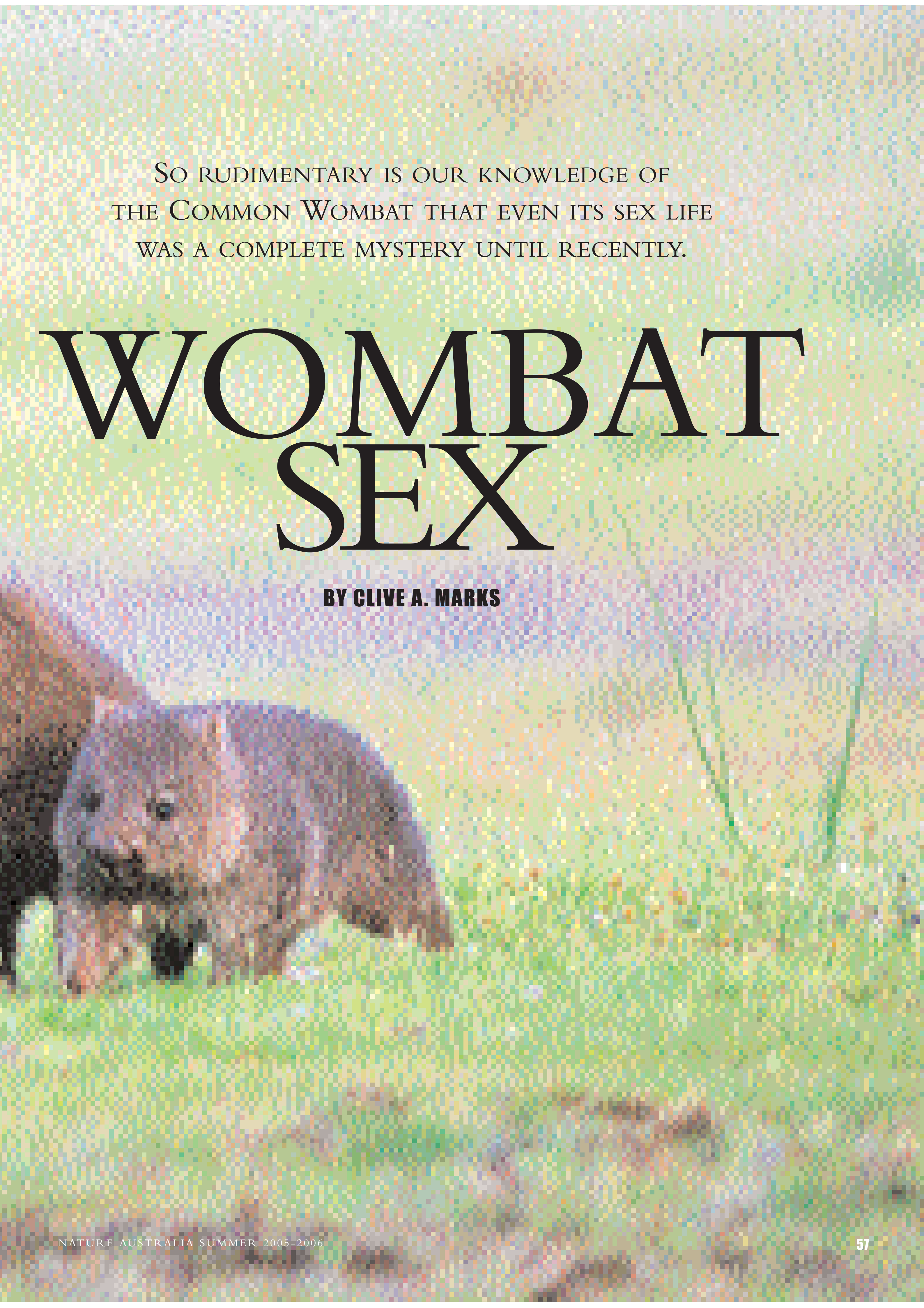
SO RUDIMENTARY IS OUR KNOWLEDGE OF THE COMMON WOMBAT THAT EVEN ITS SEX LIFE WAS A COMPLETE MYSTERY UNTIL RECENTLY.

WOMBAT SEX

BY CLIVE A. MARKS



WHILE MORE NUMEROUS than the other two species of wombat, the title of 'Common' Wombat is nonetheless undeserved. It suggests that the biology and behaviour of this species is well known, yet this is far from the case. So rudimentary is our knowledge of the Common Wombat (*Vombatus ursinus*) that even its sex life was a complete mystery until relatively recently.

But in an obtuse if not flippant sort of way, Australians have always nursed a fascination for the sex life of wombats. If only I'd been given a dollar every time I was asked the question: "Is it true that a wombat eats, *roots* and leaves?" Yet until recently there were no recorded observations of courtship or mating in wild wombats. Obviously a comprehensive answer to this question was impossible!

A LOVE BITE *with chisel-like incisor teeth is the type of foreplay that removes hair and punctures skin.*

In Australia, while some instances of copulation and 'mock' copulation during 'play' had been observed in captive wombats, there were no documented claims of successful breeding. Lack of knowledge about the structure of wombat burrows, and few attempts to construct appropriate artificial burrow environments in captive situations, seemed to contribute to their poor captive-breeding success. This, and the fact that neither courtship nor copulation had been seen in the wild, led biologists to suspect that mating may occur within the burrow. Such a cryptic and apparently dignified strategy may well have appealed to earlier naturalists who were imbued with a sense of Victorian modesty.

Attempts to mate wombats in captivity were often conducted with some trepidation, anyway. Frequently, newly introduced wombats were quickly separated as sexual interactions became quite aggressive. The male would attack the female, vigorously biting and raking her hindquarters. A love bite with chisel-like incisor teeth is the type of foreplay that removes hair and punctures skin. Sometimes the female would ardently resist with the sort of backward kicks that would send a Sumo wrestler flying. It was suggested that in the wild, the amorous male would have to 'trap' the female within the confines of the burrow in order to have his wicked way with her!

Just as some people become more sexually liberated when travelling


JURI LOCHMAN/LOCHMAN TRANSPARENCIES

abroad, so too it seems do wombats. For it was in the German city of Hannover that the first successful captive breeding of wombats was recorded. In fact, careful observations at the Hannover Zoo gave the first insight into the breeding and subsequent growth and development of these Australian tourists. With absolute precision, details of the wombat's sex life were recorded and, surprisingly, it seemed anything but modest. It appeared to be a physically demanding process, complete with chasing, biting, grunting and loads of heavy breathing. But why had this display of uninhibited lubricious behaviour never been recorded in Australia before? Captivity can affect the behaviour of animals, sometimes quite substantially, and observations of wombats

The Common Wombat is an iconic Australian marsupial, yet even basic details of its sex life have remained a mystery until very recently.

COURTESY CLIVE MARKS

in a German zoo were not necessarily thought of as being 'typical' of free-ranging wombats in Australia.

IT WAS AS LATE AS 1990 THAT I observed and filmed Common Wombat courtship and mating at Tonimbuk Farm in Victoria. This 35-minute sequence of infra-red footage gave the first insight into their far-from-common sex life back home. Mating, as seen in captive wombats, occurred *above* ground with both wombats lying on their sides. The female, after a prolonged period of copulation in the same position, broke away and began to trot in a pattern of circles and figures of eight. The male chased her, following closely behind, and then bit her on the rump. She immediately stopped just long enough to permit him to roll her on her side and begin copulating again. If the male was slow to mount, she would kick back aggressively and not let him roll her on her side again until she

CLEARLY, IN ORDER TO *do the 'wild thing', wombats seemed to need loads of space.*

had run round in more circles and figures of eight. This happened seven times. Clearly, in order to do the 'wild thing', wombats seemed to need loads of space. I wondered if captivity was cramping their style.

The events recorded at Tonimbuk very closely matched the observations in Hannover and did suggest that mating was not restricted to the burrow. Furthermore, they confirmed courtship and mating behaviour in Common

Courtship behaviour in the Common Wombat. The male chases the female in circles and figures of eight, trying to bite her on the rear. If she's ready she will allow him to flip her on her side and mate, after which she gets back up and the chase-and-mate sequence continues several times.

Wombats to be a very physical and almost violent affair. The male biting the female appears to be normal and no doubt accounted for some of the scarring and hairless areas often seen on wombat rumps. The observation allows us to speculate why captive mating may result in abnormally aggressive encounters. If the female only permits mounting after a 'chase', small pens may prevent this. If the male uses a 'bite on the bum' as a cue for her to stop and permit mounting, it is possible that any sexual encounter will result in escalating aggression without copulation taking place as the female has little space to perform her 'hard-to-get' behaviour. In

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this scenario, typical conditions of captivity may be inconsistent with the requirements of this species to breed. In the Hannover Zoo, the wombats were permitted the free run of the large elephant and rhinoceros enclosure at night so open space was not an issue.

Shortly after seeing some film footage of wombat courtship and mating, Androo Kelly at Trowunna Wildlife Park, Tasmania, was determined to sexually liberate his wombats. He had seen the signs of wombat sexual frustration before, resulting in a well-bitten female that did not fall pregnant. On the next occasion that he saw signs of wombat love, he released them from captivity into the grounds of the park. With freedom to lead the wombat '*dance d'amour*', the female permitted copulation and Androo saw the same sequence of behaviours as documented in the film. He also found a pouch young some months later!

Catriona MacCallum at the Western Plains Zoo in Dubbo has probably had the most spectacular wombat breeding success of all. Joining and modifying the pen systems to permit a chase, she not only found that wombat breeding was possible in captivity, but she found herself with the first recorded case of wombat twins. Perhaps sometimes, a change is as good as a holiday!

Because of its burrowing habits, wombats possess a backward-opening pouch—a great vantage position for a well-developed young and a way to ensure that you are out of the way during serious earth moving!

As the Common Wombat is increasingly held in captivity throughout Australia, there are compelling reasons to find out more about this cryptic marsupial. Let not the label 'common' deter us from this task or, worse still, lull as into a complacent attitude when it comes to the conservation status of this wombat. Habitat fragmentation increasingly impacts upon its populations. I hope that it will never be the task of any future biologist to more fully elucidate the sex life of the 'Uncommon' Wombat.

So, I am finally able to answer that great Australian wombat sex conundrum, but with an unexpected feminist twist. For it seems that, in the wombat dance of love, it is the female wombat that calls the shots; and eats, roots and *leaves*! □

Being the largest burrowing herbivore, it seemed probable that Common Wombats would mate within the confines of their extensive burrow system. But they turned out to be less modest!

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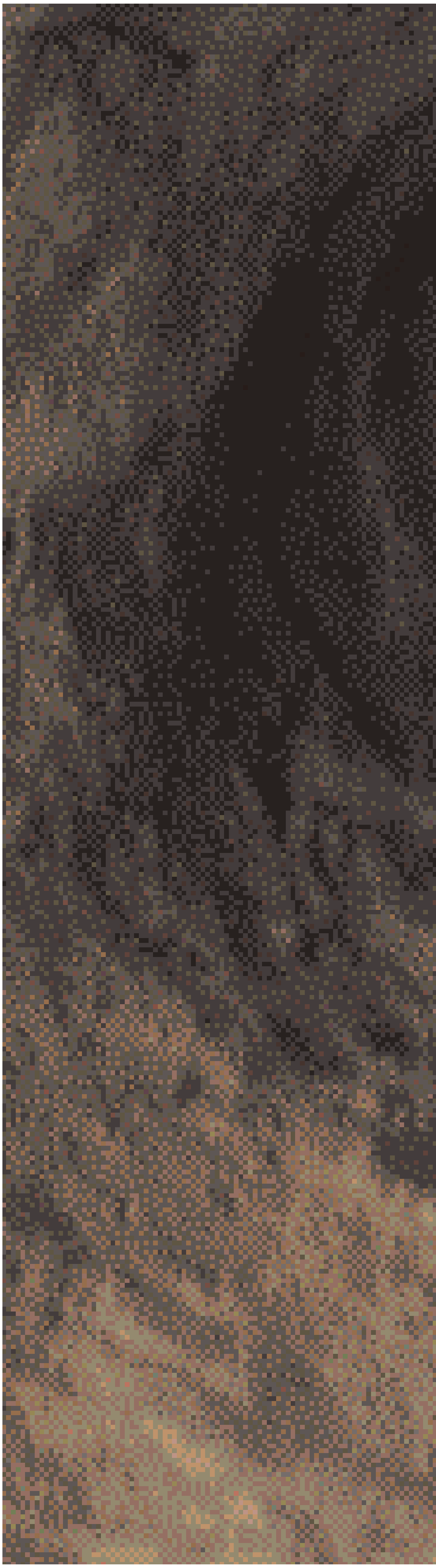


Common Wombat

Vombatus ursinus

Classification
Family Vombatidae.

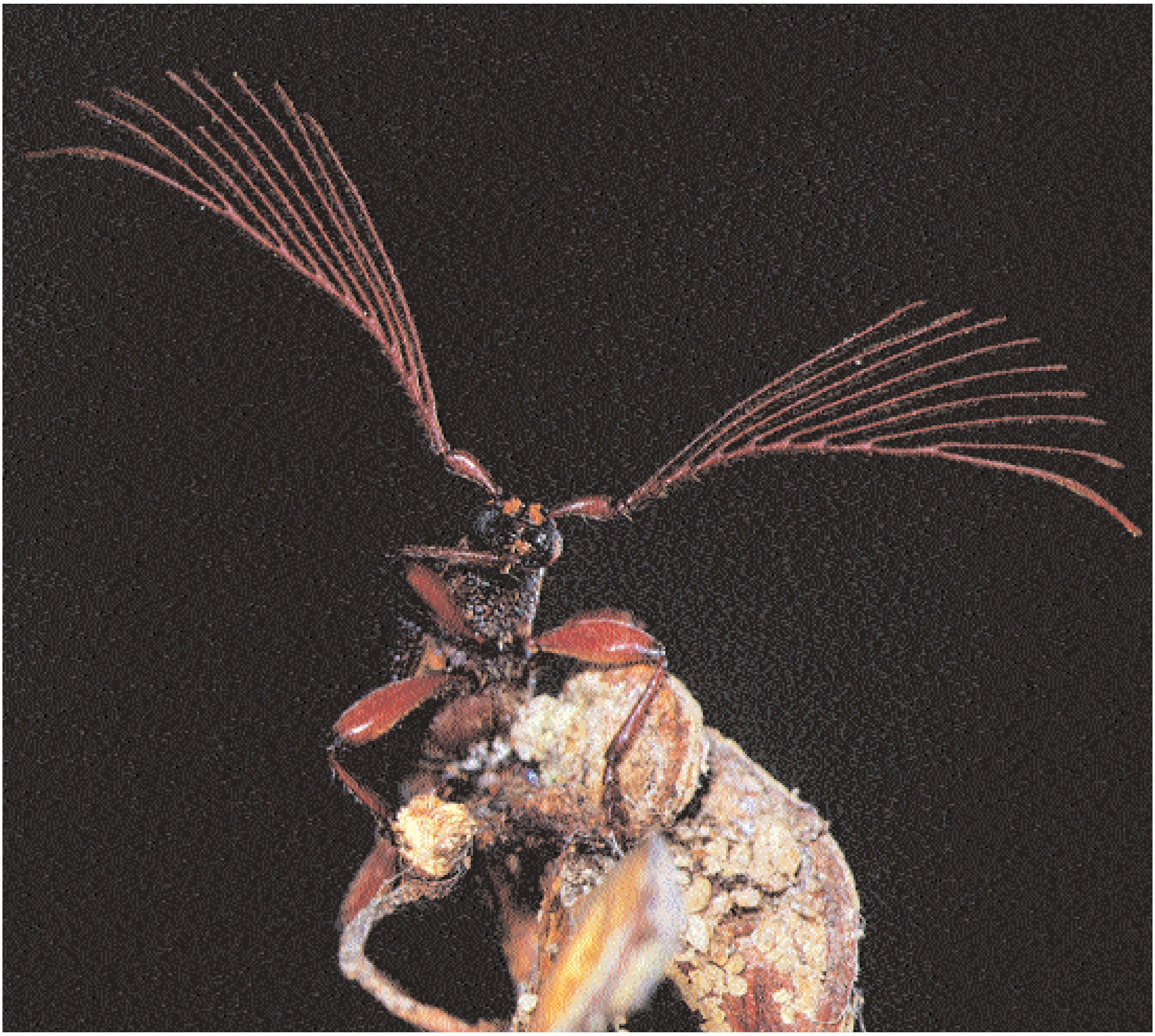
Identification
Large, generally nocturnal burrowing marsupial with squat, round body and course pelt that varies from black, chocolate brown to blonde. Can grow to over 1 m in length and over 35 kg (mean 25 kg) in weight. Distinctive cube-shaped droppings.

Habitat and Distribution
Alpine forest, heath, coastal scrub and open forests with suitable burrowing habitat and forage. Once more widepsread across south-eastern Aust.; now largely restricted to Tas., and highlands in Vic. and NSW, extending to south-eastern Qld border. Patchy populations in western Vic. and eastern SA.

Biology
Diet of grasses, herbs and sedges. Digs a number of large burrows, some up to 30 m in length. May move many kms in an evening. Births occur at all times of year, almost always with single young.

NICHOLAS BIRKS

(Left) Emperor Gum Moth caterpillar (*Opodiphthera eucalypti*).

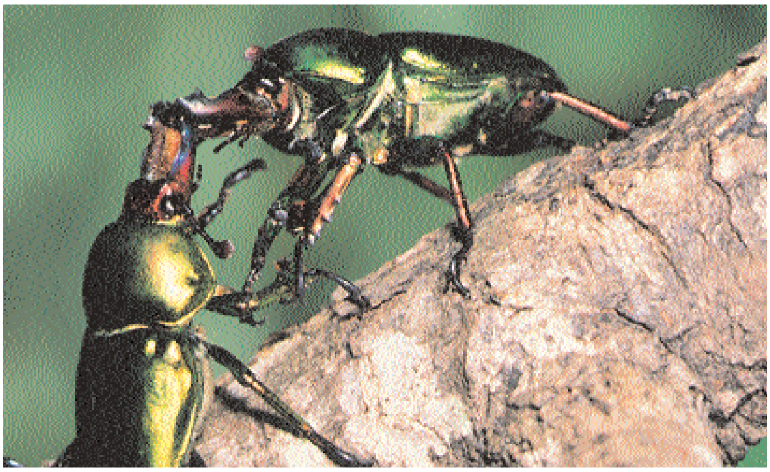


Longicorn beetle *Piesarthrius* sp.

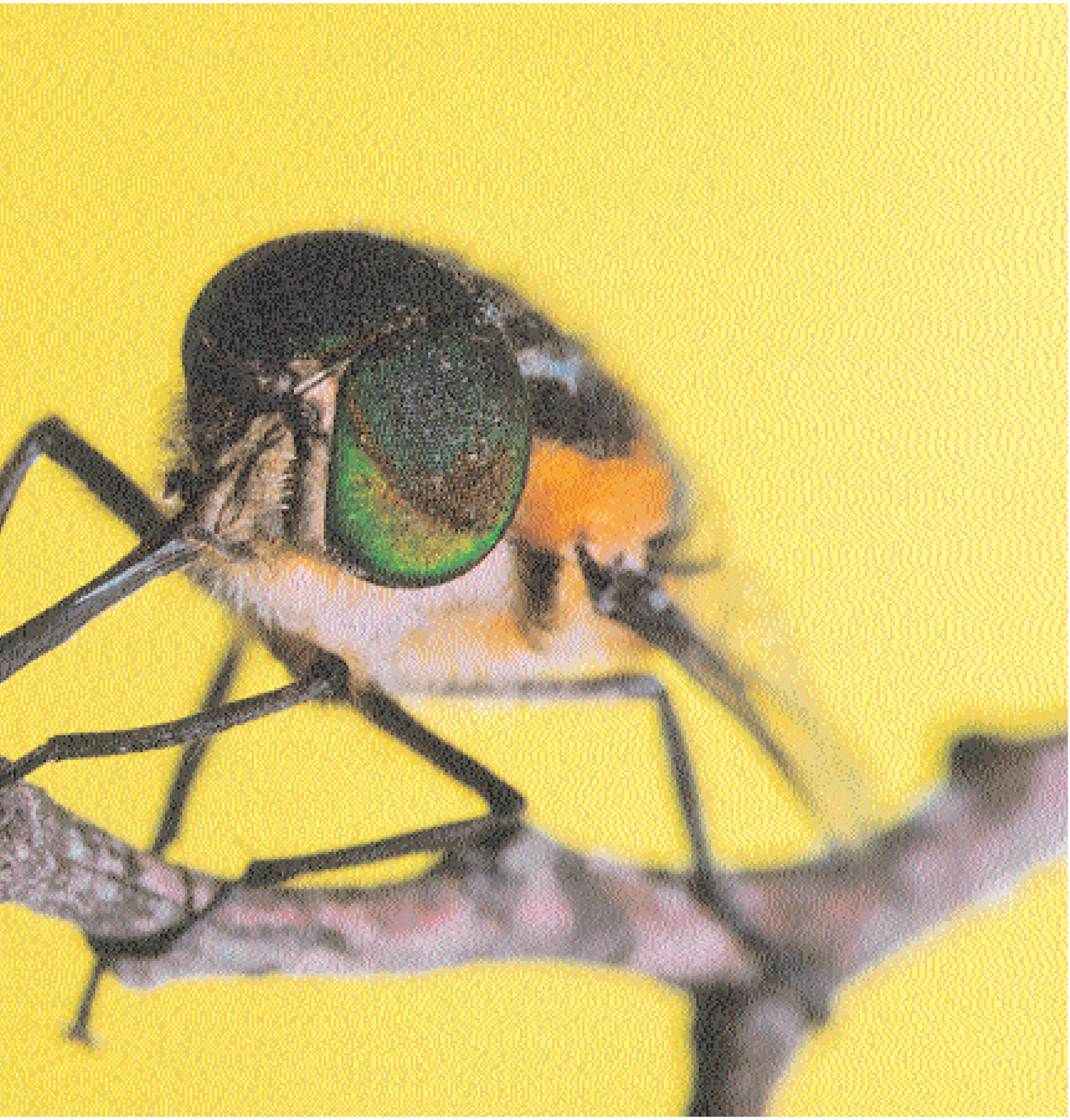
Insect Gallery

BY GUNTHER SCHMIDA

Emperor Gum Moth (*Opodiphthera eucalypti*).



Sparring male Golden Stag Beetles (*Lamprima aurata*).



March fly.

Sqirming fleshy tentacles of doom

The Star-nosed Mole sees its world through pink-coloured tentacles.

THE *WIND IN THE WILLOWS* OPENS with the Rat taking his friend and fellow rodent the Mole on a picnic to the riverbank. Mole unpacks the fat, wicker luncheon-basket on a tablecloth and spreads out a number of small mysterious packets, which the Rat has explained contain food much loved by Moles. When it was ready the Rat said, "Now, pitch in, old fellow!" and the Mole unwrapped the food and began to eat in a manner befitting a talking Mole bestowed with English manners and picnic etiquette. However, if the Mole had the eating habits of a Star-nosed Mole, most of the food would have been eaten before the Rat drew another breath.

The Star-nosed Mole (*Condylura cristata*) has a soggy, subterranean lifestyle in marshes and wetlands from Canada down through the north-eastern United States. Coated in waterproof black fur and having heavily clawed forelimbs for digging, it blindly burrows through the damp soft soil and feeds on the abundant worms, small insect larvae and other tiny animals it comes across. As its name suggests it has a nose that looks like a star, but this is a rather bland description of what is the most extraordinary-looking sense organ. Twenty-two-tentacled Octopus-nosed Mole would be more apt.

Surrounding the nose is a fleshy array of 11 pairs of finger-like tentacles that are splayed across the mole's face. While some of us see the world through rose-coloured spectacles, the Star-nosed Mole sees its world through pink-coloured tentacles. These squirming fleshy tentacles are packed with 25,000 touch receptors that send information via 100,000 nerve fibres to the mole's brain. For us this would be the equivalent of having the sensitivity of our entire hand magnified six times and then concentrated into a single finger tip.

And what does the Star-nosed Mole do with all this information rushing to its head? When the tentacles of doom touch something that may be worth eating, the mole brings its lowermost central pair of tentacles into contact with the prey. These super-sensitive tentacles allow the mole to make even more precise decisions about what to do next, and if the brain says "Eat", the prey becomes fast food; really fast food. From the moment the mole finds prey, moves to prey, decides to eat prey, grabs prey, bites prey with its tweezer-like teeth and swallows prey, it takes just over one-fifth of a second.

Kenneth Catania and Fiona Remple at Vanderbilt University in the United States have found that the Star-nosed Mole is the champion of mammalian eating competitions. Using a high-speed video camera to film the mole's feeding behaviour, they found that it could eat ten mouthful-size pieces of earthworm in 2.3 seconds or 0.23 seconds per piece. Although the structure of the star, and the fact that a large part of the mole's brain is dedicated to processing information it receives from the star, was already known from earlier studies, the actual speed at which it could literally inhale food was unknown. Their results also suggest that the mole has pushed its brain and nervous system to its operating limits for moving quickly and processing information coming from the star. So it is not surprising that the mole often makes mistakes and misses a bit of food and then backtracks to make the right decision.

What are the advantages of super-efficient feeding? It seems intuitive that, in terms of time and energy spent foraging, it is cheaper for a large predator to catch one prey that weighs 100 kilograms than to catch 100 prey that each weighs one kilogram. However, if the predator expends very little energy locating each prey item, then it could survive on a diet of small animals. Catania and Remple suggest that the star evolved as an adaptation for high-speed feeding when the ancestors of Star-nosed Moles first moved into wetlands.

BY SIMON D. POLLARD

By evolving an exquisitely sensitive appendage with its large surface area and flexible feelers, the Star-nosed Mole could make an efficient living by finding very small prey very quickly. In fact, the researchers have calculated that the size and mobility of the star allow the mole to find 14 times as many small prey items in a given time compared with its close cousin the Eastern American Mole (*Scalopus aquaticus*).

The Star-nosed Mole is the only mole to have evolved such an elaborate and delicate star. This may be because its fleshy muzzle is less likely to be damaged as it is pushed and shoved through the damp soft soil found in wetlands, unlike the drier soil of other mole habitats.

When Kenneth Grahame's Rat tells the Mole what food is inside the wicker basket, the list of goodies rolls off his tongue so quickly, it is easy to imagine that he was actually trying to whet the appetite of a Star-nosed Mole. "'What's inside it?' asked the Mole, wriggling with curiosity. 'There's cold chicken inside it,' replied the Rat briefly; 'coldtonguecoldhamcoldbeefpickledgherkinssaladfrenchrollscresssandwichespottedmeatgingerbeerlemonadesodawater—' 'O stop, stop,' cried the Mole in ecstasies: 'This is too much!'" However, life is no picnic for the Star-nosed Mole as it races against time to find wormsinsectlarvaecrustaceanstiny-insects…□

The super-sensitive fleshy tentacles of the Star-nosed Mole.

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Naked apes letting their hair down

We are not so naked that we won't wax or shave to improve the look and feel of even the most hard-to-reach places.

FORGET ARMPITS, PIGTAILS AND PUBES, just for a moment. The rest of our body is as hairy as the next great ape's, at least in the number of follicles per square centimetre. Humans, with dense, fine, short hairs, just look naked, so we can rightly be called 'naked apes', or 'third chimpanzees', or even 'silverbacks' (Gorillas aren't the only males to get long grey hairs on their back as they get older!).

Although anthropologists tell us we *look* naked, humans, it seems, can't get naked enough! We are not so naked that we won't wax or shave to improve the look and feel of even the most hard-to-reach places. There are 14 pages of beauty salons in the Sydney Yellow Pages, most offering waxing services for just about everything—eyebrows, upper lips, legs, backs, armpits, crotch.

On top of all this fuss over unsightly body tufts are beards and head hair. Fashion, health and even religion have a big impact. The Taliban (Islamic rulers of Afghanistan 1996–2001) banned shaving, and decreed that beards be longer than a man's fist. Barbers have since re-opened to high demand. But you don't have to be an Islamic fundamentalist to realise that we pay close attention to removing facial hair. Barbers and hairdressers command over 15 pages in my phone book, responding to demand for frequent trims and hairstyles to enhance facial attraction and to send out the right kind of signals—whether you're a job applicant, intellectual, company director, or lover.

Charles Darwin considered many tangled arguments about why hair is different on men and women, and why all humans have a mat of hair at the junctions of the limbs and torso. He wondered too if reduced body hair was naturally selected to free humans from ticks and other parasites, but thought this unlikely because he was unaware at the time of any specific adaptations for removing parasites in other relatively hairless, tropical landlubbers (elephants and rhinos). Nor did the loss of human hair to regulate body temperature appeal much to Darwin because it doesn't really explain retention of our head hair, most exposed to the sun. Darwin favoured sexual selection to explain different head and face hair on men and women.

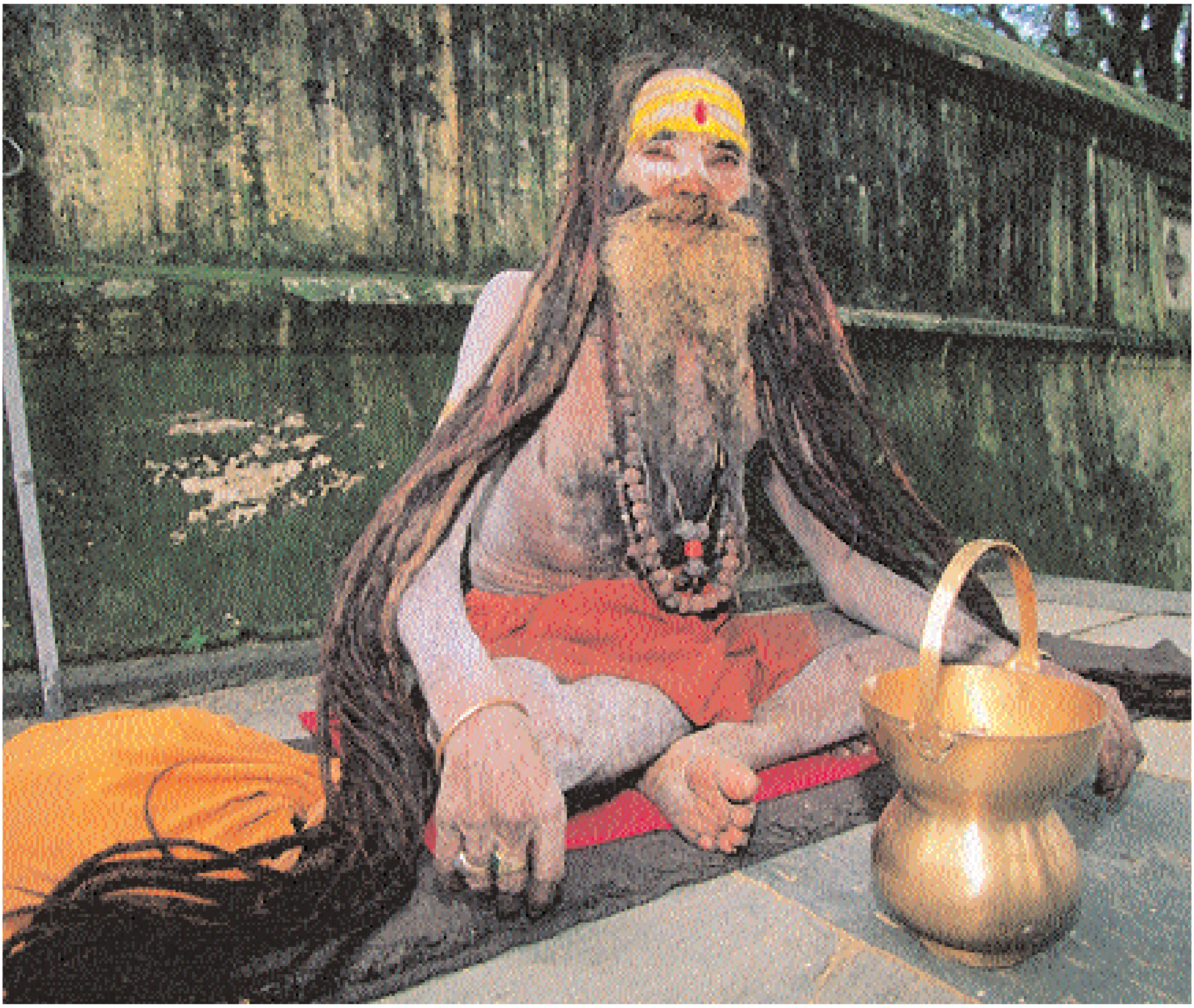
Mark Pagel (University of Reading) and Walter Bodmer (Oxford University) combed new threads into these theories. They too rejected the hairless, bipedal, body-cooler argument (naked skin gains too much heat during the day and loses too much at night). And they doubted the 'aquatic ape theory', which purports hairlessness to have evolved during an aquatic or semi-aquatic phase of human evolution—the fossil evidence is just not convincing. They reckon that sexual selection could well explain human retention of face, head and pubic hair, but that relative hairlessness elsewhere on the body was largely driven by advantages conferred by eliminating ectoparasites like fleas and ticks. Darwin was wrong. A tendency to hairless and tick-free skin could easily have sparked a selective advantage through lower infections, which then kicked off the whole process of choosing mates that advertised clean skin ("Look! No fleas!").

BY RICHARD FULLAGAR

The oldest hairdos depicted archaeologically were once thought to be on 30,000-year-old Venus figurines from Western Europe, but it turns out that these carvings are probably woven hats (see "Stone Clothes", *Nature Aust.* Autumn 2001), and thus the earliest evidence of covering up, if not removing, hair! Genetic studies of lice take us further back, and indicate that the Human Body Louse, which lives in clothing and only feeds on the body, evolved 50,000–100,000 years ago, presumably when we started wearing layered clothes (see "Lousy Clothes", *Nature Aust.* Winter 2004). So we must have been 'naked' at least since modern hunters walked—not streaking but dressed to kill—out of Africa. Maybe other early humans were a lot hairier. Could this explain the scant evidence of human interbreeding with hairy, cold-adapted Neanderthals? Perhaps they were just too flea-ridden and ugly. Could it explain Neanderthal extinction through infection?

Human retention of hair in or on the nose, ears, armpits, chest, genitals and other remote locations usually has a functional explanation. Hairs might be filters, cushions, signals of sexual maturity, or pheromone dispensers. Pluck some hairs from different parts of your body and have a sniff. Twirl them around. Pubic hairs are coarse and curly with an irregular diameter, which is handy because it means they can't get matted into dreadlocks when you walk to work. But human head hair stands up in a world of its own. How come head hair is so much longer than everywhere else?

Norbert Mesko and Tamas Bereczkei (University of Pécs, Hungary) suggest that long hair is linked with reproductive success. They tested several possible functions of long hair: to cover up or draw attention away from less attractive (more masculine) parts of the face; to advertise absence of parasites, assuming only individuals free of infection can afford to grow their hair long; or to send a 'costly signal' (like a peacock's tail) to advertise good genes. They got male subjects to examine computer images of six hairstyles (short, medium, long,



COLIN MONTEATH/AUSCAPE

A Hindu Sadhu (holy man) from Kathmandu, Nepal. Long hair means different things to different people.

dishevelled, bun, and unkempt) on a set of female faces and to rank the effects of these hairstyles on attractiveness (femininity, youth, health and sexiness).

The results showed that unkempt or dishevelled hair, which might indicate parasites, has little impact on attractiveness, but that hair length is a pretty good indicator of general health and, presumably, genetic quality. Long hair certainly costs a lot in terms of production (head hair consumes more energy, grows faster and is shed more rapidly than body hair) and daily maintenance (long hair takes more time to care for than short hair). Hairstyle, particularly medium and long hair, is very important in enhancing attractiveness, whether you have something to hide or not. Longer hair makes less attractive women look more feminine and healthy, while it makes more attractive women more feminine and sexy. Obviously this study might only be true for a limited range of female hairstyles and for certain cultures, but the basic message probably holds: long hair will impress your mate, because to afford the costs of production and maintenance, you've got to have good genes. The next plan is to see how men make the cut, and what women want.

I read somewhere that transplanted pubic hair (that is, adding to it, not removing it) is becoming trendy in South Korea, but I can't see it catching on as a surgical cure for baldness in the West. Still, with all this artificial adding and removing, it's hard not to think that it's the end of evolution for human hair. The medium (hair) and the message (mate with me) might be the same, but what you see (or don't see) is no longer what you get. □

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Immortal plants

A tree can be viewed as a close-knit colony of many individuals, and this colony has the potential to live forever.

I WAS BOTH SHOCKED AND AWED BY the ideas offered by French tropical botanist Francis Hallé in his wonderfully titled book *In praise of plants.* I was certainly amused and captivated—it's a fascinating book. Hallé is particularly keen to show that most animals and plants are fundamentally different, and that we can't simply generalise from what we know about animal biology to plants. To my delight, Hallé also concludes that plants are far more interesting!

One of Hallé's key concepts is that a tree can be viewed as a close-knit colony of many individuals, rather than a single organism, and that this colony has the potential to live forever. What he means is that there is a repeated pattern, and each unit can continue to grow (whether part of the tree or as a cutting or graft) as long as it contains a bud. The bud, according to this interpretation, can be considered the true individual—it cannot be divided any further. (Even if we use genetic uniformity to define an individual, in a long-lived tree a slow build-up of mutations in vegetative cells can result in some branches having a distinct fingerprint.) So a tree is like an ant nest or sea anemone: individuals die, but the colony persists.

So a tree is like an ant nest or sea anemone: individuals die, but the colony persists.

Apart from providing an interesting linguistic or philosophical exercise, does any of this matter? It does if you consider colonial organisms to be, to all intents and purposes, immortal. Clearly most trees are mortal: Australian wattles tend to flourish and die within a decade or two, and even our most majestic street trees have a maximum life span of one or two centuries. Structural problems develop. Food and water supplies can't be guaranteed. Fungal pathogens somewhat short-sightedly kill their host. Winds blow them down. And so on.

In fact, the longest-lived plants are not the grand trees. Granted a Bristlecone Pine (*Pinus longaeva*) chopped down in California in 1964, is often cited as the oldest tree. It was just under 5,000 years old when felled, although there are claims that other individuals of this species are 8,000 years or more old. And a massive Huon Pine, spread over 2.5 hectares (the size of a city block) in the Mount Read area of Tasmania, is estimated to be about 10,000 years old, but there is some debate over whether to call this an 'individual' tree or a 'colony of clones'.

If we accept Hallé's view that most plants are colonial anyway, we shouldn't care too much if trees like the Huon Pine survive only because they spread vegetatively at their base by producing new stems to replace old (that is, sucker or layer). This brings into contention the Creosote Bush (*Larrea tridentata*) from California, now over 11,700 years old (see "The Lengthening Limits of Life", *Nature Aust.* Winter 1997). But this is a baby compared to a strange plant lurking in the Tasmanian World Heritage Area.

Some years ago, I took part in an *Australian Geographic*-sponsored expedition to Bathurst Harbour in south-western Tasmania. While I was wading through tea-coloured streams searching for new species of red algae, Jayne Balmer (Tasmanian Department of Primary Industries, Water and Environment) was collecting samples from one of Australia's oddest, perhaps its oldest, and certainly one of its rarest, plants. A member of the family Proteaceae and closely related to warratahs (*Telopea*), King's Holly (*Lomatia tasmanica*) was first discovered in 1934 by local identity Denny King. That plant is now assumed dead, but King found a second population, confirmed by Tasmanian botanist Winifred Curtis in 1965. It looks healthy enough, extending along creek gullies for over a kilometre, but none of the plants produces fruit or seed. Genetic testing by Jasmyn Lynch (who works with Balmer) and colleagues from the University of Tasmania showed no detectable variation across the entire population. This is usually good evidence of a vegetatively reproducing species (although some plants that grow from seed may be genetically indistinguishable from one another, such as the Wollemi Pine, and, like the branches on an old tree, vegetative off-shoots are not necessarily genetically identical).

Microscopic examination also demonstrated that King's Holly has three sets of chromosomes. When it comes to chromosome numbers, plants do mix it up a lot, and multiple copies are not uncommon. But triploids, as they are called, are rare. In *Lomatia*, and in fact in all its close relatives, a double (diploid) set of 11 chromosomes is standard issue. The fact that King's Holly has 33 chromosomes explained why it couldn't produce fertile seed—triploid plants rarely find a way to split this odd number up and produce viable gametes (the reproductive cells that have a single or haploid set of chromosomes). It's thought this odd set of chromosomes resulted from the successful fertilisation of a freak diploid gamete, with a normal haploid gamete, many years ago. Two plus one equals three!

Lynch and colleagues hypothesise that

BY TIM ENTWISLE

EVE LAZARUS

King's Holly: part of a 43,000-year-old clone?

every plant in the one-kilometre stretch was once connected, and that fire has probably fragmented the 'clone'. Based on a combination of its current extent, carbon-dated fossils, the lack of genetic diversity, absence of seed, and the unlikelihood of triploids occurring twice, they hypothesise that this clone may have started life over 43,000 years ago. Hard to confirm, but a tantalising proposition.

A few thousand kilometres north, plant ecologist Rob Kooyman has discovered another long-lived clone. He suggests, provocatively, that the Peach Myrtle (*Uromyrtus australis*) in New South Wales's Nightcap Range is, at least functionally, an immortal plant. That is, in the right circumstances it could live for ever. Kooyman and his research supervisor Peter Clarke (University of New England) are still trying to confirm the exact age and life history of this intriguing plant. Like King's Holly, the Peach Myrtle has found a way to survive without reproducing from seed. Each individual consists of a large group of stems up to 12 metres high, the biggest of which seem to be about 1,500 years old. The plant 'regenerates' itself by replacing old stems with new, and is likely to be at least 10,000 years old.

The real stayers, however, are giant fungal networks said to be the largest living organisms in the world (see "Largest Living Organism", *Nature Aust.* Summer 1993–94) and possibly functionally immortal as well. Plenty of algae, fungi, bacteria and other microbes reproduce almost exclusively by splitting in two (without any sexual fusion), and you could describe their extended families as exceedingly old but disjointed individuals. All this casts a dark shadow over the paltry efforts of most animals, which at best live for a few hundred years or, if you are a sea anemone, a couple of thousand years. Being a plant, or a microbe, has its benefits.

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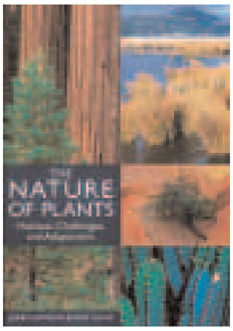
Dr Tim Entwisle is Executive Director of the Botanic Gardens Trust, Sydney.

reviews



The Nature of Plants: Habitats, Challenges, and Adaptations

By John Dawson and Rob Lucas. CSIRO Publishing, Collingwood, Vic., 2005, 314 pp. $64.95 rrp.

Books like this are usually written by Americans or Europeans, and the text and illustrations invariably emphasise northern-hemisphere examples. What is refreshing about this book is that its authors hail from New Zealand, and their text has a strong Australasian flavour. Many of the plants they describe and illustrate come from New Zealand, Australia and New Caledonia. As a detailed introduction to the world of plants this book is very good, and well pitched towards the category of reader who enjoys Nature Australia. In clear readable English the authors explain such phenomena as pollination and seed dispersal, and adaptations to fire, drought, cold, herbivory, and a life in water. The text can be read chapter by chapter, or be consulted when questions come up, such as 'How does sap rise?' The photos, mainly by Rob Lucas, are so outstanding that the book is almost worth buying just for these. The text appears to be pitched to an international audience, but its New Zealand bias ultimately becomes a minor weakness, with too many New Zealand examples used to illustrate the concepts.

—Tim Low

Seven Deadly Colours: The Genius of Nature's Palette and How it Eluded Darwin

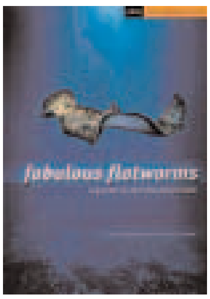
By Andrew Parker. Simon & Schuster, Pymble, NSW, 2005, 286 pp. $34.95 rrp.

The supporters of Intelligent Design argue that life is just too complicated to be the result of the directionless lottery of evolution, and to them the eye is too perfect to have evolved by chance. Charles Darwin also felt the eye was perhaps too perfect for evolution, but as Andrew Parker explains in Seven deadly colours, the eye is not quite as perfect as we tend to think.

This book deals with the physical aspects of colour, how it is 'made', and how much our 'perfect' eyes fail to see. While colour pigments are known to us all, what about structural colours, iridescence, and yellow fluorescence?

There is much fascinating information in this book, but sometimes the flow is interrupted by complicated explanations that might have been better in an appendix. I also would have liked answers to unanswered questions. For example, can parrots see yellow fluorescence? One of the aims of this book is to show that the eye is not perfect. Why then does Parker specifically exclude image-forming organs from his definition of an eye? Surely the 'proto-eyes' of snails and slugs and the light-sensing organs of other more primitive animals are part of the story of the eye's evolution?

—Bill Rudman
Australian Museum



Fabulous Flatworms: A Guide to Marine Polyclads

CD-ROM by Leslie Newman and Lester Cannon. CSIRO Publishing/Australian Biological Resources Study, 2005, $69.95 rrp.

Following on from the excellent book Marine flatworms (reviewed in *Nature Aust.* Winter 2004), "Fabulous Flatworms" is an interactive CD-ROM covering similar but also new ground. Both works are profusely illustrated and cover evolution, classification, and all aspects of flatworm biology. Although a hardcopy book has obvious aesthetic appeal, the electronic medium enables features not previously available. For instance, video clips showing predation, reproduction, gliding and swimming are included, plus many more still images. A further departure from the book is that the CD-ROM is more strongly geared towards identification, making good use of both anatomy (internal and external) and living colour. Species can also be listed alphabetically, taxonomically or geographically, with each linked to the relevant images and descriptions.

"Fabulous Flatworms" is not an exhaustive guide to all species, and some can be difficult to identify from the photographs alone, thus requiring a careful reading of the description. However, with more than 400 world species depicted, most that are likely to be encountered can be readily recognised. Surprisingly, or perhaps not, about three-quarters of species included are yet to be formally described. Highly recommended.

—Shane Ahyong
Australian Museum

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23° S: Archaeology and Environmental History of the Southern Deserts

Edited by Mike Smith and Paul Hesse. National Museum of Australia Press, Canberra, 2005, 436 pp. $42.95 rrp.

Twenty-five essays by 40 scholars provide archaeological and environmental perspectives on six deserts strung around the Tropic of Capricorn, 23° S of the equator. Despite some similar geological origins, deserts are diverse places. For example, the sandy Atacama Desert in South America is 150 kilometres wide and lacks obvious life forms, contrasting with a 2,000-kilometre stretch of Australian aridity, which has sustained Aboriginal populations for over 22,000 years.

23° S is an academic conference volume divided into five sections: Environmental History, Dynamics of Settlement, Rock Art and People, Hunters and Herders, and Historical Perspectives. Whereas the early environmental history is forensically complex and hazy, the recent past comes alive with Bushmen, Inca and Pintubi. Nicely illustrated rock paintings and engravings demonstrate the rich and diverse desert cultures.

Mike Smith is an Australian archaeologist who authored the recent exhibition on deserts at the National Museum of Australia, while Paul Hesse is a geomorphologist, well known for his research into climate change. It's a good combination, which has kept the chapters brief, despite complex arguments, scientific uncertainties and technical jargon (hence a useful Glossary). Highly recommended for anyone interested in the details of environmental history and desert peoples.

—Richard Fullagar
University of Sydney

Rhythms of the Tarkine: A Natural History Adventure

By Sarah Lloyd and Ron Nagorcka. Published by Sarah Lloyd, Birralee, Tas., 2004, 98 pp. and 99-track CD, $35 rrp.

The Tarkine area covers approximately 447,000 hectares of the north-west of Tasmania. The region hosts Australia's largest temperate rainforest, the largest area of unprotected wilderness remaining in Tasmania, and an astonishing variety of other cultural, biological, geological and landscape values. The authors spent several weeks exploring, recording the sounds, and documenting the natural history of the Tarkine.

The 98-page booklet is a descriptive diary account of 11 different places they visited in the Tarkine. The authors elaborately describe the different vegetation, birds and animals that inhabit the areas. The birds at each site are well documented and each species is accompanied by a number that relates to a track on the CD. The CD comprises 99 tracks that were recorded on their expedition. These are mainly bird calls but also other animals such as the Tasmanian Devil and some invertebrates. The booklet and CD together create a very strong image of the pristine beauty of the Tarkine. It almost made me feel like I was sitting on the forest floor.

Useful appendices listing the fauna sightings at each area, and the scientific names of the flora and fauna, are included.

The author sadly points out that when travelling in Tasmania, breathtaking beauty is juxtaposed with massive destruction of the unprotected forests of the Tarkine.

—Georgina Brown
Australian Museum

Fruits of the Australian Tropical Rainforest

By Wendy Cooper, illustrated by William T. Cooper. Nokomis Editions Pty Ltd, Clifton Hill, Vic., 2005, 632 pp. $235 rrp.

Reviewing books can be a mixed blessing and my encounter with this one was no exception. It's a big, detailed, specialist botanical work and as such somewhat daunting. Yet it's also a joy just to drool over the luscious illustrations—this book can hold it's own on any coffee table.

Still, it would be a waste if it spent its life on the coffee table, for it contains an inordinate amount of information on rainforest fruits and the plants that bear them. Thankfully everything is extremely well-organised in species accounts, glossary, key and bibliography, so you don't lost. It is a botanist's delight—the amount of information is truly mind-boggling.

And then there are the illustrations. What can I say? You could easily frame any of them and not be disappointed. But they aren't just beautiful; they do what the best natural-history illustration must do—they capture the essence of the subject matter. You really do get an accurate impression of what the fruits look like.

So I am torn between wanting to drag this book with me on my next rainforest walk and the impulse to put it on a pedestal in my lounge room. Should all my dilemmas be this good!

—Greg Gowing
Australian Museum

SOCIETY PAGE

Get involved! Across Australia there is a network of active societies, large and small, local and national, that exist to further the cause of the subject that you hold dear. Whether your special interest is conservation, birds, science, national parks, bushwalking or a particular group of animals, there's a society for you.

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q&a

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Katydid eggs on a camelia leaf.

Katy Did It

Q: *Could you tell me what laid these curiously arranged eggs on my camelia leaf?*

—Lance Dover
Pennant Hills, NSW

A: This egg mass is produced by a katydid (a tettigoniid cricket), probably the spectacular Mottled Katydid (*Ephippitytha trigintiduoguttata*), which occupies a large range over much of Australia in a diversity of habitats. Females have a short, broad, flattened ovipositor (egg-laying organ) that they use to split the edges of leaves. They then lay and glue their eggs securely into place in the split. Black and yellow nymphs hatch in the spring months and then take six to eight months to reach adulthood. Very little is known about the life history of these katydids, but they are apparently quite easy to raise in captivity on a diet of leaves found in the local area.

—Dave Britton
Australian Museum

One-legged Ducks

Q: *I have a pair of Pacific Black Ducks (*Anas superciliosa*) that regularly visit my backyard and I noticed that both were resting on their left legs with their right legs tucked up into their bodies and bills tucked under their right wings. They stayed like this for at least half an hour. Why do ducks stand on one leg? Also, is there a 'handedness' to ducks, or do they alternate the standing leg?*

—Alan Moskwa
Kensington Park, SA

A: Standing on one leg is easy for ducks (and other birds) because special tendons in the leg lock it into place and it thus requires almost no extra energy to retain this position. Several explanations have been proposed for why birds do this. Most frequently suggested is that it helps birds regulate their temperatures by letting them hide one leg, with its exposed surfaces, in the well-insulated belly feathers. Birds can sleep with one half of their brain while the other side stays alert, so it may be that standing on one leg allows the other leg to 'sleep' as well. Another thought is that standing on one leg makes it easier for a resting duck (with its head pulled into the side of the body or laid on its back) to monitor its surroundings. This is because it takes less effort to rotate slightly on one leg to look at something than it would to shift position if standing on two.

Handedness is well known in parrots but little studied in other birds. There is no reason to believe that ducks would not have a natural preference for one side over the other. If it is simply like people crossing their legs preferentially, then there may be only limited alternation. If, however, the practice results from one or more of the reasons suggested, then changing feet would be expected. Observations on sleeping ducks might warrant a good school science project.

—Walter E. Boles
Australian Museum

Thirsty Koala

Q: *We live in Belair on the city side of the Adelaide Hills, and Koalas are common in our gardens most of the year. It is often stated that Koalas rarely drink, and that they get the water they need from the leaves they eat. Yet we saw and photographed a Koala come down to our garden pond and spend about 40 minutes deliberately drinking in broad daylight. How common is this behaviour?*

—Ian Gibbons & Judy Morris
Belair, SA

COURTESY ALAN MOSKWA

Why do ducks stand on one leg?

A: This behaviour is unusual. First, Koalas normally move at night and are seldom on the ground after sun-up. It's the drinking, however, that is particularly worrisome. Although Koalas do drink in the wild, they obtain most of their water from the leaves and dew. Drinking for 40 minutes indicates a serious problem with the kidneys. Researchers at the University of Adelaide are concerned about the number of Koalas in the Adelaide Hills that have damaged kidneys and have found aluminium deposits in all that they have examined (*The Veterinarian* June 2004). Oxalate crystals in Koala kidneys (oxalosis), caused by eating plants with high levels of oxalates, can also lead to a violent thirst. There is likely to be a relationship between oxalates and aluminium deposits but that link is currently not completely understood. Whatever the case, raging thirsts are a very bad sign of Koalas and the animals invariably perish.

—Rob Close
University of Western Sydney

COURTESY IAN GIBBINS & JUDY MORRIS

Koala drinking from a garden pond.

Answers to Quiz in Nature Strips (page 16)

1. *She-oaks*
2. *Aboriginal painting styles*
3. *Eight or ten*
4. *Forest trees*
5. *Hobbits*
6. *1986*
7. *Sponges*
8. *Twenty-one per cent*
9. *Keratin*
10. *A Baobab Tree*

fireant t/c

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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 the DVD *"Wilderness"*. Spring's Pic Teaser was a nose-leaf of the Eastern Horseshoe Bat (*Rhinolophus megaphyllus*).

Kimberley birdwatching??

Fertilising the greenhouse

Why are so many of us laid back about the possible impacts of this change?

HOKUSAI'S *THE GREAT WAVE off Kanagawa,* portraying three puny fishing boats defying a massive wave that frames Mt Fuji, is a beautiful depiction of humanity's tenacious spirit and use of technology in the face of the awesome power of nature. Presently there is an even greater wave threatening humanity—the steeply climbing concentrations of greenhouse gases, particularly carbon dioxide. The 'Keeling Curve', named after the American scientist who discovered it, describes the steady and ongoing increase in atmospheric carbon dioxide from 315 parts per million (ppm) in 1958 when measurements began, to the current levels of 379 ppm.

The Keeling Curve tracks the steady rise in post World War 2 economic prosperity, driven by the consumption of fossil fuels. It also proves beyond doubt that industrialisation has changed the Earth's biogeochemical cycles. The increase of 64 ppm of carbon dioxide over the last 46 years may not seem like much, but ice cores from Antarctica show that this in fact represents a sky-rocketing deviation from previous levels for at least the last 400,000 years and most probably millions of years, when carbon dioxide fluctuated from 280 ppm to 180 ppm. Such an increase is significant because of carbon dioxide's known capacity to trap heat and hence the apt name 'greenhouse gas'.

Another remarkable feature of the Keeling Curve is the seasonal drop of carbon dioxide by a few parts per million during the northern hemisphere spring and summer, when vegetation grows, and a slight rise when growth stops for the winter. (The comparatively small land area in the southern hemisphere is no match for the vast expanses of carbon-absorbing vegetation in the north.) Numerous studies have demonstrated that increased concentrations of carbon dioxide act as a plant fertiliser. The current high levels of carbon dioxide will therefore not only change the climate but also alter the functioning of the biosphere due to increased plant growth.

The failure of the USA and Australia to sign the Kyoto Protocol, designed to curb carbon dioxide emissions worldwide, signals a 'business-as-usual' mentality. However the magnitude and complexity of global change mean there is no such thing as 'usual' anymore. Why are so many of us laid back about the possible impacts of this change? I suggest one reason is that we have become distracted by the scientific squabbling regarding possible effects of increased greenhouse gases. Global and regional forecasts range from benign to cataclysmic changes in sea levels, air temperatures and rainfall patterns. Such uncertainty can give the impression that there is nothing much to worry about. However, such thinking is delaying adaptive responses to global environmental changes, considered by Sir David King, the British Government's chief scientist, to be a greater threat to civilisation than terrorism.

It is impossible, however, to make rock-solid predictions about our near-term environmental outlook. This point is demonstrated by ecological scientists' inability to accurately account for what has happened in the recent past. For example, my own group's research in northern Australia, and that of my colleagues around the world, is currently detecting the rapid expansion of native woody vegetation in marginal landscapes over the last 50 years. We are unsure if this expansion is a 'natural' ecological process due to changed rainfall patterns, the effects of overgrazing, the breakdown of Indigenous fire-management practices or some combination of all of these factors, or symptomatic of the 'fertiliser effect' associated with increased carbon dioxide concentrations.

Such uncertainty has tangible implications for environmental policy. For example, should the expanding woody vegetation be cleared for ecological restoration, as is often argued by pastoralists? Or should this phenomenon be celebrated as a passive form of carbon sequestration that is much cheaper than the Australian Government's currently championed engineering response to rising carbon dioxide, which involves pumping carbon dioxide deep into the ground? Answers to such questions are political because they demand making choices about socially acceptable economic and environmental costs and benefits.

I have no doubt humans will adapt to future environmental change, given that our species survived the global climate change caused by the last ice age, managing to colonise all terrestrial habitats and even creating enormous artificial ones (cities). Yet the cavalier application of science and technology has triggered global environmental change that potentially threatens our industrial civilisation. It is ironic that the development of an ecologically sustainable global civilisation must also be underpinned by science and technology. Managing the global greenhouse will teach us a lot about this new kind of science that is global in outlook yet humbly acknowledges uncertainty, complexity and the critical importance of human values.

PROFESSOR DAVID BOWMAN IS DIRECTOR OF THE AUSTRALIAN RESEARCH COUNCIL KEY CENTRE FOR TROPICAL WILDLIFE MANAGEMENT, CHARLES DARWIN UNIVERSITY, DARWIN.

BY DAVID BOWMAN

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