AUSTRALIA

WINTER 1998

ARE OUR OFFSHORE ISLANDS SAFE?

TUSKED FROGS

WATTLE-BIRDS

LYREBIRDS

AUSTRALIAN TORNADOES

TIDAL WAVES

Free Blossom-bat Poster

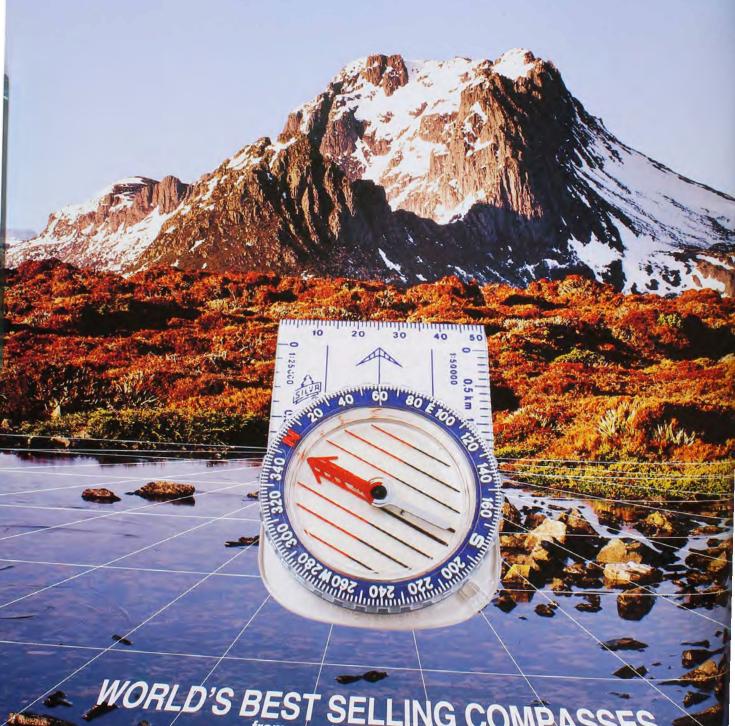




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Up Front

o you worry about being wiped out by a giant 100-metre-high wave as you stroll down the city streets? When a thunderstorm hits your neighbour-hood do you quake in fear that a tornado could be about to twist your life apart? No? Well maybe you should consider it, because both these disasters are a possibility if you live in Australia.

In this issue's Views From the Fourth Dimension, Michael Archer presents us with the possibility that 'tidal waves' or tsunamis may be regular visitors to the Australian coastline and at any moment we could all be dumped by the mother of all waves. Feeling safer because you live farther inland than us crazy coastal dwellers? Well think again, because we are all much more likely to experience the ferocity of a tornado. These devastating twisting

columns of air belong to the same family of weather phenomena that includes the gentle gusts of wind that swirl papers around a school playground or car park, and they are much more common in Australia than we would all like to think. They can also occur just about anywhere, from our densely populated city suburbs to the middle of the outback. In "Twisting the Night Away" Geoff McNamara gives you the run-down on tornadoes in Australia.



For less threatening reading you can

explore the mysterious life of lyrebirds. These birds are extremely secretive and it's a feat just to catch a glimpse of them, let alone study their behaviour. Or why not delve into the life of Tusked Frogs and find out why they have been endowed with tusks like those of an elephant or walrus? Studying the survival techniques of tiny blossom-bats has led Fritz Geiser to question the long-held belief that the ability to maintain a near-constant body temperature (homeothermy) is a general mammalian characteristic. Discover why in his article "Cool Bats". And Mark Eldridge raises the issue that all may not be well on our offshore islands. As animals become extinct on the mainland, many scientists have pinned the hopes of an entire species' survival on tiny offshore island populations. But are these animals up to

the task? Find out in "Trouble in Paradise".

In our regular features we take a light-hearted look at the misnamed Little Wattlebird, discover how our rainforest trees got their names, meet the rare Carpentarian Rock-rat, and highlight the greed that is destroying our beautiful Indo-Pacific coral reefs. All this, plus your free poster is the tiny Common Blossom-bat. Happy reading.

-Jennifer Saunders



Natüre

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Front Cover
Now only found on
four offshore islands,
the Burrowing Bettong
(Bettongia lesueur)
became extinct
throughout central and
western Australia in
the 1940s. Photo by
Jiri Lochman/Lochman
Transparencies.

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TROUBLE IN PARADISE?Being safe and secure from predators on an island may not save a species from the enemy

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A storm cloud has the potential to evolve into a whirling vortex of destruction, sucking up everything in its path . . . if the conditions are right! Geoff McNamara gives an exciting explanation of tornadoes in Australia.

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TUSKED FROGS

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THE BACKYARD NATURALIST WATTLE WE CALL THIS CLAYTONSBIRD?

The Little Wattlebird has been thrice denied, for it has neither beauty, nor song, nor, in fact, wattles. So what should it be called?

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RARE & ENDANGERED CARPENTARIAN ROCK-RAT

A survey of the rugged hinterland of the Gulf of Carpentaria revealed a new species of rock-rat, tenaciously clinging to just a few limited patches of suitable habitat.

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STRANGE NAMES IN DARK FORESTS

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RAPING THE REEFS AND REAPING THE PROFITS

Next time you see a Napoleon Wrasse in a restaurant tank, think about the species that died to get it there.

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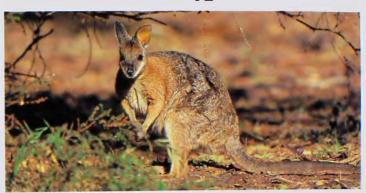
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LETTERS

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

Understanding Magpies

Thankyou for an excellent magazine. I particularly enjoyed the Spring 1997 issue containing Nick Cilento's article and study of the much-maligned Australian Magpie.

My own experience as a child living in the hills near Perth (Lesmurdie, Western Australia) was of being absolutely scared witless by this bombing behaviour, and I would swing a great stick above my head and throw rocks at the retreating bird. One dear old chap who witnessed this behaviour sagely advised me that I

would only aggravate the Magpie. I recall thinking that I was the one who was aggravated.

However as an adult living in South Australia, I have changed my behaviour. I have discovered that, on turning and facing the oncoming Magpie, it will always abort its attack before making contact. Another approach is to have your pet Dog with you. In this case, I have been ignored by the Magpie and my Dog has become the target, who seems to think it is all a bit of a game.

This would seem to be consistent with Cilento's con-

clusion that the male Magpie is not overly serious about the attack but is merely 'showing off' to his mate.

I hope my experience may be of help to others who, deep down, also love these rather perverse Australian creatures.

> —Stephen Dose Redwood Park, SA

Aboriginal Isolation?

I was interested in the article by Michael Archer, "Worries about Withering Wombats", in the Spring 1997 issue of *Nature Australia*. I was particularly drawn to the last two

paragraphs where the danger of restricting migration, as advocated by a number of politicians and academics as well as Pauline Hanson, could be a threat to our longterm survival.

One connotation that could be drawn from Archer's article is that, as a result of their long-term isolation and small numbers, the Australian Aborigines must have been in a parlous state at the time Europeans arrived. Indeed the Tasmanian Aborigines must have been close to, if not at, the point of no return as a people.

Perhaps Archer could enlighten us on what effect 40,000 years of isolation had on the original Australians and their prospects if there had not been an influx of "biological and cultural change" brought about by European settlement.

—Don Moran Tea Gardens, NSW

More on Wombats and Hanson

I was astonished when Michael Archer, in the Spring 1997 issue, transmuted a Hairy-nosed Wombat into Pauline Hanson! The need for genetic diversity is well known, and Archer points out the danger of inbreeding, quoting the Amish of Pennsylvania. Not all additions to a genetic pool are necessarily advantageous, and in Australia the 'bad' gene for Thalassaemia (faulty red blood cells) has been introduced from the Eastern Mediterranean.

Australia already has a very diverse genetic pool. The biggest contribution is from the English, but that has a wide base—Roman soldiers, Viking invaders, French Normans, religious refugees from the Continent, and so forth. The next largest contribution would be Celtic from Irish immigrants. There were many refugees from central and southern Europe after World War 2. Add in smaller groups such as the Afghan camel drivers, Chine se who have been here for 200 years, and recent South Asian arrivals. Nor should we overlook that there has been the introduction of Indigenous genes



OON W. HADDEN/NATURE FOCUS

Learning to live with Magpies.



Tammar Wallabies are considered to be dedicated herbivores, yet they are known to eat a variety of animals.

into the mainstream pool. Is Archer seriously suggesting that Pauline Hanson is going to make any significant difference to this diversity?

Archer makes a plea for maximising our diversity, but the present politically correct 'multiculturalism' is the exact opposite, as it accentuates and perpetuates the biological and cultural differences, which he rightly deplores. It seems to me that people in the community who espouse the preservation of separate cultures are the ones who fear change, and probably pose a worse threat than Pauline.

(I was enjoying reading about wombats!)

—John Bloomfield Casuarina, NT

Elusive Hyphens

No, Nature Australia, we pedants can't resist pointing out that you got it wrong. The longest living mammals (Quick Quiz, Spring 1997) are not humans at something under two metres, but Blue Whales at around 25 metres.

The longest-living mammals, on the other hand, undoubtedly are humans, at three-score years and ten or somewhat more.

But you're in distinguished company in your neglect of the crucial hyphen. After all, Tim Flannery titled his brilliant and compelling book *The future eaters* (those who will eat in the future), when I'm perfectly certain that what he intended was *The future-eaters* (those who are eating their future).

—Angus Martin Biotica, Melbourne, Vic.

Carnivorous Herbivores

The report in the Spring 1997 issue of Nature Australia of carnivory by herbivorous Spanish slugs calls for further comment. The mild surprise inferred by the question mark in the title ("Meat-eating Slugs?") highlights the general lack of awareness of the extent to which many presumed herbivores are, in fact, nothing of the sort.

In The inadequate environment (1993) I discussed a number of examples of animals which, like most slugs (there are species that are wholly carnivorous), are considered to be obligate herbivores but eat animal tissue whenever or wherever the opportunity arises. This carnivory may take the form of predation, cannibalism, scavenging, coprophagy or the digestion of ruminant micro-organisms, and its function is the alleviation of the chronic shortage of nitrogen from which most herbivores suffer for most of

Carnivory by herbivores occurs among arthropods, molluses, fish, reptiles birds and mammals. However, probably of most interest to readers of your journal are the examples of active predation by those birds and mammals that most people—even many biologists—assume to be wholly herbivorous.

All birds and mammals start life as obligate carni-

vores, nurtured by protein provided by their mothers' bodies. But many seed- and nectar-eating birds must feed their young on insects. And mammalian herbivores such as the Giant Panda, the Gorilla, squirrels, voles, bats and many Australian possums, all, to a greater or lesser extent, prey upon other animals, both invertebrate and vertebrate. More recently Hippopotamuses have been reported eating Impala, and seagrass-eating Dugong s not only eat fish caught in nets, but systematically feed upon ascidians (sea squirts).

The quintessentially Australian wallabies are also considered to be obligate herbivores. However, the Tammar Wallaby is known to eat a variety of animals, including young birds and mice, and insects which it actively digs up. Allied Rockwallabies and Rufous Harewallabies are also known to supplement their diet with insects. And Michael Archer reported how his pet Swamp Wallaby snatched and ate

chicken from his plate on the table (Nature Aust.* Spring 1994). The same behaviour has been recorded for a pet Allied Rock-wallaby.

This number of cases begins to suggest that carnivory may be much more common among the possibly wallabies-and other 'herbivores'-than is believed. In science, as in life generally, we often do not

Sydney to sell this fish. According to Dave Pollard, the fish is not found in New South Wales waters, and is therefore not listed as a threatened species in this State. In an analogy, neither are Tigers found in New South Wales. Does this mean that it could be legal for us to sell Tiger fur in shops here as well? Also, as Koalas are not found in Hong Kong, do

As Koalas are not found in Hong Kong, do we believe it is legal to trade Koalas there?

see something until we go looking for it. How many more examples await such directed looking?

-Tom White University of Adelaide, SA

Wrasse Report

While Australia and its environmentalists continue to condemn the live fish trade by Asian restaurants selling Napoleon Wrasse (Cheilinus undulatus), Australia is itself exporting this fish to Asia. This species is listed by the IUCN as threatened. This is defined as being prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming critically endangered or even extinct in a very short period.

Restaurants in Sydney's Chinatown are also selling live Napoleon Wrasse. An 80centimetre individual was seen squashed into a small tank at the Golden Century Restaurant, Sussex Street, Haymarket, last October, The price tag . . . \$A1,000. As I write this, OceanNEnvironment is trying to gather resources to purchase this fish for release in Queensland waters.

A phone call to the Fisheries Research Institute revealed that it is perfectly for restaurants in we believe it is legal to trade Koalas there?

Further questions to the Queensland Fisheries Management Authority confirmed that it is not only legal to catch Napoleon Wrasse, a threatened species listed by IUCN, in Queensland waters, but there are no restrictions imposed on this species for commercial fishermen. Ben McMullen cites the reason being that the species is naturally low in abundance in the wild! Do we see a point in this argument? A species that is naturally found in small numbers, therefore go for it, catch as many as you can. Apparently research restrict harvest of Queensland Grouper (Epinephalus lanceolatus) and Napoleon Wrasse is in the pipeline. However, based on the track record of Australia's fisheries departments, it might be the year 2020.

Meanwhile, it is perfectly legal for Australians to harvest Napoleon Wrasse and sell them to restaurants in downtown Sydney and Asia. Those supporting an Australian ban on exporting this fish should contact Colin Griffith, Director of National Parks and Wildlife, at Environment Australia (GPO Box 636, Canberra, ACT 2601).

> --Michael Aw OceanNEnvironment Carlingford, NSW

Aborigines and Ticks

Mention was made by

Stephen Doggett (Nature Aust. Autumn 1997) of the Australian Paralysis Tick's ability to cause paralysis and occasionally death in species with a short historical association with the tick. Doggett also mentioned that, until an antivenom was produced in the 1940s, this species list included humans. Aboriginal Australians have occupied this continent for at least 50,000 years, so is it not possible that they may have immunity acquired Paralysis Tick envenomation during this long prehistoric association?

Certainly the nature of a hunter-gatherer lifestyle frequent ensure encounters with ticks, and one would consider that such a long association would reduce the effect of the tick's preliminary A venom method of testing this hypothesis would be to see if there have been any cases in the past of Aboriginal Australians being diagnosed with Paralysis Tick envenomation. If a level of immunity is diagnosed, would it then be possible to identify the biological mechanism for responsible such immunity?

> -Michael Westaway Taring, Old

Despite contacting several Aboriginal research organisations, I was unable to obtain any information on the effects of the Paralysis Tick on Aborigines. However, Dr Salvador Gala, from the Department of Immunology at Westmead Hospital, offered some useful comments regarding the possible biological mechanism of resistance, if indeed a low incidence of tickinduced paralysis was found to exist in Aboriginal populations.

Gala explained that the biological mechanism of resistance would be unlikely to have an immunological basis. A specific immune response to any particular infectious or envenomating organism requires that an individual first be exposed to the organism, with the effect that the immune system undergoes certain changes in which it acquires the ability to eliminate the organism, and subsequently attains a state of

'immunological memory' to help eliminate the organism more rapidly following a subsequent exposure. However, as Gala explained to me, there is no evidence that specific immunological memory can be conferred as a genetic trait within any given population. What is more likely is that Aborigines may have a genetic basis for resistance to the effects of the Paralysis Tick venom, possibly as a result of evolutionary influences consequent to their lifestyle, as suggested by Westaway. Gala cited several examples

of genetic but non-immunological resistance to environmental organisms in humans. The high prevalence of sickle cell anaemia among various populations throughout the world may relate to the resistance that this genetic mutation confers against malaria. More recently, a remarkable degree of resistance to HIV infection has been demonstrated in individuals with a genetic variation (or polymorphism) in an immune-cell molecule called the CCR5 receptor. The venom of the Australian Paralysis Tick is a neurotoxin and causes paralysis by blocking electrical conduction in nerve cells, but little is known about the exact molecules in the nerve cells that are targeted. Gala suggested that, if Aborigines are indeed resistant to the paralysing effects of tick venom, perhaps they will be found to have a polymorphism in one of these nerve-cell molecules.

If anyone knows anything about the incidence and effects of Australian Paralysis Tick envenomation among Aborigines, please let us know.

> -Stephen Doggett Westmead Hospital, Sydney

NATURE AUSTRALIA welcomes letters for publication and requests that they be limited to 250 words and typed if possible. Please supply a daytime telephone number and type or print your name and address clearly on the letter. The best letter in this issue will receive a Funnelweb Spider towel from the Museum Shop. The winner this issue is Michael Westaway.

HELP GIVE OUR WILDLIFE ONE MORE CHANCE.

Established in 1985, the NSW Wildlife Information & Rescue Service (WIRES) is the largest volunteer wildlife rescue organisation in Australia. WIRES works to rescue injured, orphaned and distressed native animals, caring for them until they can be released back into the wild.

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บ	I would like to be involved in WIRES work. Please send me more information.

Forestville NSW 2087



Nature Strips

COMPILED BY GEORGINA HICKEY

Careful, She Might See You

Budgerigars (Melopsit-tacus undulatus) are prodigious breeders. With abundant food, they are able to breed rapidly, enabling them to exploit unpredictable desert rains. Large flocks gather around temporary waterways, with many birds pairing and breeding. Male Budgerigars feed their incubating mates and subsequent offspring. This concentrated breeding effort and the abundance of alternative partners creates a tense environment in which both sexes can assess each other's performance—and change partners if necessary.

In large breeding flocks, males may be tempted to court other females but must also ensure that their mates are not tempted by other males. Aliza Baltz and Anne Clark, while at the University of Binghamton in New York, observed that captive male Budgerigars tend to seek extra-pair copulations when their mates are out-of-sight in the nest box. But are they really trying to hide their unfaithfulness from their mate? Perhaps when the female is around, the males are simply too busy guarding her from other males to have

time to be unfaithful himself?

In a series of experiments in which pairs of birds were housed away from the rest of the flock, eliminating the need for mate guarding, males were tempted with the presence of another female. Again the researchers found that males tended only to court the new female if an opaque barrier was placed between him and his 'wife'. Those few that did attempt courtship in full view were rewarded with aggressive beak jabs and rude vocalisations.

Females may be right to judge an unfaithful partner harshly. Promiscuous males

tend to be less successful fathers—perhaps because they spend more time courting other females than feed. ing their young. Low fleds. ling success, however, may also reflect the qualities the mother. It might be that males with poor-quality mates are compensating for their mate's inadequacies by breeding with other females as well. The battle between the sexes continues.

Disease Fit for a King?

M ad with rage and twice as dangerous. It's the image of Tyrannosaurus rex that springs to mind, courtesy of museums and Steven Spielberg films. But why did T. rex have such a bad attitude? Scientists may have found the reason: a nasty case of gout.

One of the oldest diseases known to medicine, gout was reported in *T. rex* by Bruce Rothschild (Arthritis Centre of Northeast Ohio) and colleagues after they discovered a spherical hole in a cast (exact replica) of the forearm



A seemingly perfect couple, but when she's not looking, the male Budgerigar may look elsewhere for sex.



Is the rapid increase in Antarctic Fur Seals a natural or human-induced phenomenon?

bone of 'Sue', the *T. rex* specimen discovered in South Dakota (and recently sold to the Field Museum of Natural History in Chicago for nearly SUS8.4 million).

Gout is caused when excess uric acid in the body precipitates as crystals in the lining of a joint. It is the accumulation of millions of these needle-shaped crystals that erodes holes in the bone and causes great pain and swelling. The researchers at first thought the hole was just a bubble that formed during the casting process, but they were assured it was not a flaw. Then they found similar lesions from the hand bone of another tyrannosaurid. The erosions showed a slight raised lip around the edges, a distinctive feature of gout, compared with other inflammatory diseases such as arthritis.

While *T. rex* obviously did not consume the alcohol with which we often associate gout, red meat was high on the menu. Red meat contains a large amount of chemicals called purines, which metabolise to uric acid.

Although gout has been observed in monitor lizards, turtles, crocodiles and some birds, this is the first report of dinosaur gout. Only about one woman for every 20 men suffer from gout, so if dinosaurs follow the same pattern, who could blame 'Sue' for being angry?

__^ T

to near oblivion less than 100 years ago, is proving to be cause for concern.

The increase in these seals has been so rapid and extensive that they have been wreaking ecological havoc in coastal and freshwater ecosystems on parts of the Antarctic Peninsula and nearby islands. On Signy Island,

the rise within the species' normal range of population sizes over the last few thousands years, before humans visited Antarctica? These have been critical questions facing conservationists trying to protect Antarctica from degradation.

Looking for answers Hodgson and Dominic Nadine Johnston from the British Antarctic Survey analysed seal hairs in lake sediment core samples from Signy Island to determine population patterns including the timing of booms. Their investigations revealed that the present increase on the island is far greater than anything experienced by the species during the past 7,000 years and that it is unlikely to be a natural

Hodgson and Johnston believe the increase in seals is linked to the massive reduction of baleen whales in the Southern Ocean since the 1920s due to the whaling industry. As the whales declined, the krill upon which they fed appear to have become abundant and capable

The number of seals that visit each summer rose from 100 before 1976 to over 20,000 in 1994.

Seals Boom, Ecosystems Bust

Normally, a population boom in an animal that not so long ago was facing extinction would be a welcomed phenomenon. However, a recent explosion in numbers of the Antarctic Fur Seal (Arctocephalus gazella), a species that humans hunted

for example, the number of seals that visit each summer rose from 100 before 1976 to over 20,000 in 1994. At sites where the seals haul themselves out of the water, vegetation destruction, soil erosion and eutrophication of freshwater lakes have been extensive.

Is this increase in Antarctic Fur Seals a natural or humaninduced phenomenon, and is

evidence of regenerated bone over the front hole indicates that the patient survived the operation and lived long enough for the hole to heal; indeed long enough to receive (and survive!) his second trepanation, which is only partially grown over.

The reason why neurosurgery was carried out on this approximately 50-year. old individual back in 5100 BC remains speculative. In traditional African societies. trepanations may be administered to those who have physical head injuries or suffer disorders such as persistent headaches, epilepsy, tumours or mental disease. Whatever the ailment suffered by this Neolithic Frenchman, we hope the cure was not worse than the complaint.

-n.

NO₂ Smoking

lot of plants, including many Australian natives need to experience a fire before their seeds will germinate. For a long time it was assumed that it was the heat from such events that provided the critical trigger for germination. However in recent years certain seeds have been shown to respond to smoke, even when there is no fire (see *Nature Aust.* Summer 1996–97). Now, for the first time, researcher8 have narrowed the trigger down to a specific compound in smoke.

Plant ecologists Jon Keeley and C.J. Fotheringham, of Occidental College in Los Angeles, collected dormant seeds of Whispering Bells (Emmenanthe penduliflora), a common Californian wild-flower that proliferates after fires, and exposed them to either straight nitrogen dioxide (NO₂) or wood smoke (which contains NO₂).

With as little as one minute's exposure in either situation, the researchers managed to trigger germination in every seed. They had the same success when they exposed seeds to NO2 vapout from sand, paper and water that had absorbed smoke two months earlier.

Plants with seeds that germinate after a fire eventwhatever the exact trigger

COURTESY KURT W. ALT

of supporting a much larger than normal seal population.

These findings will be important to future decisions on conservation of the Antarctic environment.

---K.McG.

Neolithic Neurosurgery

well-preserved human skeleton, excavated from the stone-age burial site at Ensisheim in France, provides evidence that brain surgery was practised more than 7,000 years ago! The skull had two large holes in

it—one at the front about six centimetres across and a larger one at the top of the skull about nine centimetres across.

The team of scientists studying the skull had to rule out the possibility that the holes were created from other means, such as fractures, infection, tumours, or disturbance from animals after burial. Kurt Alt (from the Institute of Human Genetics and Anthropology in Freiburg, Germany) and colleagues noted that the holes are remarkably free of surrounding cracks, and that

they resemble the 'trepanations' created by modern neurosurgeons, who remove sections of the skull to get at the brain or to relieve pressure from around it. The straight, slanting edges of the holes indicate that the bone was removed by a mixture of cutting and scraping, demonstrating great craftsmanship and well-founded anatomical knowledge*. Furthermore,

^{*} Malcolm C. Lillie has since reported evidence of an older (7,620-8,020-year-old) trepanation from a cemetery in the Ukraine (Nature vol.391, p.854, 1998).

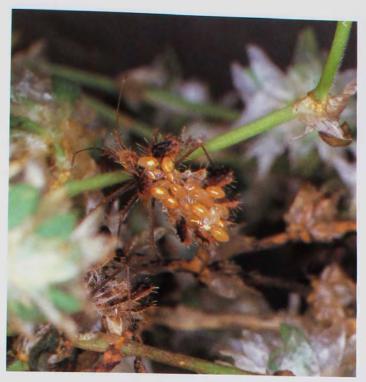
may be-have evolved seedlings used to growing in the cleared post-fire environment. Because NO2 is a common air pollutant (produced not only in the smoke of natural fires but also cars and aeroplanes), Keeley and Fotheringham's discovery raises the worrying issue of whether air pollution could trick the seeds of some plants into germinating at the wrong time for their seedlings to thrive.

—K.McG.

Egg-dumping Bugs

ithout the option of doting grandparents on which to dump the kids, the Mediterranean Golden Egg Bug (Phyllomorpha laciniata) has hit on a novel alternative: females lay their eggs on the backs of their neighbours. Arja Kaitala of the University of Stockholm investigated the details of this peculiar parenting arrangement.

She examined over 900 adult bugs and found that



both males and females carry the eggs, between one and 15 individual, although males had, on average, twice the burden of females. The eggs are firmly glued onto the bugs' backs and it's

extremely difficult to remove them without damaging their

Eggs that don't have transport don't fare too well. Kaitala killed six egg-carrying males and left them A male Golden Egg Bug carries its namesake on its back.

where she'd caught them. By the next day all of the eggs and corpses were gone. Similarly, 86 per cent of eggs that she placed in the flower heads of the plants on which the insects live were gone within one day and none remained after a week. In contrast, marked retained 84 per cent of their eggs when they were recaptured a week later.

But, although the taxi service is an effective way of reducing egg mortality, it isn't perfect. About a fifth of the piggy-backed eggs are parasitised by a species of wasp. Males are better at looking after their cargo, with fewer of their eggs suffering from the wasps' depredations.

And why do these bugs submit to such a liberty in the first place? At any given moment during the mating season, up to 30 per cent of individuals are involved in copulation, a process that



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may last 20 hours and leaves the bugs open to exploitation. They're apparently so wrapped up in the act that they are unable to stop other females climbing on top and unloading their offspring on them.

-G.Т.

Monkey Mates Foil Foe

ne of the great debates among animal behaviourists has been why different species sometimes associate together. Some argue it makes finding food easier; others say being in a group protects against predators. Red Colobus Monkeys (Procolobus badius) living in the Taï National Park in Africa's

Ivory Coast frequently associate with smaller Diana Monkeys (Cercopithecus diana). Because the two monkey species have little dietary overlap, Ronald Noë and Redouan Bshary (from the German Max Planck Institute for Physiology of Behaviour) decided to investigate the predation hypothesis. They played tape-recordings of a Chimpanzee and a Leopard (both of which prey on monkeys), and also recordings of a generator and a blank tape, to mixed monkey groups.

The two species actively sought each other out when they heard the Chimpanzee tape, but not when they heard the Leopard tape. The groups also stayed together longer after hearing the Chimp call,

compared to the Leopard, generator or blank tapes. Furthermore, the association between the two species was most prevalent from September to November—the Chimpanzee hunting season.

By hanging in large groups, Red Colobus and Diana Monkeys contribute to each other's protection, and reduce the chance of becoming lunch. Red Colobus Monkeys benefit from the vigilant Diana Monkeys, which scan the ground and foliage for Chimps and call loudly when they detect danger. But what do Diana Monkeys get out of the association? The researchers suspect Dianas seek 'safety in numbers', which has the effect of shielding them from

the surprise aerial attack of another predator—th Crowned Hawk Eagle (Stephanoaetus coronatus).

Plant's Pocket Predators

that long been recognised that the small hair-tufts ampockets on the underside leaves provide refuges for predatory arthropods (see Nature Aust.* Summe 1991–92). In exchange for shelter and protection, scientists have suspected that these 'pocket predators' rich the plants of pests. This had never been proven experi

Red Colobus Monkeys work best with other monkey species.



IRIAN MÖLLERS

mentally . . . until now.

Using the commercial cotton plant Gossypium hirsutum, Anurag Agrawal and Richard Karban (University of California at Davis) attached small tufts of cotton fibre to the lower surface of the leaves, artificially providing 'mite houses' or 'leaf domatia' as they are known. (This particular species of cotton does not have naturally occurring domatia, although close relatives do.) researchers observed a 30 per cent increase in fruit production by the plants with the domatia. They also noticed that herbivorous spider mites were consistently fewer on these plants, while predators such as big-eyed bugs (Geocoris spp.) and the



After nesting, Leatherback Turtles migrate along virtually identical paths despite different departure times and the vastness of the open ocean.

minute Pirate Bug (*Orius tristicolor*) were five times more abundant. Eggs and nymphs of these predators were found tucked within the cotton tufts, but nowhere else on the leaves.

The increased reproductive success of the experimental plants is proof that plants benefit from the association. By providing refuge areas, a plant can support a number of predators, which in return reduce the population of damaging herbivores. These results may provide new strategies for controlling agricultural pests without the use of chemicals. By engineering plants to yield leaf domatia, the mutual association of predator and plant could bring pest species under biological control.

—К.Н.

Turtles with a One-track Mind

hen turtles lay their eggs they are very vulnerable, as are the young hatchlings when they emerge. Consequently, much conser-

*Previously ANH

vation effort has been directed towards protecting their nesting beaches. However, a new study tracking migrating Leatherback Turtles (*Dermochelys coriacea*) suggests they may also be vulnerable at sea.

Stephen Morreale from Cornell University and colleagues attached satellite transmitters to the carapaces of eight female Leatherback Turtles after laying eggs on a beach near Playa Grande, Costa Rica. The endangered turtles were tracked for up to 2,780 kilometres south-west through the Pacific Ocean.

When the researchers compared the satellite tracks for the four years of the study, they found the Leatherbacks had followed virtually identical routes. In one instance, two turtles that had left 13 days apart were only 20 kilometres from each other after travelling more than 700 kilometres.

The chance of turtles following the same route at random is very low, given their access to the open ocean. In contrast, another local turtle species, the Olive Ridley Turtle (*Lepidochelys olivacea*), follows diverse and widespread routes.

How do the solo Leatherback Turtles follow the same route in millions of square kilometres of open ocean? They may be guided by food sources, ocean floor features, magnetic cues or even temperature gradients. Either way, the existence of ocean corridors for Leatherbacks has important implications for their conservation. By clustering along specific pathways, the turtles increase the vulnerability of their entire population. Thus, while protecting nesting beaches is important, it may be equally important to safeguard the interconnecting migratory corridors to keep turtles on track.

—A.T.

Leaf-eating Frog

n a reversal of the human norm, it's the adult frogs that don't like eating their greens. When tadpoles grow legs they also grow an appetite for things that move, shifting from an herbivorous to an insectivorous or sometimes carnivorous diet.

When Indraneil Das (now at the Centre for Herpetology



The only folivorous adult frog-Rana hexadactyla from India-just goes to show it's not easy eating greens (or flowers).

in Madras, India) investigated the diet of Rana hexadactyla, a large green frog from India, he found that the tadpoles consumed the traditional tadpole fare of leaf fragments, switching to a diet of insects at metamorphosis. However, the diet of the adult frogs consisted of around 80 per cent plant material, including leaves, flowers and five species of algae, making them the only adult frogs in the world to quite happily sit down to a meal that consists almost entirely of foliage.

The frogs are well suited to their unusual diet, with conical teeth to tear off bite-sized pieces of vegetation and extra large guts to deal with the big helpings of low-nutrient food they eat. (All other members of the genus *Rana* have sharper teeth that curve backwards, presumably to stop live prey from escaping from the mouth.)

But a frog cannot live on greens alone. Das found that, just before the breeding season, female *Rana hexadactyla* start to increase the amount of animal material in their diet, allowing them to harvest

energy more quickly for egg production.

—G.Т.

The Neanderthal's Nose

Those jutting brows, so often exaggerated in movie cavemen, turn out not to have been the only bony protuberances that are characteristically Neanderthal.

species, extinct or surviving, the typical Neanderthals had, it now seems, two triangular bony features protruding into the front of the nasal cavity. Neanderthals occurred in Europe and western Asia from about 200,000 to 30,000 years ago.

Schwartz and Tattersall speculate that the unusual nasal features helped these early hominids tolerate the cold dry air of the time. The

Neanderthals were an entire ly separate species, quite distinct from modern-day humans and not, as it was once thought, simply one of our primitive ancestral variants.

Confirmation of this has since come from DNA tests carried out by Matthias Krings (University of Munich) and colleagues on an extract from a Neanderthal bone specimen. The sequence of Neanderthal mitochondrial DNA was found to be significantly different from that of modern humans, and indicates that they last shared a common ancestor around 600,000 years ago.

_K.McG.

Neanderthals were an entirely separate species, quite distinct from modern-day humans.

Palaeoanthropologists Jeffrey Schwartz (University of Pittsburgh) and Ian Tattersall (American Museum of Natural History) have identified what they describe as "extraordinary architecture of the internal nasal area" in a series of Neanderthal skulls that they studied.

Unlike any other hominid

projections may have increased the surface area upon which air could be warmed and moistened before it was inhaled into the lungs, or they may have helped recapture moisture on exhalation.

The nasal find adds to a significant body of anatomical evidence that indicates

What's Good about Garlic Breath?

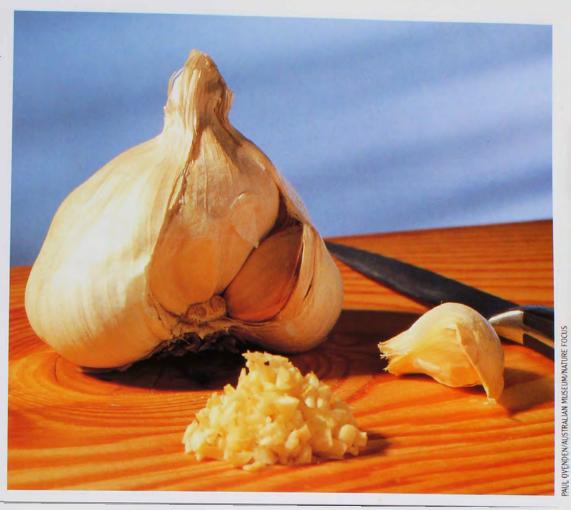
arlic (Allium sativum) is reputed to cure all manner of ailments from cancer and the common cold to high blood pressure and heart disease. The bad breath we get from eating garlic is not just the price we have to pay for the alleged health benefits

The bad breath we get from eating garlic is a sign that garlic is good for us.

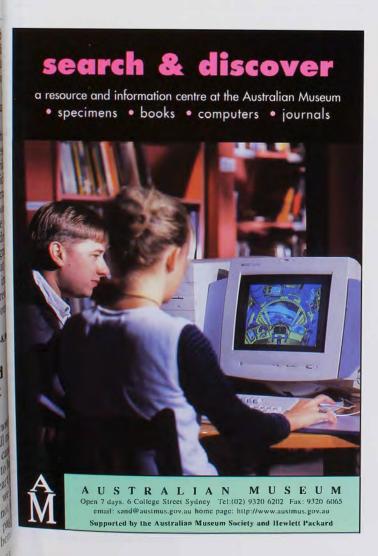
but proof that it actually works!

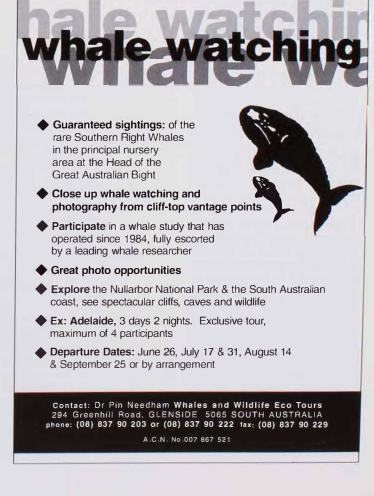
Werner Lindinger and colleagues from Innsbruck University in Austria compared the volatile compounds present in freshly cut garlic with those present in a consumer's breath. Most of the strong-smelling sulphides present in cut garlic peaked in concentration in breath samples a few hours after consumption. Allyl methyl sulphide, dimethyl sulphide and acetone were exceptions. They peaked much later and were still evident on the breath after 30 hours.

High concentrations of acetone, the researchers believe, are particularly indicative of the medicinal effects of garlic. Acetone is the product of the breakdown of many fatty compounds in the blood, including cholesterol. The amount of acetone given off by crushed garlic is far less than the peak levels found in



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Huddling helps Emperor Penguins to stick it out through the winter.

the breath, even a day after eating the garlic. This observation may indicate the enhanced metabolism of fatty constituents in the bloodstream and lead to a drop in unwanted cholesterol and, therefore, the chance of a heart attack.

—P.R.

Why Emperors Huddle

t must surely be one of the most extraordinary acts of paternal devotion! Throughout the bitter Antarctic winter, the Male Emperor Penguin (Aptenodytes forsteri) stands resolutely upon the sea ice, incubating, within an abdominal fold above his feet, a solitary egg left in his charge by his partner before she shuffled off to pursue a feed in distant waters. Freezing winds, sleet and snow howl around him for weeks on end and he goes without food, steadfastly maintaining his vigil over his embryonic offspring until his partner returns.

It is now clear that a group mentality is critical to this single-minded approach fatherhood, thanks to the first

metabolic study ever to be conducted on free-living Emperor Penguins during winter.

In a breeding colony in Adélie Land, André Ancel (from the National Centre for Scientific Research in France) and colleagues took measurements of metabolic rates and weight and water loss of 36 males during the incubation period. After initial measurements, 26 of these birds were dling for which brooding male Emperor Penguins renowned.

Tests revealed that huddling made a significant difference to the way the birds survived the winter. At the end of the incubation period. free-ranging birds were seven per cent heavier than their caged counterparts and had lost 25 per cent less water. Metabolic rates of the freeranging birds were found to -K.Mca

needed.

abandon brooding) as much

as three weeks earlier than is

Poison Pairs

pavlova of frog egg floating in the local dam is a familiar childhood memo, ry. Frogs are cold-blooded perhaps even cold-hearted individuals that simply spawn and move on. Or are they! New research suggests that some frogs provide as much care for their offspring birds and mammals.

Janalee Caldwell from the University of Oklahoma spent two months in a lowland Amazon rainforest studying parental care by the Spotted Poison Frog (Dendrobate vanzolinii) and reports pair bonding in amphibians for the first time. These tiny black frogs have a unique pattern yellow spots and lines, make ing individuals and pairs east ly recognisable.

Caldwell found that the same pair of frogs cooperate. extensively to care for their single tadpole, keeping guard over it in a small water-filled cavity typically in a sapling of

Throughout the bitter Antarctic winter, the male Emperor Penguin stands resolutely upon the sea ice, incubating a solitary egg.

released back into the colony. The other ten were split into two groups and maintained in enclosures subjected to similar environmental conditions to those found at the colony. The major difference between the caged and free-ranging birds was that the latter could participate in the mass hud-

be about 16 per cent lower than in the captive penguins—partly attributable to energy saving due to hud-

The research team speculates that, without huddling, Emperor Penguins would experience the metabolic trigger to resume feeding (and

vine in the forest understorey. About every four or five days the male guides his mate to their tadpole by means of a soft buzzing call. The pair enters the cavity together, where they undergo courtship behaviour for about three hours, resulting in the deposition of several unfertilised eggs for the tadpole to eat. The cavities in which the tadpoles develop are so tiny that there is no other food present and they would starve without the parents' care.

While the tadpole is developing in the cavity, another egg may be laid and fertilised above the water line inside the same hole. When the new tadpole attains a certain size, the male poison frog piggybacks it to another suitable cavity to avoid cannibalism by its sibling. After a few days the male guides his partner to the new site, where they court and deposit eggs as food for their latest Each tadpole addition. requires about two months to transform into small

Spotted Poison Frogs make good parents.

froglet, and the parents may care for more than one tadpole at a time.

Exactly how long the poison pairs remain together is unknown. But it does appear that, in their stable rainforest environment, Spotted Poison Frogs have opted for a quality, not quantity, approach to parenting.

-A.T.

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Danielle Clode, Karina Holden, Karen McGhee, Philippa Rowlands, Abbie Thomas and Geordie Torr are regular contributors to Nature Strips.

QUICK QUIZ

- 1. What is it that researchers in Project Phoenix are looking for?
- 2. Which marsupial was depicted on the nowdefunct Australian one-cent coin?
- 3. How many claws did Tyrannosaurus rex have on each front foot?
- 4. What is the fifth planet away from the Sun?
- 5.Name the most southerly point on the Australian mainland.
- 6. Which chemical element is represented by the symbol Hg?
- 7. What colour are the Patas Monkey's testicles?
- 8. If fireflies aren't flies, what are they?
- 9. Which animal is being touted as a more appropriate Easter symbol for Australia?
- 10.What is the common name of *Cacatua* roseicapilla? (Answers in Q&A)



This was the Little Wattlebird, a strong, agro honeyeater that always looked like it'd taken too long lighting the wick of a Mt Vesuvius firework.

WATTLE WE CALL THIS CLAYTONS-**BIRD?**

BY STEVE VAN DYCK

N THIS ACTIONABLE AGE WHERE OUR parents and uncles are scrutinised for the origins of all our deep-seated psychological hang-ups, I would like to lay the blame for most of my inadequacies

squarely at the feet of May Gibbs.
Didn't May Gibbs (creator of Snugglepot and Cuddlepie) realise that the instant my parents switched off the lights and went to bed, all the brooding pods on the banksias outside suddenly sprouted bristly limbs that took them shinning down the trees on a beeline for my bedroom window? Waiting there for me to make the fatal mistake of going to sleep! Ms Gibbs has a lot to answer for! The gobbling John Dory was bad enough around bed time, but Banksia

Men were the outer limit . . scary, naked, scrawny and knobbly. And mean. Individually they were snivelling, but collectively they oozed enough meat-ant meanness to strangulate any boy whose eyes shut for more than a blink. Wirelesses and TVs pedalled 'Laxettes' in those days, but there was no need of them in our camp.

The trouble was that some of the night-time concerns bubbled over into the daylight hours. This meant that sideways glances were always in order when walking below or climbing up banksia trees. It was a very good idea to keep one eye on the banksia cones while the other checked on the progress of the eggs and chicks in the nests of the local birds. One nesting species in particular, with its silver-splashed grey feathers, mean-looking eye, snapping beak and uncontrollable mood swings, I never completely trusted, and often suspected of being nothing more than Banksia Men in diurnal drag. This was the Little Wattlebird (Anthochaera chrysoptera), a strong, agro honeyeater that always looked like it'd taken too long lighting the wick of a Mt Vesuvius firework.

Come spring, and these bizarre birds would go berserk. Every banksia tree seemed to have one jerking and squawking up on top. When the redundant Eastern Yellow Robins and Magpies eventually woke with the dawn-din they could scarcely compete with the wattlebirds' cacophony "cac-coph-phon-y, cac-coph-phon-y, caccoph-phon-y". I was certainly not the only callow youth to grow pimples and chin stubble to a backdrop of those deliciously ridiculous calls. But now, decades on, I suspect few of us would be grown-up enough to admit to the flush of nostalgia evoked by the sound of a wattlebird calling today. When it comes to reflective sinusitis, wattlebird 'song' does it to me as easily as the music from "Blue Hills", the smell of heliotrope flowers, or the taste of nasturtium leaves.

To imitate one of the Little Wattlebird's songs all that is necessary is to recall a line from the old classic "Johnny's so late at the fair". Just whis tle, ad nauseam, the line that says "He promised to buy me a bunch of ... ", but don't go as far as the words "blue rib bons" otherwise you'll wreck the per fect excerpt. The same wattlebird tune, in a minor key, was used to good effect in that lesser classic, Beethoven's Pastoral Symphony (in the first part of the 'peasants merry-making' bit).

On this particular theme, Alison Hay wrote to Wild Life magazine in 1951 saying that a more reliable weather fore cast was hidden among the inflections of Little Wattlebird calls than in any prediction offered by Sydney meteorolo gists. She had observed that sunny days were assured when "cooked-apple, cooked-apple, cooked-apple!" echoed



LITTLE WATTLEBIRD

Anthochaera chrysoptera

Classification

Family Meliphagidae (honeyeaters). Three endemic spp. of wattlebird: Little (A. chrysoptera), Red (A. carunculata) and Yellow (A. paradoxa). Some authors separate the eastern and western 'wattleless' forms into two distinct spp.: A. chrysoptera ('Brush Wattlebird' of the east) and A. lunulata ('Little Wattlebird' of the west).

Identification

Mostly dark grey tinged with olive brown, feather shafts white giving flecked appearance. Wings and tail dark grey-brown, tail white-tipped. Beak black, legs dark grey, iris reddish brown washed with grey. Length 31 cm, weight 65 g. Sexes similar but female slightly smaller and duller. Three subspp.: A. c. lunulata from WA with less crown streaking and redder iris; A. c. tasmanica from Tas. larger and darker than mainland forms; and eastern A. c. chrysoptera.

Distribution

Mostly coastal heaths, woodlands and gardens along eastern and southern Australia from Fraser Island to Vic. and west to near Adelaide and Kangaroo Island; also in Tas. and in south-western WA from Moora to near Esperance.

Food

Nectar, insects, other invertebrates, and plant exudates.

Reproduction

Breeds all months, but mostly July-December. Nest is a stiff affair of woven twigs and grass, lined with soft material, often banksia-cone down. While the soft bottom rots out quickly after use, the shell might remain in place for years leaving a twig doughnut or a sublethal prickly crown suitable for Sunday School Easter pageants. Only female incubates 1-3 cream-pink brown-blotched eggs (28 mm long) for 12 days. Young leave nest at 16 days old. Pairs capable of raising 3 clutches annually.

across the coastal banksia flats. But when the tune was pitched in a more subdued key to "go-careful, go-careful, go-careful!" with the 'go' more strongly accented, then it was prudent to bring the washing in!

John Gould was more pragmatic in his description of its "...harsh and peculiar notes which have not unaptly been said to resemble a person in the act of vomiting, whence the native name of Googwar-ruck. While thus employed it frequently jerks up its tail, throws back its head, and distends its throat as if great exertion was required...". God only knows what mountain dew the wat-



tlebirds had been feeding on where Gould reached this conclusion, but more recent work by Mark Jurisevic and Ken Sanderson of Flinders University has shown wide variation in Little Wattlebird calls around the Australian coastline. particularly in respect of the dawn chorus. According to them the birds from South Australia were actually far more musical than those from northern New South Wales! (No doubt a superannuated Don Dunstan would lay modest claim to achieving cultural refinement all the way down to the most diffident of South Australian songsters!)

For a bird not blessed with sensation-

al beauty or voice, the Little Wattlebird stands thrice denied, because it was not blessed with wattles either! This poor bird is celebrated for everything that it is not. Or, at least, for that which it has not .. wattles ... colourful fleshy bits that dangle from bigger fleshy (and generally feathery) things. Turkey gobblers have a long retractable wattle called a snood, fancy fighting fowl known as Old English Game have scarlet wattles that are even nowadays snipped from their necks for judging, cassowaries have great pendulous levers that no-one in their right mind would tug, but Little Wattlebirds are always entirely wattleless. Their two bigger cousins have the appropriate fandangles and richly deserve the title of 'wattlebird', not quite so richly though in the case of the punklooking, cherry-studded Red Wattlebird (Anthochaera carunculata) from woodlands and suburbs in southern parts of the Australian mainland. Its metallic call has always reminded me of the morning clash between starter motor, fly wheel and my father when getting our Morris Minor fired up for the road.

Tasmania's Yellow Wattlebirds (An-

A Little Wattlebird feeds its demanding young.

thochaera paradoxa), which are lucky to be around considering the numbers that were shot and eaten by Tasmanians, have wattles to weep for. Even Captain Cook waxed lyrical in their praise: "The wattlebird [is] so called because it has two wattles under its beak as large as those of a small dunghill cock". But the Little Wattlebird is a Claytons. Many years ago Sydney-based birdwatcher Harry Wolstenholme suggested that 'Mock Wattlebird' might be a more appropriate name, but even that is a copout. If I'd been born pre-1929 (the publication date of the famous gumnut adventures), I would have happily suggested one particular common name that strikes me as unique as well as descriptive. But alas, I was from one of the post-Gibbs generations that flinch at the mention of certain unsavoury bushland associations that still lurk in the shadows from the tuck-me-up times of childhood. I just don't think I'd be able to revel in the squawking and shenanigans of the Little Wattlebird if its name suddenly changed to my secretly preferred 'Banksiabird' . . . overnight!■

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

The often inaccessible, rocky habitats that rock-rats prefer have probably discouraged research on this interesting group of rodents.

CARPENTARIAN **ROCK-RAT**

BY COLIN TRAINOR

HE SANDSTONE RANGES OF THE monsoonal tropics support a treasuretrove of interesting, rare or restricted birds, reptiles, mammals and plants. While the rocky uplands of western Arnhem Land and the Kimberley region have been subject to considerable biological research, comparable work in the rugged hinterland of the Gulf of Carpentaria has only recently been undertaken.

The often inaccessible, rocky habitats that rock-rats (Zyzomys spp.) prefer have probably discouraged research on

this interesting group of rodents. Much of what we know about rock-rats comes from two studies in the 1980s, one in Kakadu National Park and the other on the Mitchell Plateau in the Kimberley. These studies found that the large rock-rat species-the Arnhem Land Rockrat (Z. maini) and Kimberley Rock-rat woodwardi)-(Z.have more special-ised habitat needs

than the smaller Common Rock-rat (Z. argurus). Larger rock-rats prefer the most rugged elements of the rocky uplands, including scree slopes or crevices along the base of cliffs. These areas are rich in dry monsoon rainforest plant species (providing food for rock-rats), are fire-resistant and offer shelter from predators.

Research officers from the Parks and

The biologists watched with foreboding as a hot wildfire burnt through the area.

Wildlife Commission of the Northern Territory conducted a series of biological surveys at sites throughout the Gulf region between 1985 and 1988. At one particularly rugged sandstone gully (Banyan Gorge) on Wollogorang Station near the Northern Territory-Queensland border, they captured several small (27-35 grams) oddlooking rock-rats on a boulder-strewn slope covered in dense thickets of scraggly dry rainforest, above a large, scenic Syzygium rainforest. These were presumably Common Rock-rats as they were within their weight range, but two coy animals had light grey fur on the upper body (compared with the usual ginger brown colour of the Common Rock-rat) and very long hind feet. These characteristics intrigued biologists Don Langford and Peter Latz, who were now quite familiar with the

colouration. body thick, carrot-shaped tail, large eyes and energetic disposition of the Common Rock-

In addition to the small rock-rats, rare or interesting occurrences of species such as the Ghost Bat (Macroderma gigas), kock-brachyotis), Perrogale Ringtail 12 Short-eared Rockropseudes dahli), Rufous Owl (Ninox rufa)

and Chameleon Dragon (Chelosania brun-nea) were recorded from the nooks and crannies of the gorge cliff lines, and in the rainforest, at Banyan Gorge. With such a smorgasbord of interesting species present in such a small, semi-arid oasis, the biologists watched with foreboding as a hot wildfire burnt through the area in early 1987. A follow-up expedition was plan-



ned immediately and, to the biologists' relief, several more rock-rats were captured, including one animal that was three times the size of a Common Rock rat. This 'giant', along with the two small grey individuals, which turned out to be juveniles, was later described as a new species—the Carpentarian Rock-rat (*Z. palatalis*).

Since then three more Carpentarian Rock-rat populations have been located. All the known sites occur on Wollogorang Station, just 10-70 kilometres away from each other (one of the most localised distributions for an Australian mammal). Each site is characterised by deep sandstone gorges or escarpments, relatively extensive dry monsoon rainforest on scree or rocky slopes, and permanent water. This habitat is extremely limited



in northern Australia. The Carpentarian Rock-rat is therefore thought to be a glacial relict (that is, a leftover from former wetter times), tenaciously clinging to suitable habitat in gorge refuges, which provide a buffer against fires and

damage by cattle.

Breeding appears to be year-round, although the reproductive rate is low with captive and wild-caught individuals having a litter size of only one or two. The peak breeding season for the Carpentarian Rock-rat seems to be from the middle to the late dry season, possibly timed to take advantage of the abundant fruits and seeds available at this time.

Threats to this species include recent changes in the fire regime. The loss of traditional Aboriginal burning regimes is known to endanger the monsoon

rainforest on which the Carpentarian Rock-rat relies. In the short term, frequent, hot, late dry-season fires consume seeds and fruits that the Carpentarian Rock-rat eats, and in the longer term, rainforest and tropical broadleaf communities contract, reducing the habitat available for the rats. The estimated suitable habitat at each of the sites is less than a few square kilometres, and the core monsoon rainforest habitat at each site is believed to cover the equivalent area of just a few football fields. The small population sizes (estimated at fewer than 500 individuals at two of the sites) and limited habitat will continue to place wild populations of the Carpentarian Rock-rat at risk of extinction. A captive population is being maintained at the Territory Wildlife Park near Darwin,

and a Recovery Plan has been drafted, detailing a range of actions, including active fire management, needed to improve the status of the Carpentarian Rock-rat.■

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Colin Trainor recently completed a Master of Science degree at Northern Territory University, on the habitat use and population dynamics of the Carpentarian Rock-rat. He is now an ecologist with Birdlife International Indonesia Programme.

Some trees even have woods that look like meat products— Beefwood, Baconwood, and the greasy-looking Muttonwood and Tallowwood.

STRANGE NAMES IN DARK FORESTS

BY TIM LOW

N AUSTRALIAN PIONEER HISTORY, the timber-getters who worked deep in the rainforests hold a revered place. But what were these men like? They did not leave for posterity grand autobiogra-phies and thick sheaves of letters, for they were not educated men; but a legacy in words they have left us nonetheless, in the remarkable names of our rainforest trees.

Browse through any book about rain-

forest trees and you will be struck by the strangely evocative names—Bulletwood, Tingletongue, Squeaker, Maiden's Blush, Possumwood. These names offer curious insights into the thoughts and lives of the timbermen living in those dark forests.

Some names tell of the hardships they encountered. Were I a timberman today, I would steer clear of Axebreaker (Geijera paniculata), Gap Axe (Arytera divaricata), Steelwood (Sarcopteryx stipata), Flintwood (Scolopia braunii), Shatterwood (Backhousia sciadophora), and the various ironwoods. I would head towards the Corkwood (Caldcluvia paniculosa), and perhaps the Brittlewood (Claoxylon australe).

A number of names tell us how the trees were used. Names such as Coachwood (Ceratopetalum apetalum) Malletwood (Rhodamnia argentea) White Handlewood (Streblus brunon, anus) and Walking-stick Palm (Line spadix monostachya) speak for them. selves. Coachwood, a common rainforest tree in New South Wales, was consid. ered to be best for building coaches although it was unsuitable for the base as it rotted when damp. White Handlewood, also known as Axe-handle wood and Whalebone Tree, was ideal for handles because, according to forester E.H.F. Swain writing in 1928, "It is tough and stringy, does not jar the hands, is pleasant to touch, and gives long service".

Some trees and shrubs have name that capture the scent of the inner bark or broken stems when hewn. Remark. able vegetable smells issue forth from Celery Wood (*Polyscias elegans*), onion Cedar (*Owenia cepiodora*) and Turnipwood (*Akania lucens*—the bark of which has a radish-like taste). Other culinary aromas come from Brush Pepperbush (Tasmannia insipida) and Mango Bark (Canarium australasicum, which is also called Carrot Wood and Parsnipwood). Doughwood (Melicope octandra), also called Soapwood, has a pronounced

A peppery aroma is released by the crushed leaves, stems and seeds of Brush Pepperbush, a common rainforest shrub. Pioneers used the fruits of a related species as a pepper substitute.



dough-like smell, while the bruised bark and wood of Rosewood (Dysoxylum fraserianum) smells like a bunch of roses. Tingletongue (Melicope erythrococca) has inner bark that, when tasted, causes the tongue and lips to tingle and saliva to flow freely. Yellow Sassafras (Doryphora sassafras) and Southern Sassafras (Atherosperma moschatum) smell like the North American Sassafras (Sassafras albidum), and the barks were similarly brewed by pioneers into tonics. Lastly, that lingering bush odour in rainforest gullies, often wrongly attributed to Lantana (Lantana camara), is produced instead by Green Kamala (Mallotus claoxyloides), dubbed by the early timber-getters as Smell-of-the-bed and Odour Bush. Its aroma can be smelt up to 100 metres away.

A great many names depict the colour of the wood or bark when bared by the axe. There is Deep Yellowwood (Rhodosphaera rhodanthema), Orange-bark (Maytenus bilocularis), Pinkheart (Medicosma cunninghamii) and the delightfully named Maiden's Blush (Sloanea australis). Grey Possumwood (Quintinia verdonii) has smooth pale bark that shows up the claw marks of possums, while Python Tree (Austromyrtus bidwillii) and Leopard Ash (Flindersia collina) both have blotched patterns on the bark. Some trees even have woods that look like meat products-Beefwood (Stenocarpus salignus), Baconwood (Archidendron lovelliae), and the greasylooking Muttonwood (Rapanea variabilis) and Tallowwood (Eucalyptus microcorys). Socketwoods (Daphnandra species) have branches that bear a ball at the base when snapped from the trunk, while Beetroot (Elattostachys nervosa) has bright red new leaves.

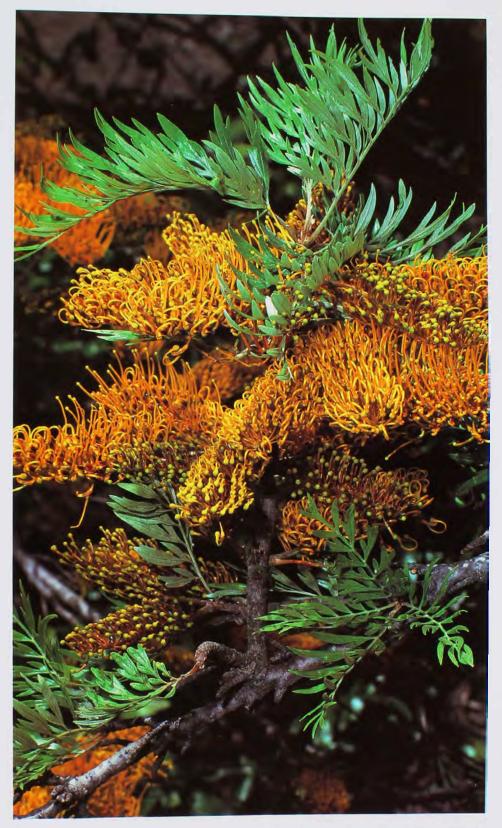
Other trees are named after the fruits, which bear some resemblance to those eaten in Europe, for example Black Plum (*Planchonella australis*) and Native Pomegranate (*Capparis arborea*). The resemblance is often vague. Fruits of the Kangaroo Apple (*Solanum aviculare*), for instance, are egg-shaped, as small as grapes, and with soft watery flesh.

Kangaroos do not eat them.

The least interesting monikers to me are those adopted from overseas timber trees because the wood is similar. Our rainforests carry plenty of oaks, ashes, birches, boxes, maples, walnuts, hazelwoods, elms, beeches and mahoganies. Among the best known are the Silky • ak (Grevillea robusta) and Crow's Ash

(Flindersia australis).

I suspect the loggers were a fairly racist lot, or perhaps they rarely encountered Aborigines in the scrubs, for there are surprisingly few names adapted from Indigenous tongues. I can think of quandongs (Elaeocarpus species), booyongs (Argyrodendron species), coondoos (Planchonella species), Yiel Yiel (Grevi-



llea hilliana), Durobby (*Syzygium moorei*) and only a few others.

Last but not least are a swag of odd names with meanings that so far elude me, although perhaps some country readers can help. What, for example, do Bulletwood (another name for Black Plum) and Squeaker and Humbug (names for Schizomeria ovata) refer to?

All of these names, like the trees themselves, are now part of Australian history. While I cannot feel pleased about the damage that logging has wrought to our rainforests, I can certainly enjoy the names the timbermen left behind.

Evidently they were men of some imagination, and their legacy of words can only enrich our enjoyment of the rainforests that remain.

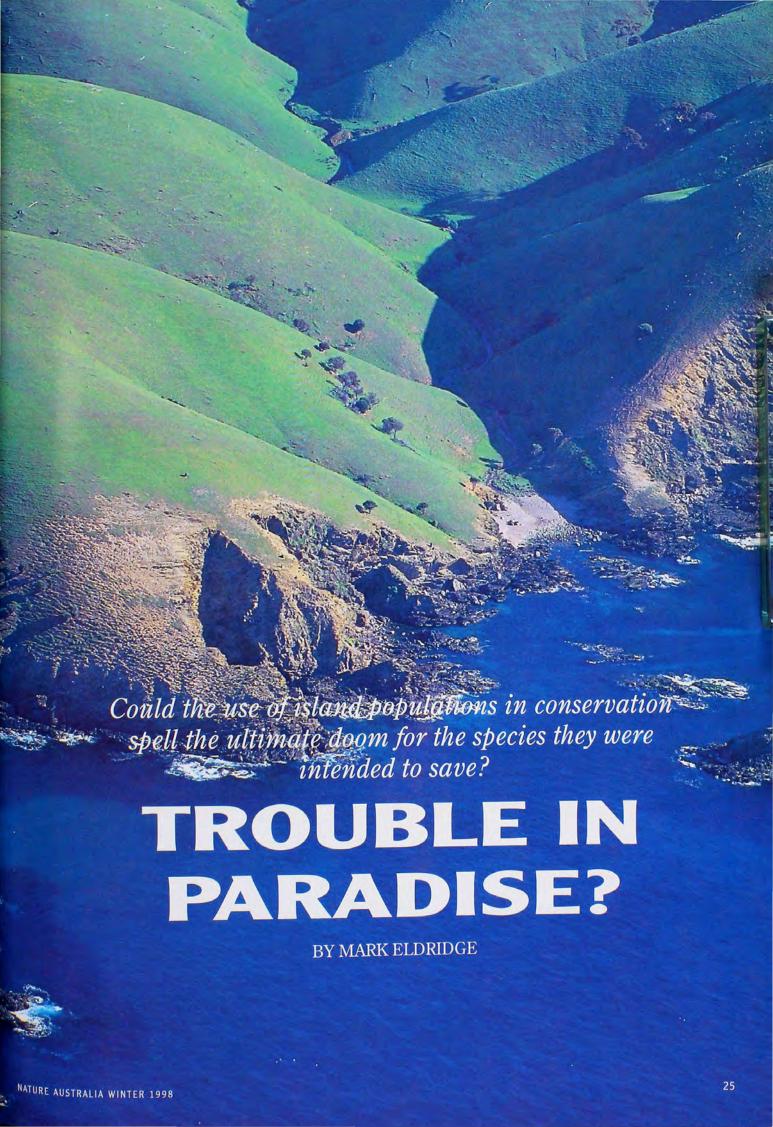
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Tim Low is a Brisbane-based environmental consultant and nature writer with a deep love of history.





otted around the Australian coast are thousands of islands that support many unique species of fauna and flora. Of the 171 mammal species known from islands, 14 are found nowhere else, with most becoming extinct on mainland Australia since European settlement. That 57 per cent of Australia's threatened mammals have populations on islands highlights the significant role of islands in conservation. Indeed, many

Island populations are far more prone to extinction than mainland populations. The majority of recorded extinctions of terrestrial vertebrates since 1600 have been from islands, even though most species are not found on islands. A variety of factors make island populations especially vulnerable to extinction. These factors mostly relate to the relatively small total size of island populations, with population size clearly limited by the area of the island.

Black-footed Rock-wallabies (*Petrogale lateralis*) on Barrow Island are severely inbred and have the lowest levels of genetic variation ever recorded.

recolonisation, even if other populations survive. Ironically then, the factors that have allowed many Australian mammals to survive in the short term on island, are the same factors that in the long term make these island populations vulnerable to extinction.

Genetic variation is believed to be

important to the long-term survival of populations as its presence allows pop ulations to adapt to environmental changes. Recent studies have shown that island populations tend to have less genetic variation than mainland populations, primarily because of their small population size and isolation. Since it would aid the long-term survival of newly established populations to have as much genetic variation as possible, the relatively low level of genetic variation present in many island populations makes them less than ideal sources of animals for conservation programs. Unfortunately though for many species island populations are all that remain.

The adaptation of populations to an island environment can also increase

That 57 per cent of Australia's threatened mammals have populations on islands highlights the significant role of islands in conservation.

of these islands are being used as sources of animals for captive breeding programs, reintroductions and translocations. But are islands all they are touted to be? Could the use of island populations in conservation spell the ultimate doom for the species they were intended to save?

Another important, although selfevident, factor is isolation. Small isolated populations are vulnerable in the long term to extinction because of chance events such as environmental catastrophes and demographic disturbances. Once an island population is extinct, isolation reduces the chances of



Although the Shark Bay Mouse (*Pseudomys fieldi*) became extinct throughout the arid zone of mainland Australia, it survived on Bernier Island. Western Australia. In 1993 a second population was established on Doole Island.

SHOTOS: HOLLOCHMAN LOCHMAN TRANSPARE





GRAHAM ROBERTSON/AUSCAPE

Burrowing Bettongs (*Bettongia lesueur*) have been reintroduced to Boodie Island and are now being experimentally translocated to parts of their former range on the Australian mainland.

their vulnerability to extinction. Island populations often become 'ecologically naive' (for example, lack of predator recognition), develop reduced dispersal abilities and have lower reproductive rates. These factors can also limit the usefulness of island populations for reintroductions to sites on the mainland.

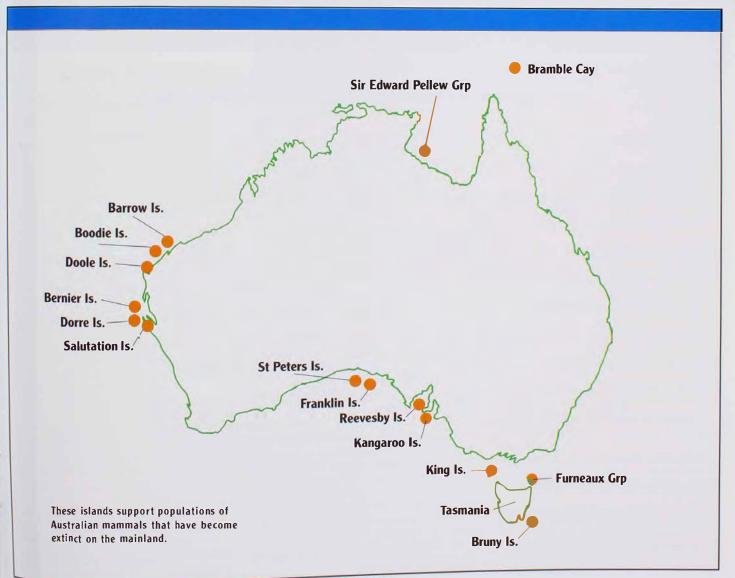
Despite the importance of islands to the conservation of Australia's mam-mals, few studies have assessed the genetic variation of island populations. In recent years my colleagues and I have begun to examine levels of variation in island and mainland populations Black-footed Rock-wallaby the (Petrogale lateralis) using highly variable genetic markers called microsatellites. The results of this research using nine different microsatellite loci have been startling. A mainland population of Black-footed Rock-wallabies at Exmouth, Western Australia, had a high level of genetic variation, where no two individuals had the same genetic profile. However, on Barrow Island we ex-

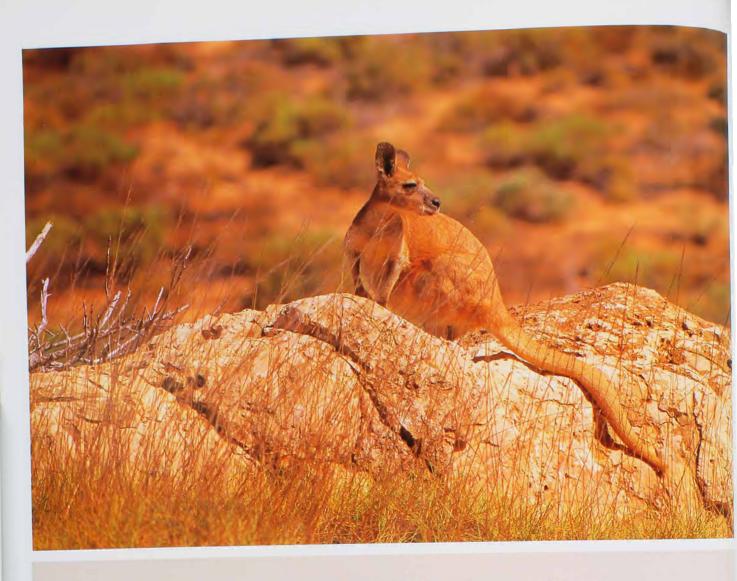


Plans are currently being formulated to use Banded Hare-wallabies (*Lagostrophus fasciatus*) from Bernier and Dorre Islands to re-establish populations in areas on the Western Australian mainland that have been cleared of Foxes and Cats.

amined 24 individuals from three different sites and all had an identical genetic profile. This low level of genetic variation is unprecedented for a wild

mammal population and indicates that Barrow Island Black-footed Rock-wallabies are severely inbred and have lost most of their genetic variation since the





AUSTRALIAN MAMMALS FOUND ONLY ON ISLANDS

Eastern Quoll (Dasyurus viverrinus)	Tasmania	T
Tasmanian Devil (Sarcophilus harrisii)	Tasmania	S
Carpentarian Pseudantechinus (Pseudantechinus mimulu	us) Sir Edward Pellew Group	T
Kangaroo Island Dunnart (Sminthopsis aitkeni)	Kangaroo	T
*Western Barred Bandicoot (Perameles bougainville)	Bernier, Dorre	T
Tasmanian Bettong (Bettongia gaimardi)	Tasmania, Bruny	Т
*Burrowing Bettong (Bettongia lesueur)	Barrow, Boodie#, Bernier, Dorre	Т
Banded Hare-wallaby (Lagostrophus fasciatus)	Bernier, Dorre	T
Tasmanian Pademelon (Thylogale billardierii)	Tasmania and nearby islands	S
*Rufous Hare-wallaby (Lagorchestes hirsutus)	Bernier, Dorre	Т
*Greater Stick-nest Rat (Leporillus conditor)	Franklin, Reevesby#, Salutation#, St Peters#	Т
Long-tailed Mouse (Pseudomys higginsi)	Tasmania	5
*Shark Bay Mouse (Pseudomys fieldi)	Bernier, Doole#	Ţ
Bramble Cay Melomys (Melomys rubicola)	Bramble Cay	Т
*Experimental release on mainland under way.	#Reintroduced or translocated population.	5

T =threatened; S =secure.

During the last 8,000 years the Euros (Macropus robustus) isolated on Barrow Island have become highly inbred and considerably smaller than their mainland counterparts.

island was separated from the mainland 8,000–10,000 years ago. This drastically limits the usefulness of this population as a source of animals for conservation

programs.

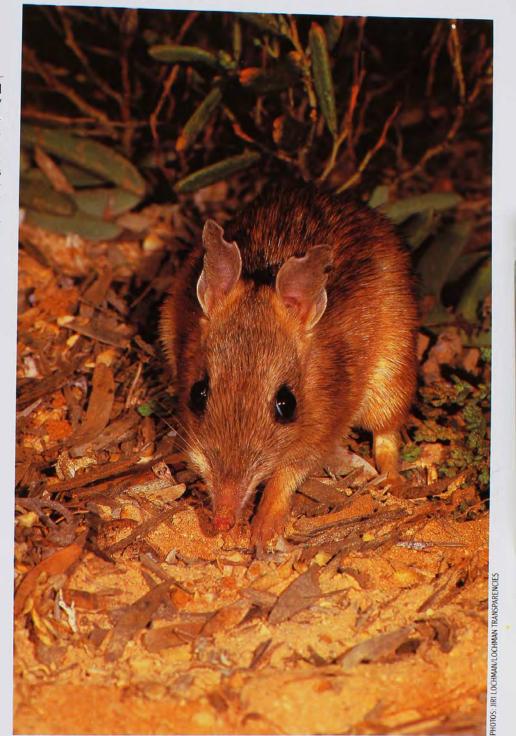
Since this discovery we have started analysing Black-footed Rock-wallabies from five other islands, as well as the Barrow Island Euro (*Macropus robustus isabellinus*). Although our analysis is incomplete, the general pattern of extremely low levels of genetic variation compared with mainland populations is evident. How can this be explained?

As well as the usual factors influencing genetic variation of island populations, it is possible that the

By breeding together animals of the same species, but from different islands, a highly diverse population would be created.

frequent droughts to which much of Australia is prone have significantly increased the amount of genetic variation lost in these populations by periodically causing severe population reductions. Regardless of its cause, research is urgently required to assess the levels of genetic variation in other island populations, which include some of our most highly endangered mammals. The results of these studies have the potential to significantly alter management strategies.

One interesting pattern to emerge from our research concerns Black-footed Rock-wallaby populations from several different islands. Although the population on each island has low levels of genetic variation, there are genetic differences between islands. This is to be expected as the random processes perating within each population would result in each isolated population becoming fixed for a different set of genetic markers. Therefore by breeding together animals of the same species, but from different islands, a highly



Experimental releases of Western Barred Bandicoots (*Perameles bougainville*) from Bernier and Dorre islands to predator-free areas of the Western Australian mainland are already under way.

diverse population would be created one that would be extremely useful for reintroductions as it should contain much of the original genetic diversity of the species. This gives hope that, with innovative management, the levels of genetic variation in some populations can be restored. However, in the absence of management, the long-term survival of many island populations cannot be assured. Of equal concern is the fragmentation of mainland populations, with protected areas rapidly becoming 'islands' in a sea of unsuitable habitat. Populations trapped in these 'mainland islands' are also likely to be vulnerable extinction. highly to However, with creative yet responsible

management, both our 'mainland' and offshore islands have the potential to preserve much of the unique fauna and flora of Australia.

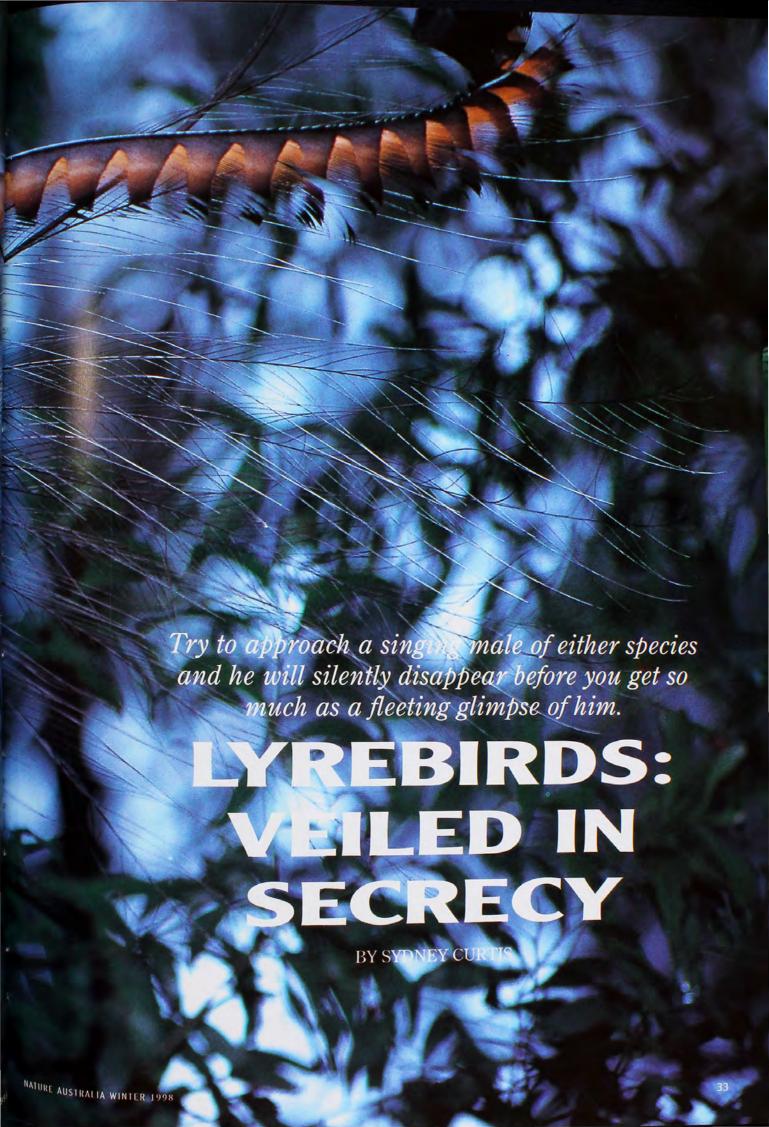
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spends hours a day on the ground in loud song, the price of survival is eternal vigilance. The famous English ornithologist John Gould wrote that, of all the birds he had ever studied in the field, the Superb Lyrebird (Menura novaehollandiae) was by far the most shy and difficult to stalk. Equally shy is Albert's Lyrebird (M. alberti). Try to approach a singing male of either species and he will silently disappear before you get so much as a fleeting glimpse of him—unless he is accustomed to people, which only rarely happens.

Lyrebirds roost in tall trees at night but spend the day scratching for food in the leaf litter and top few centimetres of soil. They are fast runners and can leap vertically two metres or more. If alarmed, they may jump up a tree, branch to branch, until high enough to glide away, but mostly they simply run

Lyrebirds are the size of a small domestic hen and weigh about one kilogram. They have acute eyesight and hearing, and large, strong feet with long claws. Adult male lyrebirds have very

The nest is a cosy fit for an Albert's Lyrebird mother and chick.

long tails (about 70 centimetres for the Superb Lyrebird, 50 centimetres for Albert's), which are highly ornamental and used in spectacular display. The tail consists of a broad outer pair of feathers (lyrates), a central narrow pair (medians) and six pairs with widely spaced barbs (filamentaries). The name 'lyrebird'comes from the elongated 'S' shape of the male Superb's lyrates, although the resemblance to that ancient musical instrument the lyre owes more to artistic imagination than live appearance. The male Albert's Lyrebird has relatively plain lyrates and, in the dim light of the rainforest, he looks rather unremarkable—until he suddenly inverts and spreads his tail. Then the previously inconspicuous silvery underside of the filamentary feathers becomes the outside of a dome of shimmering beauty that completely encloses his head and body, and a bright rufous patch under the tail is revealed—a spectacular sight, rarely seen, such is his extreme shyness.

In both species the female's tail, although plain, is also long (about 40 centimetres) and, as the nest is a domed structure with a side entrance, her tail develops a bend in it from fitting into the nest. The female alone builds the nest, incubates the single egg, and cares for

A male Albert's Lyrebird may sing continuously for up to an hour or more at a time, but not all of it is with his tail in a display position. While singing he moves a vine on his display platform up and down with his foot, causing screening foliage to shake.

the chick. Most nests are well camelaged, but a Superb Lyrebird nest in granite or sandstone country may be conspicuous... on a ledge of a rock fact where no terrestrial predator can get to it.

With six to seven weeks incubation and a similar period tending the chick in the nest, the mother is tied to that spot for over three months. No wonder she chooses mostly to remain silent although she too has a powerful voice During the nesting period the male sings and displays. His song is so loud it may be heard a kilometre away and his song sessions total several hours a day.

The courtship behaviour of the Superb Lyrebird is well known. The male clears all vegetation from an area about a metre in diameter and rakes the soil up into a low mound on which he displays both visually and vocally. During the winter breeding season, each male maintains a number of these mounds in an area from which he excludes other males, singing to pro-



HOTOG: CLEW TUBELED



claim his territory, offering vocal threats if another male intrudes and, only if necessary, attacking the intruder. These territories are not spread all over the forest, but are in groups such that the males are able to hear one another's loud calls and females can make a preliminary choice based on singing ability. This arrangement is known as a 'dispersed lek'. The Superb Lyrebird male is known to copulate with more than one female, his display apparently aiming to attract any female he can.

By contrast, little is known of the mating habits of Albert's Lyrebird. As far as I am aware, there is no written eye-witness account of their copulation. I have, however, tape-recorded vocal behaviour that I believe indicated copulation was taking place; but more on that later.

For more than 100 years after Albert's Lyrebird was described, the nature of the display arena remained unknown—a tribute to the extreme shyness of the birds. It is not an earth mound like the Superb's but a sparse platform of criss-

A Superb Lyrebird's tail in full display tends to form a flat roof over the bird, in contrast to the rounded dome shape of an Albert's. This is 'Timothy' in 1953, a recognised individual in Victoria's Sherbrooke Forest that lived to an age of 25–26 years.

crossed vines or sticks on the ground, surrounded by a leafy screen. As the male steps on the vines they spring up and down under his weight, or he may grasp a vine and move it up and down. This causes vegetation in the screen to move, which may serve to distract a predator (or curious human) stalking the lyrebird's song. However, it may also signal to the female.

Sonagraphic analysis, which produces a printed representation of the song, often shows additional sounds coinciding perfectly with certain rhythmic notes, and I have noticed that the leaves shake in perfect time with those rhythmic notes. I believe that the bird is in effect tapping one dry stick or vine on another, the only case of which I am



LYREBIRDS

Classification

Family Menuridae. Two living species, the Superb Lyrebird (*Menura novaehollandiae*) and Albert's Lyrebird (*M. alberti*); one early Miocene fossil species (*M. tyawanoides*).

Identification

Large birds (about 1 kg), with bodies about the size of a small domestic hen. Albert's rufous brown; Superb more grey brown. Long ornamental tails: about 70 cm for adult Superb male, 50 cm for adult Albert's male, 40 cm for females and young birds of both species. In rest position, a mature male Albert's tail curves upwards; that of a Superb is straight but droops slightly at end. Plain-tailed immature males indistinguishable from females.

Distribution and Habitat

Albert's: from Mt Mistake, southern Qld to Blackwall Range near Ballina, northern NSW; a north-south range of only a little over 100 km. Largely confined to rainforest at higher altitudes, its original lowland habitat having been cleared for development. Superb: from near Stanthorpe, just north of Qld/NSW border to Vic. and introduced into Tas. Inhabits mainly wet, and to a lesser extent dry, sclerophyll forest, also temperate rainforest and, in northern NSW, subtropical rainforest. Nowhere do the two species coexist.

Reproduction

Male Superbs appear to be polygamous or promiscuous. Mating habits of Albert's unknown. In both species female alone builds the nest, incubates the single egg (about 6–7 weeks) and cares for chick (another 6–7 weeks). In breeding season (about May to August) mature males defend territories in a dispersed lek situation. Each male has a number of display courts from which he gives extensive vocal and visual display. (Females are capable of song and mimicry, but mostly remain silent.) A Superb's court is a low mound of raked earth; the court of an Albert's is a sparse platform of thin vines or sticks lying on ground. In display, the large ornamental tail is spread wide and brought forward to cover head and body in a shimmering filamentous roof of great beauty.

Behaviour

Roost in tall trees but spend the day on ground. Feed on invertebrate fauna in leaf litter and top few centimetres of soil. Fly poorly but run rapidly and are capable of leaping vertically 2 metres or more. Outside breeding season, males wander at large and may forage together. Females and young birds wander about much more.

Status

Most remaining Albert's Lyrebird habitat and much Superb habitat in permanent reserves. Both species probably secure, although small isolated populations such as the Albert's of Tamborine Mountain and Blackwall Range must be regarded as being at risk.

aware of a wild bird accompanying its song with a musical instrument—if one may so regard rhythm sticks!

The males of both species have elaborate visual and vocal displays aimed at attracting females. The complex song consists of lyrebird sounds intermingled with mimicked sounds of other species and, although there are similarities between the two species, there are some remarkable differences. One concerns the use of mimicry.

YREBIRDS ARE SUPERB MIMICS AND copy any sound they hear. Right? Wrong! A male lyrebird's song includes calls of other birds, but I believe he is copying other lyrebirds, not the other birds. Superb Lyrebirds, introduced into Tasmania between 1934 and 1949, provide evidence of this: they brought their own suite of mimicked sounds with them and in the 1960s their song still included recognisable calls of Eastern Whipbirds (Psophodes olivaceus) and Pilotbirds (Pycnoptilus floccosus), neither of which occurs in Tasmania. The sounds are passed on from generation to generation, with all the birds in one area



using the same 'borrowed' sounds. In normal circumstances, by hearing the other birds, they keep the mimicked sounds true to the models. However, today in Tasmania, away from the reinforcing 'role models', the Eastern Whipbird and Pilotbird calls are no longer recognisable.

Albert's Lyrebirds provide proof of this cultural transmission of song. They have evolved a complex song about 50 seconds long consisting of the same sounds, mostly mimicry, always in the same order, which may be repeated over and over like a broken record. A colleague, Vicki Powys, has dubbed this stereotyped song the 'albertcycle'. (By contrast, Superb Lyrebird song is not cyclic. The sounds come in random

order.)
This long repeated song appears unique in the avian world. I have found 'Spotty', shown here in June 1961, was perhaps the most famous of several individually recognised Superb Lyrebirds of Sherbrooke Forest, Victoria. He was 21-22 years old when he disappeared, probably taken by a



no reference in the literature to anything similar. Furthermore, all the males I recorded in one locality used the same albertcycle—proof positive that they learn their songs from listening to older lyrebirds.

Why do lyrebirds use 'mimicry'? How did the albertcycle arise? How is it used? To attempt to answer these questions requires consideration of the complex communication system that is lyrebird

A mature male lyrebird is strongly territorial, and may occupy the same area each breeding season for his whole life

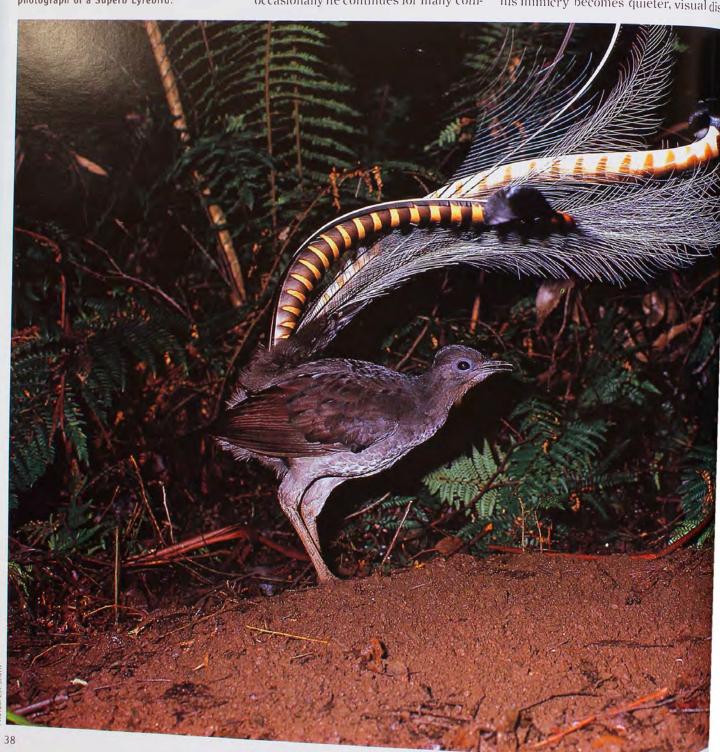
At various times during a song session, a lyrebird may hold his tail in the normal rest position, or inverted over his back, as in this photograph of a Superb Lyrebird.

(20 years or more), proclaiming his territory with loud song. All males in a particular area have the same territorial song but different areas may have different songs or dialects. Powys found 12 Superb Lyrebird dialects within a 25-kilometre radius of Sunny Corner, east of Bathurst, New South Wales. When a male hears a neighbour commencing his territorial song, he will stop singing to listen and then respond with his own territorial song. Thus they continually check on one another to confirm each remains within his own territory.

An Albert's Lyrebird, after pausing to proclaim his territory, may continue his albertcycle from where he left off, start again from the beginning, or (less often) take up in another part of the cycle. But occasionally he continues for many com-

plete albertcycles under circumstance that clearly indicate the albertcycle aimed at attracting the female for maing. To understand why this is so, consider first Superb Lyrebird matin behaviour, as elucidated by that doyence lyrebird experts, the late Norma Robinson.

A mature male Superb Lyrebird is displaying and singing on a mound Another lyrebird approaches. The male doesn't yet know the intruder's sex, and makes some loud questioning calls that sound like 'plik plik' or 'clonk clonk'—his 'short plik song'. If satisfied that his visitor is female, he adds a series of repeated notes to form a 'long plik song'. These are followed by more of his usual display song. If she comes to his mound his mimicry becomes quieter, visual display sing.



There is no spare room in a lyrebird nest and the female's tail has to bend around while she is in the nest. After some weeks the feathers become permanently curved, as can be seen in the tail of this female Superb Lyrebird.

play intensifies and, if copulation takes place, he precedes it with a series of

'clicking' sounds.

No Albert's Lyrebirds have become sufficiently accustomed to people to allow similar detailed observations of their courting behaviour, but vocal behaviour apparently analogous to Superb's is recognisable. The albertcycle may be interrupted with loud 'gronk gronk' sounds. Sometimes these are followed by soft rhythmic notes and both repeated several times. This behaviour appears equivalent to the Superb's





'short' and 'long plik songs'.

I once recorded all the song of a male Albert's Lyrebird from when he first came down from his roost until he stopped singing to feed. He sang at three different display platforms for 33, 4 and 65 minutes respectively, with 32, 5 and 84 complete albertcycles, and only eight, one and seven territorial songs. He ignored his neighbour's territorial songs, which normally would have stimulated a response. I could not watch him

ture' again shows they learn to sing by copying other lyrebirds. It is these soft rhythmic notes that are sometimes accompanied by 'rhythm sticks', which is consistent with the shaking of the leaves being a signal to the female.

So why do lyrebirs have this complex vocal communication culturally transmitted from generation to generation? Why do they use mimicked sounds so extensively? How did they

No Albert's Lyrebirds have become sufficiently accustomed to people to allow similar detailed observations of their courting behaviour.

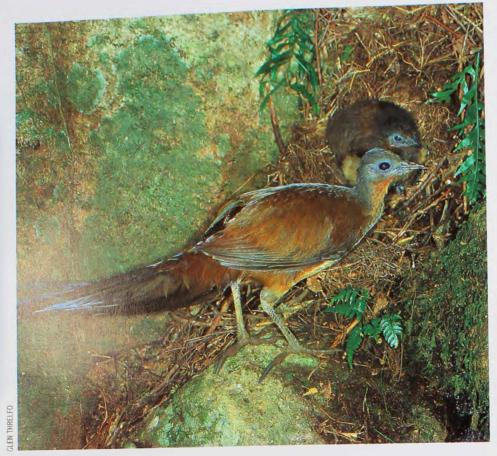
(to have tried would have terminated the performance) but I knew a female was in the immediate vicinity . . . and the performance ended with 'clicking'! It seems reasonable to conclude that mating took place, and that the albertcycle is therefore aimed at the female.

In the 'gronking song', two distinct sounds forming the rhythmic notes are repeated in regular groups or 'bars'. Recordings of males from one area had two 'beats to the bar', those from another area all had three 'beats to the bar', and so on, up to six. That all male in any one locality have the same 'time signa-

acquire the sounds in the first place? Some lyrebird must originally have added each mimicked sound.

I have encountered only one example of deliberate mimicry. A Satin Bowerbird (*Ptilonorhynchus violaceus*) gave his advertising call and the Albert's Lyrebird immediately interrupted his albertcycle, gave a perfect imitation of the call—just once—then continued his albertcycle. That bowerbird call occurred in a different place to the regular one in the albertcycle, so clearly it was deliberate mimicry.

Do lyrebirds in the wild mimic



ound leaves no fossils,

so we can never know how

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arose.

A female Albert's Lyrebird attends her chick in the nest.

mechanical sounds as is claimed? In one sense they do: in their breeding-season song, both species have included mimicry of a beak being tapped on a branch, and of beating wings, but not axe-blows or other human-generated sounds.

Outside breeding season they may do so. For many years a Albert's male Lyrebird moved into my parents' property Tamborine Moun-(Queenstain land) after the end of each breeding season. My mother told me that on one occasion he gave a perfect imiof tation starter motor of a tractor. But only once. With European settlement.

some lyrebirds may have imitated axeblows or saw-strokes but, finding the sounds unsuitable, did not incorporate them into their permanent repertoire.

There is a story of a male Superb Lyrebird chick taken from a nest and raised away from other lyrebirds. He learnt to sing what he heard—a flute. When later released, his 'flute' sounds were suitable and became part of the local repertoire. I've listened to these birds and it does sound plausible, but

the story has been queried on the grounds that the same flute-like songs occur in an area 100 kilometres away. If anyone can confirm the story and put me in touch with the family who raised the chick, I'd be most grateful.

Sound leaves no fossils, so we can never know how ancestral lyrebirds sang, but we can speculate as to how their complex vocal behaviour arose. In the distant past much of Australia was covered in forests dominated by Antarctic Beech (Nothofagus brassii), probably similar to the beech forests of New Zealand today, which have relatively little ground cover under the for-

est canopy. With such good visibility, ancestral lyrebirds evolved lek behaviour based on visual display, and the highly ornamental tail resulted. When beech forests gave way to forests with dense undergrowth, visual display became ineffective except at close range. Vocal display supplanted visual display as the basis of initial female selection, leading to ever more complex song. Continuous song for long periods has the advantage of keeping the lines of

communication open, but needs a great variety of sounds if monotony is to be avoided. Innovative individuals 'bor rowed' from other species, with the new sound taken up by the other males.

Lyrebirds once ranged over most of eastern Australia—a fossil species has been described from Riversleigh, northwest of Mt Isa. At some stage the population split into two, with Albert's Lyrebirds in the north and Superbs in the south. Alec Chisholm, in his book The romance of the lyrebird, pointed out that the tail of an immature male Superb Lyrebird shows a resemblance to the tail of a mature Albert's Lyrebird, suggesting that perhaps Albert's Lyrebird is the more ancient form from which the Superb Lyrebird evolved. Alternatively both may have evolved from a common



ancestor with an underdeveloped tail and only the Superb subsequently acquired the fancy bits. Lyrebirds have now been lost from everywhere north of Brisbane, and the two species almost meet in northern New South Wales.

With Albert's Lyrebirds one can imagine an initially short song gradually being extended but being retained as a song in stereotyped order—the albertcycle. Superb Lyrebirds borrowed more calls and from a greater range of species, but did not retain the fixed order.

In display a male Albert's Lyrebird inverts his tail over his back. It may be partly spread, as in this photograph, or fully spread to enclose his head and body in a dome of feathers. The bright rufous tuft of feathers at the base of the tail is not found in Superb Lyrebirds.

While we can deduce much about the vocal behaviour of Albert's Lyrebirds from our knowledge of Superbs, their intense shyness has precluded extensive observation. There is a solution, though: a video camera at each display platform, linked to a monitoring station. About a dozen cameras should do the trick. If any researcher can come up with such resources, I'll gladly show them how to find the display platforms.

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Sydney Curtis grew up on Tamborine Mountain, an Albert's Lyrebird area. As a National Parks Officer in the Queensland Department of Forestry, he commenced research on Albert's Lyrebirds in 1968, and has continued this in a private capacity since 1975. He gratefully acknowledges the encouragement, guidance and advice of the late Norman Robinson.

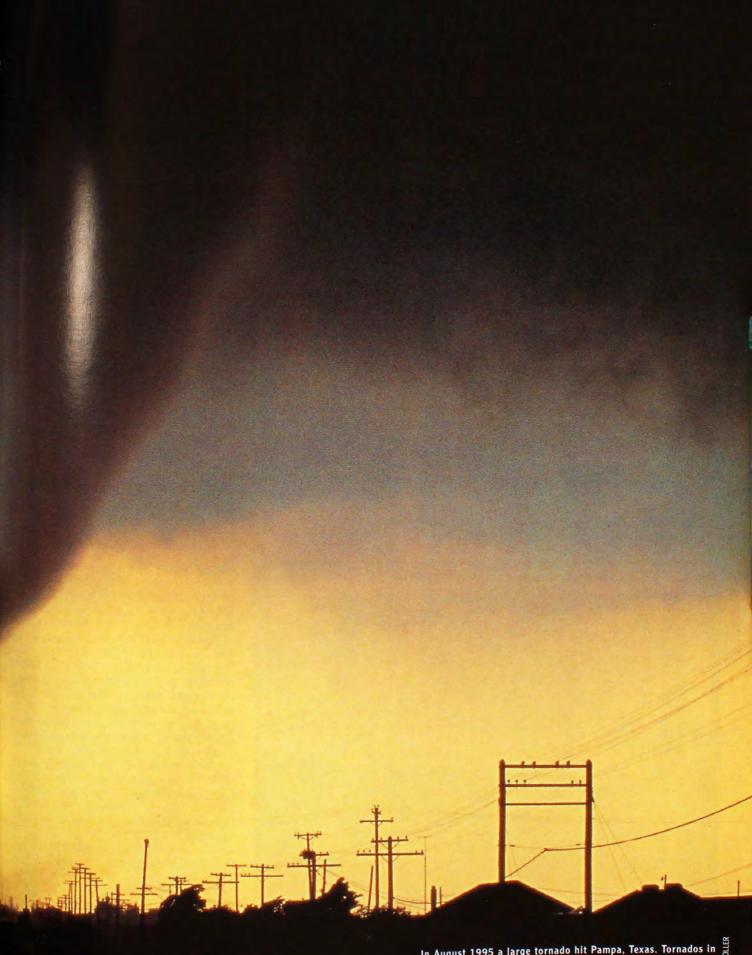


He heard the word over and over again coming from the crowd of victims and shaken neighbours: tornado.

TWISTING THE NIGHT AWAY

BY GEOFF McNAMARA





ERTH, WESTERN AUSTRALIA, 15 luly 1996, 9pm: Rod Paterson drove the four-wheel drive from kerb to kerb, slowly winding his way along the four-lane highway. He and his team of State Emergency Services (SES) volunteers had passed through the police road block and were still a kilometre and a half from the disaster area. Through the heavy rain the car's headlights picked out the debris of people's lives that littered the road: chairs, clothes, personal papers, children's toys. Here and there scattered across the asphalt were roof tiles and other building materials. At one site not far away, a steel girder had impaled a concrete driveway. Oh, and there were trees, lots of trees, plucked from the soil and thrown in all directions.

Arriving at the site, Paterson stopped the truck and stepped out into the dark and frightened night. White-faced victims wandered around, staring incredulously at the wreckage that was once their homes: one house had lost its roof; the house next door was simply gone. A few doors away the petals on the roses were still intact. When Paterson saw how the damage was focused along a narrow path through the residential suburb of South Perth he knew that what had passed through here was no ordinary storm. Squalls and thunderstorms sweep entire cities with their violence. blind selectiveness, which destroyed a home and spared its neighbour, could only be caused by one thing. As Paterson and his team began their initial reconnaissance, sorting out those who needed help first, he heard the word over and over again coming from

the crowd of victims and shaken neighbours: tornado.

USTRALIA IS OFTEN CONSIDERED TO BE a safe place to live. Not many earthquakes, the occasional cyclone, a few dangerous animals and insects. But tornadoes? Do we really get them? The answer is yes, and in larger numbers than you might think. Tornadoes can strike at many places around Australia, including Sydney (a tornado swept through the suburb of Chatswood in November 1994 causing an estimated \$20 million damage), Adelaide (January 1991, \$75 million damage) . . . and Perth. They can also be just as violent as they appeared in films like "Twister". On 13 January 1976, an elderly couple were killed in central Victoria when a tornado picked up the car they were travelling in and hurled it 100 metres into a ditch on the side of the road.

Tornadoes are the most violent of a family of phenomena involving twisting columns of air. At the other end of the spectrum are wind devils, gentle vortices often seen in school playgrounds. These playful phenomena usually appear on warm, sunny days when hot air rising from baking playgrounds and car parks interacts with breezes to form a rising swirl of dust and leaves. At most they might lift a beach umbrella and carry it cheerfully downwind, or perhaps become strong enough to lift the occasional roof tile. A similar but terrifying phenomenon can form over large fires where the abundance of rising hot air can create a fire devil (also known as a 'fire whirlwind'). The potential devasta-



tion of fire devils is hard to imagine: following the earthquake that shook Tokyo in 1923, a fire devil claimed the lives of 60,000 people. Fortunately such events are rare.

Tornadoes on the other hand are usually associated with foul weather. Tornadoes start their lives as a column of rising and spinning air within thunderclouds. Although the air within the tornado is rising, the lower end of the tornado descends from the cloud as it grows. It's only when the tornado reaches the ground that damage is done.

The tornado itself is as invisible as the wind. What makes tornadoes so spectacular—at least before they start picking up cars, houses and people—is the dark funnel in their centre. As a tornado develops, it looks as if the funnel is reaching down towards the Earth from the base of the thundercloud, almost as if the host cloud is being sucked down into the tornado. But the funnel is simply the condensation of moisture inside the tornado: as the tornado spins faster, the pressure in the centre falls, allowing the formation of a conical or tubular 'cloud'.

Despite decades of study, no-one knows for sure why tornadoes form. What is known is that popular tornado breeding grounds are thunderstorms.



In October 1993 part of a eucalypt forest was flattened by a tornado at Tia Falls, 30 kilometres east of Walcha, New South Wales. The damage suggests that the wind speeds were up to 250 kilometres per hour. It cut a path approximately 23 kilometres long by half a kilometre wide.



Thunderstorms are created when warm air heated by the Sun rises. As it rises, the air cools and the moisture it contains condenses to form those tall, pillowy clouds meteorologists call cumulonimbus*. As the moisture cools and condenses, it releases the heat energy that kept it as a vapour. This heat drives the rising air to even greater heights. Although the upward-moving air tends to hold the rain aloft, eventually gravity wins and the rain falls.

Another way thunderstorms develop is when a 'cold front' moves in. A cold front is simply a large mass of cool air. Being cool, it tends to hug the Earth's surface, forcing air masses in its path upward and creating a thunderstorm. But thunderstorms, violent as they can be, do not always create tornadoes. An extra ingredient is often needed.

According to Andrew Treloar, Senior Meteorologist at the Severe Weather Section of the New South Wales Bureau of Meteorology, the one thing you need to get an intense tornado out of a thunderstorm is windshear. Windshear occurs between two or more air currents that are moving at different speeds. If

*The word cumulonimbus comes from the Latin words cumulo meaning heaped, and nimbus meaning rain-bearing.

CLASSIFYING TORNADOES: THE FUJITA SCALE

Because tornadoes are difficult to measure directly, the Fujita scale was developed in 1971 to help researchers estimate the strength of tornadoes from the damage they caused. Even though the classification levels are a little 'fuzzy' around the edges, the scale remains a useful one. The South Perth tornado, in July 1996, is estimated to have been an F1.

F0: weak tornado, wind speed 64-116 kph
Damage to chimneys and windows; shallow-rooted trees pushed over.

F1: moderate tornado, wind speed 117–180 kph Moving cars pushed off road; caravans overturned; trees broken.

F2: strong tornado, wind speed 181–253 kphRoofs torn from frame houses; cars blown from roads; large trees snapped or uprooted.

F3: severe tornado, wind speed 254–332 kph
Walls torn from frame houses; trains derailed and overturned; cars lifted off ground; most trees uprooted.

F4: devastating tornado, wind speeds 333-419 kph
Frame houses destroyed; bark stripped from trees; cars, trains and uprooted trees thrown or rolled considerable distances.

F5: incredible tornado, wind speed 420–512 kphWhole frame houses tossed from foundations; cars thrown through the air; asphalt torn from roads.



one current is moving faster than another, they 'rub' past each other creating wind's version of friction. The wind needs to be changing in speed and direction with height, which sets up turning and twisting forces in the atmosphere. Within a thunderstorm these forces can turn into a tornado.

To picture how windshear can create a tornado, think of rubbing plasticine between your hands. If your hands represent two layers of air travelling at different speeds above the ground, you can imagine that the air between them—represented by the plasticine—experiences opposing forces on either side. Like the plasticine between your palms, the air between the two layers starts to roll, elongating into a horizontal column of

rotating air.

The rotating column of air gets caught in the updraught of the thunderstorm and transfers its rotating motion to the updraught. The now vertical rotating column is called a 'mesocyclone'. Ranging from 10 to 20 kilometres across and extending from a kilometre above the ground to 15 kilometres in height, the mesocyclone can produce a 'wall cloud', a shallow cylindrical-shaped cloud (picture a giant cake tin) extending beneath the thundercloud. The winds below the mesocyclone are fast—up to 120 kilometres an hour. Further concentration of a core in the centre of the mesocyclonewith winds reaching anything up to 500 kilometres an hour—is the tornado.

Tornadoes shouldn't be confused with cyclones, which are large (typically 500 to 1,000 kilometres in diameter), rotating, low air-pressure systems. Cyclones, like tornadoes, usually rotate anticlockwise in the northern hemisphere and clockwise in the south. They are frequently encountered in the tropics, especially around the north of Australia. However, tornadoes can form within the individual thunderstorms of a cyclone. In fact, as Treloar explained, sometimes a lot of the extreme wind damage done in a tropical cyclone is actually caused by

an embedded tornado! Treloar remains cautious, however, for much of what we know about tornadoes is still theory. It's very hard to observe what goes on inside tornadoes, or even thunderstorms for that matter. Not that scientists haven't tried. In the United States, where the densely populated rural areas have made tornadoes seen downright common, scientists are conducting experiments to find out what makes tornadoes twist. One is called VORTEX, or Verification of the Origins of Rotation in Tornadoes Experiment VORTEX consists of a number of mobile weather radar systems capable of sensing both rainfall and wind direction. These radar systems are hauled around the countryside in search of tornadoes.

At the peak of its intensity this tornado from Pampa, Texas shows a dark mass of debris gathered at the base and revolving upward.



Twin waterspouts over the warm waters of the Gulf of Carpentaria. A waterspout is caused by cool unstable air masses passing over warmer waters. This results in the formation of vigorous updraughts that can tighten up into a spinning column. They can be dangerous for boaters and shoreline locations.

Similar research in Australia is difficult. Not only is Australia a large country with a relatively small population, the fact is, compared with most meteorological phenomena, tornadoes are tiny. They can range in size from 100 metres across up to perhaps a kilometre at most, and satellites and standard weather radar don't have the resolution to see them. In fact, the best way to spot a tornado is by eye, but with Australia's sparsely populated outback that's a big job. It's hard to know about the frequency of tornadoes in Australia, but to improve things the Bureau Meteorology is recruiting a network of 'storm spotters', volunteers spread around the countryside who report severe storms such as tornadoes. So far about 3,000 storm spotters have been recruited across Australia, and Treloar says the network really helps to fill in the gaps in our knowledge of where, and when, Australian tornadoes occur.

The information collected about tornadoes is fed into computers to try and work out what's going on. Treloar explained that, over the last 10 to 15 years, there have been some pretty good computer models designed to mimic what happens in thunderstorms. These models allow meteorologists to alter the initial conditions of 'virtual thunderstorms' to see which ones produce tornadoes. But at the end of the day, tornadoes remain a mystery, with no defini-

tive explanation for why they occur. The best meteorologists can do at the moment is issue warnings that a particular thunderstorm might produce a tornado.

Tornado warnings are rare, but important because few phenomena produce the devastation tornadoes are capable of. So just how does a tornado do all the damage? The rotating air current in a tornado can reach speeds up to 500 kilo-

ing houses of their roofs, especially flatroofed houses. As explained by Associate Professor Geoffrey Boughton from Curtin University's Department of Civil Engineering, it all has to do with aerodynamics. The wind tearing across the ground hits a house and has to go somewhere. Some of the air goes around the house, but most goes up and over the top. By the time the wind gets to the top of the wall it's moving upwards quite

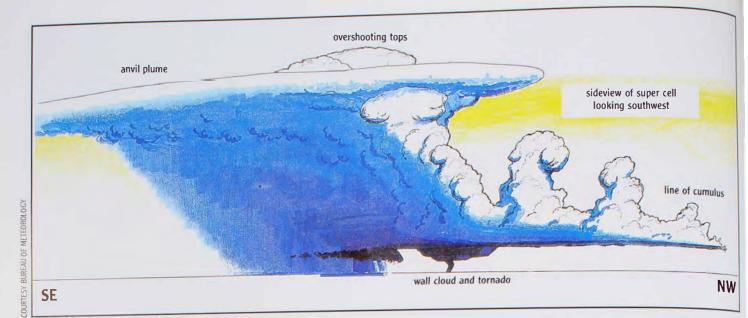
The best way to spot a tornado is by eye, but with Australia's sparsely populated outback that's a big job.

metres an hour. Compare this with maximum wind gusts in a hurricane of 360 kilometres an hour (although sustained speeds of 160 kilometres an hour are more common) and you begin to appreciate the destructive force behind a twister. But it's not just wind speed that gives a tornado its savage fury. When a tornado strikes a wall, for example, the wall experiences opposing wind forces at either end. It is the *rotation* of the tornado that literally twists things apart.

The severe horizontal winds within a tornado are particularly good at reliev-

quickly. The wind overshoots the top of the house creating suction above the house. It's this suction that raises the roof.

It's sometimes difficult to tell whether storm damage in Australia is the result of the twisting force of a tornado or something less exotic like the single-direction winds in a squall. Tony Bannister, a meteorologist with the Western Australian Bureau of Meteorology, explained that the reason it's sometimes hard to tell the difference between squall and tornado damage is



This illustration displays the features of a severe weather system that produces thunderstorms and, potentially, tornadoes.

because of the speed of Australian tornadoes. A tornado travelling at 50 or 60 kilometres an hour may also be spinning at 100 kilometres an hour. So, on one side of the tornado the wind speed will

be 160 kilometres an hour and on the other it's only 40 or 50 kilometres an hour. Most of the debris will be blown by the 160-kilometre-an-hour wind, in the same direction the tornado is mov-

ing. The resulting debris pattern blown mainly in one direction-mimics that left by a squall. This makes it difficult to determine whether wind damage is the result of a tornado or a squall. In comparison, tornadoes in the United States tend to spin faster, but move slowly across the land. The result is debris thrown in all directions, a pattern that isn't easy to duplicate any other way. As Bannister put it, the best thing is either a witness to the event or a clear debris pattern that shows the path of a tornado. It just happens that in suburban Perth on the night of 15 July 1996 both were available.

ARLIER THAT DAY THE WESTERN Australian Bureau of Meteorology forecast that a strong winter cold front would move through Perth after lunch. Winter cold fronts are common to the south-west coast of Western Australia, but Bannister recalls this was quite a strong one. The front crossed the coast at about 4pm and a warning was put out for possible severe squalls and thunderstorms that evening and night.

It wasn't long before reports of minor damage done by wind gusts up to 100 kilometres an hour began to come in to the Western Australian SES Headquarters. Rod Paterson, then a volunteer but now a full-time SES employee, received his first call as soon as he got home from work. The call was to a few houses that had been damaged by fallen trees.

By the time Paterson and his colleagues were back at the base, the storm was raging. "We thought there wasn't much point in going home, so we ordered a pizza and waited for the phone to ring again. But before the pizza arrived we were gone", Paterson recalled. At about 8.40 that evening, a

This tornado from Northam, Western Australia is made visible by all the dust that has been sucked up into its funnel.

squall moved through the Perth metropolitan area accompanied by a severe thunderstorm. No-one knew that a tornado had formed within that thunder-

storm.

The tornado began forming over Rottnest Island, about 20 kilometres west of Perth. Heading eastward with the storm, it eventually touched down outside Sir Charles Gairdner Hospital in Shenton park. This is where the only reported sighting of the tornado took place: a nurse saw the dark twister move through the well-lit car park. The tornado did some minor damage to the hospital, bringing down a few trees and blocking the ambulance entrance before moving off into the night in search of other prey.

It moved eastward across Kings Park where it tore branches from some trees and uprooted others, flinging debris in its path. It crossed the Swan River, passed over the Kwinana Freeway, and entered the densely populated suburb of

South Perth.

As the tornado travelled along Mill Point Road, it tore the roof from a block of flats, hurling the debris up to 300 metres away. A steel girder later found sticking out of the concrete driveway could not be budged by the SES team that found it. "It would take more than a five-story fall to do that", Paterson later commented. "It would have gone up before it came down." Elsewhere it raised a charity clothing bin into the air and scattered its contents for 200 metres down the road.

The tornado then destroyed a house: its flat roof was torn off and the front windows were blown in, but the walls were left standing. The shattered remains were all that was left of the home of an elderly woman. She had lost everything, and never moved back. The block of land remains vacant.

It passed through the backyard of a nearby property, but only touched the house. The strange thing was that the expected debris from this house was nowhere to be seen. Paterson recalled that there was some debris left behind, bits from the garden like broken branches and a garden shed, but not what was missing from the house. Unaccounted debris was found over a kilometre away. "Either that's the debris from the house or it's still up there", said Paterson.

The tornado continued along Mill Point Road before dissipating over the neighbouring suburb of Kensington. The tornado had carved a seven-kilometre-long path of destruction only 40 metres wide. Travelling at at least 80 kilometres an hour, the tornado had twisted the night away in a mere five minutes.

In the darkness that followed, 90 SES volunteers were called out to help people through the night. A total of 22 people were evacuated, 33 sets of traffic lights damaged, and 30 houses severely damaged. Powerlines had come down, some of the power poles snapped off. Fences and brick walls were left lying in

pieces. The total repair bill was estimat-

ed at \$20 million. Miraculously no-one

was injured.

This isn't the first time a tornado has struck at a densely populated area and it's unlikely to be the last. Nor was it the most severe. Tornadoes are classified according to the Fujita scale (see box), with F0 being at the bottom end and F5 at the top. The South Perth tornado has been rated as an F1, a moderate tornado. However there are records of at least F3 tornadoes in Australia. As Australia's population spreads, the chance of encountering tornadoes becomes greater. Since tornadoes are so hard to predict, we may end up finding out about their frequency and intensity in Australia the hard way.

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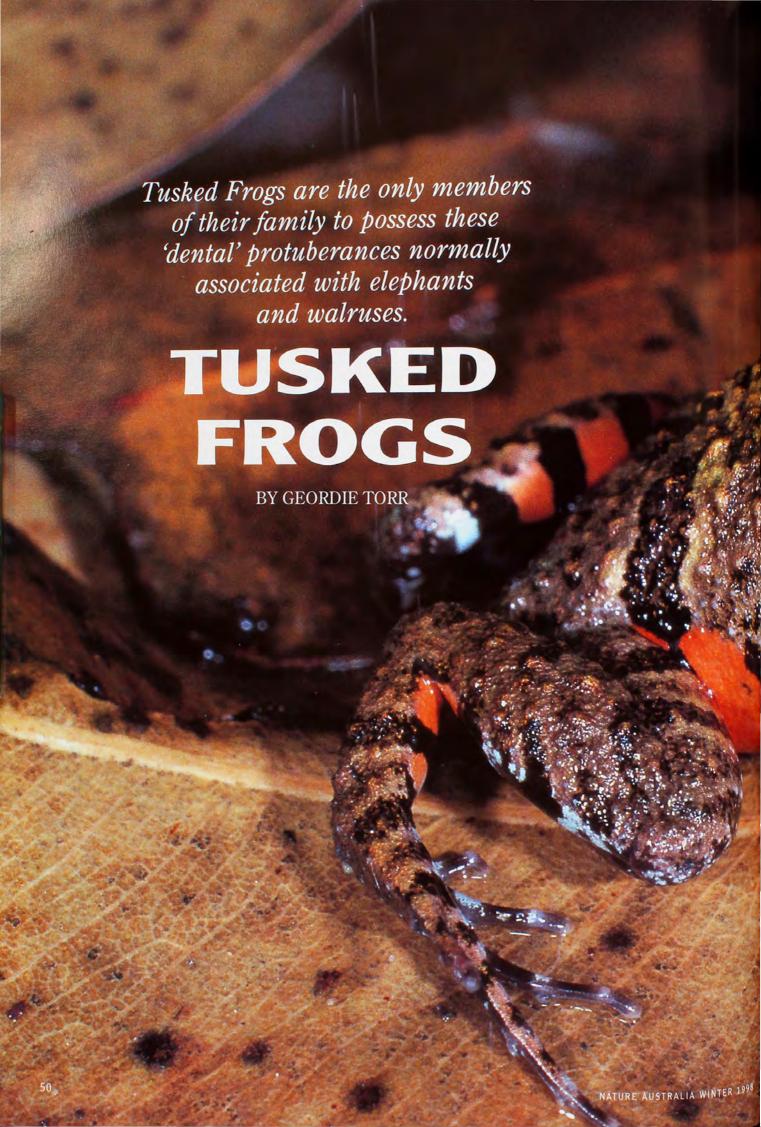
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Geoff McNamara is a freelance science writer and a regular contributor to Nature Australia as well as to several other science and technology magazines in Australia, Asia and England. He would like to thank Tony Bannister, Geoffrey Boughton, Rod Paterson and Andrew Treloar for their help in preparing this story.



A willy willy or dust devil on a dry plane in the Northern Territory. These columns of whirling dust look like a small tornado but only occur on fine days. The fine days. They are the result of an updraught from the hot surface and are usually harmless.





N QUIET PONDS AND FARM DAMS IN the forests and paddocks on Australia's east coast lurks a bizarre creature armed with a pair of fearsome curved tusks. Guarding a nest made of froth, this creature is nothing to fear. Unlikely as it may sound, it is a frog.

The Tusked Frog (Adelotus brevis) takes its name from two sharp tusks found at the front of its lower jaw that fit

into special pits in the roof of the mouth. The tusks are not 'real' teeth. but bony extensions of the lower jaw. From above, these frogs aren't much to look at, the rough, dark brown, mottled skin on their back looking remarkably like the moist dirt, mud and leaves in which they live. But flip a

Tusked Frog over and it's a frog of a wholly different complexion. Like their tusks, these frogs keep their more outrageous sartorial excursions hidden. Their bellies are a striking mosaic of black and white, and they have brilliant red patches in the groin and on their back legs—thought to act as a distraction to predators as the frogs make their escape. In keeping with the more sedate

aspects of their outward appearance, the male's call is an unprepossessing 'cluck', repeated a few times each minute.

As Tusked Frogs are the only members of their family (Myobatrachidae) to possess these 'dental' protuberances normally associated with elephants and walruses, they have been placed in a genus all of their own. Being so unusual makes them especially interesting to biologists who study evolution, because

evolutionary biology is one place where a tabloid fixation with the weird and wonderful actually serves a purpose beyond momentary titillation. It is the study of the bizarre, the outliers, the freaks. that gives us some of our clearest insights into the hows and whys of evolution. If species is just like

its close relatives, then the majority of its characteristics will simply be evolutionary baggage left to it by its distant ancestors. This makes it difficult to determine how those characteristics first evolved. By studying the weirder species, in which a trait has evolved more recently, it is possible to gain a much better understanding of how such a trait evolved.



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You wouldn't want to meet him in a dark swamp. The formidable tusks that give these frogs their name are much longer in the male than in the female.



ANY ANIMAL SPECIES SHOW MAJOR differences between males and females, ranging from a simple size difference to the possession of ornaments such as the train of a Peacock or the mane of a Lion. This is known as sexual dimorphism, and was first explained by Charles Darwin who proposed that a process called sexual selection was responsible. Sexual selection can act through two different mechanisms. The first is male-male competition, where males fight each other for access to females (see Nature Aust. Winter 1996). This tends to lead to larger size in males and tools useful for fighting such as big horns or chest shields. The second mechanism is female choice, where females exert their powers as consumers and choose their mate sbased on certain criteria of attractiveness (see Nature Aust. * Summer 1994-95). Female choice is often behind the bright, showy colours of some males



and can explain the presence of apparently useless ornaments. It can also be responsible for differences in body size if females choose their mates on the basis of this criterion.

But it isn't always necessary to resort to sexual selection in order to explain sexual dimorphism. Natural selection can also lead to differences in the sexes by acting through some form of ecological divergence. For example, male mosquitoes lack piercing mouthparts as only the females suck blood.

In most frog species the female is the larger sex, the result of natural selection for greater egg production—the larger a female is, the more eggs she can produce. In some species the male is larger and is often found brawling with other males, an indication that sexual selection is boosting the male's size.

Tusked Frogs, unlike almost all the other members of its family, have larger

males than females. Males also have larger heads and longer tusks. Despite this anomaly and its being one of the more bizarre members of the Australian frog fauna, no-one had ever tried to elucidate why male and female Tusked Frogs were so different, nor why they possessed such a fearsome pair of weapons on their lower jaws. Not until Kaliope (Poppy) Katsikaros who, as a Master's student at the University of Sydney, spent many a cold night knee deep in Campbell's Dam in Ourimbah State Forest, about 80 kilometres north of Sydney, light rain falling around her, ears aching as she sought a quiet 'cluck'.

However, before getting out among the living, hopping, clucking frogs, she had to make a pilgrimage to the inner city resting place of some of their deceased brethren. Museum collections aren't just dusty old accumulations of dead animals; they are an invaluable source of information—those dead animals can tell some interesting tales

On casual inspection the male Tusked Frog looks much like any other brown frog but his teeth are unique among Australian species.

about what they got up to when they were alive.

Painstaking measurements of all the available museum specimens revealed that the males were about 25 per cent longer than the females and also had larger heads, legs and tusks, even after taking into account their larger overall body size. Female tusks were often no bigger than tiny (less than .5 millimetre) bumps in the lower jaw, whereas male tusks were well-defined, often curved structures around two millimetres long but up to four millimetres in the largest individuals. If these differences were the result of natural rather than sexual selection, then the first evidence would be a difference in diet. So, with her head still spinning from the alcohol fumes, Poppy cut the specimens open and inspected their last meals, discovering just the dif-

^{*}Previously ANH

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ference she was looking for. The female frogs' diet was dominated by arthropods such as grasshoppers and crickets, while the males apparently had a predilection for molluses. The males also had a broader diet, even going so far as to consume other frogs, including those of their own species.

Unfortunately the discovery that the diets of the two sexes were different did-

n't provide the quick and neat answer that it might have. The differdidn't really ences explain why the males had such large tusks and big heads. It's a little hard to imagine the male frogs having to employ their sharp tusks in life and death battles with vicious pond snails! It's far more plausible that the

differences in diet arose because the two sexes were living in different habitats due to their different reproductive roles. The males spend most of their time around ponds and other water bodies, calling for females, and so would usually dine on the available pond life. The females, on the other hand, are more often away in the forest where arthropods are more common. The case for

natural selection was already looking a little shaky, so it was time to investigate the possibility of sexual selection . . . and time to hop into the pond.

SUITABLE STUDY SITE LOCATED AND A Ahead torch donned, Poppy set about trying to catch some frogs. The males advertised their presence with their quiet clucks, allowing her to home

She secured a wide rubber band around the waist of a male frog, attached it to some fishing line and swung him over to land next to a calling male.

> in on them, a painstaking process where every movement, sound or stray torch beam scares the frog into silence. However, patience and an ability to stop breathing for minutes at a time are rewarded with success. Once the position of the calling site had been narrowed down, it was often possible to locate the male by looking for the results of his reproductive efforts. Female

Tusked Frogs lay their eggs in a floating foam nest. The nests are relatively conspicuous, the white bubbles standing out against the dark water and vegetation. The male stays with the nest for a few days until his offspring hatch and so could often be found by searching around and underneath the nests. This also made it possible to locate males on nights when they weren't in the mood for calling.

The females proved considerably more difficult to locate, however. The lure of a clucking male drew some out of hiding, and a few females were found clutched in the tight embrace of a male (a joining known as amplexus). But eventually it became clear that the only option was to resort to the unpleasant and distinctly

messy job of installing a network of buckets in the muddy ground and connecting them with a plastic fence designed to capture any frogs leaving or entering the pond. This also allowed for the capture of any 'wandering males' that didn't have calling sites of their own. Faced with the problem of individually marking her charges, Poppy used the marbled undersides of the frogs to iden-



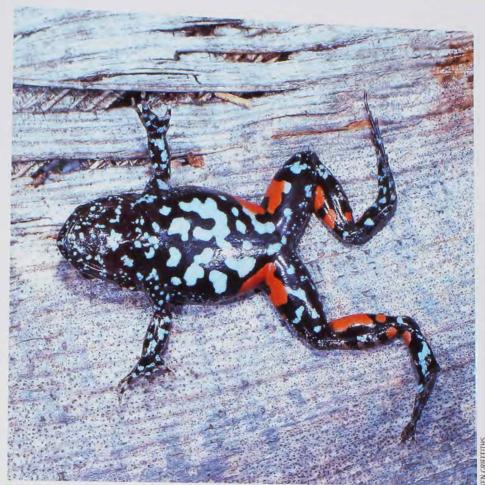
tify them, sketching the distinctive pattern so that she could recognise them in

the future. The crucial question here was whether or not the differences between males and females—the big bodies, heads and tusks—gave males an advantage when they competed for matings. If so, it would be strong evidence that sexual selection was playing a major role in generating the differences between males and females. Three years of rainy nights and cold feet later and the answer to that question emerged from the impressive mass of data that Poppy had built up. First, the 'wandering' pittrapped males were smaller than the territorial calling males, implying that smaller males are prevented from setting up territories and excluded from calling, and hence have a significantly reduced chance of mating. Second, the measurements of males in amplexus and guarding nests revealed that the larger males were mating more often. And finally there was a correlation between the body sizes of males and females in amplexus, indicating that larger males tend to mate with larger females and hence produce more offspring. So larger males were most certainly more successful in the nightly struggle for mates than were their smaller rivals.

But what about the tusks? There was plenty of circumstantial evidence that the males were fighting. They excluded each other from calling sites and used the same sites repeatedly. These sites were regularly spaced around the perimeter of the pond, suggesting that males were actively defending a defined area. And, if calling males were exposed to playbacks of other males calling, they changed their clucking advertisement call to a 'territorial' call (a series of short trills) and would sometimes emerge from their burrows, presumably in search of the intruder. Males were also observed giving territorial calls when other males were close by, and one male was seen to leap at an intruder.

However, proof that the tusks were being used as weapons was going to require first-hand experience of the males in action. Because natural interactions were so rare and just sitting around in the cold waiting for them to happen was so mind-numbingly tedious, Poppy decided to engineer a few border incursions of her own. She secured a wide rubber band around the waist of a male frog, attached it to some fishing line and swung him over to land next to a calling male. To put the fighters in the mood she provided a soundtrack of an unfamiliar calling male. Then she sat back to watch the conflict escalate.

And here again came evidence that Tusked Frogs are a little unusual. In most frog species the males sort out their differences in a relatively harmless manner using a chest-to-chest wrestling position. No such sportsman-like behavhere. One of the provoked encoun-



Just as no two zebras' stripes are the same, neither are the black-and-white marbling patterns on a Tusked Frog's belly.

ters resulted in a calling male leaping out and savagely biting the smaller, harnessed male around the throat. Given this predilection for sorting out their differences in a rather violent manner, it's pretty clear that male-male combat is behind the oversized tusks of the male frogs and is probably also responsible for their larger overall size and big heads, although female choice may have played some role there.

And so the mystery was solved. Those tusks certainly aren't for battling malevolent pond snails. Like most things in this world, it all comes back to sex.

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Geordie Torr is a graduate student in the Department of Zoology at James Cook University. His research interests include evolutionary biology and behavioural ecology of reptiles and amphibians.

TUSKED FROG

Adelotus brevis

Classification

Family Myobatrachidae (southern frogs)

Identification

Dorsal colour dark grey to brown. Underside mottled black and white. Red in groin and behind back legs. A pair of sharp tusks on the lower jaw, about 2 mm in males, 0.3 mm in females. Males larger than females (female snout-vent length up to 40 mm, males up to 50 mm).

Distribution and Habitat

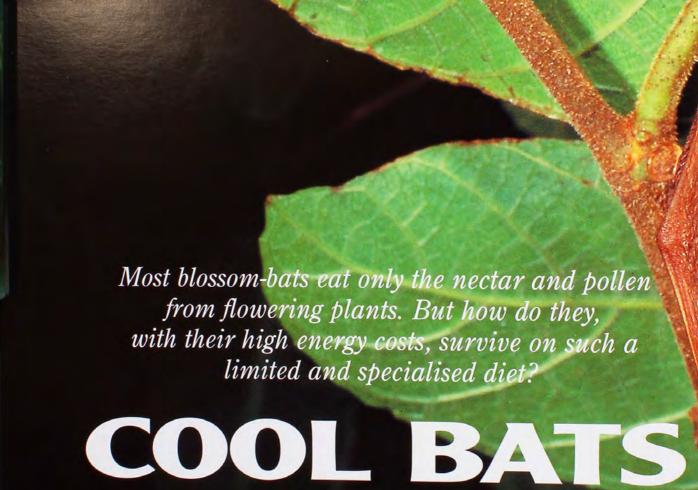
Found in rainforest, wet sclerophyll forest and in open grazing areas along the east coast from central eastern Qld to southern NSW.

Behaviour

Female lays around 250 eggs in a floating foam nest. Eggs hatch in a few days and tadpoles take about 70 days to metamorphose at 20° C. Male call is a quiet 'cluck', repeated a few times each minute. Food consists of mainly invertebrates, especially arthropods and molluscs, but other frogs occasionally eaten.

Status

Uncertain. Anecdotal evidence of declines.



BY FRITZ GEISER



HE COSTS OF LIVING FOR A SMALL blossom-bat are huge. If expressed as energy used per gram of body mass, these mouse-sized bats expend more than ten times that of a human, just to stay alive. During flight or other strenuous activity their energy expenditure (or metabolic rate) can increase another tenfold. To sustain such energy demands, many small mammals and birds must consume large amounts of food each day, often the same or even more than their body mass. Think about swaggering to a counter at your local fast food outlet and ordering several hundred hamburgers!

Most blossom-bats, as their name implies, eat only the nectar and pollen from flowering plants. But how do they, with their high energy costs, survive on such a limited and specialised diet? I discussed this with Brad Law, who had recently obtained a PhD on the biology and ecology of the Common Blossombat (Syconycteris australis). In particular, we wondered whether blossom-bats were homeothermic like humans (in other words, did they continuously regulate their body temperature at a constant high level, regardless of the environmental temperature?), or whether they employed some physiological or behavioural tricks to help them get by.

It is well known that, as an energysaving strategy, many small mammals allow their body temperature and metabolic rate to fall to very low levels

during parts of the day or night when at rest, particularly when food is scarce. Then, using internal heat production, they warm themselves up just before their next activity period. This physiological state of reduced body temperature and metabolic rate is called daily torpor, during which body temperature may fall to around 20° C and metabolic rate is reduced by about 60-80 per cent of resting levels. It differs from hibernation, which is a more extreme form of torpor and typically occurs during winter. Hibernating animals let their body temperatures fall to around 5° C and metabolic rates can be as low as one per cent that of active animals. This strategy allows the animal to go for months without eating, often surviving entirely on stored fat.

Many people believe that daily torpor and hibernation are processes that occur only in mammals from temperate regions and the Arctic, not Australia's warm eastern coast. Moreover, until recently, it was thought that, of the bats, only some insectivorous members of the suborder Microchiroptera were capable of entering torpor. All 'megabats' in the suborder Megachiroptera, including the blossom-bats, were believed to be strictly homeothermic.

BRAD AND I THEREFORE DECIDED TO study the use of energy by the Common Blossom-bat and determine whether or not the species could enter

The Common Blossom-bat does not consume pollen directly from flowers but by grooming the fur and wings after a bout of nectar feeding.

torpor. With the help of Gerhard Körtner, a postdoctoral fellow in my laboratory, the first bats for the project were netted during autumn near Iluka on the northern coast of New South Wales. They were immediately taken to the University of New England in Armidale and kept in a large holding room with branches for roosting and plenty of space for flight. We gave them an artificial 'nectar' diet of blended banana, apple juice, Sugar, and Infasoy baby food (as their protein source). The bats loved these 'banana smoothies'. with each of the five bats helping themselves to about 22 grams of the food. Given that each bat weighed around 18 grams, this meant they ate more than their body mass each day!

Once the animals had acclimatised to their new home, we attempted to induce torpor by withholding food overnight and subjecting them to a range of constant temperatures. During this time we measured their rate of oxygen consumption to estimate their metabolic rate and daily energy needs. The bats remained active for most of the night and sustained high metabolic rates. However, even at temperatures as high as 26° C, as soon as lights came on in the morning the bats' metabolic rates began to fall, dropping to less than 30



At about the size of a mouse blossom-bats, like this Common Blossom-bat, are the smallest members of their family.





A Common Blossom-bat feeds at a banana flower. Its long snout and tongue help it reach the nectar.

per cent that of active animals within about half an hour. This rapid fall in metabolic rate seemed to indicate torpor, but to actually prove it we had to show that their body temperature had simultaneously declined.

Initially we attempted to measure the body temperature of torpid bats by using a fine rectal probe. The bats disliked this intrusion so much that they quickly changed their daily activity pattern and began to rest all night, expending so little energy that there was apparently no need for them to enter torpor the following morning. We therefore decided to implant tiny temperature-sensitive radio-transmitters, which allowed us to measure body temperature remotely without ever having to touch the animals. Sure enough, the bats *did* lower their body temperature, to about 18° C. However, if

room temperature dropped below this, their internal heating mechanism would kick in to stabilise their body temperature at this minimum level.

We could now establish that torpor always commenced immediately after the lights went on in the morning (remember bats are nocturnal and for them daytime is rest time) and lasted several hours. During this time they reduced their metabolic rate to a minimum of about 15 per cent that of resting bats, meaning that up to 85 per cent of the energy they would have used to stay warm was saved. At the end of a torpor bout, typically a few hours before the lights went out, the temperature of the bats increased at the amazing rate of up to 1.5° C per minute. This means that they were able to warm themselves from a low of 18° C to their normal body temperature of 35° C within about 30 minutes.



hey were able to warm themselves from a low of 18° C to their normal body temperature of 35° C within about 30 minutes.

Dionne Coburn, an Honours student at the University of New England, and I netted blossom-bats near Iluka in both summer and winter. Bats from both groups were again returned to Armidale where they were held under conditions simulating the natural day length they experienced at the time of capture. Somewhat surprisingly, the bats caught in both winter and summer exhibited daily torpor. However, when we examined our data in more detail, we

could establish that torpor patterns differed between summer and winter bats, but in a way that was exactly the opposite to what had been observed in species from cold climates.

In summer, bouts of torpor were longer, lasting an average of 7.3 hours, while in winter they were only 5.5 hours. Since body temperatures and metabolic rates during torpor were lower in summer than in winter, the overall daily energy expenditure of bats

AUSTRALIAN BLOSSOM-BATS

Classification

Order Chiroptera (bats), suborder Megachiroptera (megabats), family Pteropodidae (flying-foxes, fruit-bats, blossom-bats), subfamily Macroglossinae (blossom-bats), two Australian genera, each with one species: Common Blossom-bat (Syconycteris australis) and Northern Blossom-bat (Macroglossus minimus).

Identification

Very similar in appearance. Both lack an obvious tail (although M. minimus has a rudimentary palpable one), have a long brush-like tongue that is used to lap nectar, and have soft reddish fur on back, lighter underneath. Head-body length about 6 cm, body mass about 18 g for S. australis, 16 g for M. minimus. M. minimus has a flaplike interfemoral membrane ('pyjama') on each leg, absent in S. australis, but it lacks the obvious upper incisors present in S. australis.

Distribution

S. australis: east coast of Australia north of Booti-Booti, NSW, and New Guinea. M. minimus: northern, tropical Australia, South-East Asia and Melanesia. The two species overlap in north-eastern Qld.

Habitat

5. australis roosts solitarily in rainforests (especially littoral rainforest) and wet sclerophyll forests, but also in banana plantations. In NSW it requires heath for feeding, not too far from roosting sites. M. minimus roosts individually or in small groups in palms, bamboos, mangroves and rainforests and occasionally buildings.

Nectar and pollen from a number of flowering native trees and bushes, especially Banksia, but also Melaleuca, Eucalyptus and some rainforest species. Where the species overlap they may also eat fruits and leaves. Both species are major pollinators of a variety of native species, and are probably significant seed dispersers for some plant species.

For S. australis in northern Australia and New Guinea, breeding appears non-seasonal. In NSW, one young is born in Oct./Nov. and a second between Feb. and Apr. Young suckled for up to 3 months. M. minimus appears to have similar breeding patterns, becoming aseasonal in far northern part of range.

5. australis common where limited habitat occurs, although it is formally listed as 'Vulnerable' in NSW, under the Threatened Species Conservation Act 1995; M. minimus common over a wide range.

Since the blossom-bats did so well in captivity, we decided to go one step further to determine if there were any seasonal changes in the way they used torpor. Many mammals from the northem hemisphere enter torpor more frequently, and allow their body temperature to fall to lower levels, during the winter. However, no-one had ever conducted a detailed study on seasonal changes of torpor patterns in mammals from the tropics or subtropics. Animals like blossom-bats are faced with entirely different changes in temperature and food availability during the year than are temperate animals. In comparison to temperate areas, the seasonal climatic changes in the sub-tropics are moderate and food is available all year round, although it may fluctuate.

To conduct the seasonal study,



The Northern Blossom-bat, although similar in appearance to the Common Blossom-bat, is distinguished by a flap-like membrane on each leg.

caught in summer was reduced by almost 20 per cent relative to wintercaught bats. Initially we were baffled by this rather unexpected finding. However, after reading how the nectar of Banksia flowers, one of the main food sources of the Common Blossom-bat, is produced in much greater volumes in winter than in summer, it became obvious that these 'cool' bats adjust their thermal biology and energetics to food availability. In summer, not only is overall nectar availability patchy and unpredictable, but the bats also have less time to forage because of the shorter nights and have to wait throughout long days before the next feeding period arrives. We believe that, at this time of the year, torpor is particularly important.

The Common Blossom-Bat is not the only small Australian megabat. A slightly smaller species is the Northern Blossom-bat (Macroglossus minimus), which weighs only about 16 grams. While the two blossom-bats look almost the same, and their general biology and habits appear to be quite similar, the Northern Blossom-bat is only found in tropical areas. Its range does not extend into the subtropical areas of northern New South Wales. How can this difference by explained? Is it possible that the Northern Blossom-bat is incapable of using torpor and is therefore restricted to the tropics where it is easier to keep its energy budget balanced?

To answer this question, Brad's expertise was again required. He netted some Northern Blossom-bats among flowering mangroves (Sonneratia sp.) near Cairns, in northern Queensland. The bats were flown, all-expenses-paid by Qantas, to Armidale where they were housed just like the Common Blossombats and subjected to the same experimental treatments, under the watchful eye of Wendy Bartels, a Masters student at the University of New England. Our prediction that Northern Blossombats may not enter torpor at all was quickly shattered, because they even entered torpor in the holding room when food was freely available. A detailed examination of the data, however, revealed that the minimum temperature the animals allowed their body to fall to was about 23° C, compared to 18° C for the Common Blossom-bat. The metabolic rates during torpor of the Northern Blossom-bat were also higher. So it appears that even this tropical species uses torpor, but perhaps as one would expect, torpor is not as pronounced and deep as that of their more southerly relatives and could well be a factor limiting this species to



Although blossom-bats, like this Common Blossom-bat, live in a warm climate, they enter a period of torpor to help them balance their energy budgets.

the tropics.

So, through the joint effort of a lot of people, we have revealed that yet another group of mammals, the megabats, previously thought to be homeothermic, also use torpor. What makes this even more surprising is that the entire group is restricted to warm climates, emphasising that even in mild climates torpor can be important for balancing the energy budgets of mammals. Since the majority of mammals are small and therefore could benefit by entering torpor, the question arises whether strict homeothermy still qualifies as a general mammalian characteristic as presented in most textbooks. It is possible that, as our understanding of the use of torpor improves, we will find out that homeothermy in mammals is the exception and not the rule.

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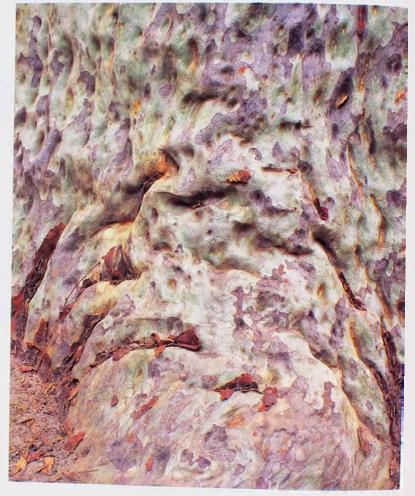
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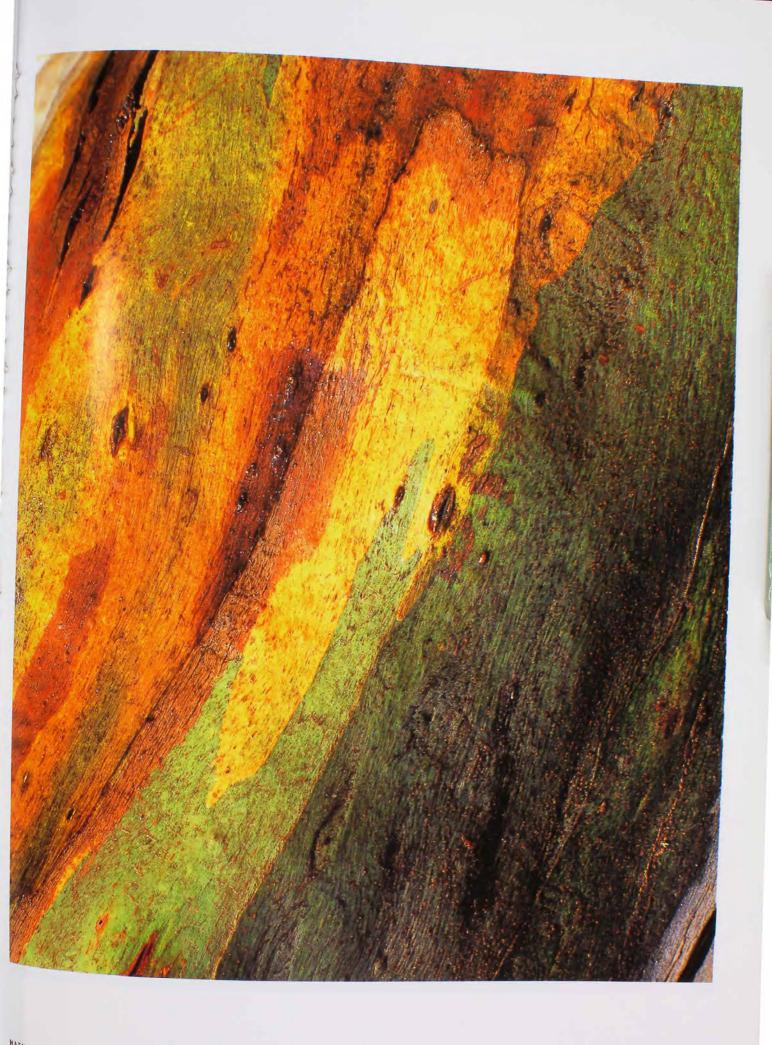
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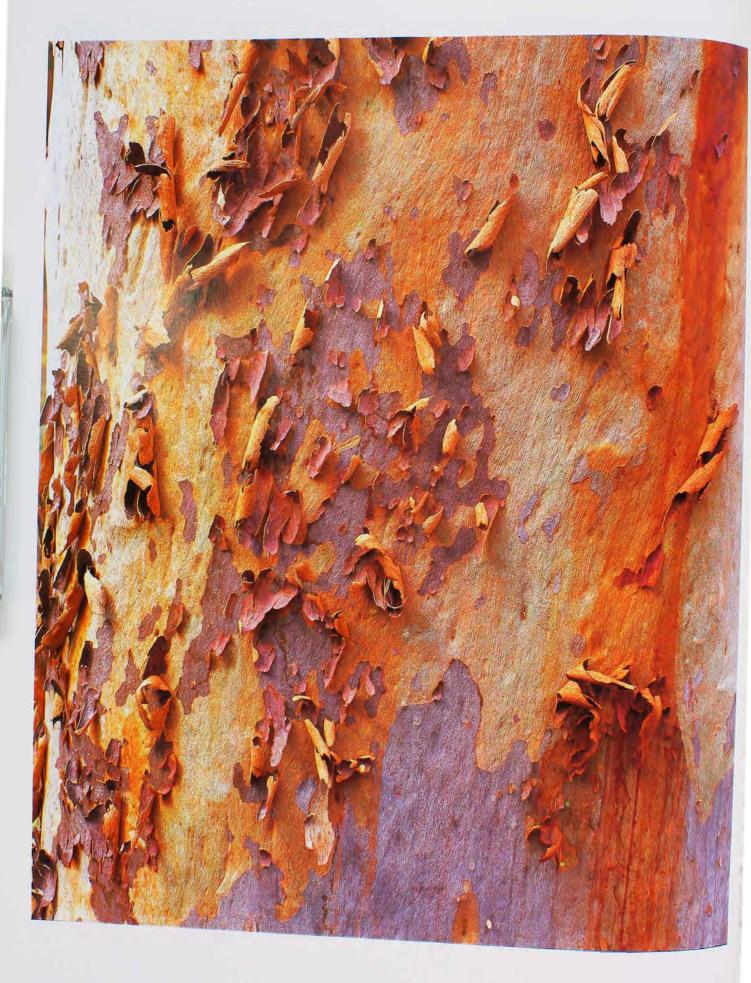
Associate Professor Fritz Geiser lectures in the Department of Zoology at the University of New England in Armidale, New South Wales. His main interest lies in working out the functional adaptations that allow animals to survive the demanding and often unrelenting conditions in their natural habitat. His main focus is on hibernation and torpor and he has worked on this topic since 1979.



WOODWORK
BY JOE SHEMESH







F H O T O A B T







P H O T O A R T





We'll almost certainly wait until the seaweed is swinging from the Hill's Hoist before we recognise that an extremely serious climate change is on its way.

THE ONE-IN-600-YEAR WAVE

BY MICHAEL ARCHER

RDINARY WAVES THAT regurgitate seaweed and surfers onto the beach are among the world's most predictable events; after a few wipe-outs even a retarded rat could learn within minutes not to turn its back on the sea. But not all waves come in such user-friendly sizes or are as easy to predict. Consider 'tidal

waves', or tsunamis—waves that can tower above the surface of the ocean, before smashing to smithereens everything in their path. Normally we think of these horrors as relatively freakish, unpredictable events. But what if, like ordinary little waves, some tsunamis were periodic, predictable events? If we could discover what that periodicity was, we could ensure we were roasting weaners in the mountains well before White Pointers began dropping into the inner city suburbs for dinner.

As I write in my high and dry office on the fifth floor of the University of New South Wales' Biological Science Building, a giddy 77 metres above sea level,

it's hard to imagine that anything apart from an earthquake could shake me out of my cosy nest. Yet years of research by Bob Young (University of Wollongong) and his colleagues have suggested that the coast of New South Wales has been struck by at least six tsunamis within the last 10,000 years. One of these, about 9,000 years ago, apparently slammed debris above a 100-metre-high cliff at Jervis Bay south of Sydney. A wave this high would tower more than 20 metres above my office window.

More intriguing, considering the common presumption that tsunamis are unpredictable, is Young's discovery that no less than five tsunamis have arrived during the last 3,000 years—an average of one coast-buster per 600 years. Because the youngest (based on radiometric and thermoluminescence dating of its flood debris) rolled in about 250 years ago, it would be tempting to assume that we could walk the streets of Sydney without carrying shark repellent for at least another 350 years. However, because the cause of these waves is not adequately understood, a rogue one could take us out at any time.

What could cause frequent tsunamis of this kind? Tsunamis are normally associated with earthquakes, landslides or volcanoes. However, catastrophic events like this are relatively uncommon in and around Australia. An alternative explanation, suggested by Young and his col-

Surf's up!



DIVINE/FPG/AUSTRAL AND PETER HENNING/AUSTRA

assume that we could walk the streets of Sydney without carrying shark repellent for at least another 350 years. However, because the cause of these waves is not adequately understood, a rogue one could take us out at any time.

leagues, might be a violent underwater slide of billions of tonnes of unconsolidated sediment that accumulates on the inclined slopes of the continental shelf. Each time these masses of sediment get too big to stay put, another massive slide occurs, triggering another tsunami. The frequency would then depend on the rate of sediment accumulation. If this is more or less constant, the slides would occur at reasonably similar intervals.

If we could reliably predict the date of the next tsunami, where in Sydney would we be safe from a mountain of rampaging water? After planting gum trees in the backyard of our house high on a hill in Maroubra, I no longer think of this place as the impregnable fortress it once seemed to be. A metre below the surface I found unexpected curiosities—shells of familiar marine molluscs like cowries scattered as rare items through what appears to be a half metre of beach sand. This is not a midden deposit, nor does it look like windblown sand because of the large shells that it contains. How did this 'beach' get into our backyard, which is far above sea level and out of sight of the shore? Perhaps a few thousand years ago, Aborigines camping on this hill heard the mother of all roars and looked up just in time to see a mountain of water crash down to destroy their coastal home. As the billions of tonnes of water raced back to the ocean or sunk deep into the scarred land, it could have left behind, as a calling card of the catastrophe, this displaced beach ripped up from its distant source.

These Australian tsunamis may seem big, but far bigger ones have lunged out of the world's oceans. Ranier Gersonde (Alfred Wegener Institute for Polar and Marine Research) reports evidence for mid-oceanic waves south of Chile that were four kilometres high following impact 2.2 million years ago by an asteroid one kilometre in diameter. By the time these waves reached the shore they would have been one kilometre high, ten times the size of the one that belted the shores near Sydney 9,000 years ago. Gersonde suggests that Australia and New Zealand were also struck by giant waves produced by this same cosmic event.

Faced with the prospect of being oblit-

erated by 100-metre waves, will we sell the house and buy another with a view high on the flanks of the Blue Mountains? It might be wise but environmental threats with long lead times almost always fail to incite us to action. If someone takes a swing at us, we don't need to be told to duck. But if we are told that global warming is worsening each decade, most of us don't get motivated enough to do anything about it even though the long-term consequences will be far more serious than a black eye. What city council, let alone real estate agent, has a topographic map showing land anticipated to be inundated if the polar ice caps start to melt with global warming, which theoretically

could raise sea levels (never mind the effects of tsunamis on top of this) another 65 metres? No, we'll almost certainly wait until the seaweed is swinging from the Hill's Hoist before we recognise that an extremely serious climate change, precipitated or at least enhanced by our own activities, is on its way.

In the final scene of "The Last Wave", Richard Chamberlain stands on a Sydney beach at night, having already endured rains of toads, mud and giant hailstones out of clear blue skies. Now, in the darkness, he listens to the sucking sounds of the ocean as it pulls back from the shore—way back, heralding the arrival of a monster tsunami. There the movie ends, leaving us to imagine the horror of the cataclysm about to sweep Sydney off the map. Silly science fiction.

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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, north-western Queensland.

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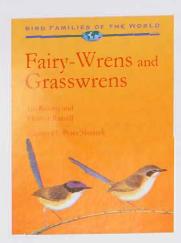


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REVIEWS



Fairy-wrens and Grasswrens

By Ian Rowley and Eleanor Russell. Oxford University Press, Vic., 1997, 274pp. \$85.00 np.

Several publishers are currently producing series on different groups of birds. Standing out among these is the 'Bird Families of the World' series by Oxford University Press. It is the depth of treatment of the subjects and the expertise of the authors that set these books apart from their competitors. This, the fifth volume in the series to appear, maintains the standard established to date

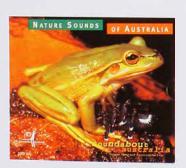
The subject is the family Maluridae, a family endemic to Australia and New Guinea. This comprises 25 colourful, active species, the most familiar representative for many people being the Superb Fairy-wren (Malurus cyaneus). Many of the members are less well known and much more elusive. As well as the 12 species of fairy-wrens, this family includes the dainty emu-wrens, the secretive grasswrens and some poorly known forms restricted to New Guinea. The species accounts are extensive and up to date, and are nicely augmented by eight full-colour plates by Peter Marsack.

The meat of the book, however, is the first half consisting of chapters on the evolution, biology and conservation of these birds. Because of their intriguing behaviour, especially the practice of cooperative breeding, the fairy-wrens and their relatives have been the subject of many studies. These chapters bring together what is known of this family, including taxonomy; environment, biogeography and evolution; morphology, locomotion and feeding behaviour; social organisation and vocal communication; cooperative breeding; and life histories and conservation.

The authors were well chosen for the volume. Ian Rowley and Eleanor Russell are a husband-and-wife team who have been studying fairy-wrens for many years and whose work has provided much of our understanding of these birds.

Like the previous books in the series, *Fairy-wrens and grasswrens* is attractively produced and should appeal to more than just people with a particular interest in this family of birds. This has my heartiest recommendations.

> —Walter E. Boles Australian Museum



Nature Sounds of Australia

By David Rentz. Sound Heritage Association, Vic., 1997. \$24.95rrp.

This work comprises a CD and a 116-page booklet boxed together. The disc contains 90 tracks of animal sounds covering mammals, birds, crickets, katydids, cicadas and, a bit of a surprise, crabs! There are actually more than 90 species represented as some of the tracks contain a succession of three or more species.

Included are calls in the normal hearing range for humans, plus a few ultrasonic calls slowed down so we can hear them. The tracks blend quietly into one another without obvious breaks, beeps or human announcements, so the CD creates a pleasant, relaxing ambience. At the same time the tracks can be easily differentiated so they can be used for identification purposes if required.

An audio field guide, however, it is not. The space and scope of subject matter covered would need a much larger CD and booklet to be complete. This should be regarded as more of an enlightening eye-opener than a means of identifying all the sounds you might hear in the Australian bush

As the blurb on the back of the box suggests, the sounds included cover both the familiar and expected, plus the bizarre and unexpected like the moth, spider and crab recordings—eye-openers indeed.

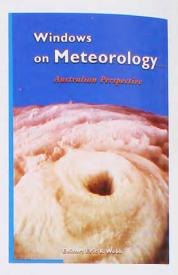
The booklet is certainly detailed and contains a lot of information from the scientists who actually work with the animals concerned. It is illustrated with line drawings, and electron microscope photos of some of the animals' sound producing organs. It also has information on how the recordings were made.

The selection of colour photos of the animals was a little disappointing in some cases, being too small or unclear to be of much value. In other cases the common names used were inconsistant (Limnodynastes tasmaniensis is referred to as Spotted Marsh Frog in plate 21 but Southern Grass Frog in plate 22) or uninspired (Brown Frog for L. peronii and Australian Burrowing Frog for Heleioporus australiacus as there are dozens of species that could qualify for these names!). But these are fairly minor matters overall.

All said and done, a very interesting item to include in

the sound library for those interested in the noises of natural history.

—Martyn Robinson Australian Museum



Windows on Meteorology: Australian Perspective

Edited by Eric K. Webb. CSIRO Publishing, Vic., 1997, 342pp. \$49.95rrp.

This is a unique 'weather' book providing an interesting and unusual perspective on Australian weather and climate, and on the development of meteorology in this country.

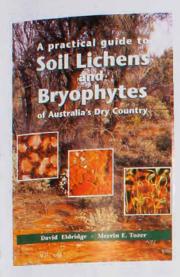
It comprises 30 feature-length articles written by prominent experts in their fields, grouped into the following categories: the Aborigines and meteorology; faunal evolution and Australia's climate history; atmospheric systems and phenomena; and technical developments for research and applications. They cover topics as diverse as Aboriginal seasonal calendars, burrowing frogs and satellite meteorology.

The text is illustrated by maps, diagrams, photographs and satellite data mainly in black and white however 16 pages of colour plates are grouped at the end of the book.

Several of the articles are too specialised and technical for the general reader, but

the book should prove a useful reference for students and would be a valuable addition to the library of any weather enthusiast, professional or amateur.

—Bob Crowder Meteorologist



A Practical Guide to Soil Lichens and Bryophytes of Australia's Dry Country

By David Eldridge and Merrin E. Tozer. Department of Land and Water Conservation, NSW, 1997, 80pp. \$14.95rrp.

Soil crusts, composed of lichens and bryophytes (mosses and liverworts), form an integral part of the biota of arid and semi-arid Australia. These crusts, when undisturbed, effectively reduce soil erosion, enhance moisture retention, improve the fertility of the soil, and can be used as indicators for the presence of specific soil constituents such as calcium carbonate and gypsum. For the first time, this handbook introduces the general public to this fascinating element of the arid flora.

The book has an illustrated introduction explaining the structure of lichens and the morphology of mosses and liverworts. The most com-mon lichens and bryophytes found in soil crusts are described and a colour photo of each one is presented. There are simple keys to differentiating lichens from bryophytes, and keys to all the species (or groups) discussed in the text. Terminology is kept to a minimum and there is an excellent glossary at the back of the book. The last section discusses

management practices and responsible conservation of soil crusts. The bibliography is thoroughly researched and the main reference works are highlighted in bold. My only complaint is that two or three of the moss photos are slightly out of focus. Also, I would have preferred a photo of *Campylopus introflexus* in its dry state, which is the way it is usually found.

I enjoyed this very readable and practical book and intend to take it with me next time I am in western New South Wales. I highly recommended it to residents of the semiarid parts of Australia, students and natural historians.

> —Peter Jobson Royal Botanic Gardens, Sydney

RICHARD FORTEY





LIFE: AN UNAUTHORISED BIOGRAPHY





A NATURAL HISTORY OF THE FIRST 4.000.000.000 YEARS OF 1 IFE ON EARTH

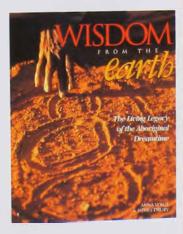
Life: An Unauthorised Biography. A Natural History of the First 4,000,000,000 Years of Life on Earth

By Richard Fortey. HarperCollins, NSW, 1997, 398pp. \$45.00rrp.

To relate life's history on Earth over four billion years in 398 pages would appear an impossible task; and it is. Having said that, Richard Fortey's attempt comes as close as any I have yet encountered. He does not try to detail the minutiae of the fossil record, or the innumerable species that have evolved and become extinct on Earth since its formation. Instead, Fortey concentrates on painting word pictures. What, in other hands, might have been a dry treatise is presented as a thrilling mystery story. Many clues remain to be discovered, and our interpretation of the evidence changes constantly, but, piece by piece, the reader is introduced to a multidisciplinary Earth science in which continual blocks move, seas come and go, climates change, and all life forms must adapt, migrate or perish.

Fortey has a nice way with anecdotes and analogies, and keeps technical jargon to a minimum, without loss of accuracy or integrity. The reader need not know much about geology or palaeontology to understand and appreciate Fortey's story, because it is our story too. At strategic points elements of his own life story are woven into this 'unauthorised biography'. He describes how he became fascinated by fossils and hooked on trilobites, his speciality, and how this has taken him all over the world-experience put to good use in the book, drawing on first-hand observation. Fortey's Life: an unauthorised biography is leavened with a sense of humour and is a thoroughly eniovable read. I strongly recommend it, especially for every school and public library.

—Alex Ritchie Australian Museum



Wisdom from the Earth: The Living Legacy of the Aboriginal Dreamtime

By Anna Voigt and Nevill Drury. Simon & Schuster, NSW, 1997, 192pp. \$39.95rrp.

Recently, there has been an increased need for books like *Wisdom from the Earth*, as people both at home and abroad desire to learn more about the Indigenous people



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of Australia and their culture. I found this book an easy read and written in a way that allows a reader, of any background, to grasp a greater awareness of key issues, such as spirituality, language and lore. One way in which the authors have achieved this is through publishing unedited conversations, providing the Aboriginal voice to explain relationships and responsibilities between land and family. The issues addressed are juxtaposed with examples of colourful, wellknown Indigenous art works, as well as magnificent photos, which celebrate both the diversity of Indigenous culture and the beauty of the Australian landscape.

-Barrina South Australian Museum

Yes, say the authors of this new book, which deals with the search for gravity waves. These waves travel across the universe at the speed of light. They are believed to be triggered by dramatic events, such as the explosion of stars and the merging of black holes. Unfortunately, detecting them on Earth is extremely difficult and has not yet been achieved.

The book gives an insider's view of the latest developments and techniques in this field. It is written with a light touch and aims to be intelligible to non-scientists. I would have liked to see more diagrams, but at such a low price one cannot complain too much. It is definitely worth reading.

John Gould

IN AUSTRALIA

-Nick Lomb Sydney Observatory/ Powerhouse Museum tion are wonderfully readable and informative. By comparison the section on Australia almost suffers from an overload of information with large blocks of quotations and scientific details. However, the wealth of information is fascinating and of great value to ornithologists and historians alike.

Half of this large volume is devoted to the catalogue of John Gould's Australian correspondence held in the Natural History Museum, London. The letters are summarised and presented in alphabetical order by correspondent. An invaluable part of the catalogue is the biographical detail included for each correspondent. We feel that this catalogue was a labour of love and that the book should be in every natural historian's library.

> -Leoné Lemmer & Carol Cantrell Australian Museum



Australian Birds: A Collection of Paintings and **Drawings**

By Peter Slater. Steve Parish Publishing, Qld, 1997, 160pp. \$29.95rrp.

This book contains more than 100 paintings and sketches of Peter Slater's favourite Australian birds. Slater's paintings in his Field guide to Australian birds are all familiar to most people, but they are portrait paintings to illustrate those features that help in identification. This portfolio has the birds in a variety of poses and activities, giving the reader more of an insight into their lives, the species' character, or the overall magic of some of the settings they can be

seen in. Accompanying these beau tiful works of art are pieces of informative text about the artist's experiences with the birds or other snippets about them that wouldn't be found in field guides.

The book is 160 pages long and is divided into sections mainly according to habitat or other groupings, such as birds of woodland and forest, desert birds, birds of prey

It has a hard cover and is nicely sized for displaying the artworks at 34 x 25 centime. tres. An excellent book for the amateur ornithologist, naturalist, artist, or just those who like to look at beautiful

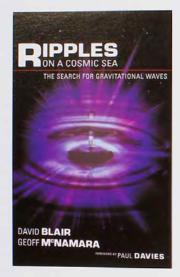
> -Martyn Robinson Australian Museum

Finding Birds in Australia's **Northern Territory**

By D. Donato, P. Wilkins, G. Smith and L. Alford. CSIRO Publishing, Vic., 1997, 192pp. \$19.95mp.

This book is a useful addition to the guides used for locating birds in different parts of Australia. It is arranged in four sections, starting with "Habitats". which presents the major vegetation types and landforms that bird observers will encounter. The major portion of the book is the following section on "Areas". It comprises 13 chapters devoted to the most important sites in the Northern Territory for finding birds. These are arranged from Darwin in the north to the border in the south. After discussing access to and accommodation and camping in the area, each chapter gives several prime birding spots within the local ity, accompanied by a well set-out map. The Northern Territory has a number of speciality birds that make the area attractive to birdwatch ers. The third section of the book provides hints on where these may best be found. The concluding section is a list of all the birds of the Territory and their occurrence at each of the birding areas. Birders to the Northern Territory should find this attractively presented book a valuable part of their gear.

-Walter E. Boles Australian Museum



Ripples on a Cosmic Sea

By David Blair and Geoff McNamara. Allen & Unwin, NSW, 1997, 184pp. \$17.95rrp.

Over the last few decades technological innovations have opened a number of new windows on the universe. Now we can make observations not only with ordinary light but with radio waves, infrared rays, X-rays and gamma

In each of these windows astronomers have made unexpected discoveries. Together with ordinary light the new windows cover the whole gamut of the electromagnetic spectrum from very short to very long waves. Do we now have everything covered? Is there any way left to get another perspective on the universe?

John Gould in **Australia: Letters** and Drawings

By Ann Datta. Melbourne University Press, Vic., 1997, 502pp. \$80.00rrp.

This book is a treat for Gould lovers, ornithologists and natural history enthusiasts. Ann Datta has produced a definitive history of John Gould's life and a comprehensive catalogue of the Natural History Museum's collections of letters, drawings and manuscripts relating to John Gould's involvement Australia.

Beautifully illustrated, this publication showcases both John Gould's drawings and the published works of Elizabeth Gould, Edward Lear, H.C. Richter and J.M. Wolf. The chapters on the origin of natural history publica-



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Launceston Field Naturalists Club

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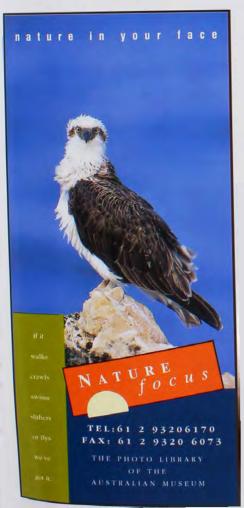
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Q A A

Bird-of-paradise Flies

I photographed this unusual flying insect in Brisbane Waters National Park. It looked like a tiny bird with a beautiful white feathery tail. What kind of insect could it be?

—Cate McGahey Gosford, NSW

 This insect is known as a bird-of-paradise fly. The name, however, is misleading because it is not a fly at all but a bug or scale insect (genus Callipappus) that only occurs in Australia. The males are called bird-ofparadise flies because of their red to purplish bodies and their long glassy white 'tails' formed by waxy filaments extruded from ducts at the base of the abdomen. It is not actually known why the male has these 'tail' filaments, but perhaps it helps stabilise them in flight (females don't fly) or it might act as a decoy, breaking or tearing off when predators bite it.

Bird-of-paradise flies are



highly sexually dimorphic and the adult female is much larger and a completely different shape to the male. Adult males and females emerge in autumn and immediately mate, after which the females attach to aerial vegetation and form a cavity in the rear of their bodies in which their eggs develop. Newly hatched nymphs leave the pouch of the moribund female and enter the soil for nymphal development, which takes place within a waxy cyst. Nymphs feed while attached to the roots of heathland, woodland and mallee plants including Banksia species.

> —Kate Lowe Australian Museum

Red Heads

• Can you explain the redheaded Peaceful Dove shown in the photo below? This bird was considerate enough to build a nest just outside my office

window, at the Department of Environment, in Cairns. Its mate is a perfectly normal Peaceful Dove but this bird not only has a red head but a red back as well. Although less visible in the photo, this is quite striking when the bird is feeding on the ground. It also has no tail. The pair's eggs have hatched and, at the time of writing, two healthy (grey) chicks are being raised in the nest. A letter to the local newspaper, requesting information, has elicited no useful responses. If the bird has been painted, or dyed, the perpetrator of the joke has been skilful in avoiding colouring the eye ring and beak. The red colouration has persisted for about a month at least and did not wash off in recent rain. Has such a bird ever been reported before?

—Stella Martin Cairns, Qld

Your photograph is interesting and appears to show an unnatural colouration. Peaceful Doves (Geopelia

from flowering plants may therefore be dismissed. I per. sonally have not heard of this colour situation in other pigeons. It will be interesting to watch developments; that is, to see if the colour wears off naturally, or is lost during moult. Moulting should occur shortly after their young gain independence. Reasons for these colour aberrations are many and include colour-marking for scientific study, or playful enterprises by local residents. My armchair Sherlock Holmes idea is that the bird has found a supply of grain inside a dampened red cloth

lesser extent) by preening.

—Wayne Longmore
Australian Museum

Wattle Tick Scale

or paper bag and, while gath-

ering the seed, the bird's

head has been dyed red. This

could later have been trans-

ferred onto the back (to a

A male bird-of-paradise fly displays his 'tail'.

striata) may sometimes be flushed with a pale fawn-pink but this is found on the bird's chest. Your bird is not a hybrid, nor is the colour normal in the species group.

Peaceful Doves are ground feeders that pick up loose seeds. Obtaining the colour

 My husband and I found some strange egg-like things on an acacia bush just beside the road on George Booth Drive (the Wallsend turn off the F3 freeway). They are about the size of a lentil, but round, and appeared to be cared for or attended by these unusual striped ants. The ants were not attempting to eat them. In fact, when we returned a few weeks later, the ants were still fussing over the 'sacs'. There did not appear to be any others on the bush or even nearby bushes. Some had gone slightly brown after a few weeks but had not opened or even reduced in size. Could these be a type of insect larva, or maybe the eggs of the striped ants?

—Toni Marsh Newcastle, NSW

The white wax-covscale insects depicted in the photo are adult female *Cryptes baccatus* (family Coccidae), commonly known as the Wattle Tick Scale. Adult females typically



How or why did this Peaceful Dove go red?

Adult female Wattle Tick Scales packed together on an acacia branch.

occur on acacia stems in closely packed aggregations of between 20 and 100. Towards the end of their life cycle these aggregations can often resemble corn on the cob, the females being packed so close together.

When they first settle, the females are flat, ovoid and brown. They quickly change colour to a light grey-white, and as they grow through autumn, winter and spring they gradually become spherical like a tick (hence the common name), increasing their volume by up to 20-fold. Most of this extra volume is taken up by the large numbers of eggs they produce (about 4,000).

The eggs are laid into a chamber beneath the female. As eggs are laid the female gradually contracts her abdomen increasing the size of the chamber until, when the last eggs are laid, the female dies leaving the eggs completely enclosed within the now drying and brown female. husk of the Depending on the weather, eggs hatch one to three weeks after being laid. The newly hatched scale insects (called crawlers) may stay within the husk of the female for several days before venturing out onto the plant.

Most of the crawlers are male. Scale insects are highly sexually dimorphic. So much so that in some cases males and females of the same species have been described as different species. In the



case of the Wattle Tick Scale things are a bit easier as the male crawlers settle in aggregations on stems adjacent to the parental aggregation so the association between males and females is much easier to determine.

The males go through five developmental stages instars. Towards the second of these instars the male begins secretion of a cottony white sack or test around himself. At the tail end of the test, a glassy hinged covering (an operculum) is formed. As male development continues, crowding again occurs within the aggregations. This time, instead of the corn-on-thecob effect seen in the adult females, males tile their aggregations. Males orientate themselves head to tail along the long axis of the stem and, as they grow, the tail end of the male slips up and over the male(s) behind it. By the end of development, most males are sitting at an angle of 15–30° off the stem, with the operculum pointing upwards to allow easy emergence.

It is not known what happens to the immature females during male development. They are thought to disperse away from the parental aggregation as crawlers, and it is only in mid to late January, when adult males start to emerge from their test, that they are again easily found as they aggregate and begin to settle near the males. Once adult females settle, mating occurs. The males are very fragile and only short lived (24-48 hours). The large male sex bias may be a way to offset the fragility of the males.

The ant associated with the Wattle Tick Scales are actually feeding off the honeydew produced as a by-product of the scale's feeding. Scale insects feed on plant phloem,

which is rich in carbohydrates and sugars but low in nitrogen and other nutrients. To get enough nitrogen and other nutrients, scale insects have to process large volumes of phloem. This results in a waste problem for the insects. The solution is to employ sanitary engineers. In the insect world that means ants. Many species of ants actively remove the honeydew from scale insects (and other sucking insects like aphids and leaf hoppers). In return for this free food source, the ants will often defend the scale insects from natural enemies. In some cases ants are thought to tend scale insects. They move the scale into their nest for protection during nonfeeding periods (usually at night), then at other times move them around the plant as they feed.

—Grant Farrell CSIRO Division of Entomology

P 1 C

Do you recognise this? If you think you know what it is, then send your answer to Pic Teaser, Nature Australia Magazine. Please don't forget to include your name and address. The first correct entry will win a Funnel-web Spider towel from the Australian Museum Shop. Autumn's Pic Teaser was a closeup of bird feathers (Scarlet-breasted Sunbird, Nectarinia senegalensis).

T E A S E R



Answers to Quiz in Nature Strips (page 17)

- Signals for extraterrestrial intelligence
- 2. Feathertail Glider
- 3. Two
- 4. Jupiter
- 5. Wilson's Promontory
- 6. No
- 7. Blue
- 8. Beetles
- 9. Bilby
- 10. Galah

Sometimes whole 250-litre drums of cyanide are emptied onto the reef, turning areas into aquatic graveyards as the chemical kills corals and invertebrates along with the targeted fish.

RAPING THE REEFS AND REAPING THE PROFITS

BY MICHAEL AW

ROPICAL REEF FISHES FOR THE aquarium trade, as well as live, platesized groupers and wrasses for discerning Asian diners, are products of coral reef devastation in the Indo-Pacific region. Destructive fishing methods, a contentious issue for the last 15 years, now threaten to wipe out many of the world's remaining coral reefs by the year 2020

In Indonesia and the Philippines, fishes for aquariums, restaurants and for the villagers' daily needs are caught using sodium cyanide. The poison, squirted directly at the fish, paralyses them and allows them to be easily caught. Sometimes whole 250-litre drums of cyanide are emptied onto the reef, turning areas into aquatic graveyards as the chemical kills corals and invertebrates along with the targeted fish. Of those aquarium fishes collected, many don't even survive to reach the market places of Hong Kong or Singapore.

Big-dollar returns encourage unscrupulous businessmen to finance these operations, decimating the fish populations on every reef within their range. It is estimated that in 1995 nearly two-thirds of the fish sold in the city restaurants of Taiwan, Hong Kong and Singapore, worth over \$US200 million, were captured using sodium cyanide. Reports indicate that over 6,000 cyanide divers squirt an estimated 200,000 kilograms of the dissolved poison onto some 33 million coral heads annually.

Entrepreneurs of these 'fishy' businesses are easily recognised by their bulging back pockets, Rolex watches and BMWs, while their hired 'killers'—usually boys from local villages—wear cheap rubber masks, torn sweatshirts

and an improvised hood if they're lucky. Local participation in these mass onslaughts is understandable; they earn up to \$US400 per month—ten times as much as a conventional fisherman. For each Napoleon Wrasse (*Cheilinus undulatus*), for example, the collectors get paid about \$US8, although the same fish may fetch \$US800 in an exclusive Chinese restaurant. The exorbitant price tag is no threat to demand: many Asians consider consuming such fish as a status symbol—a sign of their wealth and prosperity.

While the traders prosper and the rich grow fat, the locals get only the crumbs, so to speak . . . and often a good dose of cyanide poisoning and sometimes decompression sickness too! Mean-

The problem is obvious: too many mouths to feed and insufficient food to feed them.

while the reefs continue to be raped.

Fishermen all over the region are also using dynamite, literally blasting fish out of the water to feed their ever-growing communities. Nothing is wasted; even ornamental fishes such as clown-fishes are collected for food. However, the explosions cause massive fractures to the superstructure of the reef, which will eventually collapse, resulting in the loss of fish habitats and the death of an entire ecosystem.

The problem is obvious: too many mouths to feed and insufficient food to feed them. About 70 per cent of Indonesia's 190 million population are poverty stricken, with little or no social support. The Philippines and Indonesia have excellent environmental laws but a poor enforcement record. Resources for policing are near to non-existent, and

bribery is common. International aid is not lacking, but corruption, commonly disguised as operational overheads, dissipates any international funding. Conservation and non-governmental organisations, concerned with this pregressive degradation of the marine environment, have invested and donated millions of dollars towards researching educating and 'retraining' fishermen to use other methods of fishing. However, successes are too few and far between; many retrained fishermen end up going back to cyanide and dynamite because it is easier, more productive, and they feel that it's unfair for them to have to make sacrifices when others don't.

As long as there are poverty-stricken people who are sustained by the sea, and as long as there is demand by the wealthy for 'luxury' fish, dynamite and cyanide will continue to reduce coral reefs to irreversible states of degradation.

Meanwhile, the recreational diving industry in these regions is booming. Resorts, live-aboard vessels, hotels and airlines are reaping huge profits. Marine scientists also scavenge the reefs for their ecological studies and medical research. All scream blue murder at destructive fishing practices, condemning the fishermen for destroying both their playground and the environment. All promote environmental friendliness "Don't touch the reef, don't take anything". Despite the good intentions, the crux of the matter has not been addressed. Reams of research documents, unlimited marine park zonations and the best of education won't save the coral reefs. Criticism won't either. The problem is that those people who make money from the reefs, as well as those who enjoy the coral reef environment, are not paying for the privilege.

There are simply too many people that are sustained by the sea, and these people need to eat to live. If conservation efforts were directed to benefit the local people, like feeding them, or providing them with the resources and jobs necessary to benefit from marine tourism, the reef will save itself. Resort operators adopting villages; live-aboard vessels patronising the trades of local villages: airlines, hotels and equipment manufacturers contributing to environmental agencies that help the local peoplethese are just some of the measures that would help to eradicate destructive fishing and ultimately save our coral reefs.

Michael Aw is a marine photographer and photo-journalist based in Sydney. He has authored six books on the marine environment and is the Chairman of OceanN-Environment, a non-profit company dedicated to preserve the quality of the natural environment.

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

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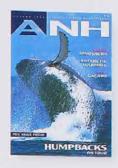
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