A brief history of sledge dogs in Greenland and Labrador is included.

The expedition ended successfully and it was time to load the dogs into the *Aurora Australis*, Australia's only ice-breaker. They were driven part way to the ship but eventually the ice conditions were so poor that they had to be air-lifted to their specially built kennels. Three weeks were spent at sea before they arrived in Hobart and then on to the United States. After arriving in Los Angeles they and their kennels were trucked to Wisconsin by way of California, Nevada and Utah.

The 22 dogs, with such delightful names as Bear, Cocoa, Copper, Lobo and Zipper, travelled more than 20,000 kilometres in about four weeks to their new home in Ely, Wisconsin. They quickly acclimatised to the conditions and became acquainted with trees for the very first time in their lives. Later, five of the dogs were used on an expedition to the North Pole. All of them are to be used as working sled dogs.

The video is excellent in all senses of the word. The photography of Malcolm Ludgate and his associates is outstanding. Chris Hilton and Jonathan Chester have done a marvellous job in relating an interesting and stirring account of the last dog sledge expedition, the dogs' removal from Antarctica and their successful relocation. I recommend this video to all who have an interest in dogs, and in Antarctica and its history. The production was well summed up by my eight-year-old daughter as "absolutely beautiful".

—Donald Horning
Macleay Museum, Sydney University



Australian Tropical Rain Forest Trees: An Interactive Identification System Volumes 1 & 2

By B.P.M. Hyland and T. Whiffin. 303pp. and 564pp.

Volume 3: Leaf Atlas of Australian Tropical Rain Forest Trees

By D.C. Christophel and B.P.M. Hyland. 260pp. Published by CSIRO Publications, Vic., 1993. $195.00rrp.

Printed dichotomous keys have long been used as an aid to the identification of plants. Since dichotomous keys tend to extensively use reproductive features, these keys usually fail if the plant is sterile when collected. Some keys require both flowers and fruits for a successful identification to be made, but the plant may flower several months before the fruits are mature. Therefore, it is very unlikely that both flowers and fruits would be present at any given time. Further complications occur in those deciduous plants that only flower when the leaves are absent!

Apart from the above limitations to the dichotomous

key, many plants are morphologically more variable, especially when considered over a large area, than can be concisely dealt with in these 'single-entry' keys. One of the theoretically better aids is the multi-access polyclave. However, these have suffered from the physical limitations of how to construct one. And printed multi-access keys have only been produced for a few large groups. Although these keys tended to be very successful aids to identification, they were usually tedious to use. However, computers are able to construct and use multi-access keys with ease and this new publication is an excellent example of such a key.

Bernie Hyland and Trevor Whiffin have produced an excellent interactive computer key to 1,056 species of Australian tropical rainforest trees (many of them as yet undescribed). The data set includes all single-stemmed woody species that are at least six metres high at maturity and occur on mainland Australia, north of 19° S latitude. The key allows the user to select from bark, leaf, flower, fruit and seedling features; as well as the family name and geographic area.

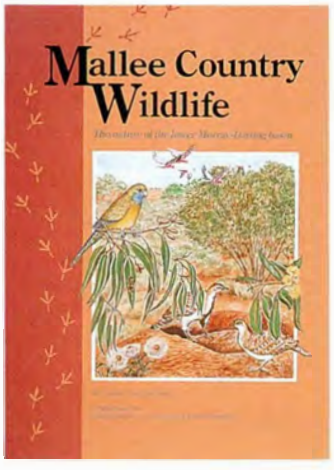
The package consists of three computer disks: one pair contains the data set and programs for use on MS-DOS computers, whereas the other disk is for use on Apple Macintosh computers. Volume 1 contains installation instructions and information on how to use the keys, descriptions and illustrations of the characters available, a glossary, and lists of the relevant species (by scientific, common and standard trade names). Volume 2 contains a short description of each species (arranged alphabetically by genus within the family), additional (diagnostic) features for each species to aid in identification, brief notes on the distribution and ecology of the species, and references to the most important literature.

The keys are easy to use and readily provided correct identification on the species that I tried. However, with a more comprehensive data set, a correct identification of some taxa would have been achieved with fewer characters. Future improvements could include: species illustrations, all the data that is contained in the volumes being in a computer-accessible form, and some guidance as to which characters are likely to lead to a correct identification.

In Volume 3 Dave Christophel has combined with Bernie Hyland to provide near life-sized low-voltage X-ray photographs of typical mature leaves of the species covered by Hyland and Whiffin. This excellent volume greatly enhances the others by clearly documenting the leaf shape, size and venation patterns of the rainforest species.

Overall, the authors must be congratulated for this very professionally presented package. It is a major contribution to the identification of Australia's tropical trees.

—Barry Conn
Royal Botanic Gardens, Sydney



Mallee Country Wildlife: The Nature of the Lower Murray–Darling Basin

By Sid Cowling and Deborah Savin. Gould League of Victoria and Department of Conservation & Natural Resources, Vic., 1993, 64pp. $19.95rrp plus postage.

This book is designed to "provide a basic understanding and overview of the different lands of the Mallee Country and guides the reader towards more detailed sources"—and it certainly does.

The typical Mallee Country is dominated by a dense growth of low trees, usually three to six metres in height, with a varying amount of low ground cover, and can be found fringing the southern borders of the arid and semi-arid regions of inland Australia. This 64-page soft-cover publication captures the heart and soul of the Mallee Country. As well as discussing the fauna and flora of the lower Murray–Darling region, it informs the reader about some of the problems associated with human settlement.

The book's format is easy to follow, and the comprehensive index makes it ideal for quick referencing. In the back of the book there is also a handy glossary, explaining some of the more commonly used terms.

Within the book, the Mallee Country is divided into 16 sections and each section is allotted four pages. The first two pages of a section discuss the vegetation of each ecosystem, as well as some of the management aspects, development problems or simply an in-depth view of some of the unique wildlife found there. They have a good mixture of text and tables, and include a cross-section drawing of each land system, habitat photographs and small regional maps.Unfortunately, a few of the photographs have been poorly reproduced but, on the whole, they are a handy addition.

The next two pages are dedicated to some of the plants and animals that occur in each area. These consist of a number of uncomplicated colour drawings and a paragraph of descriptive text on each. Unfortunately, due to limitations on space, not all species discussed have an accompanying picture.

Gould League publications are always a worthwhile addition to any educational library and *Mallee Country wildlife* is no exception.

—Peter Rowland

Evolution and the Recognition Concept of Species: Collected Writings of Hugh E.H. Paterson

Ed. by F. McEvey. Cambridge University Press, Vic., 1993, 234pp. $68.50rrp.

What is Hugh Paterson, a geneticist, doing with a photograph of a fossil on the jacket of the book of his collected writings? If you did not know, you would be tempted to think this was just another of those hyped, hastily written, palaeontological books that will be *Jurassic Park*'s legacy for science. It isn't. The book is far more important.

The jacket illustration is a photograph of a perfectly preserved insect wing from the Middle Triassic shale near Sydney. The wing is remarkable not only because of its state of preservation but for the detail it shows of a tympanum—a tympanum that once made sounds that reverberated in forests long since gone. The insect and the forests might be gone but the process of producing sound to attract reproductive mates goes on.

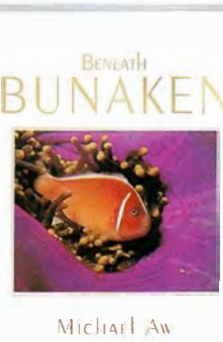
Therein lies an indication to Paterson's approach to evolutionary theory. He has investigated the origin and function of mechanisms that bring about fertilisation. And the crux of this is his Recognition Concept of Species (RCS)—that a species is "that most inclusive population of individual biparental organisms that share a common fertilisation system". This is a simple statement but it is a severe attack on the Synthetic Theory of Evolution and its basic tenet, the Biological Species Concept (BSC)—that a species is "a group of interbreeding natural populations that are reproductively isolated from other such groups". The BSC thus delineates a species' gene pool in relation to another species. The RCS, however, delineates a species' gene pool by its own fertilisation system—a species is self-defining and does not need to be considered in relation to another species. Simply put, the BSC means that the study of speciation is about what keeps two gene pools apart (reproductive isolating mechanisms or RIM). However for the RSC, it is about what keeps a single gene pool together. Paterson calls these specific-mate recognition systems or SMRS.

Some authors have argued that there is no difference between the RIM and SMRS or, begrudgingly, that they are just two sides of the one coin. One example will show that this is not so. Hybrid sterility is a well-known RIM but it is not an SMRS. And, in this, the RCS has never had to overcome the hoary problem of explaining how hybrid sterility can evolve. The feature of not having offspring can not be selected for—leaving more offspring, not less, is the corner stone of natural selection. For the RCS, while hybrid sterility is an interesting subject, its origins have to be looked for elsewhere other than in the process of speciation. To turn a phrase, the RCS has made an ass of the mule and the BSC.

With hindsight, Paterson's work was one of the first serious challenges to the Synthetic Theory, but we still need a few more years to judge his importance. One can say this much: prominent theorists such as Niles Eldredge have embraced Paterson's ideas while, behind the scenes, there has been a flurry of grant applications to prove him wrong.

This book is most welcome in making Paterson's papers more readily available. Most of his work has been published in hard-to-get African journals. It is not an easy read but Paterson's introductions help as well as give insights into the politics of biology.

—Glen Ingram
Queensland Museum



Beneath Bunaken

By Michael Aw. Ocean Geographic Media, NSW, 1993, 180pp. $120.00rrp.

Beneath Bunaken is a beautiful coffee-table book on the underwater world. Encompassing 182 of Michael Aw's award-winning photographs and the witty comments and whimsical poetry of writer/artist Kaitlyn Burke, this is not a book on diving, but rather a pictorial essay of a remote and little-visited area of the world.

Set in the Bunaken Marine Reserve off the north-eastern coast of Sulawesi Island in Indonesia (an area renowned for the diversity of its rich marine environment), *Beneath Bunaken* takes the form of a 24-hour almanac. Kind of a 'Day in the life of Bunaken', it shows us the awe-inspiring sparkling blue landscapes and flurried activities of daytime reef dwellers as well as the surreal world it becomes after dark.

Keen photographers will enjoy the appendix, which details the technical aspects of each photograph, while marine biology buffs might rightly conclude that this is the fanciest species identification book ever to grace their bookshelf.

Beneath Bunaken will also appeal to the ecologically conscious since a portion of each sale is dedicated to the installation of permanent boat moorings in the Bunaken Marine Reserve. Boat anchors cause a great deal of damage to delicate corals, often destroying decades of growth in a single instant. Setting up permanent moorings at popular dive sites precludes the need for anchors, greatly assisting in the preservation of the underwater environment.

New book owners are invited to register themselves by filling out a form included in the book's packaging. With each 100 forms received, a mooring will be laid and a plaque, engraved with the names of the 100 book owners, will be placed on shore in close proximity to the actual mooring they have helped fund.

No expense has been spared in the production of *Beneath Bunaken*. Using an expensive six-colour printing system, each of the 180 pages is lacquered for a high-gloss finish and the whole thing is packaged in a matching slip cover. Beautifully presented, this book would be a well-received gift for either yourself or a hard-to-buy-for friend or relative.

—Becca Saunders

JUST PUBLISHED

SEPTEMBER

The Rise of Fishes *By John Long. New South Wales University Press, NSW. $49.95.*
Coastal Marine Ecology *By A.J. Underwood & M.G. Chapman. New South Wales University Press, NSW. $29.95.*
Reader's Digest Photographic Field Guide to the Birds of Australia *By J. Flegg & N. Longmore. Reader's Digest, NSW. $35.00.*

OCTOBER

The Secret Oceans *By Betty Ballantine. Crawford House Press, NSW. $29.95.*
Skeletons: An Inside Look at Animals *By Jenny Johnson. Reader's Digest, NSW. $22.95.*
Dingo: Australia's Native Dog *By Lawrence K. Corbett. New South Wales University Press, NSW. $24.95.*

NOVEMBER

Reader's Digest Atlas of Australia *Reader's Digest, NSW. $75.00.*
Salinisation of Land and Water Resources: Human Causes, Extent, Management and Case Studies *By F. Ghassemi, A.J. Jakeman & H.A. Nix. New South Wales University Press, NSW. $69.95.*

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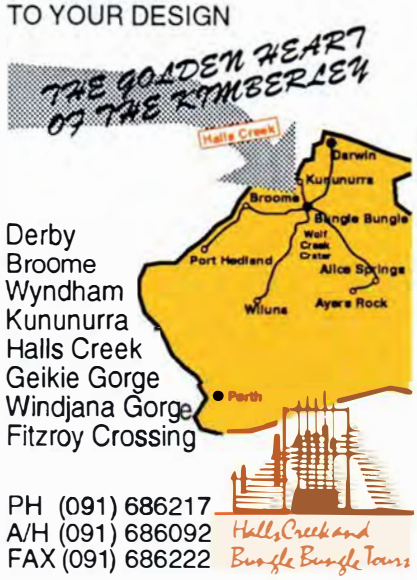

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Q&A

Big Headed

Q: *How could we have evolved with such a large head? People often talk about educating parts of the brain we don't use. How could we have evolved parts we don't use, especially as a large head surely has some disadvantages? If we don't use all of our brain, what did early man need such a large head for? Has our brain capacity changed much since early man? Is our brain capacity evolving before our needs?*

—R. Belling
Tarcutta, NSW

A: Our understanding of the processes of evolution allows for the evolution of structures or physiological systems prior to their employment. Thus, the capacity for our five-toed limbs was available in the fins that our fishy ancestors used for swimming. The pineal gland in the middle of the human brain was once an eye on the top of the head as well as a gland that produced hormones; it could therefore be said that it was an endocrine gland before this became its only function.

In the course of human evolution, the size of the brain remained at a more or less constant ratio to body size until about two million years ago, after which it nearly doubled in volume. This was not the equivalent of a photographic enlargement, but involved a great development of the cerebral hemispheres, which are involved in the coordination of information, learning, speech and what may generally be termed 'intelligence'. The 'old brain' underlying the cerebral hemispheres remains, as in apes and other vertebrates, an efficient organiser of the body's more automatic functions.

The only credible explanation for this almost explosive increase is the development of speech. Once our ancestors had developed even the simplest use of words to store information about individual experiences there was, in simple evolutionary terms, an advantage in having a brain that was more capable of integration of information, rather than relying on instinct (the realm of the old brain). As the cerebral hemispheres accumulated more nerve cells, they created the opportunity for more elaborate use of language and there was, in effect, a situation of positive feedback (the informational equivalent of an explosion).

Why hasn't the brain continued to increase in size? The answer is that the sort of life made possible by the brain, which has remained pretty much at its present size of about 1,500 cubic centimetres for the last 50,000 years, liberated humans to a great extent from the previous constraints of natural selection but put a cap on most aspects of their physical evolution. The biological cost was high. The difficulty in giving birth to a child with a large head was such that it could only be achieved by producing very immature young and then with difficulty and pain. Nevertheless, it has proved worthwhile.

Our large head evolved to house a large brain, which liberated us, to a great extent, from the slow evolution of instincts. Except in individuals with specific defects, people use all parts of their brain and it is simply not true that we have evolved some sections that aren't used. On the other hand, the potential for interaction between the millions of nerve cells in the cerebral hemispheres—involving memory, learning, thought and intelligence—is so great that we have yet to encounter a healthy person who has used up all of its capacity. Only in this sense do we have parts of the brain that we do not use.

—Ronald Strahan
Australian Museum

DENSEY CLYNE/MANTIS WILDLIFE FILMS

Appearing above ground in autumn and winter, the fruiting body of the Stink Horn fungus lives up to its name.

KATE LOWE

PIC TEASER

Do you recognise this? If you think you know what it is, then send your answer to Pic Teaser, ANH Magazine. Please don't forget to include your name and address. The first correct entry will win a $20 gift voucher from the Museum catalogue. Winter's Pic Teaser was row upon row of filleted fish.

Stink Horns

Q: *I've been bushwalking at Mt Buffalo National Park, Victoria, every summer since 1966. I also lived on the plateau for two and a half years and, during this entire time, I had never seen this plant there—until now. It was ten centimetres high and looked like a puffball split open with towering flesh-red cylinders emerging out of the split. There were tentacles around the edges and the centre was a dark sticky hole. Can you tell me what it is?*

—J. Walker
Kinglake West, Vic.

Mouse spider venom may be as toxic as funnel-web venom. Eastern Mouse Spiders are found in the east coastal and highland regions, whereas Red-headed Mouse Spiders (*M. occatoria;* male and female pictured) are found mainly west of the Great Dividing Range.

A: This plant appears to be a fungus called *Aserone rubra* (common name 'Stink Horn'). The fungus usually exists as fine threads under the soil but around autumn and winter it erupts into a fruiting body. It occurs in the eastern and southern regions of Australia and is often gregarious in native forests. The name 'Stink Horn' comes from the fruiting body, which smells of rotting meat in order to attract flies—the fungus' primary pollinators.

—Royal Botanic Gardens
Sydney

Spider Facts

Q: *I recently had to rescue someone from a mouse spider. Is it true that the LD50 (Lethal Dose 50 per cent) of this species is thought by some toxicologists to exceed that of the Sydney Funnel-web (Atrax robustus)? Also, have you any information on likely toxicity of this mouse spider to household pets like cats and dogs?*

—Ray Burton
Cardiff Veterinary Hospital, NSW

A: The venom of the Eastern Mouse Spider (*Missulena bradleyi*) has proven to be at least as toxic as funnel-web spider venom in animals such as mice. One dangerous bite was recorded from a mouse spider in Queensland but the child victim recovered fully after being given funnel-web antivenom. The danger to pets is unknown, but given that funnel-web venom does not cause significant problems in non-primate mammals (such as cats and dogs), it is fairly safe to assume that mouse spider venom would be similar.

—Mike Gray
Australian Museum

Answers to Quiz in Quips, Quotes & Curios (page 18)

1. Animatronics
2. Pitohuis
3. Wildlife Information & Rescue Service
4. An ice-free area.
5. 100 billion
6. Mt Stromlo Observatory, ACT
7. Eye colour. Adult females' eyes are pink-red, males' are brown.
8. Tim Low
9. 50
10. Tidal or harbour wave

N.N. BIRKS

Simple-minded, aesthetic perceptions of environmental values can be at odds with ecological realities.

OVERTIDYING THE OUTBACK

BY HUGO PHILLIPPS

THE NULLARBOR PLAIN IS A pretty empty kind of place, in the minds of many Australians. The name means 'no trees', although there is not much of anything else either. It is a conceptual blank, a chunk of dry, flat, sparsely vegetated land. Virtually nobody lives there, it is no good for any profitable human activity, and is crossed by a road, a railway and a telegraph line that have the longest straight stretches in the world. It may be a wilderness largely untouched by the plough or the chainsaw, but it is an uncharismatic wilderness; it lacks the biological and structural grandeur and complexity of the coral reefs, lush wetlands and tall forests, as well as the aesthetic and romantic savagery of the central deserts. Such is the myth.

On this flat land, artificial structures stand out. The telegraph wires that linked the people of Western Australia with those in the eastern States were supported by poles that, although not particularly tall, were visible from a fair distance. As the most prominent features in an otherwise featureless landscape, they were used by many of the birds of the Nullarbor as roosting sites, as perches from which to look for their next meal, and as secure places on which to build their nests. They helped maintain a little ecological diversity in an impoverished landscape. But now the poles are gone.

With the development of optical fibre technology and its application to telecommunications, telegraph poles in many parts of Australia have become redundant and are being removed. This has implications for bird conservation.

When word got out that Australian National Railways (ANR) was knocking down all the Nullarbor poles, people concerned about the effect on birds raised the alarm. ANR was asked to halt the pole removal program while the problem was discussed. When ANR refused to slow down, or temporarily halt, the program, it was asked to at least leave every fifth pole in place for the birds. ANR ignored the request. Even though questions were asked in Federal Parliament by Christine Gallus, Shadow Environment Minister, about the effects of pole removal on the Nullarbor's birds, it did not halt ANR's bureaucratic bulldozer.

Wedge-tailed Eagles (*Aquila audax*) once nested on the Nullarbor telegraph poles.

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It is interesting to look at the arguments that ANR came up with to explain their complete unwillingness to modify the pole removal program. At first they said that the birds using the poles were non-native species. This is not so; the corvids, woodswallows and raptors that have been recorded using the poles for roosting and nesting are all native birds.

ANR then said that the poles might fall across the railway lines and be a danger to trains. This was countered easily by the fact that the poles were too far from the lines to fall across them. Indeed, the poles would originally have been erected far enough from the tracks for that very reason.

The argument then moved to the possibility of vandalism; concern that travellers along the line maintenance track would knock the poles down themselves and then drag them across the tracks. Although one cannot completely eliminate this possibility, it was pointed out to ANR that the psychopaths who would sabotage trains could find many more accessible lines to vandalise than that across the Nullarbor. At this point ANR appeared to run out of simple excuses, and its next defensive tactic was more esoteric. It was removing the telegraph poles in order to tidy up the outback, with the strong implication that the removal of artificial structures and debris was somehow returning a marred wilderness to its primeval and pristine state.

Actually the Nullarbor is far from pristine (in the sense of being unaffected by events stemming from European settlement of Australia). The arrival of rabbits at the end of the last century, followed by foxes some 30 years later, has seen to that. Several bird and mammal species have declined or become locally extinct, and have been replaced by rabbits, foxes and feral cats. Of these the rabbits are perhaps the worst; not only do they have an impact on regeneration of native vegetation, but their presence also allows the feral predators to exist in the numbers that they do.

The raptors that would have preyed on the native herbivores, and later switched to rabbits, would probably also have been safe enough nesting in the trees of the Nullarbor's sparse arid woodlands...until foxes and cats came along. About the only places on the Nullarbor well and truly out of their reach were the upper part of the steel telegraph poles that ANR was in such a hurry to remove.

It is saddening that the Nullarbor poles were removed at least partly for such simplistic and environmentally misconceived reasons as 'tidiness'. There are plenty of places in the world where raptors are encouraged to nest on artificial structures, and a little corporate imagination might have used these 'railway raptors' to encourage tourists to travel by train.

However, even though the Nullarbor poles have been lost, there is still some opportunity to retain poles in other places where the lack of tall trees means a dearth of secure nesting and roosting sites for Australia's open-country raptors. A lesson that this exercise has reinforced is that simple-minded, aesthetic perceptions of environmental values can be at odds with ecological realities. After all, the last surviving population of the Eastern Barred Bandicoot (*Perameles gunnii*) on the Australian mainland, a species closely related to one that used to live on the Nullarbor, was found in the rubbish dump of the Victorian country town of Hamilton. ■

Hugo Phillipps is the Conservation Officer of the Royal Australasian Ornithologists Union, and is also active in the Australasian Wader Studies Group.

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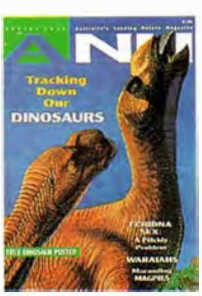

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S U P P L E M E N T S

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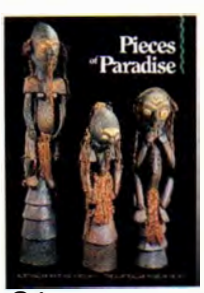

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S2
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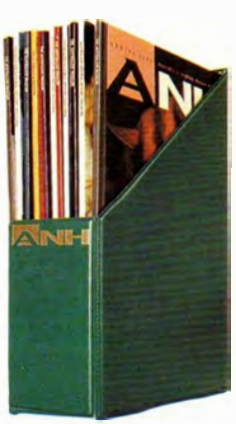
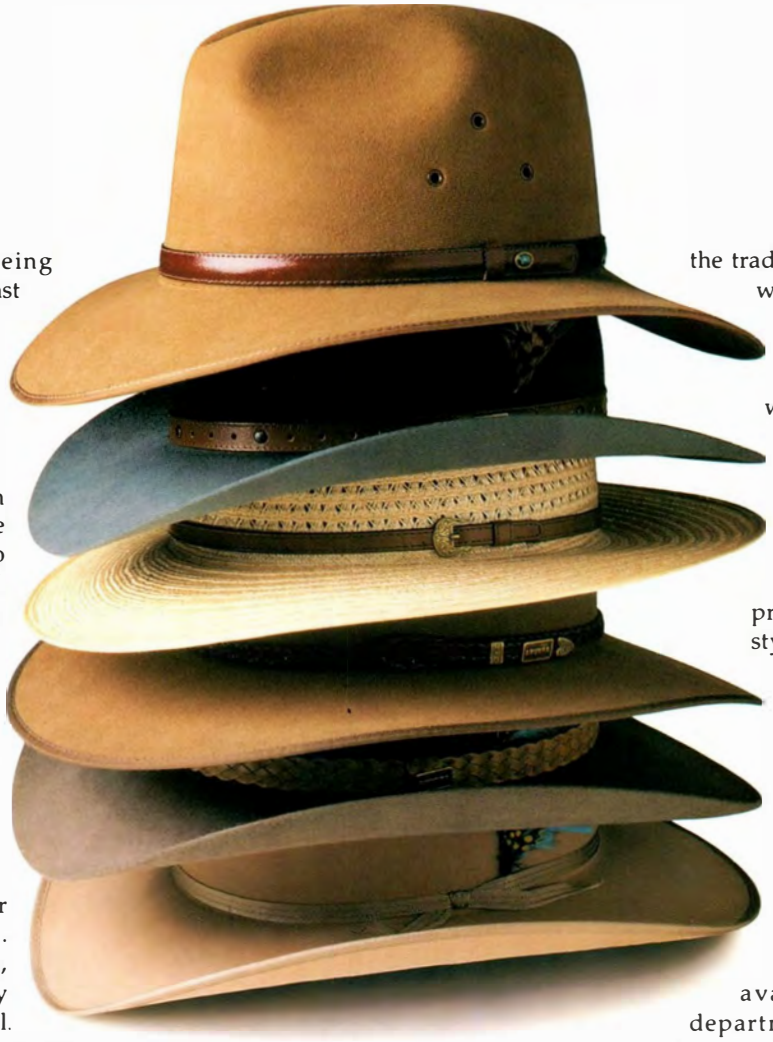


ANH's library box holds 12 issues of the magazine. Finished in durable, dark green PVC. It will ensure your copies remain in mint condition.

To order use the form opposite

The reasons for owning one, keep stacking up.



Apart from being sensible protection against our harsh Australian climate, Akubra hats are very fashionable.

The difficulty really, is being spoilt for choice.

If we had ten pages in this magazine we might just be able to show you our range of hats. That is of course, without including all the different colours and trims.

So we selected six styles to whet your appetite.

We've come a long way since the early perception that our hats were only for the man on the land. From horses to Holdens, at Akubra, undoubtably we've been through it all. Interestingly though, as time progressed and the car roof became lower it created a problem for Akubra as the traditional style hats could not be worn due to their height. But, as with our hats, fashions change and the introduction of the now popular four wheel drive allowed Akubra to raise its game once more.

In fact, it's nice to know, that the United States, so often recognised for leading the way in many trends, is delighted by the range of styles that we offer. This variety has enabled customers to buy hats that are particularly suited to them, rather than just the traditional cowboy style, for which America is renowned. The hat industry over there has named it 'The Australian Look' and we're very honoured that they have.

Over the years at Akubra, now proudly in its fourth generation of Australian family ownership, we have produced many different styles with many different names, some more famous than others.

However, with all our many hats to choose from we can assure you that one thing has remained the same, our quality. It's what our reputation is built upon.

Akubra hats are available from leading department stores, hat shops and saddleries nationwide.

AKUBRA