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On Kangaroo Island

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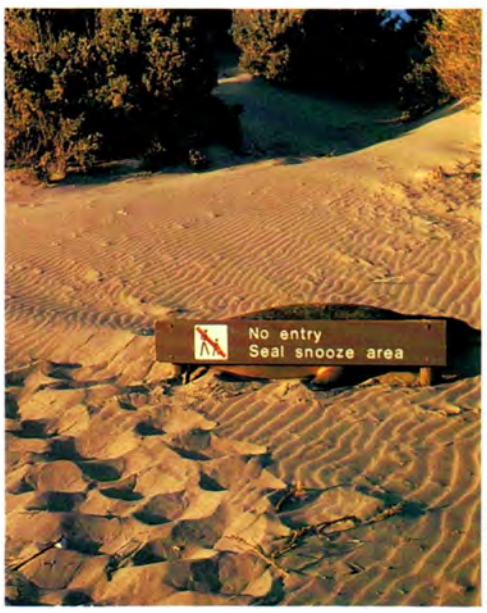
Up Front

Have you noticed that the croaks and ribbetts emanating from our ponds and creeks have dimmed in recent years? The national FROG-WATCH survey undertaken in 1991 was aimed at assessing the declining numbers of frogs in Australia. Frogman, Mike Tyler, brings us the results of the questionnaire, to which some 6,000 people replied.

Cats: in return for their companionship, we feed them and care for them. Yet even the best-loved cats remain skilled hunters and like to practise their prowess on native wildlife—sometimes repaying their owners with their trophies. We look at the impact of cats in Australia and offer advice to cat owners.

The sleeping habits of Australian Sea-lions made it easier for author Lesley Higgins to mark her subjects for identification. In order to learn all about the maternal and reproductive behaviour of these most unusual animals, she had to first sneak up behind them during nap time and write numbers on them with black hair dye!

This issue also investigates the evolution of human body odour and why we are obsessed with removing our scent. Robyn Williams starts a new column discussing changing trends in science; Mike Archer shows us that animals can have wheels; and the poster is an under-water photo of an Australian Sea-lion.



LESLEY HIGGINS

Sea-lion snooze zone on Kangaroo Island.

ANH

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Front Cover
The White-lipped or Giant Tree Frog *(Litoria infrafenata)* is probably Australia's largest tree frog. A nation-wide survey to assess the decline of Australia's frog populations, the FROGWATCH questionnaire, produced 6,000 responses. Photo by Pavel German.

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LETTERS

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

Bon Voyage

I was delightfully surprised when I discovered my subscription was the winning entry for your 1991 competition.

From 20–24 September 1992 my wife and I had the pleasure of going on a five-day whale-watching holiday run for TraveLearn by Dr Bob Morris. Bob was a charming host and a most interesting and informative speaker who held our attention and demonstrated a vast knowledge of–and fascination for–marine mammals.

The course concentrated on the Humpback Whales that pass through Hervey Bay at this time of the year on their way back to their feeding grounds in the Antarctic. It also covered many other interesting features of other marine mammals. Three boat trips were made out to Platypus Bay and on each occasion we were able to see a number of whales and dolphins at quite close range.

One day was spent on Fraser Island where Bob and a local identity introduced us to the history and development of the island, its flora and fauna, past use and present status as a proposed World Heritage Area.

My wife and I wish to extend our thanks to ANH and TraveLearn for enabling us to have this wonderful experience.

—Peter T. Deering
Bendigo, Vic.

Whale-watching in Hervey Bay.

KATHIE ATKINSON

Buried in Mystery

I have often heard reports of digs revealing past events and various dating techniques used to date artefacts. A lot of work and money is spent on this often difficult task.

People in the distant future will undoubtedly attempt to unravel the mysteries of why so many mass deaths occurred during our time. With the mass murders that Hitler, Pol Pot and others committed, plus the mass deaths from famines like that in Somalia, the resulting graves could prove a mystery to future archaeologists. This is especially true if written or other records perish.

To take the mystery out of the future, perhaps the archaeologists of today could bury time capsules in areas of mass burial, stating all relevant details for their future colleagues.

—Gloria McIntosh
Collaroy, NSW

Ibis Fill Abyss

One would have to be blind not to have noticed the extraordinary urban population explosion of the Sacred or White Ibis *(Threskiornis aethiopica)* in recent times. Nature certainly does abhor a vacuum and these highly efficient scavengers have really filled the niche created by our vast urban expansion and corresponding increase in garbage. I was at one of our local tips the other day and it was fascinating to watch a flock of these birds moving systematically through the separate area set aside for the disposal of domestic (mainly kitchen) garbage. The efficient way they first penetrated and then explored the contents of the multitude of plastic garbage bags was quite marvellous to see. If only they didn't get so grubby! Is anyone doing any research on this modern-day natural phenomenon?

—Roger Burgess
Tweed Heads, NSW

Anti Ants

In response to Peter White's ant problem (see Letters, ANH Winter 1992), there's a fair few ants where we live, including several nests in the roof of my house. Our kitchen used to be a nightmare of busy ant trails and formic acid-tainted cereal.

Thankfully, I've found my ants to be fairly easily controlled by removing the things they eat. They are simple creatures and don't bother to come into the house unless they're going to get fed (unlike cockroaches, which seem to come in for the sheer pleasure of hearing me shriek).

The ants only seem to be interested in eating meat or sugary things; keeping that kind of food out of ants' reach has banished the problem. I keep biscuits, dried fruit and sugary cereal in glass jars; jam, honey and so forth in the fridge (the jars are always sticky enough to attract ants). And in the rubbish bin or recycling nothing gets thrown away until it is washed clean, and meat scraps stay in the freezer until garbage night. Clean benches and regular washing up are an ideal scenario; but dealing with the scraps and wiping up the sticky spots before piling the dishes into a heap for the next day will also discourage ants. I don't know if this will work as well for the ants of Sydney but it's worth a try.

—Gresley Wakelin-King
Alice Spring, NT

Shocking Story

I would like to comment on the quip (ANH Spring 1992) about the Platypus and its bill-wagging whilst fossicking for food.

It seems the Platypus is not blindly 'filter-feeding', as formerly thought, but is detecting prey with its electric sense beforehand. The purpose of the wagging might be inferred by looking at vision and hearing. Our eyes see slightly different fields of view, which widely overlap in animals having both eyes facing forwards. The two images are combined to produce a three-dimensional picture that helps identify an object and its distance away. Animals with eyes on the sides of their heads have only a narrow field of stereoscopic vision. Thus birds must cock their heads from side to side and jerk them back and forth. Similarly with hearing, animals swivel their ears about, and some birds, such as the Australian Magpie, cock their head from side to side to localise prey.

I suggest this is a possible explanation for the Platypus wagging its bill. The receptors on each side of the bill do not 'see' overlapping views, except

DAVE WATTS / ANT PHOTO LIBRARY

Is the Platypus in for a shock?

perhaps in the very middle, but the Platypus finds its prey in a manner comparable to birds, lizards and other animals cocking their heads. The largest numbers of receptors are at the edges of the bill and this is perhaps the equivalent of having eyes at the sides of a narrow head.

A suggestion about the field that the Platypus 'sees': the wagging movements are extremely rapid and seem almost automatic—is the bill scanning the ground ahead like a television camera, and are the impulses that are sent back then used to build up a 'picture' as in a television set? Perhaps the animal 'sees' the area it is searching as a dark background with its prey as scattered brighter regions, as does the alien in the movie "Predator". I find this concept very appealing.

—A.G. Moskwa
University of South Australia

What Dr Moskwa is proposing is that the Platypus uses its electric sense like an electric eye. When fossicking about, looking for food on the bottom of a river or lake, the Platypus moves its bill from side to side at a rate of about twice per second. The proposal is that the signals generated by sensors located in the left half of the bill are combined with signals coming from the right half to construct in the Platypus' brain a three-dimensional image of the source of electricity—for example, a shrimp swimming nearby. The importance of this kind of mechanism is that it will tell the Platypus, which typically searches for food at night and often in murky water, how far away the shrimp is and in what direction it is swimming. Perhaps that is how a Platypus is able to catch half of its body weight in live prey in one night (see ANH Autumn 1990).

We have now made the first detailed recordings from the Platypus brain. To our surprise, the brain cells that receive the electrosensory information are getting signals from sensors in only one half of the bill. Signals from the two halves do not seem to be combined as in the case with the cells in our own brains, which receive information from both eyes. What we did find is that the electrosensory nerve cells in the Platypus brain are intermingled with other cells that receive touch signals from the bill, and have concluded that the sense of touch and electricity are closely allied in the Platypus.

Humans judge the texture of a surface by moving the fingers across it. Perhaps the Platypus is doing something similar, but without actually touching the object. It is receiving information about the shapes of nearby electric sources by moving its bill from side to side, that is, by reading a kind of 'electric braille'.

—Uwe Proske
Monash University, Vic.

ANH welcomes letters for publication and requests that they be limited to 250 words and typed if possible. Please supply a daytime telephone number and type or print your name and address clearly on the letter. The best letter in each issue will receive a $20 gift voucher from the Museum Shop catalogue. The winner this issue is Gloria McIntosh.

QUOTES & CURIOS

QUIPS

COMPILED BY GEORGINA HICKEY

Not Enough Time for Galapagos Iguanas

The Galapagos Islands have been under a scientific spotlight since 1835 when Darwin, voyaging on the *Beagle*, found crucial support there for his theory of evolution. Yet, despite the long-term scrutiny, many intriguing questions about the extraordinary array of life on this famed Pacific Ocean archipelago have persisted.

One of the most enduring zoological puzzles concerns the origin of the two Galapagos iguana species. Using modern molecular techniques, scientists have estimated that the two species diverged from a common ancestor between 15 and 20 million years ago. But since no present Galapagos island is older than three million years, the species would have to have arrived separately on the islands from different South American mainland stock—a scenario for which no evidence has been found.

New geological evidence, however, may provide a solution to this problem. A survey headed by David Christie of the Oregon State University led to the discovery of a series of submerged seamounts east of the current Galapagos chain that appear, in fact, to be drowned islands. A series of terraces was found on one of the seamounts that could have been cut by wave action. And well-rounded pebbles, their shape also consistent with the erosive action of waves, were dredged from several seamounts. The seamounts range in age from five to nine million years, with the peak of the oldest about 2,000 metres below the present sea-level.

This confirms predictions based on plate tectonic theory that the Galapagos island chain has been a feature of the region for at least nine million years and perhaps as much as 90 million years. The drowned islands are proof that life on the Galapagos Islands has had far longer to evolve and diverge than just the three million years of the oldest island currently perched about sea-level.

—K.McG.

Clues to the origin of the Galapagos Island iguanas lie beneath the sea.

D. PARER & E. PARER-COOK/AUSCAPE INTERNATIONAL

The Mother of Extinctions

Amazing things can be learned from computer databases, and not just about people. Professor J. William Schopf, a palaeobiologist at UCLA, has constructed a computer database for all known pre-Cambrian (4,600–550 million-year-old) micro-organisms. The pre-Cambrian is the 90 per cent of Earth's history that occurred before the appearance of multicellular plants and animals. All pre-Cambrian organisms (except for the multicellular forms that evolved at its very end) were single-celled microscopic marine forms. Schopf carefully sifted through the scientific literature to eliminate synonymies (two or more scientific names that actually refer to the same organism) and sorted out misidentifications. Then he produced a chart of the number of micro-organisms for uniform intervals (50 million years

The world's first mass extinction was extraordinarily slow.

long) of pre-Cambrian time.

This chart showed a quite unexpected feature—a decrease in diversity of micro-organisms starting about 900 million years ago. That a mass extinction occurred at the end of the pre-Cambrian (600–550 million years ago) has long been known, but this earlier extinction is news. The news is not that it occurred, because it is known that stromatolites (photosynthetic bacteria-like organisms that grow on mats on the sea bottom) suffered an extinction at this time; what is news is that the extinction also affected a wide variety of free-living micro-organisms. It can thus be viewed as the world's first mass extinction. Furthermore this 'new' extinction seemed to have been extraordinarily slow—it lasted for about 200 million years.

The most likely explanation for this 'mother of extinctions' is a gradual drop in atmospheric carbon dioxide levels that was supposed to have occurred at the time. As we are all aware, a drop in carbon dioxide would have led to a decrease in the greenhouse effect and a fall in world temperatures. In fact, there is evidence of glaciation at the Tropics of Cancer and Capricorn, much farther south than we see glaciers today. Lowered carbon dioxide levels would also have inhibited photosynthesis, which would have been further inhibited by the fall in temperature.

Schopf's discovery has several important implications. It points out the importance of computer databases for understanding the history of our planet and what happened during evolution. It also provides evolutionary biologists with another example of mass extinction to study, and one that is different from later extinctions in that it involved single-celled organisms. It shows that mass extinctions can be gradual. And finally it increases our understanding of the conditions under which multicellular organisms originated and diversified.

—Ralph Molnar
Queensland Museum

Lessons from Lantana

To many Australians, lantana (*Lantana* spp.) is a dreaded flowering weed that takes over gardens and bushland. To Charles Darwin's colleague, naturalist Fritz Müller, it was an evolutionary curiosity. Lantana provides a striking example of the way plants can influence the behaviour of the animals that pollinate them.

In the late 19th century, Müller noticed that lantana flowers growing in Brazil last for three days, changing from yellow on the first day, to orange on the second, through to scarlet on the third. Butterflies were only ever observed visiting yellow or orange flowers, never the older scarlet flowers, which are no longer sexually viable.

DENSEY CLYNE MANTIS WILDLIFE

Lantana's multi-coloured flowers 'talk' to the animals.

Martha Weiss from the University of California at Berkeley has recently explored this plant–animal interaction more closely. She found that, from a long way off, butterflies chose to visit larger flower displays, regardless of their colour. Thus by retaining the older scarlet flowers in the flower cluster, lantana plants increase their long-range attractiveness to pollinators.

Up close, experienced butterflies distinguish between flower colours, preferring to feed on the yellow flowers, which offer more nectar. Newly emerged butterflies will visit younger and older flowers equally, but quickly learn that the yellow flowers are more rewarding. Lantana plants thus effectively 'teach' the butterfly to focus on the more sexually viable flowers.

Many other plant species have flowers that change colour, often as indicators of the amount of reward they offer and their sexual viability. These kinds of signals allow plants to be surprisingly active in their interactions with animals.

—C.A.

PHOTO INDEX

FISH LEATHER

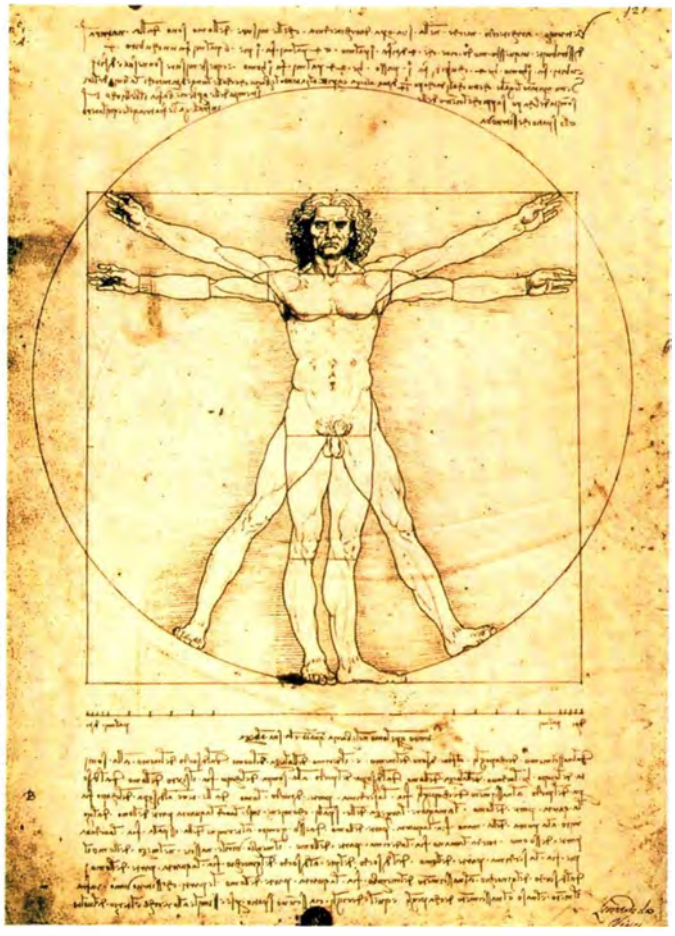
Something fishy is going on in the leather goods department. As reported by Helen Rigney in Australian Fisheries, fish leather is capturing a great deal of interest around the world and Australia is pioneering the techniques for making it.

Fish leather is soft, supple, lightweight and very strong. It also has an unusual texture. But the best part about fish leather is that it is a by-product of the fishing industry, being made from skins that would normally be thrown out. It provides a real and practical alternative to processing the hides of other animals, such as snakes and crocodiles, that are killed solely for their skins.

The most popular leather comes from Barramundi, which has an interesting arrangement of large scales and a distinctly Australian 'flavour'. Snapper, salmon and sweetlip have also been successful and different species are being tried all the time.

Several Australian companies have spent large amounts of time, energy and money into the development and promotion of fish leather as an exotic alternative to other animal hides. Being a more environmentally acceptable product, fish leather is rapidly gaining popularity both here and overseas.

—C.A.



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Leonardo da Vinci's mirror script.

Writing in Reverse

The great artistic and scientific genius Leonardo da Vinci scrawled copious notes next to his sketches that are all unreadable until viewed in a mirror when they are revealed as perfectly written Roman script. Similarly, Lewis Carol —author of, most significantly, *Through the looking glass*—was also able to write fluent mirror script. The peculiar ability of some people to write in mirror script, according to Victor Smetacek of the Alfred Wegener Institute for Polar and Marine Research in Germany, results from enforced right-handedness when left-handedness is the natural tendency. Up until as recently as a generation ago, in an over-zealous commitment to conformity, naturally left-handed children in many Western cultures were forced to use their right hands to write.

Smetacek explains that in left-handed people, language ability is located in the brain's right hemisphere (and vice versa). Enforced right-handedness in a left-handed person means words produced naturally in the right hemisphere must be transferred to the left hemisphere before they can be converted to written words by the right hand. Apparently, though, the script is unconsciously reversed in the right hemisphere before transfer to the left.

When the left hand is used in later life by a natural left-hander long forced to use the right hand, the brain is conditioned to continue the reversal procedure in the right hemisphere. But using the left hand means there is no need for the transfer of sentences to the left hemisphere and so the words flow out in mirror script directly via the right hemisphere. Smetacek believes that, despite enforced right-handedness as children, natural left-handers may find that thoughts flow more easily when writing with the left hand, even if they emerge on paper in the reverse.

—K.McG.

Mirror script results from enforced right-handedness when left-handedness is the natural tendency.

Synchronised Swimming

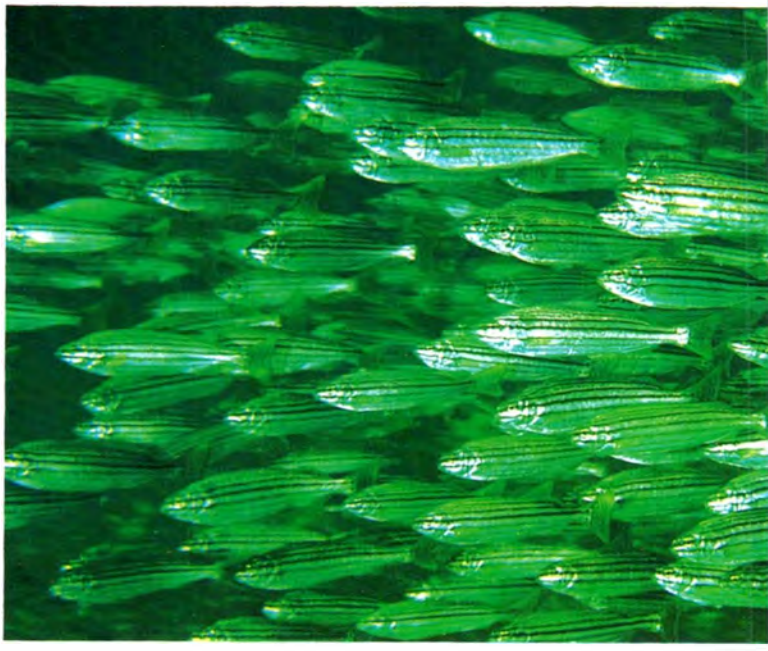
What do Esther Williams, aquatic film star of the 1950s, and a school of fish have in common? Answer: they are all synchronised swimmers! Esther Williams and her fellow swim-mates would have practised long hours to coordinate their movements. Fish schools, however, seem to be able to move and turn as a group with no practice at all. How do they do it?

Sight has a large part to play, especially when the changes in movement are slow. But as the speed of movement increases, so does the importance of sound in signalling. Sound is detected not only by the ears but by the lateral line—a series of vibration-sensitive pits that runs along the head and flank of the fish.

British marine scientists, John Gray and Eric Denton, have recently discovered what may be another means of sound-based communication—short, sharp pressure pulses. Fish may be emitting these pulses to announce their intention to change direction. The sound pulses only travel a few fish lengths but this is enough for nearby fish to receive the signals and use them to approximate the position of the pulsing fish. Having got their neighbours' attentions, fish use slower sound pulses and visual cues to give more and different information about their intended movements.

Further research is neces-

School of herring.



DICK BEILBY / LOCHMAN TRANSPARENCIES

sary to find out whether fish really do use the information the pulses are capable of rapidly transmitting. If they do, it is a fascinating way of coordinating synchronised swimming that leaves Esther Williams back at the water's edge.

—C.A.

Allergy: Defect or Defence?

Medical science has a good understanding of how the sneezing, wheezing, scratching and even vomiting and diarrhoea of an allergic reaction comes about. But *why* the allergic response exists is less clear.

Allergy is a complex reaction found in all mammals. It is a response by the immune system to what people normally view as harmless substances. Usually, it is regarded as a defective response—an immune irregularity that has survived evolution by accident.

But Margie Profet, a biologist from the University of California at Berkeley, believes the allergic response is too physiologically expensive to persist so widely without having some adaptive benefit. An entire part of the immune system, the 'IgE' class of antibodies, is devoted to causing allergy. It has no other known function. Profet proposes that its role is to rid the body of certain types of toxins, a last line of defence against the natural poisons commonly found in the environment.

While the usual substances

HORIZON INTERNATIONAL PICTURE LIBRARY

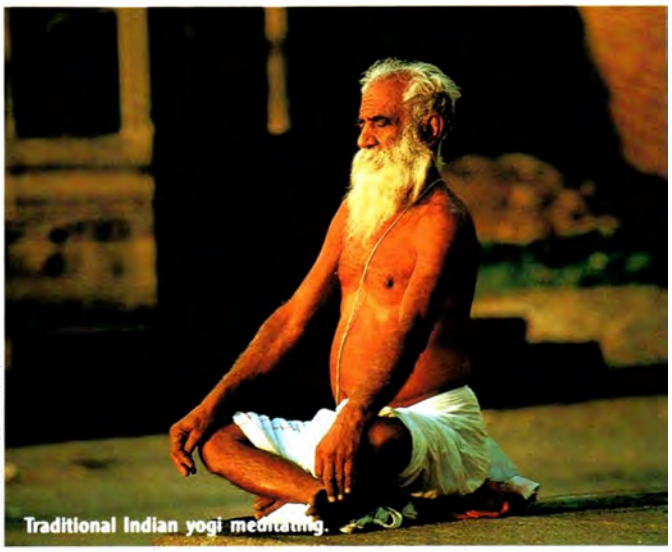
Perhaps the suffering associated with allergic reactions does us good.

that provoke allergic reactions in humans appear to be innocuous, such as pollen grains and hay dust, Profet points out that close analysis of these materials reveals that they do in fact contain an array of natural toxins. The allergic response is triggered, believes Profet, when the body's other methods of detoxifying and eliminating these toxic substances fail.

The 'toxin hypothesis' explains many of the characteristics of the allergic response not explained by the 'defective immune response' theory: why, for example, the response often becomes quicker and stronger each time the body is confronted by a particular allergenic substance; and why the allergic response occurs so quickly after exposure to an allergen, which as a toxin could represent an immediate danger. It also explains why the manifestations of allergy include so many purgative processes (vomiting, sneezing and production of tears). And it also accounts for the drop in blood pressure that usually accompanies the allergic response and that would slow the rate at which a toxin would be distributed throughout the bloodstream.

—K.McG.

Carrie Arkinstall (education officer at the Australian Museum), Dr Suzanne Hand (biologist at the University of NSW) and Karen McGhee (freelance science writer living in Newcastle) are regular contributors to QQC.



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Traditional Indian yogi meditating.

Early-Morning Cuppa with a Difference

It is a known fact that yogis in India traditionally drink their early-morning urine before meditation. But why do they do it?

Urine contains a hormone called melatonin, which is important in regulating daily rhythms. It is produced by the pineal gland at the base of the brain. At night, while you're asleep, your pineal gland makes lots of melatonin, with blood plasma levels peaking between midnight and 6am. Daylight, however, inhibits melatonin production and levels fall.

University of Newcastle psychologists Malcolm Mills and T. Faunce believe that it could be the high levels of melatonin in the early-morning urine that make it such a useful aid to meditation. Yogis meditate from about 4am to 6am. Urine passed just before this time would contain melatonin at close to peak levels. When consumed, it would maintain melatonin at high enough concentrations to produce a sedative effect, perhaps to tell the body that it's had more sleep than it really has. Melatonin apparently also slows brainwave activity, again helpful to meditation.

Mills and Faunce suggest that their hypothesis could be tested by analysing and comparing subjects' melatonin levels and mental states after drinking night urine and urine stored from the day before. (The things they don't tell you in meditation class!)

—C.A.

Ancient Toothpicks

Picking one's teeth is one of the oldest human habits according to evidence accumulated by anthropologists. Comparisons between artificial grooves found in the teeth of people living between 50,000 and 100,000 years ago in Yugoslavia and those attributed to toothpick use in other fossil and modern human populations, argue that even the archaic Neanderthals habitually probed their teeth with tools.

The Yugoslavian example is further evidence of the antiquity and ubiquity of toothpicking among human populations, known to be practised by, for example, Predynastic and Dynastic Egyptians as well as recent Europeans, North and South American Indians, Canary Islanders and Australian Aborigines. Routine use of a wooden or, in some cases, bone toothpick is also one of the oldest forms of tool use by humans. Artificial grooves attributed to toothpick use have been found in two-million-year-old *Homo habilis* teeth and in those of our more immediate ancestor, *Homo erectus*. Typically, these grooves appear as longitudinal striations mostly on molars and premolars at the gum line near the junction of the root and enamel.

Dental hygiene may even have a pre-human origin.

Dental hygiene of this type may even have a pre-human origin. As one of the few examples of non-human tool use during social grooming, a captive female Chimpanzee was regularly observed to use sticks to groom the teeth of other Chimps. On one occasion she even manufactured the toothpick by stripping a twig of its leaves.

Apart from their use in removing food from teeth, toothpicks may have helped relieve gum infections. Repetitive probing may even have occurred for reasons that transcended the simple needs of oral hygiene such that it came to have a social function. In a Neanderthal population from the Grimaldi Caves of Italy, for example, only male skulls exhibited the distinctive grooving and in these there was no clear link with any observable dental problem.

Alternative (that is non-toothpick) explanations for artificial grooving in prehistoric teeth have been proffered. These include the use of the teeth to strip reeds and other plant fibres, or to process leather for thongs, or even the jettisoning of gritty saliva through the teeth—perhaps into the world's first and yet to be discovered spittoon.

—S.H.

CARL BENTO / AUSTRALIAN MUSEUM

Old habits die hard.

Peacocks of the Spider World

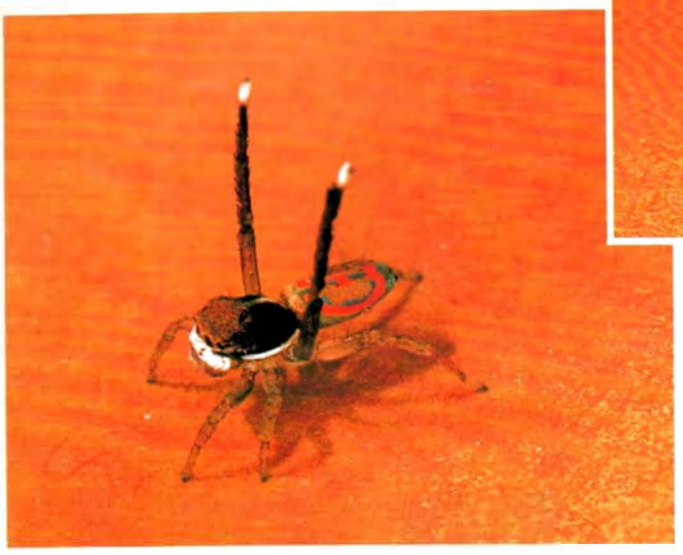
Tropical regions tend to have a monopoly on spiders with beautiful colour patterns and exotic habits. However, many suburban gardens in the southern regions of Australia harbour vibrantly coloured and fascinating species of jumping spiders (family Salticidae). In the south-west, one of the most commonly seen is the Peacock Spider (*Maratus pavonis*).

Males of the genus *Maratus* are characterised by the iridescent scale-like hairs on the abdomen and conspicuous brushes of hair on the third legs. Females, on the other hand, lack these adornments and are quite dull in colour.

The male displays his snappy garb in a spectacular courtship 'dance' for the female. As he walks towards the female he stops briefly and slowly raises one of his third legs until it is vertical. He then lowers the leg jerkily, sometimes raising the opposite leg or moving closer.

Meanwhile, the female may turn side- or rear-on to the male. His activity increases as he closes in on her. Now both third legs are raised and jerked down together stiffly onto the substrate (on hard plastic this can be heard as a tap) and he jumps forward slightly. This is repeated many times.

When the male is about three centimetres away from the female he suddenly raises his abdomen and unfolds two side flaps, thus creating an almost circular, brightly coloured 'target'. This is flanked by the third legs, held aloft, erect and straight. A quite dazzling effect is created as the male vigorously shakes his flared abdomen at the female.



DOUGLAS ELFORD

Courtship behaviour by a male Peacock Spider: third legs raised and abdominal flaps extended. Inset: the cryptic female.

The response of the female to this courtship behaviour has not been adequately observed. I have, on different occasions, seen the female appear to completely ignore the male or respond only with a brief third leg wave. She may also wobble her abdomen in a figure-of-eight pattern at him or come around behind him at which he moves away to start again.

Even when females are not visible (they are cryptic in both behaviour and colour pattern), males of *Maratus* will leg-wave as they progress through the undergrowth and appear to be making themselves as obvious as possible. When you see two or more males around, you can be sure a well-camouflaged female is in close proximity, but it requires a great deal of patience to detect her.

Earlier workers, such as O.P. Cambridge, described similar Australian species but did not fully appreciate the functions of the abdominal flaps. Cambridge believed they were for "extending and sustaining (the 'flight' of) these spiders when they jumped", an aerodynamically dubious proposition. However, he also suspected that the flaps might be developed for "sexual reasons". On this, as we have seen, he was closer to the mark.

—Julianne M. Waldock
Western Australian Museum

RAYMOND A. MENDEZ / ANIMALS ANIMALS

Antipredator response: squirting blood from the eye of a Texas Horned Lizard.

Here's Blood in Your Eye

The extraordinary ability of horned lizards *(Phrynosoma)* to squirt blood from their eyes was first recorded in the scientific literature in the 1870s. There has been a spate of reports since, but the fundamental questions about why, how and when this peculiar behaviour occurs, have remained largely unanswered.

This has been partly due to difficulties researchers have had in eliciting the response. But two American experts, George Middendorf and Wade Sherbrooke, recently managed to witness the blood-squirting behaviour in Texas Horned Lizards *(P. cornutum)* that were being attacked by dogs.

They found that the blood-squirting response seemed to be stimulated by a combination of visual and tactile cues. In later experiments where dogs were restrained, blood-squirting occurred only when humans simultaneously touched the lizards. A human acting like a dog did not encourage blood-squirting, yet the researchers found they could elicit the behaviour in the absence of a dog, after the lizard had seen one, by tapping and stroking the lizard's head just above the eyes.

In previous research, Sherbrooke found that the Greater Roadrunner and the carnivorous Grasshopper Mouse elicited other antipredator behaviours but no blood-squirting, even when they touched lizards during attacks. Although the reptiles obviously recognised the avian and rodent threats, it appeared they did not deem blood-squirting an appropriate response to these potential predators.

Middendorf and Sherbrooke believe their research suggests blood-squirting is an antipredator response that has evolved as a defence against dogs and perhaps other medium-sized mammalian carnivores.

—K.McG.

Deathwatch Beetle

The medieval Britons believed that death in their homes was announced by a sinister tapping in the woodwork. As friends and relatives set up the deathwatch vigil around the bed of a dying loved one, a pall of gloomy quiet would descend and it was then, it seems, that the morbid noise would begin.

By the late 1700s it was recognised that a beetle, and not the grim reaper, was responsible for the tapping. The insect became known, unfairly, as the Deathwatch Beetle (*Xestobium rufovillosum*).

The beetle is one of the 1,100 species of 'furniture beetles' (family Anobiidae), whose larvae play an important role in natural forests by eating decaying wood but also wreak havoc in the timber of old buildings. When fully developed, the larvae construct a chamber within the wood during late summer to early autumn where they pupate for two to three weeks. The young beetles remain inside the chamber in a torpor until the next spring. Upon emerging, the adult beetles, which are between five and seven millimetres in length, begin looking for mates.

Later it was recognised that a beetle, not the grim reaper, was responsible for the tapping.

The Deathwatch Beetle communicates by tapping its head against wood.

MARTIN BIRCH

The so-called 'deathwatch tap' is now known to be caused by the adult banging the front of its head on the wood and has long been thought of as a form of sexual communication. Oxford University zoologists Martin Birch and Julian Keenlyside set out to test whether the tapping is important in mating.

They found the tapping was, in fact, used to convey the presence of sexually mature males looking for mates, responsive females and the direction of a potential mate. Vibrations through the wood are picked up by specialised pads on each of the beetle's six feet. Normally the male initiates the tapping, quickly receives a response from a female and, through a continued conversation of taps and replies, gradually works his way towards her.

There is no natural predator of the beetle suitable for biological control. But it is hoped that, by developing a better understanding of its method of sexual communication, this could be exploited to control the beetle's breeding in places where it is a pest.

—K.McG.

Suggested Reading

Birch, M.C. & Keenlyside, J.J., 1991. Tapping behaviour is a rhythmic communication in the death-watch beetle, *Xestobium rufovillosum* (Coleoptera; Anobiidae). *J. Insect Behav.* 4: 257–263.

Birch, M. & Menendez, G., 1991. Knocking on wood for a mate. *New Sci.* 6 July 1991: 36–38.

Cambridge, O.P., 1874. On some new genera and species of Araneida *Ann. Mag. Nat. Hist. (Series 4)* 14. 178–183.

Christie, D.M., Duncan, R.A., McBirney, A.R., Richards, M.A., White, W.M., Harpp, K.S. & Fox, C.G., 1992. Drowned islands downstream from the Galapagos hotspot imply extended speciation times. *Nature* 355: 246–248.

Formicola, V., 1988. Interproximal grooving of teeth: additional evidence and interpretation. *Curr. Anthrop.* 29: 663–671.

Frayer, D.W. & Russell, M.D., 1987. Artificial grooves on the Krapina Neanderthal teeth. *Amer. J. Phys. Anthrop.* 74: 393–405.

Gray, J.A.B. & Denton, E.J. 1991. Fast pressure pulses and communication between fish. *J. Mar. Biol. Assoc. U.K.* 71: 83-106.

McGrew, W.C. & Tutin, C.E.G., 1973. Chimpanzee tool use in dental grooming. *Nature* 241: 477–478.

Middendorf, G.A. III & Sherbrooke, W.C. 1992. Canid elicitation of blood-squirting in a horned lizard *(Phyrnosoma cornutum). Copeia* 1992: 519–527.

Mills, M.H. & Faunce, T.A., 1991. Melotinin supplementation from early morning auto-urine drinking. *Med. Hypotheses* 36: 195-199.

Profet, M., 1991. The function of allergy: immunological defense against toxins. *Quart. Rev. Biol.* 66: 23–62.

Rigney, H. 1990. Fish leather? *Aust. Fisheries* Aug. 1990: 30-31.

Schopf, J.W., 1991. Collapse of the Late Proterozoic ecosystem. *S. Afr. J. Geol.* 94: 33–43.

Smetacek, V., 1992. Mirror-script and left-handedness. *Nature* 355: 118–119.

Weiss, M.R., 1991. Floral colour changes as cues for pollinators. *Nature* 354: 227–229.

QUICK QUIZ

1. What is a 'black smoker'?
2. Who wrote the books *God and the new physics* (1984) and *The mind of God* (1992)?
3. For funnel-web spiders, which sex (male or female) is the more toxic?
4. Which birds lay the largest eggs in relation to body size?
5. What was so special about the Indian children Kamala and Amala?
6. Which living reptiles are the heaviest in the world?
7. When was the first issue of ANH published?
8. What is the name of Australia's most colourful finch?
9. Name the largest natural source of underground water in Australia.
10. To the nearest million, how many square kilometres is Australia?

Answers in the Questions & Answers Section

If you put it on the ground all four feet would shoot out and the green taco would career off sideways down the yard.

TEACHINGS FROM A TETHERED TORTOISE

BY STEVE VAN DYCK

MY OLD, WELL-PADDED and blue-rinsed grandmother had a dark bedroom full of grandmotherly smells and treasures. Somewhere among all the navy blue bunion-warped shoes, the hair nets, hat pins, and pictures of her fierce-looking parents, lurked a *Pears Cyclopedia* that was even more prehistoric than the old lady. And on her verandah, the *Pears* and lots of sweet cups of cocoa saw the carefree evaporation of many a drizzly weekend for me.

In the beginning it was the old *Pears* tome that sowed the tortoise seed in my schoolboy brain and, between it and Taronga Zoo's tortoise pit, my burgeoning passion was primed on cactus-eating European plodders that looked like club-footed Nazi helmets and took five days to make a snap decision.

In the end, however, it was the old purple-haired lady that braved the ethnic jungles of Sydney's Haymarket to buy one of the cloistered reptiles for me. But what my grandmother eventually came back with from Paddy's Market was, compared to my preconceived tortoise image, nothing short of a fantastic travesty, the definitive living curiosity for which any schoolboy would willingly trade marbles, cigarette cards, ball bearings or birds' eggs.

Its ten-centimetre discus-shaped shell sported a living green algal mop that would have been an inspiration to my grandmother's hairdresser, and its neck was as long as a Giraffe's. The only way it could indulge in introspection was for it to crimp the neck in the middle and draw the two halves together like a concertina garage door. Viewed from the side, it then looked like a taipan ready to strike. But these weren't even its best features. Its feet were webbed and tipped with needle-like claws that lashed out at careless fingers. If you put it on the ground it would cringe a few times then all four feet would shoot out, and the green taco would career off sideways down the yard without the snake-head even making an appearance.

Despite its curious behaviour there was no air of disappointment around me that day, but phew, there was a vapour trail blowing around us that had my grandmother constantly checking the soles of her old navy boots. We eventually realised that if it was handled indiscreetly my leek-green, headless frisbee was capable of pumping out the most fetid of defensive garlic-greasetrap stenches through tiny pores near its front and hind legs.

The *Cyclopedia* hadn't mentioned the existence of anything like my native Australian tortoise. In fact, in that post-war decade, Australian wildlife was considered more of a practical joke than a

KATHIE ATKINSON

Snake or snorkel? The Long-neck's fierce-looking prow has to be kinked like a concertina to fit under the all-weather awning.

priceless heritage. No-one really cared that right up until 1974 at least 10,000 native tortoises were caught and sold in pet shops every year, and that 95 per cent of them would die miserable deaths through neglect soon after purchase.

I certainly had grand plans for my fetid friend. I could see him with wives, mistresses, eggs and broods of webbed dependants. So I followed the *Pears* book to a tee. The first unpalatable thing I was supposed to do in order to help it remember where bed and breakfast were, was to drill a hole in the outside edge of its upper awning. Like any good coward I got my father to perform this unspeakably barbaric act, which must have felt something like having a foot crucified with a cork opener.

My passion was primed on cactus-eating plodders that took five days to make a snap decision.

Then, after a long copper wire was tied between a tree trunk and the tender hole in the tortoise's top, it was let loose on our compost heap where, the *Pears* assured me, it would independently grow very old and fat on weeds, grass, snails and grubs.

From then on my tortoise turned introvert and became a pathetic nobody. I only ever saw it when I yanked on the cord and dragged it out of the compost. My tortoise had become the definitive disappointment. But in guilt-ridden nostalgia, I realise it was my misdirected efforts that made my pet the boring recluse it was. And along with the other 9,499 for that year, it was my ignorance that eventually caused its untimely demise.

How could I have missed the significance of those splendidly webbed feet, and how was a luxurious algal wig supposed to bloom under a metre of vegetable peels and lawn clippings?

The belated truth is that the Common Long-necked Tortoise *(Chelodina longicollis)*, one of about 15 Australian species of side-necked tortoises (all of which are now referred to by many experts as 'turtles'), spends nearly all its life swimming and cavorting in the waters of creeks, rivers, dams, lakes and swamps. Here, instead of cactus, it hunts such tucker as tadpoles, frogs, small fish and water snails.

So superbly adapted to water are these air-breathing reptiles that it is virtually impossible to drown a Long-neck. In chilly waters, they can hibernate on the muddy bottom of a billabong for months without coming up once for whiff of the great outdoors.

The fundamentals of how some species can accomplish such an ultra-Houdini underwater trick are intriguing. It seems that the humble tortoise cloaca, far from being just an everyday débouché for life's tailings, can actually create a little eddying water current of its own, from which it extracts just enough dissolved oxygen to keep the tortoise's ticker pumping through the frosty months.

The day I took my tortoise to school was its last. On account of its nauseating discharges it got banned from the schoolroom to be hitched to a distant tree. While we ten-year-olds were inside having art-and-culture forced down our throats in the guise of 'Madame Butterfly', outside my poor Long-neck got hard-boiled in the blazing sun.

These days I'm known to run for handkerchiefs whenever I hear the enraptured strain of Lieutenant Pinkerton or his Japanese geisha girl. The tears are not from good taste or the brilliance of Puccini, the composer, but from the guilt and memory of that poorly treated, much loved reeking reptile. ■

KEN GRIFFITHS

More than just a twinkle in his father's eye, this little Long-neck may live to the ripe old age of around 50.

Suggested Reading

Cann, J., 1978. *Tortoises of Australia*. Angus & Robertson: Sydney.

Steve Van Dyck is in charge of the Mammal Section of the Queensland Museum where he has worked since 1975.

At the time of European settlement, this animal occurred over 70 per cent of the continent.

THE BILBY

BY KEITH BELLCHAMBERS

IN 1837, TAXONOMISTS DESCRIBED A species new to science from the skull and skin of an animal collected in the Swan Valley, Western Australia. Known as the Bilby, or Rabbit-eared Bandicoot *(Macrotis lagotis)*, it has been described as the most beautiful and graceful of all native animals. Noted explorer–scientist H.H. Finlayson summed it up best in 1935 when he wrote that the Bilby "has carried a number of structural peculiarities to grotesque lengths yet manages to reconcile them all in a surprisingly harmonious, and even beautiful, whole".

The Bilby is a medium-sized, nocturnal, burrow-dwelling, omnivorous marsupial with special physical adaptations necessary for this unique lifestyle. It has a long sensitive nose for locating food items, large ears for cooling and to detect potential predators, and strongly clawed front feet for digging burrows and extracting food from the soil. The female has a backward-opening pouch to prevent it filling with dirt while digging.

Bilbies obtain much of their food from the soil. Diet can consist of small bulbs, grass seeds, termites and other insects, and some insect larvae such as witchetty grubs. The amount taken of each of these items varies with location and availability. In good times Bilbies may eat only seeds; in harder times their diet becomes more varied.

KATHIE ATKINSON

At the time of European settlement of Australia, Bilbies occurred over approximately 70 per cent of the continent and occupied a number of climatic zones, soil types, vegetation types and landforms. They were found south of the tropical woodlands and west of the Great Dividing Range with the apparent exception of most of Victoria, central Queensland and far south-western Western Australia. Today Bilbies occupy less than 20 per cent of their previous range. They are now found only in the Gibson and Great Sandy Deserts of Western Australia, the Tanami Desert of the Northern Territory and in south-western Queensland near Bedourie. Unfortunately the process of population fragmentation and decrease in distribution continues, endangering the survival of the species.

The occupancy of a wide range of habitat types means that a number of factors are implicated in the Bilby decline. In the temperate regions, land clearance for cropping and grazing has destroyed habitat, while in the more arid areas grazing by rabbits and livestock has changed available resources. The cessation of traditional Aboriginal burning practices has also been suggested as a cause of decline, but Bilbies persist in areas both where burning has stopped and in areas that are infrequently burnt. Predation by foxes has also been implicated in the Bilby's decline, but again, the Bilby has declined or disappeared from some areas where the fox is absent or present only in low numbers. The impact of feral cats is not as clear but they occur throughout the former and current range of the Bilby. It is thought that the effect of predators is likely to be more important now that the Bilby occurs in low numbers and in marginal habitat.

The Bilby has carried a number of structural peculiarities to grotesque lengths yet manages to reconcile them all in a surprisingly harmonious, and even beautiful, whole.

An extensive survey of known Bilby distribution has indicated current Bilby distribution correlates best with an absence of rabbits and pastoral activity. Although Bilbies do occur on pastoral land in some areas and overlap with rabbit distribution, this happens only where stocking rates and rabbit densities are low. To stabilise and then reverse the Bilby's decline requires several strategies. These include protection and management of wild populations, maintenance of captive colonies, and reintroduction of Bilbies into suitable habitats occupied in the past.

The Conservation Commission of the Northern Territory has made several experimental reintroductions of Bilbies into the wild, most notably at Watarrka National Park, approximately 350 kilometres south-west of Alice Springs. Captive-bred animals are introduced to the environment via large holding pens. When the animals are considered to be comfortable in their new surroundings, small holes are opened in the pen allowing them to come and go as they please. Supplementary food in the form of Budgie mix birdseed is provided, but once animals begin to free-range they also start to utilise the area's natural food resources and depend less on the seed provided. Predator control is important to the survival of released animals, as Dingoes and foxes have all been implicated in the loss of animals from previous releases.

All released animals are fitted with small, collar-mounted radio transmitters that interfere little with the animal's well-being or activity but allow researchers to monitor home range, burrow use, habitat preference, dispersal, behaviour and activity patterns.

The information produced from the experimental reintroductions at Watarrka will be presented as a reintroduction prescription or 'recipe' that can be used by other conservation or land management agencies wishing to reintroduce Bilbies into other suitable parts of their former range. This research has wider ecological benefits than conservation of the Bilby. In conserving and managing Bilby habitat we will also be conserving habitat for other endangered species. In addition the techniques and skills developed for Bilby reintroduction may prove useful when working with other endangered species, particularly the medium-sized mammals. ■

Suggested Reading

Johnson, K.A., 1989. Thylacomyidae. In *Fauna of Australia, Volume 1B Mammalia*, ed. by D.W. Walton and B.J. Richardson. Australian Government Publishing Service: Canberra.

Southgate, R., 1990. Reintroduction of the Bilby. *Aust. Ranger Bull.* 6(1): 23–25.

Keith Bellchambers is employed by the Conservation Commission of the Northern Territory as a Technician and Wildlife Research Officer. He is involved in the Commission's ongoing research on the Bilby, particularly the reintroduction work at Watarrka National Park.

The buds of Australian Caper Bush make nice pickles and deserve a place in bush tucker cuisine.

NATIVE CAPERS

BY TIM LOW

Pickled native capers look and taste much like their commercial counterparts.

PICKLED CAPERS SOLD IN DELICATESSENS are buds of the Caper Bush *(Capparis spinosa)*, a scrawny shrub harvested in Mediterranean lands. This shrub is widespread in Africa and Asia, and surprisingly, one variety (var. *nummularia)* is found in Australia. Botanist M. Jacobs postulated in the 1960s that Caper Bush was brought to Australia by early travellers, but biologists now accept it as a native plant. It is very adaptable, growing on rocky beaches, barrier reef islands and in Northern Territory deserts.

Australian Aborigines hold Caper Bush in high regard, not for its buds, which they ignore, but because the plant also bears sweet edible fruits. These are unusual. Egg-shaped, and ribbed along the sides, they split open upon ripening, exposing dozens of sticky, pulp-coated seeds. In some districts they go by the names 'split arse' and 'split jack'.

The buds of Australian Caper Bush do make nice pickles. I collected some in Boulia, Queensland, where Caper Bushes sprout in paddocks like weeds, and simply soaked them in vinegar. They deserve a place in bush tucker cuisine. Caper Bush is only one of more than 20 kinds of caper *(Capparis* species) native to Australia. They are small trees, shrubs or prickly creepers found variously in rainforests, open forests, deserts, or behind beaches. Most, if not all the different species, produce strongly flavoured edible fruits. Bushmen often compare them with passionfruits or pomegranates because the pulp contains many hard seeds.

Caper fruits were popular among Aborigines and settlers. Joseph Wedd, writing in 1911, noted that at Killarney, Queensland, the purple fruit of Scrambling Caper *(C. sarmentosa)* was "much sought after by the children". Of another species, Nipan *(C. lasiantha)*, he observed that at St George "I have seen it handed round for dessert at a house at which I dined". Country folk in Queensland still make drinks from the rich pulp of Native Orange *(C. mitchellii)*, which has also been used for jam making.

Some caper fruits appear to be involved in unusual symbiotic relationships. For example, Nipan fruits are actively tended by ants, which strip the seeds and probably help disperse them. Fruits of the Native Orange have a strong sickly smell attractive to mammals (birds have little sense of smell), but on the outback plains where Native Orange grows, there don't appear to be any mammals capable of dispersing its seeds. Perhaps the fruits were once eaten by the now-extinct diprotodons. The smell of another caper species, *C. canescens*, is remarkably alluring to possums. I had a ripe fruit in my room once and was startled by a Common Brushtail Possum clawing vigorously at the window screen. It seemed to be entranced by the heavy perfume.

PHOTOS: TIM LOW

One of Australia's more unusual fruits is 'split jack'; it bursts when ripe to reveal pomegranate-like seeds.

Capers belong to the family Capparaceae, an ancient, mainly tropical family closely allied to the mustard and cress family (Brassicaceae, previously called Cruciferae). Very interesting parallels can be drawn between capers, mustards and cresses. Plants in both families produce pungent mustard oils in their tissues to deter plant-eating animals. Mustard oils account for the piquancy of mustard seeds and the spicy flavours of caper buds, radishes and watercress. It is because of these oils that colonists in Queensland were able to use the rind of one caper *(C. canescens)* as a mustard substitute.

Mustard oils are also produced by an unrelated plant, the Nasturtium *(Tropaeolum majus)*. The common name for this plant is derived from the scientific name for Watercress *(Rorippa nasturtium-aquaticum)* because its leaves taste similar. Its young buds are often pickled as a caper substitute. Nasturtium leaves are attacked by caterpillars of the Cabbage White Butterfly *(Pieris rapae)*, a pest that also feeds upon cabbages, radishes and other members of the mustard family. Cabbage Whites do not attack capers, but a related butterfly, the Caper White *(Anaphaeis java)*, certainly does. In outback Australia Caper Whites can often be seen fluttering above Caper Bushes, and the larvae may denude whole trees.

If you want to try a native caper, search in the bush for a seed-filled fruit dangling on a long jointed stalk. Caper plants are often spiny, and the leaves are usually leathery. Many species have dual growth forms, beginning life as a spiny creeper with tiny leaves, then maturing into a broad-crowned shrub or tree. This is presumably because their leaves are very tasty to browsers: the juvenile plants are not worth tackling, and the adults have foliage too high for herbivores to reach.

Capers are mainly tropical plants and you won't find any near Sydney or Melbourne. New species are still being found, including a rare caper, as yet unnamed, lurking in rainforests on the edge of Brisbane. ■

Caper Bush buds are tended by small black ants; these buds are native equivalents to the pickled capers of commerce.

Suggested Reading

Hewson, H.J., 1982. Capparaceae. Pp. 207–230 in *Flora of Australia Vol. 8.* Australian Government Publishing Service: Canberra.

Low, T., 1991. *Wild foodplants of Australia.* Angus & Robertson: Sydney.

Wedd, J., 1911. Excursion to Newmarket, 8th October 1910. *Qld Natur.* 1(8): 177–180.

Tim Low is a Brisbane-based environmental consultant and the author of four books on wild foods and medicines.

Up to one in five students believe in the biological equivalent of the tooth-fairy!

CREATING CONFUSION

BY ROBYN WILLIAMS

TWO EVENTS OCCURRED RECENTly that might cause us to worry about the state of science. The first was a lecture by Dr David Suzuki for the Australian Museum on 'The Wisdom of the Elders'. The second was a poll of first-year-university biology students to elicit their belief, or otherwise, in creationism.

David Suzuki's talk was full of references to the 'boring old farts' of the scientific establishment and their conviction that science, ***their*** science, could solve all problems. Suzuki, having listed the ailments of the planet, proceeded to convince us that the common knowledge and practice of indigenous peoples over the centuries has produced ways of looking after the natural world as good, if not better, than modern science. He said we could learn much if only we talked to the aboriginal peoples of Australia, America, Asia and Africa.

Keeping science to the professionals is as absurd and counterproductive as having only Olympic athletes practising sport.

This alternative approach is not a rejection of science proper. It is an adjunct to it. It is a plea to put science back where it belongs: in everybody's grasp. Keeping science to the professionals is as absurd and counterproductive as having only Olympic athletes, the 'experts', practising sport. We all gain immense pleasure from running, jumping and fooling around, and would not dream of giving it up simply because there is an elite of world-beaters, professionals. The same with science.

Suzuki is bemoaning the fact that we have left research to the ones who specialise in studying little bits of the world and so may have lost touch with the larger picture. There are two sorts of science and, often, the pros have time only for one kind.

This may be no consolation to the 'old farts' but it should be to those who were worried that Suzuki and many other green-minded people are anti-science. On the contrary, his case depends utterly on the facts and figures provided by such luminaries as Professors E.O. Wilson of Harvard, Bob May of Oxford, Paul Ehrlich of Stanford, Dr Peter Raven of St Louis, and many more.

As for the survey of students, published by the Institute of Biology in June 1992, yes, it is a shocker. First-year biology students from 17 of our universities were asked to choose between three explanations of the form of the natural world: that it evolved according to Darwinian principles; that evolution took place but had some assistance from some 'external' force; or that it was created by God a few thousand years ago.

That 12 per cent opted for the third, creationist explanation is startling. At Sydney's University of Technology it was a whopping 20 per cent and 17 per cent at the University of Sydney itself. The least 'creationist' were Murdoch (three per cent), and the Australian National University and University of Western Australia (both four per cent). The State of New South Wales was indeed highest, with Queensland coming in at seven per cent (James Cook), 11 per cent (Queensland) and 13 per cent (Queensland University of Technology).

The startling part, other than the fact that up to one in five students who have matriculated in science from our high schools believe in the biological equivalent of the tooth-fairy, is that creationist doctrine, as the institute points out in its survey, has a central tenet that 'evolution is the work of Satan'!

Two points occur immediately. One is to wonder whether the youngsters are simply uninformed as they may always have been, or whether they are more ignorant and credulous today. The only other survey I'm aware of was done by Rhondda Jones, Professor of Zoology at James Cook, about six years ago. Her findings were much the same.

The other is to ask whether the high-school course prepares the students in any way to comment about matters of evolution. From my own cursory contact with the curriculum the answer must be 'no'.

The trouble is with ideas rather than facts. The secondary syllabus is brimming with information but not overly endowed with matters philosophical or sceptical. If you ask a young person about something academic, you'll probably find him or her immediately searching the store of mental knowledge for a 'correct' answer rather than trying to work out a reasoned response.

This may always have been the tendency. I don't remember all that much intellectual flexibility from amongst my own generation, apart from the clever sticks. What worries me is that nowadays there is so very much evidence at hand from popular culture to counteract tripe like creationism: hours of science programs on radio (ABC Radio National) and on television ("Quantum" and "Beyond 2000") not to mention David Attenborough's series and "Nature of Australia".

Clearly the youngsters are not watching or listening, or if they are, not for long. Today there are so very many media sources to choose from that I suspect lots don't even try. The science programs are not rejected; they are unknown to most young Australians. For that reason I am trying to organise their being made part of a national curriculum. It may come off.

But is creationism really tripe? Well, we know that organic evolution has been demonstrated to be a fact as satisfactorily as any other fact we may consider. And it is possible to demonstrate in dozens of ways, to the satisfaction of any reasonable person, that the Earth was created billions of years ago, not thousands. To believe otherwise requires considerable efforts of self-deception.

The point about creationism is that it is thumpingly anti-science. It is dogma, as science should never be. Even evolutionary theory must be adjusted every day, in some way. David Suzuki's plea, on the other hand, that we bring some spiritual values to modern science is, paradoxically, to give it humanity. It is not anti-science but anti-reductionist. Reductionism can be a useful tool of science, but it must always be returned to the big picture. The key is to ensure it is not a distorted picture. To tell the difference is surely the key to good education. We still have some way to go. ■

Robyn Williams is Presenter of Radio National's Science Show. His work brings him constantly in contact with the changing trends in science.

FORD KRISTO

The Green and Golden Bell Frog *(Litoria aurea)* is in serious decline and has totally disappeared from some of its previously known localities in south-eastern Australia.

ANH

The FROGWATCH survey confirmed the suspicion that there are numerous events and activities that simply make the life of frogs impossible.

FROGWATCH: TO SHUN A SILENT SPRING

BY MICHAEL J. TYLER

I HAVE ALWAYS BEEN RELUCTANT TO FILL in questionnaires or respond to consumer surveys. I have not been enthusiastic about baring my soul to hotel managements regarding my views on the temperature of the porridge, or explaining to clipboard-toting matrons intimate information such as my preferences in aftershave lotions.

Fundamentally it is a shock to the system to be accosted and, if I'm feeling antisocial, almost an invasion of privacy. Why then did I have the temerity to design a questionnaire and inflict it upon naturalists? Hopefully I can explain that the ends more than justify the means.

Following reports from several countries that populations of many species of frogs are in decline (see article in ANH Autumn 1991), there was a need to assess

C. A. HENLEY / AUSCAPE INTERNATIONAL

The Spotted Grass Frog *(Limnodynastes tasmaniensis)* is a hardy stowaway accidentally introduced into northern Western Australia recently from Pooraka in South Australia.

the state of populations in Australia. Because any corrective measures required accurate information, there was a sense of urgency. However, too few professional zoologists had study sites where comparisons against previous populations' numbers could be made. It followed that we needed the help of the general public.

I have always been impressed by the extent and depth of knowledge of the amateur naturalist. The field naturalist societies around Australia represent storehouses of knowledge of the local flora and fauna, and members of some of the groups had written to me relating their observation and conclusion that frogs often were not as common as they used to be.

The sort of questions that had to be posed were: "Are all species of Australian frogs declining in numbers, or just some?" Similarly it was important to find out whether declines were centred upon particular geographic areas. To obtain the answers a questionnaire was produced and entitled FROGWATCH.

DESIGNING THE QUESTIONNAIRE WAS not as easy as I had imagined. We had to ensure that the respondent could indicate that, in his or her area, frogs were increasing in numbers or were unchanged, if that was their belief. The reliability of their observations was likely to be linked to how long they had lived in the area and also their expertise. Hence, if someone had lived at a particular place for perhaps only three years, any changes they observed could have been attributable to the swings in numbers that are a normal event in so many frog populations. To provide an opportunity to demonstrate their familiarity with frogs, respondents were asked to mention the names of any species that they were reporting. Finally there was a series of boxes that could be ticked to signify environmental changes such as land use, drainage and road development, or the use of herbicides, insecticides etc.

Through lists provided by conservation councils throughout Australia, a wide variety of environmental organisations was approached and asked to assist the project by reproducing and distributing the questionnaire with their magazines and newsletters. The CSIRO magazine *Double Helix* and the Australian Conservation Foundation's *Habitat*, with a collective distribution of 43,000, cooperated from the outset and eventually 150 organisations became involved in the promotion and distribution of the questionnaires. There was obviously a likelihood that this readership would be heavily biased towards conservation and so influence the nature of their response. There was also a problem in obtaining an adequate number of responses from remote areas. For that reason I approached *People* magazine. I had not readily associated *People* with conservation issues, for I believed it to be a charitable journal concerned with publicising the fact that some young ladies are so poor that they are unable to afford clothing. I was advised by the reporter who interviewed me that I was incorrect, that most subscribers buy it for the large crossword puzzle. Significantly *People* had a circulation of 246,000 and published the questionnaire and an article about declining frogs.

By April 1991 we had received 6,000 responses, and the data obtained was entered into the University of Adelaide's mainframe computer to seek trends in the answers.

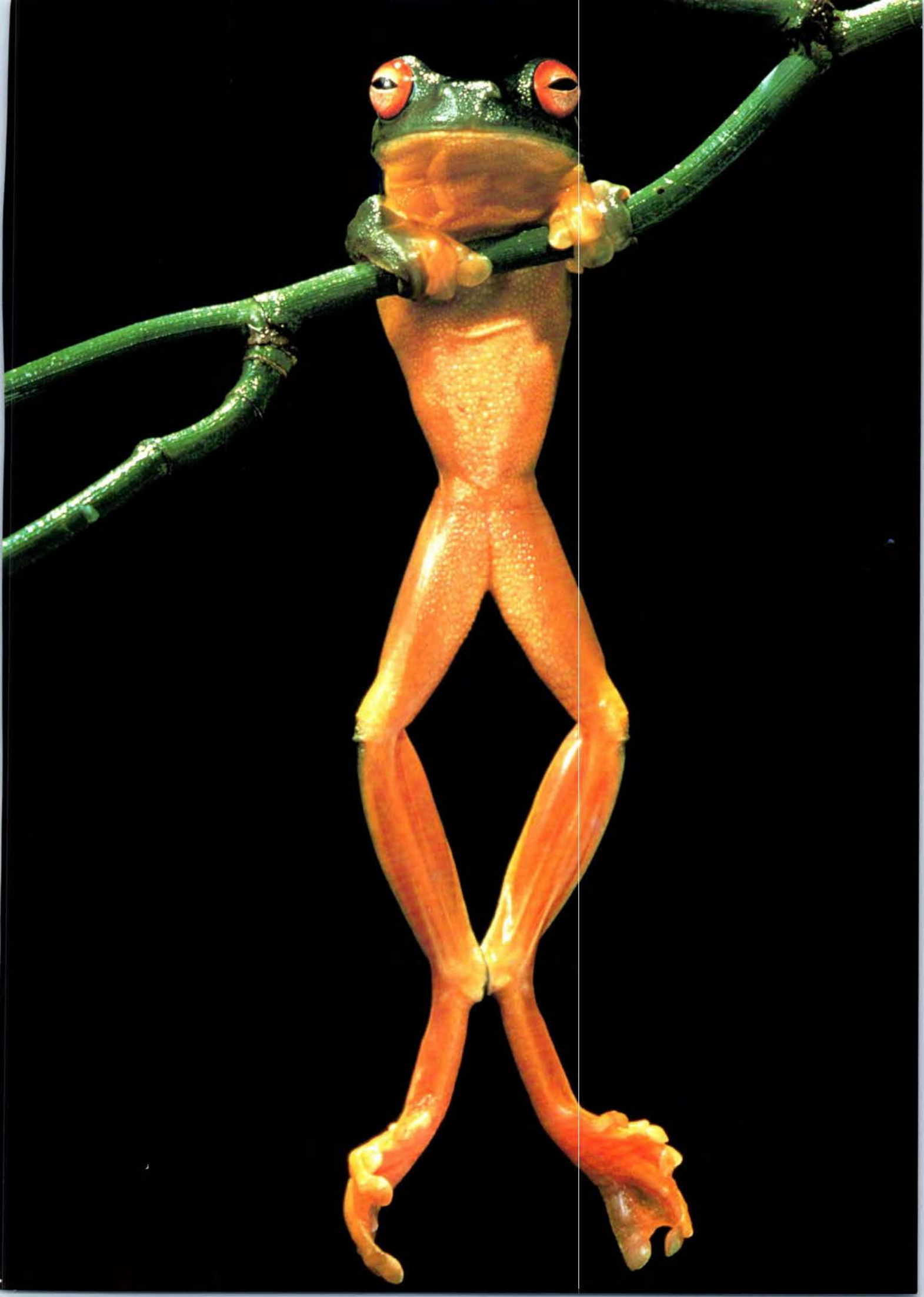
Numerous letters accompanied the completed questionnaires. One, curiously, came from a gentleman in the Republic of Yemen who said that, if I would send him colour photographs of each of the frog species found in the Republic of Yemen, he would be able to advise me which ones occur in his garden. Earthwatch in Malaya queried why they had received one. I had to respond that I had no idea. Suffice it to say, the FROGWATCH word had spread.

Two correspondents offered novel explanations for the cause of frog declines. One advised me that the United States of America and Russia are constructing a secret space station. He told me that they have shifted so many million tonnes of soil

D. & V. BLAGDEN / ANT PHOTO LIBRARY

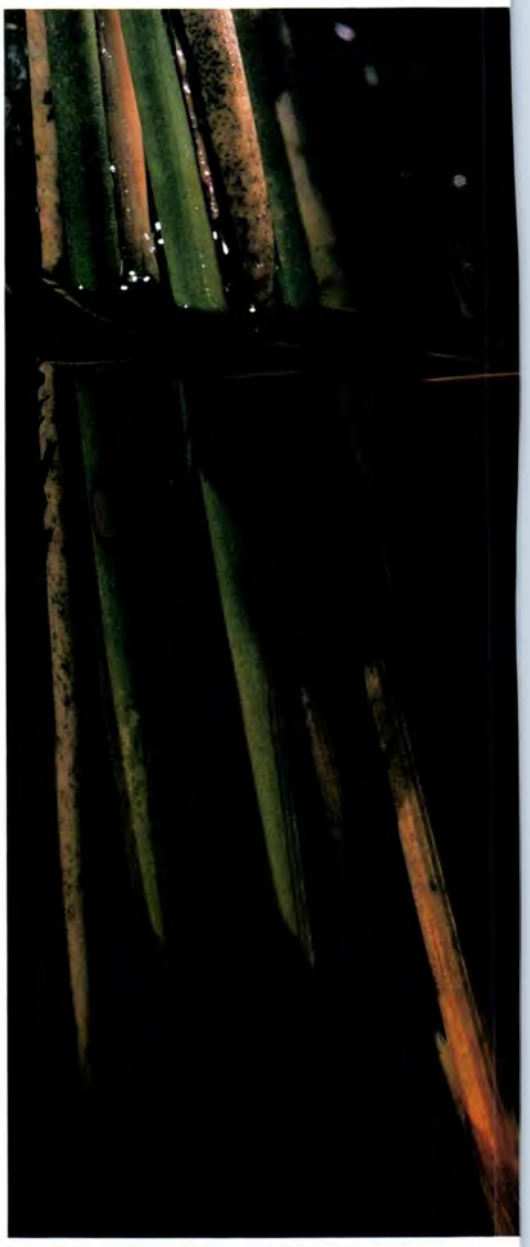
The stunning Red-eyed Tree Frog *(Litoria chloris)* spends much of the year high in the rainforest canopy, descending only to breed in temporary pools.

ANH



H. EHMANN

***Cophixalus* frogs, like this Rock Frog *(C. saxatilis)*, are confined to rainforests on the Cape York Peninsula.**



for building purposes that our planet is getting lighter, drifting closer to the sun, therefore getting warmer and so causing the demise of frogs. A second attributed the declines to an increase of carbon monoxide. He sent me a plan of a device he has invented that, powered by a vacuum cleaner motor, extracts carbon monoxide from the atmosphere. But what about the overall responses?

In every capital city and in every State or Territory, the largest number of respondents were those who considered that frogs are in decline. It is possible that the reports in the media linking frog declines to environmental degradation resulted in a biased response. And some folk who believed there to be 'no change' may not have returned the questionnaire, thinking this response to be a waste of time. Clearly any questionnaire aimed at a wide general audience, including children, cannot be either too technical or too specialised in its questions. With hindsight, perhaps if our questionnaire had asked additional questions or asked the same questions in a different way, the results might have been more informative.

But the real gold dust in the questionnaire was the comments, opinions, observations and advice that arrived with the questionnaires, and especially the observations about particular species that informants said were not as abundant as they remembered, or had disappeared altogether. Several of these species were large and among the best known in Australia: the so-called 'bell frogs', which are up to 120 millimetres long (head and body) and common around marshes and streams. There are three species in south-eastern Australia, two in the south-west and one across the northern periphery of the continent. The northern species (Dahl's Frog, *Litoria dahli)* is, like all from that area, doing well and still can be encountered in huge numbers. In the south-west of Western Australia several respondents reported declines. However in the south-east of the continent the Green and Golden Bell Frog *(L. aurea)*, Southern Bell Frog *(L. raniformis)* and Yellow-spotted Tree-frog *(L. flavipuncta-*

JIRI LOCHMAN / LOCHMAN TRANSPARENCIES

Spencer's Frog *(Limnodynastes spenceri)*, common in sandy creek beds around Alice Springs, emerges at night.

REG MORRISON / AUSCAPE INTERNATIONAL

The Trilling Frog *(Neobatrachus centralis)* is widely distributed throughout the harsh deserts of central Australia.

ta) were all reported to have disappeared totally from many of the localities at which formerly they were abundant. No-one reported 'no change' or an increase in populations. This information was depressing to receive, but invaluable in demonstrating the merit of the questionnaire because observations from the general public substantiated the data obtained by zoologists at scattered sites. It tended to confirm the suspicion of serious declines involving these species over their entire geographic ranges, and also provided credibility for reports that scientists tend to dismiss by terming them 'anecdotal'.

The FROGWATCH survey also confirmed the suspicion that there is no single causal agent that will explain the declines taking place in Australia. Rather there are numerous events and activities that simply make the life of frogs impossible. Folk living beyond the metropolitan areas of the major cities observed the suburban sprawl that slowly enmeshed their homes in a network of concrete and tarmac. The local swamps were drained and the breeding sites filled in. The impact of the loss of breeding sites clearly may take several years to have visible (and audible) effect, for the adult frogs may remain. Hence the Green Tree Frog *(Litoria caerulea)*, which can live for 15 to 20 years (the published record is 23), may be around for one or two decades after the last breeding site has disappeared. Few Australian species of frogs can live for as long as this, but the principle—that the loss of a breeding site may have little observable impact to nearby residents until years afterwards—clearly holds good.

Several respondents reported that they had observed large numbers of dead frogs following the spraying of herbicides to control grasses or weeds near water. Relatively little has been published on the effects of herbicides upon frogs, and in Australia I'm unaware of even one study on any herbicide in use on any species of frog. This probably is equally true for the rest of the fauna. We have been lulled into a false sense of security, relying heavily upon toxicological data derived from work overseas on species of animals occupying

H. EHMANN

The Holy Cross or Crucifix Toad *(Notaden bennettii)* is too fat to hop so it runs like a grass mouse.

totally different environments. Hence FROGWATCH focused attention upon a perceived threat that had not been considered previously. It was not surprising that FROGWATCH did not contribute to an understanding of the declines and disappearances of frogs in protected areas in national parks: areas where there is no evidence of environmental degradation of any kind. These population changes remain a mystery that currently defies explanation.

SO WHERE DO WE GO FROM HERE? What is being done, and what can those who care about frogs do to increase the chances of the survival of these magnificent animals?

At an international level, the Species Survival Commission of the International Union for the Conservation of Nature (IUCN) has set up an international group of specialists to stimulate and coordinate research on frog populations. Termed the Declining Amphibian Population Task Force, its directors will review progress in January 1994 at the Second World Congress of Herpetology being held at the University of Adelaide.

In Australia frogs have been the subject of an 'Action Plan' that establishes what actions are needed to be promoted and funded (principally by Federal and State governments). The estimated total costs of these programs for mammals, birds, reptiles and frogs has been estimated by the planners to run into hundreds of millions of dollars, which is far in excess of the funds available. It follows that the goals of reversing the trends of declining populations of almost any species of animal will not be achieved without public participation. In any case the cooperation of the general public is essential, for a change in habits will reduce the environmental degradation that contributes to frog decline.

There is concern that all of the barred frogs, like the Northern Barred Frog *(Mixophyes schevilli)*, are in decline.

JEAN-PAUL FERRERO / AUSCAPE INTERNATIONAL

For a start we need to examine the existing frog breeding sites. In the dry season, when water is at its lowest or has evaporated completely, remove all junk: bottles, cans, dumped clothing, plastic etc. (There really are people who dump unwanted chemicals from the garden shed into the local pond or stream!) A school or other community group could consider adopting a pond or a section of a creek and monitoring its changes over future seasons.

Dams used as watering holes by cattle tend to have smooth, barren edges. There is nowhere for frogs to hide during the day. Certainly many species migrate long distances to reach a pond to mate and breed, but they can be vulnerable to predation there. A heap of rocks or a few large logs put on the bank at one end can make a dam user-friendly, and need not detract from its main purpose.

Changes in our attitude to the use of chemicals and disposal of waste are needed. We tend to be far too ready to use insecticides and herbicides in gardens, while many local councils spray weeds with reckless abandon, to the extent that the benefits of this activity may not have been weighed against the ecological damage to other organisms that happen to be there.

I'm not sure that stocking programs that involve the transfer of frogs from one place to another is as good as it is made out to be. It sounds positive, and is great for places just a few kilometres apart. But we are finding there are genetic differences in populations separated by as little as 50 kilometres, and it is possible that interbreeding would jeopardise the future chances of survival.

Funding for research, public help to improve the local environment, education schemes; all are essential to improve the survival of frogs. If no action is taken Rachel Carson's book title *Silent spring* could be an inappropriate name. It will need to be changed to *Silent spring, summer, autumn and winter.* ■

The decline and disappearance of frogs in protected areas in national parks currently defy explanation.

The Slender Tree Frog *(Litoria adelaidensis)* is confined to the south-west of Western Australia.

JIRI LOCHMAN / LOCHMAN TRANSPARENCIES

Suggested Reading

Baringa, M., 1990. Where have all the froggies gone? *Science* 247: 1033–1034.

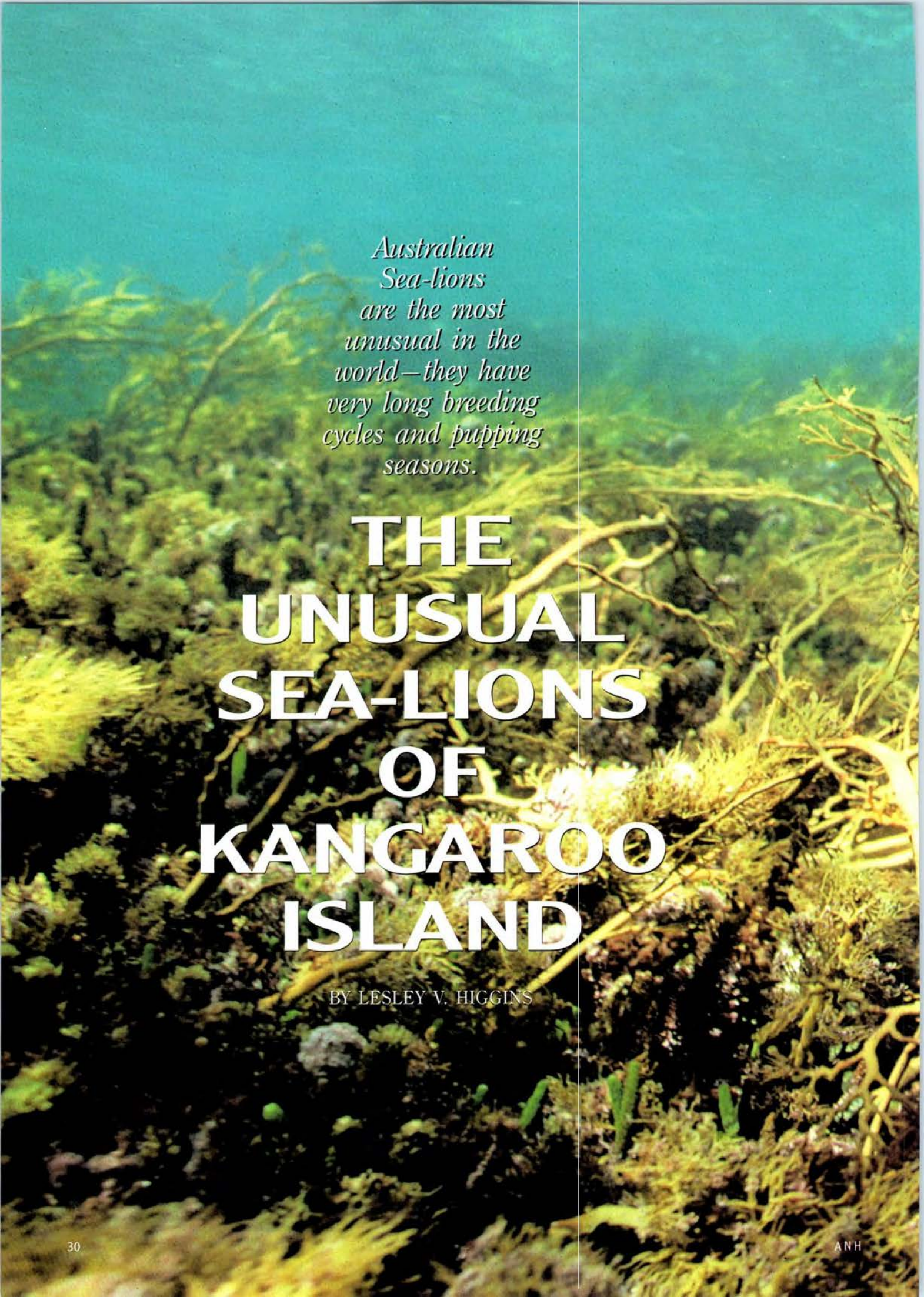
Burke, R.L., 1991. Relocation, repatriation, and translocation of amphibians and reptiles: taking a broader view. *Herpetologica* 47: 350–357.

Czechura, G.V. & Ingram, G.J., 1990. *Taudactylus diurnus* and the case of the disappearing frogs. *Mem. Qld Mus.* 29: 361–365.

Dodd, C.K. & Seigel, R.A., 1991. Relocation, repatriation, and translocation of amphibians and reptiles: are they conservation strategies that work? *Herpetologica* 47: 336–350.

Osborne, W.S., 1990. Declining frog populations and extinctions in the Canberra region. *Bogong* 11: 4–7.

Michael J. Tyler is Associate Professor in the Department of Zoology at the University of Adelaide and former Chairman of the South Australian Museum Board. His research interests are confined to the study of frogs.



Australian Sea-lions are the most unusual in the world—they have very long breeding cycles and pupping seasons.

THE UNUSUAL SEA-LIONS OF KANGAROO ISLAND

BY LESLEY V. HIGGINS

KEVIN DEACON

Australian Sea-lions forage in shallow waters and not off the continental shelf.

TIM LOW

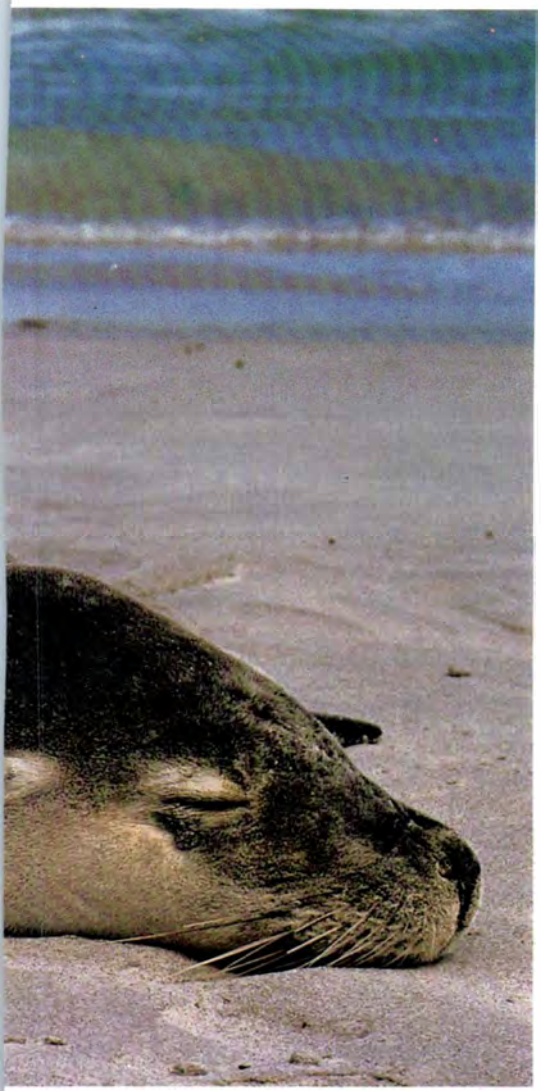
Australian Sea-lions were almost hunted to extinction by 19th-century sealers and explorers.

I KNEW SOMETHING WAS GOING TO HAPPEN when the female became agitated and began circling and bending her head around to look at her rear end. I had first spotted her two days previously on the beach and now I was lucky enough to witness another Australian Sea-lion giving birth. Thirty minutes later, I watched the dark, wet mass of pup slowly emerge and plop out onto the sand. The female immediately touched it with her nose and began vocalising to it. She then gently bit the pup, lifted it up and dropped it a few times in what is an instinctive effort to ensure that the pup is breathing properly. I once saw a female actually revive a pup that was not breathing by bashing it on the rocks until the fluid was expelled from its lungs.

What was I doing watching sea-lions reproduce? It was and is one of my greatest thrills, besides being a necessary part of my research as a marine mammalogist. My five-year study of Australian Sea-lions began in the winter of 1986 at Seal Bay, Kangaroo Island, South Australia. For my doctoral dissertation project I had decided to find out more about this mysterious sea-lion, which according to the literature, didn't seem to have an annual breeding cycle. Australian Sea-lions are the most unusual pinnipeds (seals and their relatives) in the world. Not only do they breed on a non-seasonal cycle of some 17.6 months, but the pupping seasons last five months instead of two, and the breeding behaviour of females causes some interesting variations in male behaviour, which will be described later. First, some background.

AUSTRALIAN SEA-LIONS *(NEOPHOCA cinerea)* are found only in Australian waters. Prior to the period of seal exploitation during the last century, Australian Sea-lions inhabited a larger range and were probably more abundant than they are today. They were formerly found around the islands of Bass Strait and northern Tasmania. Today the sea-lions inhabit a range beginning at The Pages, a pair of islands just east of Kangaroo Island off the coast of South Australia, and extend west to the islands off Houtman Abrolhos in Western Australia. Information on their former abundance is not available except that, beginning around 1800, they were collected for skins and meat by explorers and sealers and were almost exterminated. The latest count indicates that the total number of sea-lions today is about 10,000–11,000. Australian Sea-lions have been classified as rare under South Australian State legislation.

Kangaroo Island is home to the third largest population of Australian Sea-lions,



The female gently bit the newborn pup, then lifted it up and dropped it a few times to ensure that it was breathing properly.

LESLEY HIGGINS

A female sea-lion instinctively lifts her newborn pup to ensure it is breathing.

with about 400–500 animals on land at any one time at Seal Bay Conservation Park. This number has remained relatively constant since counts were initiated in 1962 and reflects an underestimate since many of the sea-lions are at sea during censusing. Until the mid-1950s, this rookery was virtually inaccessible to humans except by boat. Then a dirt track was cut through the mallee scrub to the coast, enabling locals and tourists to view the sea-lions at close range. By the early 1970s, the rookery was suffering from unregulated human disturbance and in 1972, under the National Parks and Wildlife Act, certain parts of Seal Bay were designated off limits to the public. Since 1987, only guided tours are allowed on what the rangers call the Main Beach, which is an area where the animals rest in between foraging trips to sea. Guided tours have greatly lowered the potential of harassment to both the sea-lions and the tourists.

Seal Bay is an ideal place to study sea-lions. Not only are the animals habituated to the presence of people because of tourism, but the rookery is easy to get in and out of, and the public is kept out of the breeding areas. My main interest was in observing mating and maternal behaviour and documenting the breeding cycle. In order to record the behaviour of individual animals, I marked them using a technique that involved hitting them with oil-based paint pellets fired from a sling shot. Later, when they were sleeping, I would sneak up behind them and write numbers on them using a squeeze bottle filled with black hair dye. Towards the end of every breeding period, about one third of the pups were tagged with colour-coded flipper tags – a different colour for each year class. Visitors to Seal Bay may still see some of these tagged animals.

THE SEA-LIONS AT SEAL BAY ARE DIFFerent from other species of sea-lion in many respects. The most unusual difference is in their breeding cycle. The average female will suckle her pup for about 17 months and will wean it a few weeks before the birth of the next pup. Thus the breeding period, which is five months long, really occurs every 17.6 months and is not fixed seasonally over time. During the 1970s breeding occurred in the autumn or spring, but in the 1980s,

LESLEY HIGGINS

Two bulls fighting over a female with a pup: male aggression sometimes causes pups to be fatally injured.

it occurred in the summer or winter, and the 1990s will see a shift back to autumn and spring breeding. This is very strange for a seal, considering that all the other species breed every 12 months on annual cycles, including the New Zealand Fur-seal on Kangaroo Island. What causes this aberrant behaviour? We don't know yet, and the conventional ideas relating the timing of reproduction to day length and temperature control make no sense at Seal Bay or anywhere else within their range.

One possible explanation for the long non-seasonal breeding and lactation cycle comes from Nick Gales who, working out of Perth's Murdoch University, has been studying the Australian Sea-lion at Seal Bay in Western Australia. He believes the influence of the Leeuwin Current, which results in reductions in nutrients and hence available food, is strong enough off the coasts of Western and South Australia to force the sea-lions to extend the length of lactation to ensure their pup's survival to independence. The fact that the New Zealand Fur-seal breeds every 12 months on Kangaroo Island may be because they forage off the continental shelf where the food supply is greater, rather than in the poor-quality waters with the Australian Sea-lions.

Another unusual aspect of the breeding behaviour is that, during this time, the females avoid their normally large groups and prefer to give birth in relative isolation. At Seal Bay, breeding females are spread out in time and space; not only does the pupping season last five months, but they use as many as 18 different pupping sites in a one-kilometre-long stretch of coast. Although tides were higher during winter pupping, virtually all the females in my study gave birth near or on the beach as they did in the summer, except for a few that pupped in the vegetated dune areas above the beach. In fact, most of the females gave birth within five metres of where they had given birth previously.

When the females are at sea feeding, pups seek shelter in the holes and crevices in the rocks. Here they remain hidden until their mother's return. These pup holes range in size from barely larger than the pup itself to large enough to hold three pups. Some of these holes are also used as resting sites by Little Penguins *(Eudyptula minor)*, which have a breeding colony nearby, although it is impossible to tell who gets there first—the penguins or the pups. The pup holes were used by almost all the pups in my study, especially when they were less than two months of age. At this age, pups were susceptible to male attacks, and the approach and vocalisation of territorial males would cause the pups to scamper into their holes.

Approximately 20 per cent of pup deaths are directly attributable to male aggression. Perhaps the reason males attack young pups is because of displaced aggression. When it occurred, pups were always attacked by territorial bulls attending breeding females, and the pups seemed to be 'male substitutes' to the attacking bull. The kinds of injuries inflicted on pups—puncture wounds, lacerations and broken bones—which usually result in the pups' death, are barely noticeable when sustained by an adult male.

The low density of females during the breeding period effectively prevents the males from copulating with large numbers of females. Male Australian Sea-lions do not control large harems, as do Northern Elephant Seals, for example. Instead, they have evolved a different breeding system. A bull will stake out a pregnant female as soon as she comes ashore in the breeding area and will defend her until she is ready to mate—about a week after the birth of her pup. The greatest number of females a male can attend at one time

AUSTRALIAN SEA-LIONS

Neophoca cinerea

Family
Otariidae ('eared' seals)

Identification
Males black-brown, with top of head and back of neck white. Females grey or brown above, cream below.

Distribution
Western and southern coasts of Australia, from Houtman Abrolhos in the west to The Pages in the south.

Population
10,000–11,000

Pupping Interval
17.6 months between birth of pups

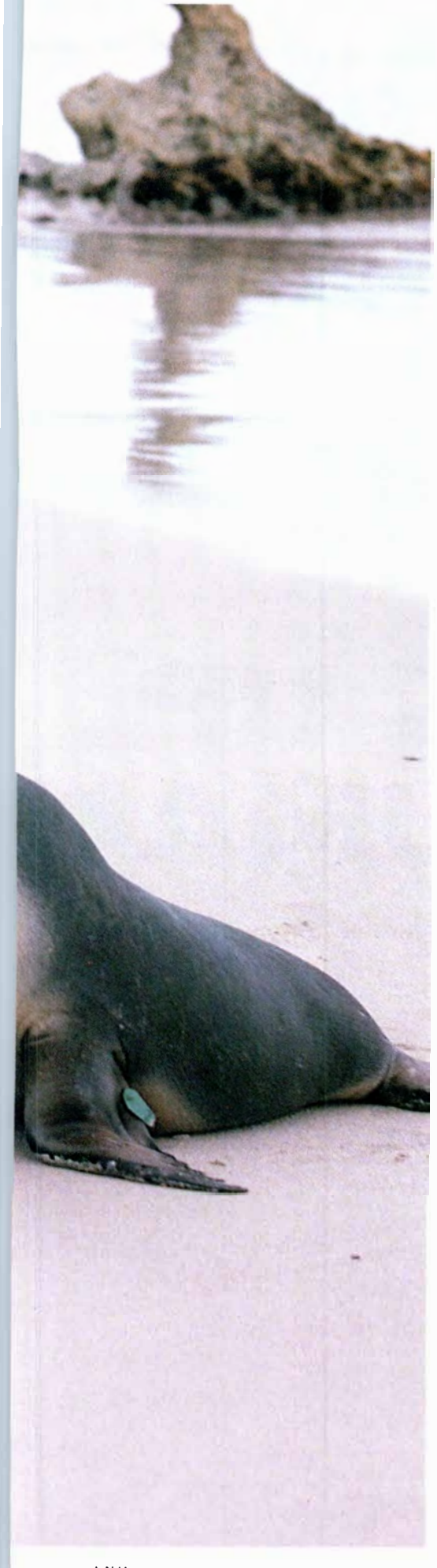
Prey
Fish, squid and octopus; some crustaceans such as lobster and shrimp.

Diving Depth
Average 67 metres; maximum 92 metres (figures available for females only).

ROGER MARCHANT

Sea-lion pups are suckled for almost 17 months then weaned a few weeks before the birth of the next pup.

YVONNE DYMOCK



During the pupping season at Seal Bay, the Main Beach resounds with the cries of weaned pups still hopeful of getting a drink.

is usually four, although most males are with just one female at a time. The most successful male in my study attended and copulated with a grand total of seven females during the course of the pupping period. The inability of males to defend large groups of females meant that roughly half of all adult males copulated at least once during each breeding season—pretty good odds for a sea-lion!

When males fight, it is mainly when the breeding females are ashore on their territories. Sometimes fights involve more than two males. Fighting behaviour involves chest-to-chest pushing, lunges at the neck and fore-flippers, and bites to the neck or back with the object of displacing the other male onto his back. During fights there is sometimes a specific male 'I surrender' vocalisation, which serves to minimise injuries by signalling the attacking male to desist so that the defeated male can retreat without sustaining more bites. This sound can also be heard frequently among juvenile and subadult males when they engage in mock battles.

Unlike other species of sea-lions, whose males remain in their breeding territories throughout the pupping season, males at Seal Bay sometimes leave their territories to look for breeding females or to forage at sea. Sometimes they were found on what I called the 'bachelor beach', a place usually frequented only by beat-up and exhausted bulls looking for nothing more than a rest away from the competition.

Females, of course, just go about the business of pup rearing and generally ignore the males. They usually wean their 17–18-month-old pups just before the birth of the next one. In fact, during the pupping season at Seal Bay, the Main Beach resounds with the cries of weaned pups that are still hopeful of getting a drink. Occasionally, weaning doesn't seem to work, and the pup follows the female into the breeding area. For some reason, about five per cent of the females I studied were unwilling or unable to keep the older pup away after the birth of the new pup, and an unfair contest for the teats would ensue. Of the ten instances in which I saw this happen, only once did the pup survive with the older sibling suckling. This pup was half the size of other pups the same age, but was otherwise healthy and survived to the next breeding season. In other cases, the yearling either pushed the pup away and caused it to starve to death, or the mother finally managed to wean the older one after all.

Very rarely do females suckle other pups on a regular basis and there seems to be a strong instinct against this. In my study, three females adopted a pup when their own pup died, and one female suckled two pups simultaneously. Otherwise, females were aggressive towards other pups and only rarely did pups try to suckle on other females.

I came to greatly respect and appreciate the sea-lions of Seal Bay. They taught me that you can't make assumptions about wildlife but, with patience and fortitude, you can begin to understand it. The population of sea-lions at Seal Bay has served as a measuring stick to compare with other Australian Sea-lion populations. At other breeding colonies in Australia the sea-lions do appear to breed on a 17–18 month cycle, although some of the colonies are out of sync with each other by as much as six months. How this has evolved is a mystery and more research needs to be done on food habits and physiology before we can begin to explain it fully. ■

Female sea-lions ignore the aggressive males, preferring to go about their business of looking after the pups.

Suggested Reading

King, J.E., 1983. *Seals of the world.* Cornell University Press: Ithaca, New York.

Marlow, B.J. & King, J.E., 1974. Sea-lions and fur seals of Australia and New Zealand—the growth of knowledge. *Aust. Mammal.* 1: 117–135.

Marlow, B.J., 1975. The comparative behaviour of the Australasian sea lions *Neophoca cinerea* and *Phocarctos hookeri* (Pinnipedia: Otariidae). *Mammalia (Paris)* 39: 159–230.

Walker, G.E. & Ling, J.K., 1981. Australian sea-lions. In *Handbook of marine mammals. Vol. 1. The walrus, sea lions, fur seals and sea otters*, ed. by S.H. Ridgway and R.J. Harrison. Academic Press: London.

Dr Lesley Higgins is a marine mammalogist with a research fellowship at the Institute of Marine Sciences, University of California at Santa Cruz. In addition to her research on the Australian Sea-lion, she has studied Steller Sea-lions and elephant seals at Año Nuevo, California, and California Sea-lions on the Channel Islands.

CARL BENTO / AUSTRALIAN MUSEUM

Why do humans not wish to smell of humans but are happy to smell of rutting stags and civet cats?

PICKING UP THE HUMAN

BY MICHAEL STODDART

ASK ANYONE YOU MEET in the street which of the five senses—sight, touch, hearing, taste or smell—is the least important and the huge majority, if not everyone, will answer that smell seems to play little part in our lives. Several might say they have head colds and cannot smell anything anyway, yet life goes on pretty much as before. A few might reflect that not to be able to smell freshly mown grass, a garden after summer rain, or a favourite perfume would be regrettable but would agree that such deprivation does not compare with that imposed by blindness, or deafness.

Ask the same people whether the sense of smell is important to Chimpanzees, dogs, pigs and mice and you will get a unanimous yes. Humans have risen above the animals, have they not? In becoming human did they not become distanced from the animals? Do not most religions enshrine humankind as being at the centre of creation, the pinnacle of perfection?

Now imagine you are an observer from another planet, visiting Earth to study its zoological creation. There you discover a species that is well endowed with scent-producing glands upon its body. These glands occur all over the body with significant aggregations (up to 900 per square centimetre) localised in the anal-genital region, around the mammary glands and in the armpits, and they begin to produce their perfume at the onset of puberty. If you compared this species with its closest relatives, you would notice that it is far better endowed with scent-producing organs and produces a lot more odour. There would be no failure in your logic if you concluded that the sense of smell, and communication through odour, was

Despite being the most richly perfumed of all apes, we have an obsession with the removal of our scent.

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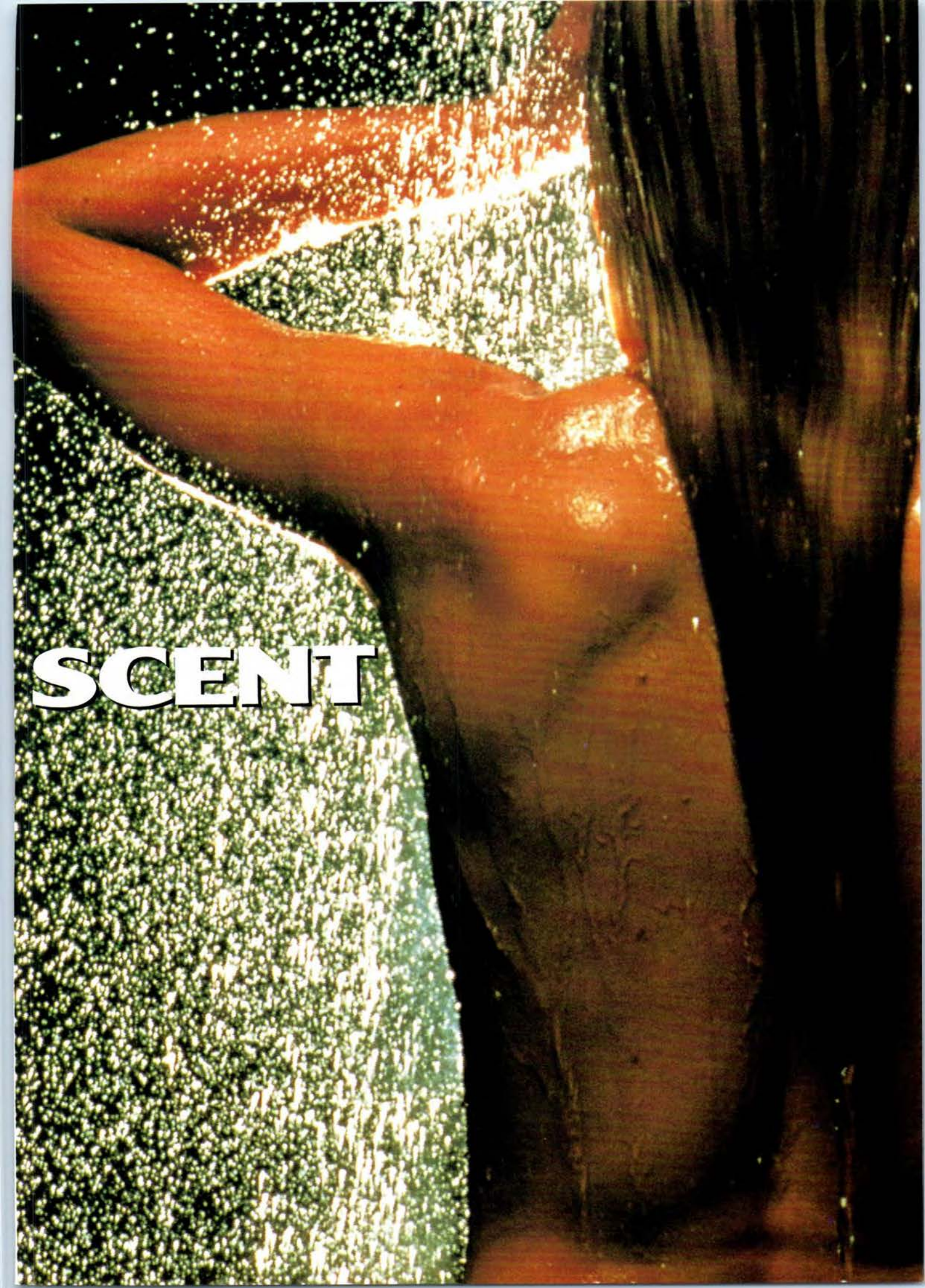
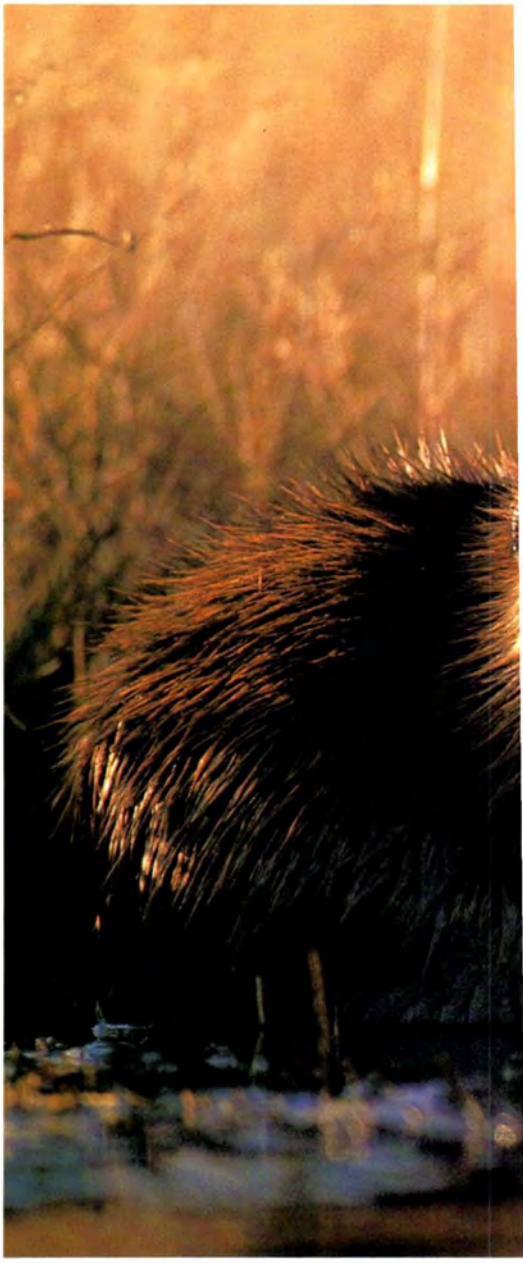

SCENT

important for that species. The species you were looking at was *Homo sapiens*, our own species—the most richly perfumed of all the apes.

If you had stooped to peeping through keyholes, or rather shower curtains, you would have noticed something that would have puzzled you. This richly scented ape goes to inordinate lengths to remove all traces of its body odour, bathing and showering far more frequently than is necessary for reasons of hygiene. Often the most scented regions of the body are attacked with shaving utensils to rid the regions of their hair, and almost universally the shower-time ritual ends with the liberal application of perfumed unguents of one kind or another. The creature that emerges from the bathroom smells very different from the one that entered. Had you access to a chemical analytical laboratory you would have discovered that the unguents that now adorn the skin of humankind contain the sex attractants of Himalayan musk deer, beavers, civet cats, as well as substances used by plants to attract insects for the purposes of sexual reproduction. On the journey back to your home planet you would doubtless have mused upon this curious and enigmatic situation. Is the sense of smell important to humankind? Why do humans not wish to smell of humans but are happy to smell of rutting stags and civet cats?

THE SENSE OF SMELL IS, IN EVOLUtionary terms, far more ancient than the visual and acoustic senses. Sending messages via chemical compounds—chemocommunication—is as ancient as life itself. The integration of metabolic processes in each cell of your body depends upon chemical messages passing from one cell organelle to another. When sexual reproduction first evolved, a mechanism to ensure that the two participating individuals found one another was required. Chemocommunication was ideally suited to the purpose. As geological time passed, and ever more complex animals evolved, changes to the chemosensory system occurred. The advent of a terrestrial, air-breathing lifestyle was a major evolutionary challenge, for now chemocommunication between individuals could occur only via the gaseous medium. The structure of the mammalian nose—correctly called the olfactory system—is a perfect blend between structural simplicity and functional complexity.

If you stoop to peeping through keyholes, you will notice that this richly scented ape goes to inordinate lengths to remove all its body odour.



Olfactory receptor cells—up to 100 million of them—lie in the mucous membranes in the upper part of the nasal cavity. They transmit their messages in the form of nerve impulses to the ancient smell brain—the rhinencephalon—for processing. In humans this is found in the lower third of the brain in the middle of the head, and is also thought to be involved with the seat of emotion. Once processed here the nerve impulses travel to the learning part of the brain, the cerebral cortex. When you try to remember the *name* of a particular scent it is this part of the brain that is stimulated; when you react emotionally to an odour it is because of the stimulation of the emotional centre.

Humans produce scents from two major types of glands lying in the skin. The sebaceous glands, one of which is associated with every hair on the body, produce an oily, pleasantly scented secretion. Its function is to condition the hair,

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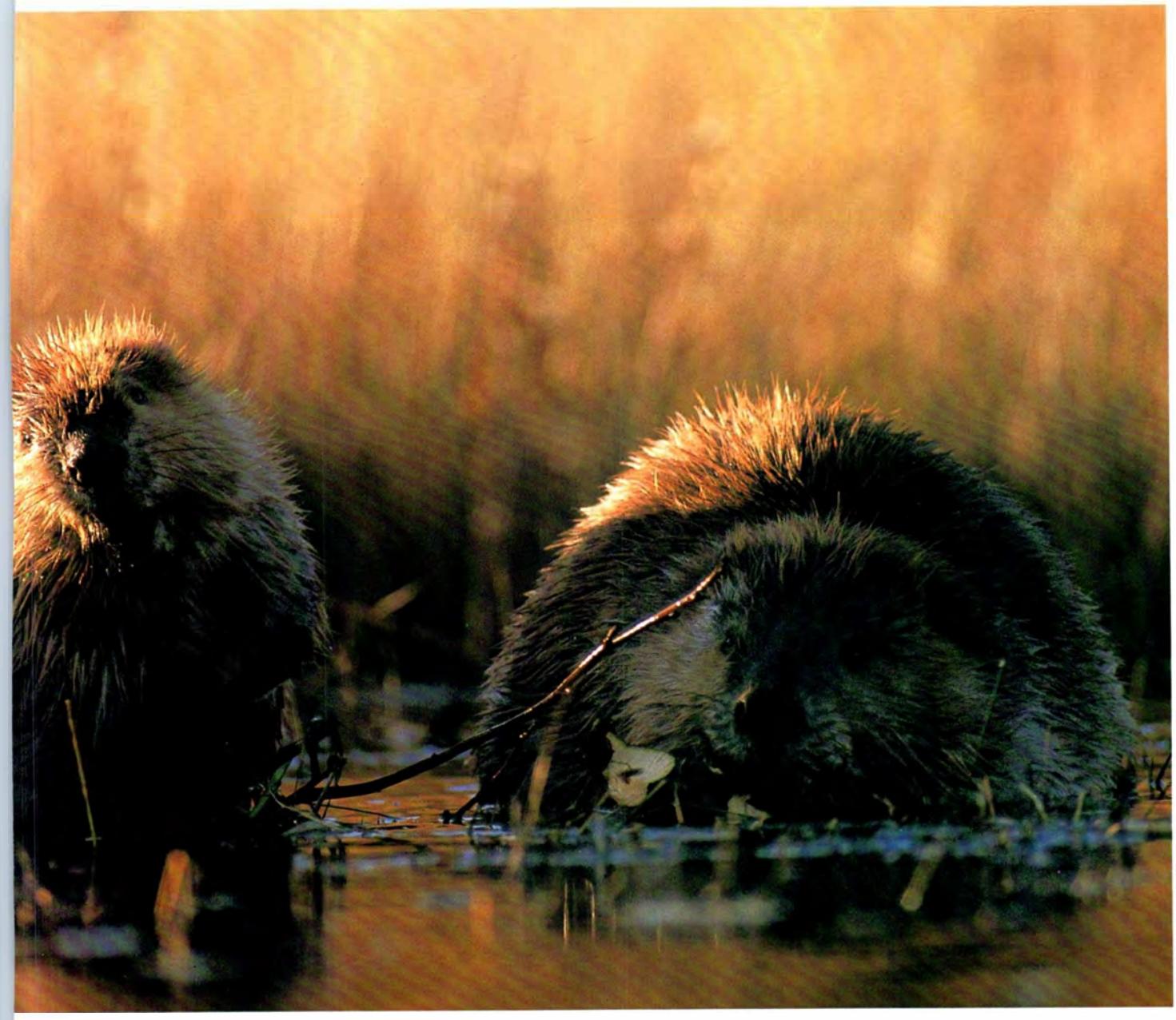
Eskimos rubbing noses.

GIVE ME A SNIFF

Captain Beechy of HMS *Blossom* reported in 1831 that Eskimos greeted one another by rubbing noses and then licking the palms of their hands and rubbing them first on their own faces and then over that of their guests. This description forces one to recall the greeting ceremonies of many animals that sniff and lick one another.

Ling Roth in 1890 described the greeting of the hill people from Khyoungtha in India: "Their mode of kissing is strange; instead of pressing lip to lip they apply the mouth and nose to the cheek, and give a strong inhalation. In their language they do not say 'Give me a kiss' but they say 'Smell me'."

If they could talk, most mammals would say the same. These two simple examples of cultural differences in greeting behaviour, developed independently under different social circumstances, are clearly linked to a biological phenomenon—that of the indelible odour envelope that accompanies every one of us wherever we go.



JEFF FOOTT / AUSCAPE INTERNATIONAL

Most of our perfumes contain sex attractants from animals like beavers, which produce a musky scent.

keeping it waterproof and supple. On some parts of the human body, chiefly around the nipples and in the areolae, the lining of the mouth, the vaginal labia and the foreskin, sebaceous glands are found without hairs. The production of scent by sebaceous glands is under hormonal control. The second major type of gland is called the apocrine type; these glands produce a watery secretion when stimulated by nervous impulses. They are normally associated with hair and occur at greatest density in the armpits, pubic mound, the anal–genital region, the face, scalp and eyelids, and inside the nasal cavity. The largest aggregations occur in the armpits (or axillae) where they form an axillary organ. Humans have very much larger axillary organs than Chimpanzees–the only other ape to have any such aggregation. Research has shown that axillary organ secretion has a delicate, pleasant odour, but the presence of a large flora of bacteria quickly breaks this down into rancid-smelling fatty acids. Shaving the armpits does not eliminate the presence of bacteria but dramatically reduces the surface area upon which they may be found. A shaved armpit may remain fresh for 20 times longer than an unshaved armpit.

Why do humans produce odour? The answer to this question is unclear, but has generated much debate. There is no doubt that the basic use of chemocommunication was to facilitate sexual reproduction in primitive organisms. Research conducted over the past 25 years has shown beyond doubt that mammalian reproduction is under olfactory control. In female mice a newly established pregnancy can be terminated by the smell of an adult male mouse, provided he is not the sire of the litter. Female mice housed together in small cages cease to experience normal oestrous cycles, eventually ceasing to cycle altogether. Furthermore the scent of an adult male is able to restart the oestrous cycles of such females synchronously and to keep the cycles regular. Juvenile female mice also mature more rapidly when exposed to the

ESTHER BEATON

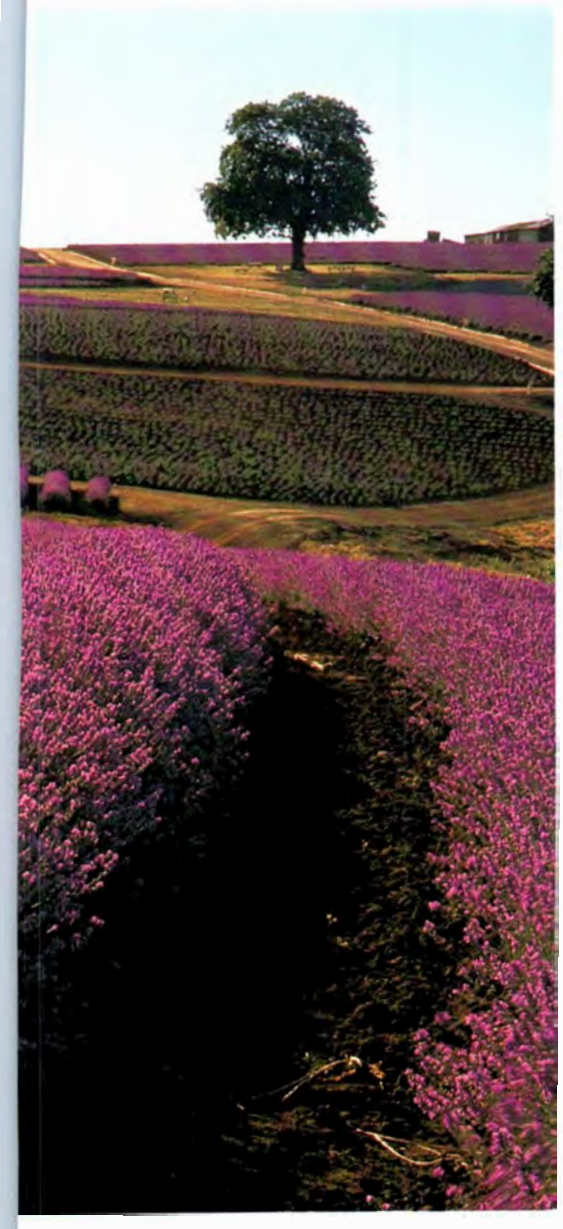
Lavender is farmed in Tasmania for the world's perfume industry.

odour of adult males than when denied such exposure.

Pigs, too, rely upon odour to coordinate their sexual behaviour. Boars produce a steroid substance—5a-androstenol—in their salivary glands. Sows normally take no notice of this but when they are ovulating they respond to it with a clearly marked behavioural reaction. They adopt a rigid stance with the head held low, inviting the boar to mount and mate. The steroid is now available in aerosol marketed as 'Boar Mate'; in piggeries that rely on artificial insemination, the sows ready for service identify themselves following a brief spray on the snout. Fascinatingly, the human armpit produces the same compound found in boars' saliva. It is made by bacteria from the apocrine secretion and occurs in both sexes. Does it play any role in human sexual behaviour?

The evidence to support a role of odours in human reproduction is equivocal. Martha McClintock in 1971 reported that the menstrual cycles of women living in an all-female college residence who had little contact with men were longer and more synchronised than those of women who had regular contact. Like all studies on humans McClintock's lacked rigorous controls. Nevertheless the data seemed to suggest that the odorous environment is able to exert some influence on reproductive physiology. This was taken a step further by a group of researchers in California who applied an extract of the underarm secretion of a woman to the upper lips of a group of female volunteers. A control group received a placebo (that is, just the solvent without the secretion). Within three months the menstrual cycles of the experimental group had become much more synchronised than those of the control group. Various other studies have suggested that the starting date of the menstrual cycle, and the likelihood that the cycle will be fertile, is positively influenced by the presence of male odour. Such studies, which lack the rigour of experimental research, must be interpreted with caution but cannot be dismissed as valueless

At least one perfume manufacturer has accepted that 5a-androstenol—the 'human pheromone'—plays an active part in sexual



allure and has launched a range of perfumes containing the compound. Users should be advised that there is no acceptable scientific evidence proving its worth.

PERFUMES ARE UNIVERSALLY USED BY peoples all around the world. It is fabled that the Greek goddess of love, Aphrodite, was perfume personified and that she alone knew the secret of their power to stimulate sexually the human mind, and it was in her honour that aphrodisiacs were so named. The history of perfumes goes back to the beginning of recorded time. The ancient Egyptians were skilled perfumers, using as ingredients materials we today associate with incense–frankincense, cinnamon, labdanum, galbanum, henna, cyprus, juniper, cassia, sandalwood etc. The ingredients were macerated in wine and honey, and their odours taken up by cones of myrrh. A sweet scent was so important to Egyptian culture that the hieroglyphic symbol for happiness was a nose. The ancient Romans also made much use of perfumes, despite a general edict from Rome in 188 BC forbidding all but the most

Fascinatingly, the human armpit produces the same compound found in boar's saliva that is marketed in aerosol form as 'Boar Mate'.

modest use of perfumes in social ceremonies. Two hundred and fifty years later, at the funeral of his wife Poppaea, Nero burned tens of tonnes of incense to perfume the air, the trees, the mourners and her spirit, to help it on its way. Some historians think this type of reckless extravagancy may have hastened the decline of the Roman Empire.

For the ancients the idea of fine odour as a sanctifying agency was widespread. Illness was purged with strongly smelling medicines, and sulphur was burned to fumigate the sick room. During the plague of the Black Death in the 14th and 15th centuries the only antidote available was a posy of sweet-smelling herbs. Plague doctors wore curious beak-like masks into which scented potpourri could be placed. Some carried small incense burners as plague torches before them to protect them from the scourge, and they were never far from a fragrant pomander when tending a victim. It is perhaps for the same reason that most disinfectants, and even clothes washing powders, contain perfumes–the notion that cleanliness

Ancient Egyptians were skilled perfumers, using spices like (clockwise from top left) cloves, juniper, cinnamon, star anise, coriander, cardamom and nutmeg.

and purity are associated with a sweet odour has ancient roots.

Until modern methods for extracting the essential oils of plants became available there was little difference between perfumes and incense, other than the method for the release of odour. Since the earliest of times incense has been compounded from a modest handful of ingredients. These were given to Moses before he led the Children of Israel into the desert. Although rather little is known about what happens during their heating process, resin alcohols have a structure that resembles steroids, and it is known that any molecule with a steroidal shape will smell like a steroid. Could it be that the human desire for incense is because it subliminally 'reminds' us of the ancient time in our evolution when, like other mammals, our noses gave us much information about potential sex partners?

Perhaps our enigmatic approach to body odour is related to a desensitisation of our olfactory system, which occurred a very long time ago in our evolutionary past when our ancestors started to adopt a gregarious lifestyle. Any advertisements of oestrus, as occurs in mice and many other mammals, would have threatened the pair-bond between one male and one female, necessary for the long period of juvenile dependency. Desmond Morris in *The naked ape* describes a suite of physical and physiological adaptations aimed at strengthening the pair-bond. A desensitisation of the nose, such that biological odours lose their meaning, is simply another adaptation in that suite. Our love of perfumes and incense, which contain mammalian sex attractants or their mimics, may be because of their effect on the memory traces still present in our brains. They serve to stimulate the brain resulting in a heightened awareness of the world about us.

Fickle it might be, but the human sense of smell is far from obsolete. Future research may reveal that it plays a full and complex role in many aspects of our lives. ■

Suggested Reading

Lake, M., 1989. Scents and sensuality. *The essence of excitement.* John Murray: London.

McClintock, M.K., 1971. Menstrual synchrony and suppression. *Nature* 229: 224–245.

Morris, D., 1967. *The naked ape.* Jonathan Cape: London.

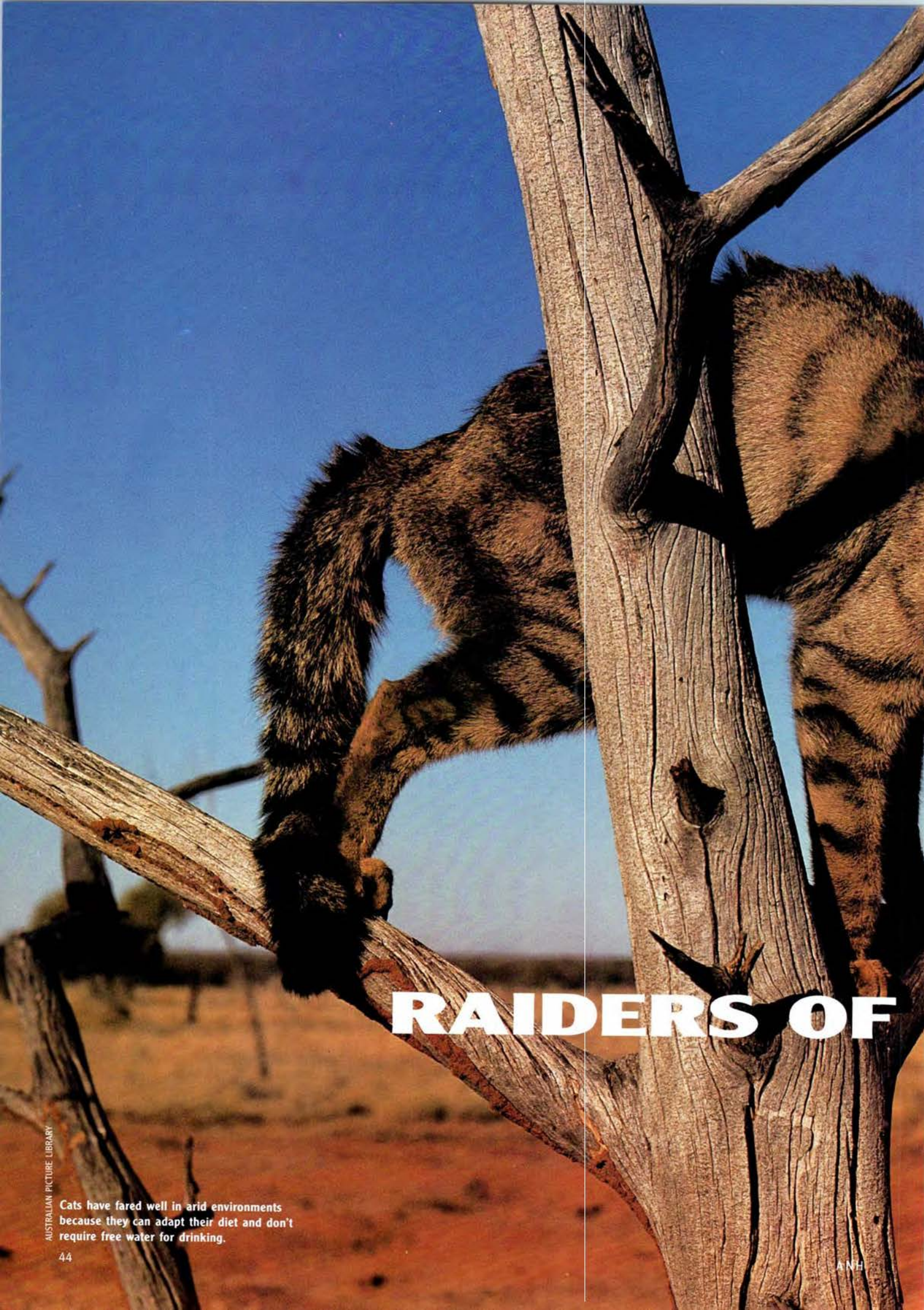
Roth, H.L., 1890. On salutations. *J. Anthrop. Inst.* 19: 164–181.

Stoddart, D.M., 1990. *The scented ape: the biology and culture of human odour.* Cambridge University Press: Cambridge.

Van Toller, S. & Dodd, G.M. (eds), 1988. *Perfumery, the psychology and biology of fragrance.* Chapman and Hall: London.

Michael Stoddart is Professor of Zoology at the University of Tasmania. His interest in olfactory biology started when he was a graduate student at the University of Aberdeen (UK) studying the population biology of aquatic rodents. As a researcher at Oxford and teacher at the University of London he developed the power of the comparative method of zoology to help explain some of the more perplexing features of human biology. His views on human olfactory biology are set out in his most recent book The scented ape.

DENISE GREIG



RAIDERS OF

Cats have fared well in arid environments because they can adapt their diet and don't require free water for drinking.

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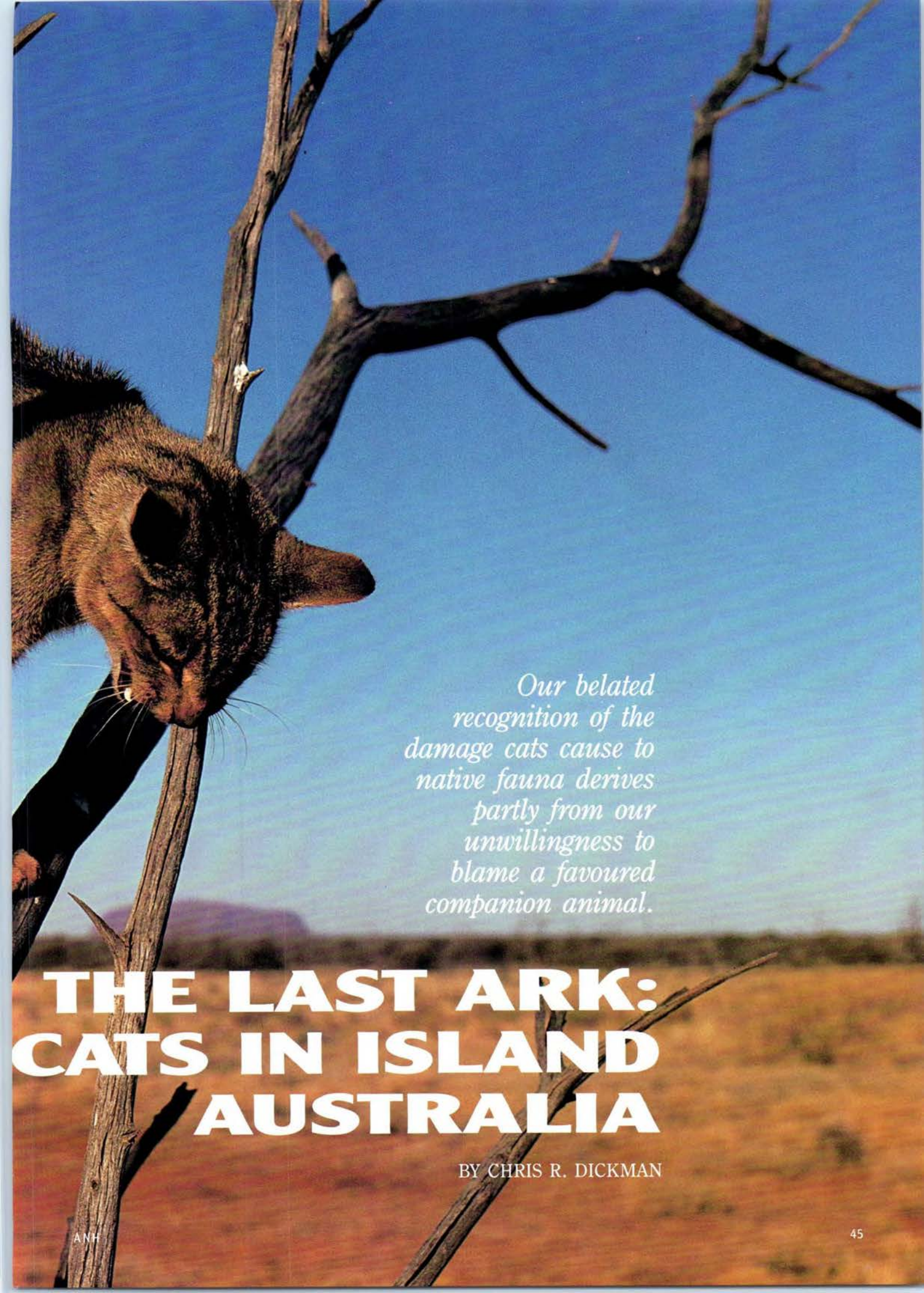
ANH



Our belated recognition of the damage cats cause to native fauna derives partly from our unwillingness to blame a favoured companion animal.

THE LAST ARK: CATS IN ISLAND AUSTRALIA

BY CHRIS R. DICKMAN

JIRI LOCHMAN / LOCHMAN TRANSPARENCIES

Cats' secretive habits make it difficult to determine the extent of their hunting activities and impact on native species.

FERAL CATS

Identification
Domestic and feral cats are similar in appearance, but feral cats can achieve larger maximum size (8.2 kg) than domestics (6.0 kg). Feral males average 4.8 kg, 45 per cent more than females (3.3 kg). Both sexes usually striped tabby, with variable amount of white on belly, chest and paws.

Distribution
Worldwide, all habitats. Found throughout Australia and on at least 45 offshore islands. Most abundant in suburban areas; feral populations abundant in many arid and semi-arid areas, less so in dense forest.

Origin
Probably derived from the African wild cat *Felis sylvestris lybica;* domestic cats transported initially from Egypt to Greece, the Roman Empire, subsequently worldwide.

Reproduction
Sexual maturity at 10–12 months in females, 12–14 months in males; 2 litters per year (maximum 3) in spring and summer–early autumn. Gestation 9 weeks, lactation 10–12 weeks, litter size 2–7. Longevity unknown, probably 8–10 years.

Behaviour
Adults usually solitary, using home ranges of 1–10 km² for several years; young remain with mother for 5–7 months.

Control
Usually trapping, shooting, poisoning.

Value
Feral cat pelts exported in small numbers until 1988, none since. Major value (domestic cats) as companion animals.

FOR THE ANCIENT EGYPTIANS, CATS *(Felis catus)* were the most sacred of all animals. First domesticated at least 3,600 years ago in the 18th Dynasty of Egypt, cats feature prominently in surviving art relics and appear to have had the status of minor deities. Herodotus tells us that all members of a household would shave their eyebrows upon the death of a pet, and that its body would be later taken for embalming to the city of Bubastis, before burial in sacred repositories. The magnitude of these burials was discovered only during construction operations earlier this century, when hundreds of tonnes of mummified cats were dug up from sacred sites (the remains were used subsequently as fertiliser). Elsewhere, in medieval Europe, cats were valued as vermin catchers. However, they were also viewed with suspicion and awe due to their connection with sorcerers and witches, and their use in various cult practices.

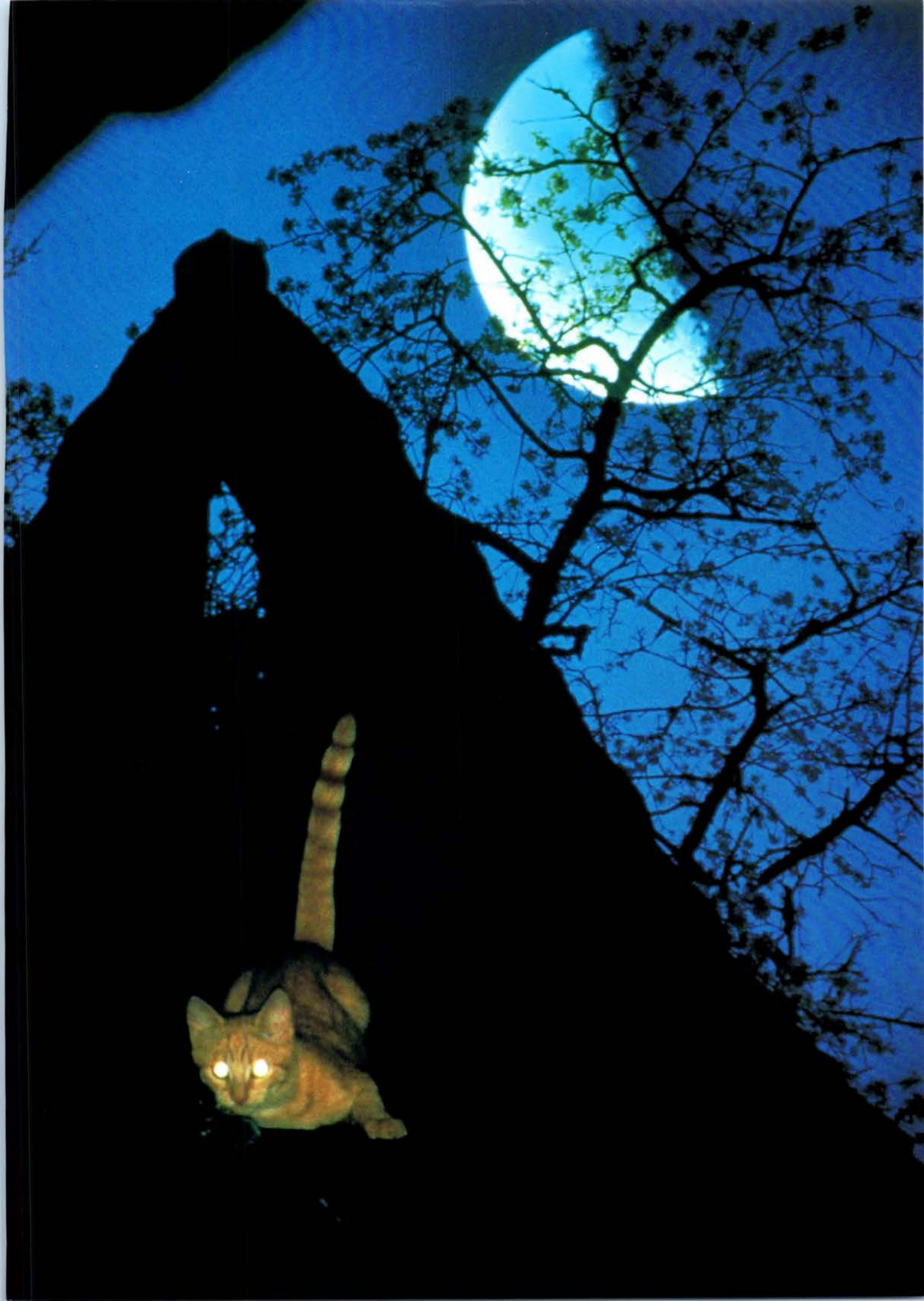
Cats have now spread with human help to most parts of the world, including many islands in the Pacific Basin. Here, the double-edged association between cats and humans is particularly apparent. The depredations of cats have caused population reductions and extinctions of several species of native reptiles, birds and mammals throughout the region, and considerable effort is invested each year in programs of eradication or control.

In Australia, we have only just begun to appreciate the damage cats may be causing to our native fauna. This belated recognition derives in part from our unwillingness to see a favoured companion animal be blamed for losses of native animals and also from the secretive habits of wild or feral cats in the bush. Cats leave little sign of their presence, lying low or slinking quietly away at the first signs of disturbance, and burying their faeces wherever substrates are soft enough. Yet, there is now accumulating evidence that cats, both domestic (that is, those kept as companions by humans) and feral, constitute a major threat to native fauna and that they should be accorded some priority, along with introduced foxes and rabbits, for effective management.

CATS OCCUR THROUGHOUT CONTINENTAL Australia and on at least 45 Australian offshore islands. They are not obviously limited by any environmental factors, and achieve relatively high densities of 0.01–0.02 per hectare in habitats as diverse as mallee woodland and sand-dune desert. Maximum densities of over ten per hectare are attained by domestic cats in local areas of human habitation. The total Australian cat population is probably five to ten million.

Cats are largely opportunistic predators but show some preference for small mammals. In most Australian studies, rabbits constitute the single most important prey. In forest and heathland habitats an array of native vertebrates is taken, with

To reduce your cat's hunting activity, it should at least be kept in during the night.



PAVEL GERMAN

This Common Ringtail Possum was probably injured by a cat.

mammals up to the size of small brushtail possums comprising over 75 per cent of the diet. Studies of feral cats at North Head Reserve in Sydney indicate that Long-nosed Bandicoots *(Perameles nasuta)* and Common Ringtail Possums *(Pseudocheirus peregrinus)* together comprise over 50 per cent of the diet during spring and autumn, with introduced Black Rats *(Rattus rattus)*, rabbits, songbirds, skinks and invertebrates comprising the remainder. During lean times in the Simpson Desert invertebrates can form more than half the diet, but after rains when small mammal populations increase, native animals such as Long-haired Rats *(Rattus villosissimus)*, Spinifex Hopping-mice *(Notomys alexis)* and Sandy Inland Mice *(Pseudomys hermannsburgensis)* are taken exclusively. In the Tanami Desert, feral cats have been implicated recently in the demise of a small colony of Rufous Hare-wallabies *(Lagorchestes hirsutus)*. The persistence of cats in arid environments is due in no small way to their ability to switch prey items in the diet, as well as to their flexible use of burrows, logs and rock crevices for shelter, and independence of free water for drinking.

Although it is clear that feral cats prey upon a wide variety of native vertebrates, this is not sufficient to conclude that they have adverse effects. Additional information is needed on cat numbers, the numbers of native animals taken as prey, and how native species have fared with the introduction of the cat when the effects of other changes wrought by Europeans are removed.

The best information on losses of wildlife comes from work by David Paton on domestic cats in Victoria and South Australia. This work, based largely on questionnaire responses from people with and without cats, indicates that cat numbers range from 0.0001 per hectare in rural areas to two per hectare in city suburbs. On average, 50–60 per cent of cats in all areas surveyed caught mammals, 50–60 per cent took birds and about a third also caught reptiles. Cats with bells took similar proportions of prey to those without, suggesting that bells have little deterrent effect. Respondents in the survey indicated also that twice as many mammals (16) were returned on average by their cats each year than birds (8) or reptiles (8). Comparable studies in North America have shown that cats return to their owners only about half of the prey they capture, so the actual numbers of prey taken may be considerably greater than the estimates suggest. In Adelaide and Sydney, bird densities are in the order of 10–30 per hectare, while mammal densities are probably much less than this. If cats take as few as 10 birds and 20 mammals per hectare each year, this will account for more than 50 per cent of the populations of these vertebrates. For many taxa, this may mean that populations within suburban areas can be sustained only by continued immigration from less disturbed areas of surrounding bush, if these exist.

There are dangers in extrapolating the results of a single survey to other parts of Australia, but there seems little doubt that domestic cats are capable individually of killing 30 or more vertebrates per year in suburban areas. Multiplied by the areas of suburbs in eastern Australia alone, tens of millions of native vertebrates are likely to fall victim annually to domestic cats. It is worth remembering that these estimates are based on well-fed domestic cats that should not need to kill for food. Depredation rates, and impacts, of feral cats can be expected to be greater.

THERE IS LITTLE CERTAINTY ABOUT when cats were first introduced to Australia. They accompanied the first European settlers, and were liberated in large numbers in the last century to control plagues of exotic herbivores such as rabbits and mice. But there is some evidence that cats were established before European settlement, possibly arriving

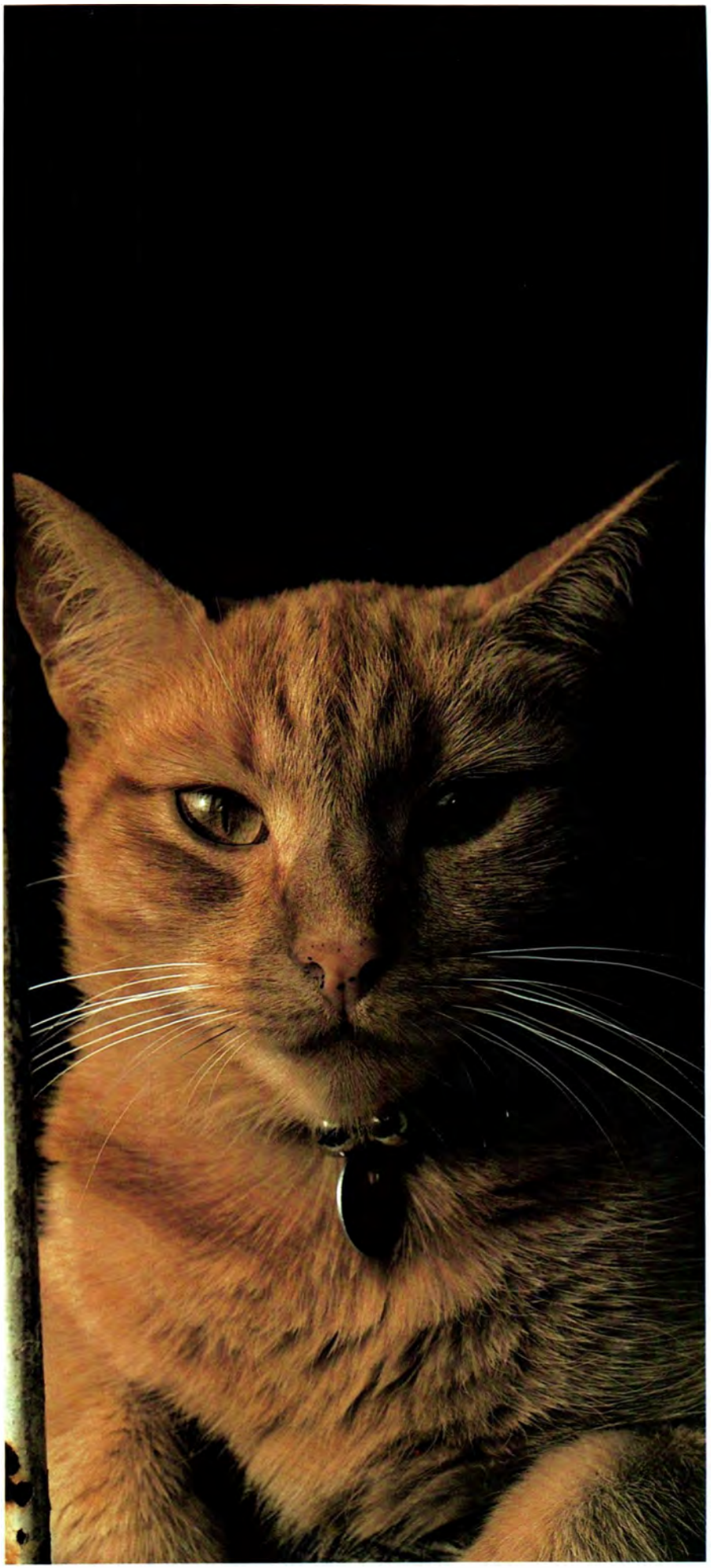
in the 17th century on Dutch or Asian trading vessels that ran aground on the Western Australian coast. Cats are believed to have always been present by many Aborigines of the central deserts, or to have moved into central areas a long time ago from the west. The presence of cats in remote arid regions was also noted by some, but not all, explorers in the late 19th century. Whatever the precise date of entry, it is clear that cats have been established in Australia for a long time, and that any effects on native fauna should have become manifest at least in the first half of the 19th century. What is the evidence for an early impact of cats?

Remains accumulated by Barn Owls *(Tyto alba)* at long-term roost sites indicate that several species of small mammals became extinct soon after European arrival in Australia. The Big-eared Hopping-mouse *(Notomys macrotis)* disappeared prior to 1844 from Western Australia, as did the Darling Downs Hopping-mouse *(N. mordax)* from southern Queensland. The Shark Bay Mouse *(Pseudomys praeconis)* was similarly last recorded from mainland Western Australia

In eastern Australia alone, tens of millions of native vertebrates are likely to fall victim annually to domestic cats.

in 1858, but persists offshore on Bernier Island where cats do not occur. Several further species suffered dramatic reductions in range just after European settlement, but persisted until the later part of the 19th century or to the turn of the present century. These species include the Short-tailed Hopping-mouse *(Notomys amplus)*, Long-tailed Hopping-mouse *(N. longicaudatus)*, White-footed Rabbit-rat *(Conilurus albipes)*, Gould's Mouse *(Pseudomys gouldii)*, Broad-faced Potoroo *(Potorous platyops)* and others. Finally, two further species disappeared at or just prior to European settlement and are not known as intact specimens; these are a hopping-mouse from Chambers Gorge in South Australia, and a pseudo-mouse from western Victoria.

Three aspects implicate cats in the early demise of these native mammals. First, the extinctions and reductions in range took place just before or just after European settlement, well before extensive changes in land use, fire regimes or liberations of other exotic species had occurred; cats, alone, were present. Second, all species that became extinct



DENISE GREIG

Cats with bells take similar proportions of prey to those without bells.

Although the major impact of cats may be direct predation, they also carry diseases that can have adverse effects on native fauna.

were small (50–800 grams) and within the size range most preferred by cats. In contrast, no species over one kilogram in weight were lost until the relatively recent demise of the Eastern Hare-wallaby *(Lagorchestes leporides)* in 1890. Third, most species that disappeared early were occupants of open habitats, where they would have been most prone to predation from cats. Only the Broad-faced Potoroo appeared to use dense vegetation, although sub-fossil remains indicate that its geographical range also encompassed open heath and woodland habitats.

Regional analyses further incriminate cats in an early wave of extinction of native mammals. In western New South Wales the species that disappeared earliest were small, and occupants of open habitats. Thus, of 13 species last recorded in 1857 or before, ten weighed less than 220 grams. In contrast, ten of 13 species surviving beyond 1857 weighed more than 350 grams. Although some of the small species that disappeared were only marginal occupants of New South Wales, they could be locally very abundant. Diary accounts by David Brock and John Browne, who accompanied Charles Sturt on his Central Australian Expedition in 1844–1845, record Aborigines feasting on abundant 'Jerboas'. This species, the Dusky Hopping-mouse *(Notomys fuscus)*, is now rare and restricted to small areas of sand-dune in South Australia and Queensland.

There has been no experimental work documenting the effects of feral cats on native fauna, but strong inferences have been obtained from introductions of cats to offshore islands. For example, cats were introduced last century to St Francis Island in South Australia, and had eliminated the previously abundant Brush-tailed Bettong *(Bettongia penicillata)* by the early 1900s. Extinctions of Tammar Wallabies *(Macropus eugenii)* on Flinders Island, South Australia, Dibblers *(Parantechinus apicalis)* on Dirk Hartog Island, and Golden Bandicoots *(Isoodon auratus)* and Spectacled Hare-wallabies *(Lagorchestes conspicillatus)* on Hermite Island, Western Australia, have also been attributed to introductions of cats.

Cats have long been valued as vermin catchers.

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WHY SHOULD CATS HAVE AFFECTED native species so greatly? Australian systems have been marked by a paucity of mammalian carnivores throughout their recent history (see ANH Winter 1991), so it is possible that many species are 'predator-naive'. Yet, in the open, arid areas where extinctions attributable to cats have been most prevalent, native species would have formerly been preyed upon by a carnivorous marsupial, the Western Quoll *(Dasyurus geoffroii)*. It is possible that this species was a less abundant or a less efficient predator than the cat, and hence that its predatory impact was weak. More probably, however, effective anti-predator behaviours of prey species that co-evolved with quolls were simply ineffective in the presence of a novel predator. Field experiments on native small mammals support this notion. Both the Yellow-footed Antechinus *(Antechinus flavipes)* and Ash-grey Mouse *(Pseudomys albocinereus)*, for example, avoid the faeces of Western Quolls and hence may reduce the risk of meeting the predator itself. In contrast, neither species shows marked aversion to cat faeces placed on the ground surface, and hence little response to the presence of cats in an area.

Although the major impact of cats may be direct predation or possibly competi-

KATHIE ATKINSON

A well-fed domestic cat is able to kill up to 50 vertebrates each year in suburban areas.

tion, they carry diseases that can have adverse effects on native fauna. In eastern Australia the disappearance of Eastern Quolls *(Dasyurus viverrinus)* has been linked tentatively to toxoplasmosis, a blood disease caused by a protozoan parasite that is prevalent in feral cats. They also are vectors for sarcosporidiosis, a protozoan that manifests itself as cysts in muscle tissue and that annually causes losses of significant numbers of sheep and possibly native mammals.

Despite the abundance of observations linking cats to extensive losses of native species, other evidence suggests that their impact has been minimal. In parts of central Australia, vulnerable native fauna appeared to coexist with feral cats for several decades before declining or becoming extinct. In Tasmania, cats have been present for over a century but have not caused any known extinctions. In these situations cat predation may have been mitigated by the availability of rock piles, structurally dense vegetation, or other habitat features that act as refuges for native species. Alternatively, cat predation may be intermittent or focused on components of prey populations, thus prolonging a still-inevitable decline. At Hamilton in Victoria, for example, a population of the Eastern Barred Bandicoot *(Perameles gunnii)* is declining at about 25 per cent a year despite high adult reproduction. Cats kill over 50 per cent of the young produced and, unless controlled, will contribute substantially to the extinction of this local population. Cats and Eastern Barred Bandicoots have 'coexisted' at Hamilton for over 150 years.

FURTHER RESEARCH IS CLEARLY NEEDed to understand the precise impact of cats on wildlife throughout Australia. However, in view of the diverse body of historical, circumstantial and inferential evidence that has been adduced for the adverse effects of cats, programs of public education and cat control must also be developed now. Education programs will

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A declining number of Superb Lyrebirds led to the introduction of rigid laws for control of domestic cats in the Victorian Shire of Sherbrooke in 1991.

need to provide information on the numbers of individuals and range of native species that are killed by domestic cats, and provide information specifically to cat owners on how to reduce their pets' hunting activities. Such advice should include keeping cats indoors, de-sexing by the age of six months, ensuring that pets are well fed, taking stray domestic animals to designated animal shelters, and keeping only one, at most two, cats per household. The familiar cry that 'my cat is too old / placid / well-fed to hunt' should be put into the context that at least 90 per cent of domestic cats do kill; non-hunting pets are aberrations rather than the norm.

Programs for controlling cat numbers will need to target domestic and feral populations separately. At the local level, councils should enact laws requiring domestic cats to be identified and registered. Individual identification can be achieved simply and safely by implanting a microchip under the skin, which could be read by a scanner at a council registry. This would have the additional benefit of allowing owners to be reunited with lost pets. Councils should charge fees for registration, but subsidise costs for owners whose pets are de-sexed. As with dogs, cat owners should be charged with the responsibility of not allowing their pet to trespass on private property or public land, and of confining their cat even if just at night. Regulations embodying these and other proposals were passed in 1991 by the Shire of Sherbrooke in Victoria, and could act as a guide for councils everywhere. The enlightened decision of the Shire of Sherbrooke was taken partly to stem predation of the Superb Lyrebird *(Menura novaehollandiae)* in Sherbrooke Forest, which caused a decline from 130 birds in the 1960s to only 60 in 1990. Widespread adoption of laws by local councils would reduce the appalling toll of cats on native wildlife, and also lessen the potential contribution of domestic cats to the feral population. To ensure uniformity at the local level, State governments should ideally take the lead by legislating for cat control and providing detailed guidelines for adoption by local councils.

In contrast, feral cats will be controlled in many areas only by programs of continuous eradication or biological control. One continuous control program is being negotiated currently by the Diamantina Shire Council in south-western Queensland, in which the Federal Government will pay a bounty of $2 a scalp for feral cats. This program is intended to reverse declines of threatened species in the region, such as Bilbies *(Macrotis lagotis)* and Kowaris *(Dasyuroides byrnei)*, and follows a three-day exercise by the Australian Army along the Diamantina River in August 1992 in which sharpshooters killed over 400 feral cats.

Biological control programs should be more useful for controlling cat numbers over larger areas. At least five viruses may be useful, including feline panleucopaenia (cat flu) and feline herpes virus. However, before such organisms are liberated it will be essential to determine the susceptibility of cats and of native species that could be potentially affected. To be socially and politically acceptable, it will be important also to ensure that pet cats are vaccinated. Vaccines exist for both cat flu and the herpes virus.

A further potential advance in biological control may flow from a CSIRO-coordinated program to engineer viruses that cause self-sterility in pest species. This offers the exciting prospect that control is achieved more effectively and perhaps more ethically by reducing births rather than increasing deaths. Although research is currently centred on the rabbit and fox, it could in future target cats.

Hard decisions will clearly need to be made soon by Local, State and Federal Governments about cat control and funding. The future of much native wildlife is at stake. ■

Suggested Reading

Clutton-Brock, J., 1981. *Domesticated animals from early times.* British Museum (Natural History): London.

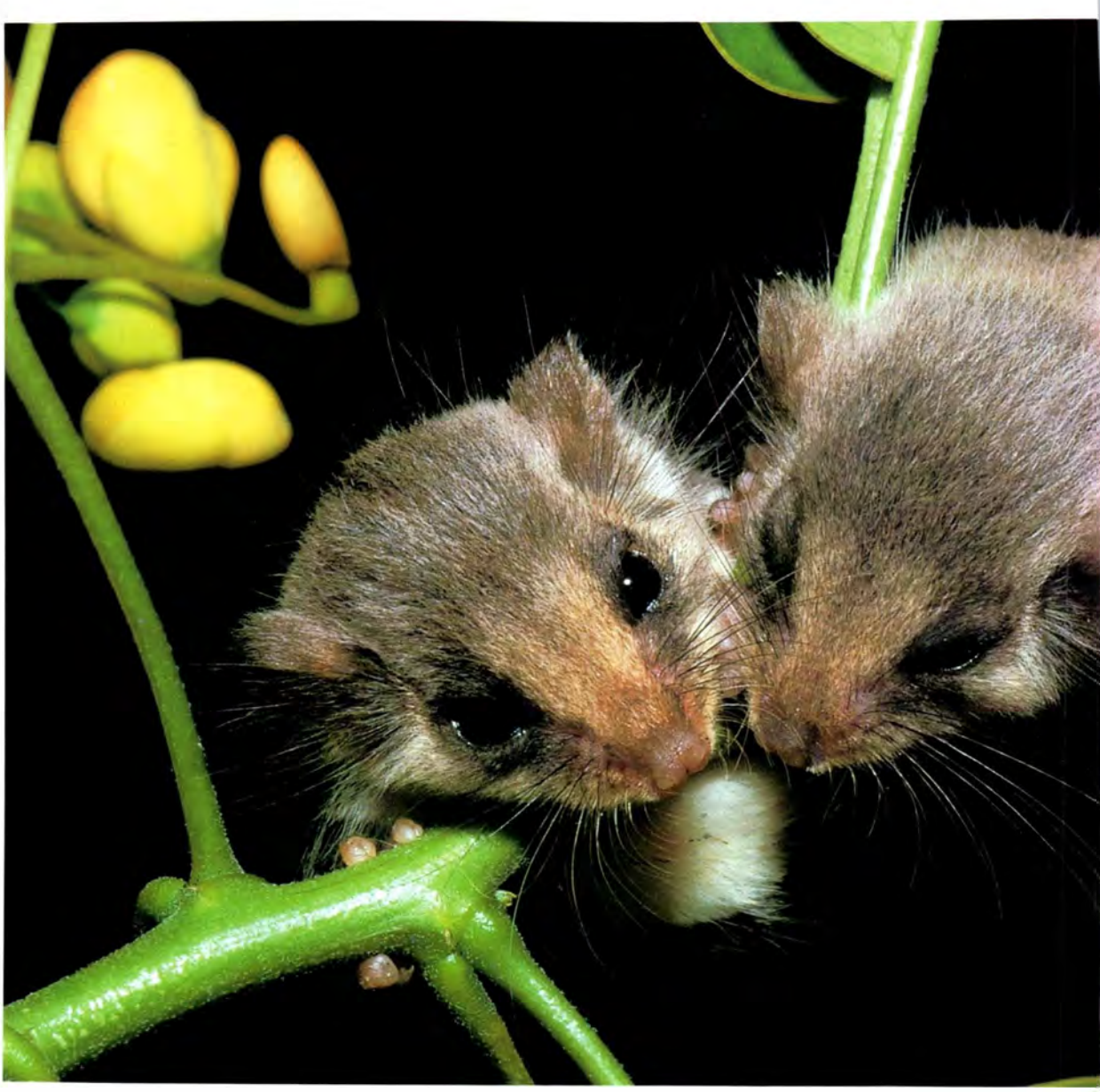
Dickman, C.R., 1992. Predation and habitat shift in the house mouse, *Mus domesticus*. *Ecology* 73: 313–322.

Jones, E., 1989. Felidae. Pp. 1006–1011 in *Fauna of Australia, Vol. 1B, Mammalia*, ed. by D.W. Walton and B.J. Richardson. Australian Government Publishing Service: Canberra.

Paton, D., 1991. Loss of wildlife to domestic cats. Pp. 64–69 in *The impact of cats on native wildlife*, ed. by C. Potter. Australian National Parks and Wildlife Service: Canberra.

Wilson, G., Dexter, N., O'Brien, P. & Bomford, M., 1992. *Pest animals in Australia.* Kangaroo Press: Kenthurst.

Dr Chris Dickman is a Senior Lecturer in the School of Biological Sciences at the University of Sydney, and Director of the Institute of Wildlife Research at the University.



PHOTOART

A bent-wing bat (*Miniopterus* sp.).

Young Feathertail Gliders (*Acrobates pygmaeus*).

NOCTURNAL PURSUITS

BY WESLEY TOLHURST

The tiny Honey-possum (*Tarsipes rostratus*).

SEVEN YEARS AGO A FRIEND AND I SAT in the school library and read through every edition of ANH Magazine we could find. I was then 14 and a keen naturalist and budding photograper. I was inspired by the unending wealth of beauty I found in the Australian outdoors, something that has never failed to amaze me.

Now, as a theology student, the philosophy behind my photography is based on the belief that the Australian wilderness is essentially balanced—or at least is much more so than man-made environments. I think it does us good to experience nature because we can learn so much from it, and to this end I use my photography.

As a nature photographer I don't feel I can claim the credit for the beauty of my photographs because the artistry has already been achieved within the subject. My photography is, therefore, an interpretation of the character of nature.

Baby Brown Antechinus (*Antechinus stuartii*).

Feathertail Glider.

Common Ringtail Possum (*Pseudocheirus peregrinus*).

NOCTURNAL PURSUITS

How did we rationalise to students the presumed impossibility of animal wheels?

LIFTING LIDS OFF THE LIMITS OF LIFE

BY MICHAEL ARCHER

A White Wheel Spider: who said animals can't have wheels?

FOR TOO MANY YEARS I UNCRITICally taught tripe to first-year university students, smug rhetoric that might have stifled their biological imaginations. "Why", they were asked, "can't animals evolve wheels?" At the time, it did seem a fair enough question. I was unaware of any animal with wheels and found it hard to imagine how such a thing could evolve. So the questions rolled on. Why *can't* animals survive in outer space? Why *can't* insects or any arthropods become as large as humans? Always the emphasis was on the presumed inability of some creature to evolve something no-one had yet seen. In effect, we taught that 'not seeing a thing existing' probably equalled 'a thing unable to exist'. How did we rationalise to students the presumed impossibility of animal wheels? No problem; it would be *impossible* to provision a rotating roll of rogue rump with blood vessels and nerves. As the wheel turned these would wind up, tear out and the misbegotten wheel would get a gangrene flat. With such facile 'Just So' stories, we flattened any urge those students may have had to consider life's potential for profound innovation.

Enough! I will never again presume to define for life its evolutionary limits, for two main reasons. First, in front of us looms the vast, incredibly exciting frontier of genetic engineering with its potential for transgenic designer beasts. If we want a plant to glow like a fluorescent light, we can click into its embryonic genome the instructions used by a firefly to produce the enzyme luciferinase; then, by adding luciferin to its water, the plant literally glows with 'de light'! And consider what borrowed genes could do for our own less than perfect bodies. Would we like stronger backs, the ability to breathe under water or protection from the sun's ultraviolet rays? Solutions may surround us in the genetic libraries of shrews, frogs and corals. Possibilities in this arena for biological innovation are simply mind-boggling.

Second, the *history* of life provides us with many additional reasons for squirming in the face of 'Life can't do it because . . . ' statements. Stretched out behind us are 3.5 billion years of 'Impossible but we *did* it!' messages written in the rocks. What may have been non-existent in one time period frequently became the order of the day in the next. Sexual reproduction with its natural transgenic experiments would have seemed a ridiculous impossibility to the sexless prokaryotes that filled Earth's younger seas.

Yet, despite an accumulating history of 'impossible' innovations, each generation was unable to visualise future possibilities. If we could time-travel back 550 million years, 150 million years before animals colonised the land, we could ask Professor Trilobite, spokesthing for one of the most successful groups of the day, "Why couldn't animals live on the land?" After shaking her gills and clacking her mouth parts in spasms of amusement at the thought, she would shriek "Surely you jest! Any animal stupid enough to leave the ocean's protective waters would starve, wither under the sun's deadly rays, turn a revolting purplish colour and die in dehydrated agony. Animals on land? Dear me, you must be mad!"

With her shrieks of laughter following us up the time tunnel, we might next stop on the light-freckled floor of a hot, dry 220-million-year-old forest. Here a snarling primitive mammal savages aromatic bits from a decomposing dinosaur's toe. "Professor Protothere", we ask, "why couldn't mammals live in the ocean?" (knowing full well that whales and other marine mammals did evolve 165 million years later). After gagging on a piece of toenail at the thought of such an absurdity, he would lean back on his meal to fix us with his most condescending look. "What extraordinary naivety! For starters, think of the fatal heat loss a hot-blooded mammal would suffer in the oceans. And how could we stop from dehydrating in that saline soup? What would happen to our helpless young when they dropped out of the birth hatch? But, hey, don't stop there! Why don't you ask me why mammals can't fly?"

And on it would go, up through time—each generation declaring future innovations impossible with all the best *ad hoc* but wrong rationalisations their limited minds could muster. And here we are again. Just another point in time with a past behind us and a future ahead. So why should we imagine that the future innovations of life will be any less 'impossible' than those that have evolved before?

Yet we can't resist the presumption that the *known* of life is the basic sum of its capacity. We still 'know' that it is impossible for animals to evolve wheels. Right? Consider the recent study by Johannes Henschel (Desert Ecological Unit of Namibia) of the wheel spiders. True, these arachnids aren't equipped with Steelcats but have evolved eight on the floor and a decidedly novel way to use them. When pursued by pompilid wasps (which use living spiders as 'stay-fresh' food for their larvae), they stretch out their eight equally long legs, like the spokes of a rimless wheel, tip on their side and begin, majestically, to cartwheel to safety down the smooth sides of the desert dunes.

True, these spider wheels may not be exactly what I had in mind when I first declared animal wheels an impossibility, but that's what they most certainly are. Further, these evolved, self-repairing, self-guiding and non-polluting wheels were clocked at speeds of almost two metres per second and 2,640 revolutions per minute, a wheel rotation rate that in a car would translate to speeds in excess of 300 kilometres per hour. Perhaps we should reconsider the design of our own vehicles, constrained as they have been by the requirements of axle-supported wheels—the same wheels that have squashed thousands of golden impossibilities before their simple biological message to us smug humans could be understood. ■

Suggested Reading

Henschel, J. R., 1990. Spiders wheel to escape. *S. Afr. J. Sci.* 86: 151–152.

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.

DR JOH R HENSCHEL / ARPL

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Most travellers pass by the Kennedy Range unaware of its striking escarpments and canyons.

SHARK BAY, NINGALOO REEF AND KENNEDY RANGE

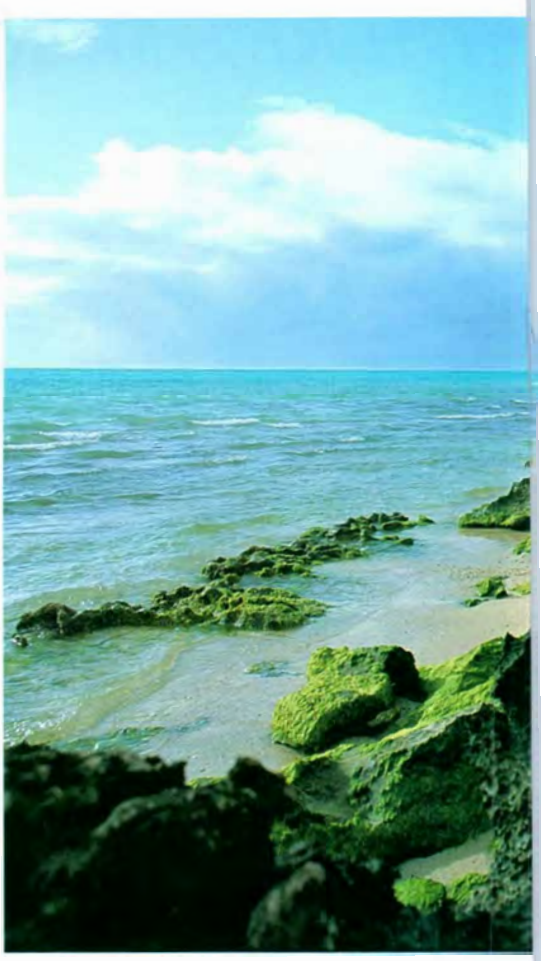
BY LORNA ROSE

THE AREA OF WESTERN AUSTRalia that forms a rough triangle joining Shark Bay, Exmouth and the Kennedy Range offers many attractions for nature enthusiasts. The main approach to Shark Bay from Perth follows the North West Coastal Highway and passes through 'everlasting' country. In late winter and spring this area is transformed into vast patchwork quilts of brilliant yellow, snowy cream and fairy-floss pink ephemeral flowers. When dried, these 'everlastings' retain their shape and colour.

It is at Shark Bay's eastern peninsula, at a point called Monkey Mia, that wild bottlenose dolphins come close to shore to visit people. Dolphin territory is refreshingly random. Zoo-like feeding times are unheard of; the dolphins have been coming to this beach of their own accord to interact with their visitors for the past 30 years.

The Monkey Mia phenomenon started one steamy summer's night in the early 1960s when a woman, unable to sleep, walked along the beach. Cooling off in the shallows she encountered the friendly dolphins for the first time. So intrigued was she that she returned night after night to establish a link. When word got around other people came, until gradually the bond between humans and dolphins became known worldwide.

Visitors may feed the dolphins only under the rangers' supervision; the fresh fish provided is placed directly into the dolphin's mouth, as teasing or touching them while feeding is prohibited. Knee-deep is the wade-in limit as the dolphins come to *you*—they may be stroked as they swim alongside. Each has its own distinctive personality (see article in this issue).

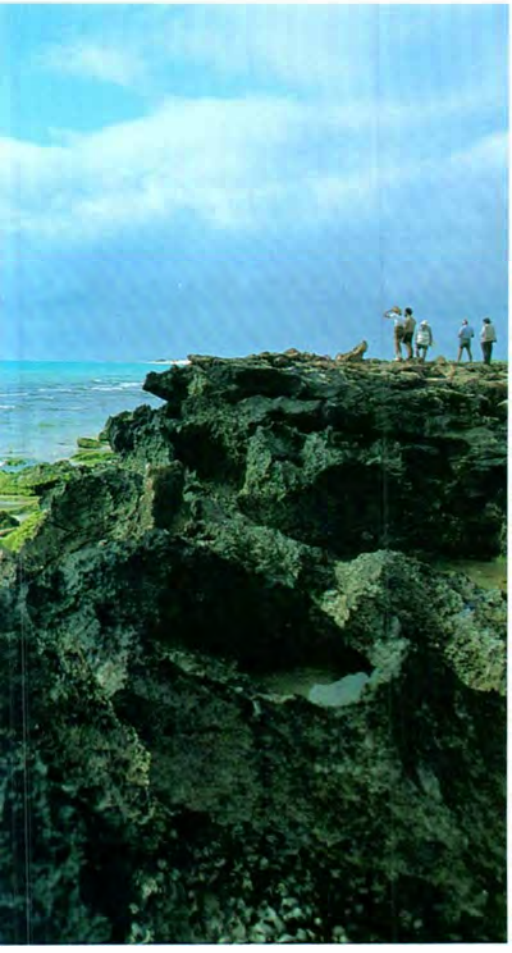


Further south are the stromatolites of Hamelin Pool—odd structures created by single-celled organisms. Although these stromatolites are only 1,000 or so years old, as a group they are an extremely ancient life form that gives us some understanding of the beginning of life on Earth (see ANH Spring 1988). Communities of millions of micro-organisms trap sediment and organic material that, over hundreds of years, form the layers that create the rock-like stromatolites. Since they are built very slowly—about five centimetres a century—the structures are not spectacular. Their shapes, however, are distinctive—like stunted, stumpy columns. Sometimes visitors even walk around looking for them, not realising they are actually underfoot! As a protective measure, a boardwalk is planned in order to minimise human impact on these fragile structures. The Hamelin Pool foreshore has been granted A-class reserve status by the Department of Conservation and Land Management (CALM), and is part of the recently proclaimed Shark Bay Marine Park.

The beach is another intriguing part of Hamelin Pool, consisting of trillions of minute sea-shells. Older beach deposits of these shells are so compacted that the

Sunset at Shell Beach, Shark Bay.

PHOTOS: LORNA ROSE



Ningaloo Reef, where turtles may be seen occasionally.

Kennedy Range, Western Australia.

original settlers quarried them and built houses—and even a church—from the blocks they called coquina. These lightweight cellular blocks provided good insulation for their dwellings. Today they are only quarried to repair the original buildings.

Shark Bay is on the doorstep of Western Australia's own stunning barrier reef: Ningaloo Reef. This is Western Australia's largest coral reef, forming a 260-kilometre line of coral that winds up the coast as far north as North West Cape. The massive living reef we see today is the outer surface of accumulated remains of previous generations of corals and over 200 species have been recorded, as well as 500 fish species.

The endangered Loggerhead Turtle *(Caretta caretta)* and the Green Turtle *(Chelonia mydas)* have nesting sites between Shark Bay and Exmouth Gulf. On some specialist tours visitors can spend time assisting in the Marine Turtle Research Project, managed by CALM, by

tagging turtles and counting eggs.

On the mainland at the northern end of Ningaloo Reef is the Cape Range National Park. Within this park the Milyering Visitor Centre provides information about the land and marine environments. There are many campsites in the park from which visitors can explore the nature trails developed throughout the area. At the end of a boardwalk among mangroves, a hide offers the chance to closely observe birds in their natural habitat. Among the birds our group spotted were a Great Egret *(Egretta alba)*, a large and graceful bird with a neck longer than its body, and a less common bird, the Collared Kingfisher *(Halcyon chloris)*, which in Australia is confined to mangrove forests.

Inland to the east, the Kennedy Range lies in the Gascoyne region within a day's drive of Carnarvon. These strange rock formations have weathered over millions of years to become a low but awesome plateau, which is reputed to contain some of the best escarpment and gorge country in Western Australia.

Lack of water in the core of the range has discouraged invasion by feral foxes and goats. However, the abundant water in valleys, springs and creeks surrounding the dry core supports a great variety of life forms. Acacias, including the Mulga *(Acacia aneura)*, Cadjeput *(Melaleuca leucadendra)*, River Red Gums *(Eucalyptus camaldulensis)* and Coolibahs *(E. microtheca)* are part of the 300 or so species of tree recorded there.

Within three days we had spotted 24 of the 50 or so species of birds from this region. Among them, the Diamond Dove *(Geopelia cuneata)*—the smallest member of the pigeon family and essentially a bird of the arid zones—feeds almost entirely on small seeds from a wide variety of ephemeral herbs and grasses. Also sighted was a Pied Honeyeater *(Certhionyx variegatus)*. The black-and-white male performs a striking aerial display by ascending vertically and then rapidly descending with wings closed and tail fanned while whistling his song.

The range abounds in marine and wood fossils, embedded in the rock or loose on the surface. On the western side of the range, chert used by Aborigines for making stone blades and spear tips is plentiful. Most travellers pass by the Kennedy Range unaware of its striking escarpments and canyons. In the south and west the plateau is carved with intricate gorges, making it a delight for walkers and climbers.

It is less than 200 kilometres drive back to the North West Coastal Highway at Carnarvon for the return journey to Shark Bay and back to Perth, or for further adventures in this amazing part of the country. ■

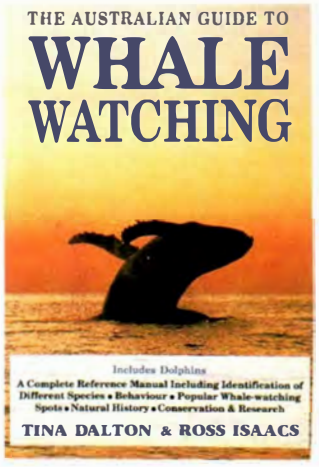
Lorna Rose is a Sydney-based horticulturalist writer and photographer. She recently travelled through Western Australia with Coate's Wildlife Tours, which specialises in wildlife and natural history tours for small groups.

FURTHER INFORMATION

Contact the Western Australian Tourism Commission in your nearest capital city for information on accommodation, transport and facilities in this area. Coate's Wildlife Tours can be contacted at PO Box 150, North Beach, Western Australia 6020; phone (09) 447 6016; fax (09) 246 1995.

REVIEWS

COMPILED BY
JENNIFER SAUNDERS



The Australian Guide to Whale Watching

By Tina Dalton & Ross Isaccs. Weldon Publishing, NSW, 1992, 96pp. $14.95.

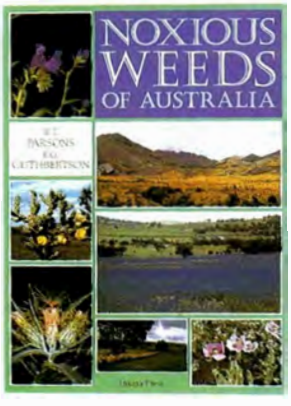
Many might consider that the market for books on whales and dolphins was already a trifle crowded. However, this new arrival on the scene fills a timely gap in the information and picture avalanche. No-one can doubt that there has been an enormous increase in interest by Australians in the marine mammals, and many people are no longer satisfied to look at pictures. This book answers the question, "Where can I see whales in Australia and what are they doing while I am watching them?" There are about 45 species of whales and dolphins in Australian waters but, when it comes to 'watching' with any degree of certainty, we are really only talking about two species. These are the Southern Right Whale and the Humpback Whale.

This book covers many of the same topics dealt with in other titles. These include chapters on anatomy, sensory systems, communication, feeding etc; all useful information. However, the really valuable chapters are those headed "Popular Whale Watching Spots" and "Behaviour". The former gives detailed information, State by State, on where to find the best whale watching spots, what you can expect to see, accommodation, access and, where relevant, the historic features of the area.

The behaviour chapter makes use of Ross Isaccs' experiences with Humpbacks and his fantastic photographs of them. This species is probably the most easily identified of the large whales and certainly performs the most spectacular displays. Fortunately for us watchers, a lot of it takes place out of the water. Each recognised behaviour feature of Humpbacks is explained (to the extent of current knowledge) and, where there is doubt, a couple of possible explanations are given. The closing chapters emphasise the need for caution in the rapidly growing industry of whale watching from boats.

Overseas experience has shown that pressure from this quarter can lead to a decline in sightings of these magnificent mammals. So keep a copy of this book and a pair of binoculars by your side when next you're sitting on a headland gazing out to sea.

—Linda Gibson
Australian Museum



Noxious Weeds of Australia

By W.T. Parsons & E.G. Cuthbertson. Inkata Press, NSW, 1992, 692pp. $175.00.

This very substantial book is layed out in a simple fashion following standard botanical classification and nomenclature. Each plant family is briefly described, and this coarse classification is followed by a detailed plant profile. Headed with the plant's common name, the profile includes its weed status (described State by State) and a map of its distribution. An explanation of the botanical nomenclature follows, as does a brief description of the plant's habitat, morphology, life cycle, origin, dispersal, properties and control method.

The method of control is given greater emphasis and, to the author's credit, cultural methods are generally put forward as the initial control treatment. I would, however, like to have seen an even greater exploration of these controls—particularly as poor cultural controls have created many weed problems. This deficiency is most probably the result of poor documentation by field operators and clearly displays the need for greater information networking within the weed control industry.

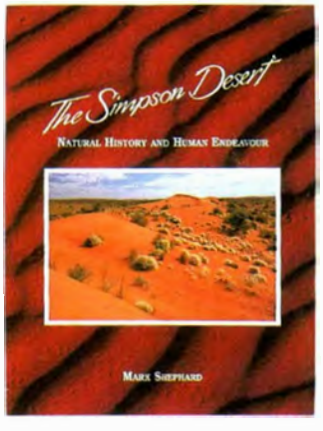
Biological as well as chemical controls are also treated in detail. Plants that have not had chemicals registered for their control are pointed out. All described chemicals are listed in the "Properties of Herbicides" appendix.

The one major flaw of this book is that chemicals not registered in Australia are suggested for use. This may encourage the importation of products that have not been tested by domestic authorities and may not be suitable for use within the Australian environment. The suggested use of unregistered chemicals is frowned upon by the New South Wales Department of Agriculture regardless of the likelihood of their future registration.

The introductory section explains the terminology used throughout, lists the government agencies responsible for weed control and provides notes on photosynthesis that may be helpful to the botanically uninitiated. A concise explanation of noxious weed legislation in Australia is most helpful and the simply worded glossary makes the book easy to use. The book is large and desk bound, so it is not suitable for use in the field. Its price reflects the quality of production and the vast quantity of information contained within.

Noxious weeds of Australia is the best book of its type I have read. I recommend it to anyone who has a vested interest in weeds and their control.

—Andrew McGahey
The Total Earth Care Company, NSW



The Simpson Desert: Natural History and Human Endeavour

By Mark Shephard. Royal Geographical Society of Australasia, SA, 1992, 184pp. $44.95.

Most Australians do not know their deserts and, until recently, the thought of travelling in them has filled most people with dread. Today, however, an increasing road network and the availability of evermore reliable and comfortable four-wheel

drives are tempting more and more people to visit them. One of the least visited, yet most unusual, of Australia's deserts is the Simpson. My first opportunity to visit the Simpson came in 1981 when I entered its southern fringe with a palaeontological expedition. The visit filled me with fascination and respect for the region, yet my enjoyment would have been enhanced enormously had I been carrying Shephard's book.

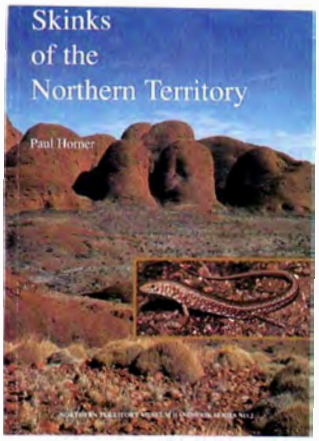
From an author's point of view, one of the best things about deserts is that they are relatively simple. So simple are they, in fact, that they can often be dealt with

authoritatively in a single-authored book of less than 200 pages. *The Simpson Desert* is such a book and manages to give a good account of the region's geology, geography, botany, zoology, Aboriginal and European history, and conservation.

Much of the information provided will be of interest to all Australians. Personally, I found the section dealing with the Wangkangurru people of the central Simpson Desert to be fascinating. The Simpson is so hostile that some late 19th-century and early 20th-century explorers believed the central parts had never been inhabited. However, the truth is that the last Aborigines to live permanently in the area left only in the late 19th century. It is difficult for us urban dwellers to imagine the level of understanding that the Wangkangurru people must have had for their environment in order to survive there. Their exit from the desert, however, was extraordinary as their survival in it, for they apparently left of their own accord. According to Shephard they heard by word of mouth about the reliable food and water supplies at Killalpaninna Mission and, over several decades, the groups just drifted in. Perhaps as a result of their voluntary presence at Killalpaninna, the missionaries found them to be the most persistent in regard to their own language and culture. We know little of their desert life, but in the words of one inhabitant Irinjili, "We knew nothing of weeks, or months, or years; we had no idea of how long we had been there. We just stayed there one night after another".

This book is both beautiful and instructive. It is large format and hard covered and, although it would be an invaluable aid in desert travel, it is not a field book and may suffer from the experience. I would recommend it to anyone with an interest in Australia's interior, history or people. It is, of course, a must for anyone who intends to travel in the Simpson.

—Tim Flannery
Australian Museum



Skinks of the Northern Territory

By Paul Horner. Northern Territory Museum of Arts and Sciences, NT, 1992, 174pp. $19.95.

The past decade has seen a marked increase in the number and scope of books devoted to the reptile fauna of Australia. Among these are several extensive treatments of all, or nearly all, the described reptile species, and various State-based field guides or handbooks for particular groups of reptiles in Western Australia, Victoria and New South Wales. The publication of Horner's handbook on the scincid lizards of the Northern Territory is the latest of these regional guides and the first of its kind for the Northern Territory.

The group of reptiles (Scincidae) dealt with in this guide are the most speciose in Australia, comprising 230 species of which almost half (96 species) occur in the Northern Territory. By virtue of the subtlety in differences between species and sheer weight of numbers, the scincid lizards of northern Australia have been one of the most problematic groups of reptiles for naturalists with either a professional or passing interest in identifying the various species. It is no mean feat for Paul Horner to have produced one of the most needed regional guides on a large and particularly complex group of reptiles.

This handbook is exemplary in its layout and style. There is a brief account of each genus consisting of a diagnosis, the number of species Australia-wide and in the Northern Territory, and the world distribution for the group. A key to all the Northern Territory species is given and includes illustrations of certain diagnostic features. Each species account is clearly set out in sections that diagnose and describe the species; list similar species; give the distribution, including a spot locality map and habitat preferences; and provide remarks on abundance and habits. The species descriptions consist of an account of the colour, pattern and certain features of scalation. In most cases, the colour description in combina-

tion with the colour photograph is usually sufficient to allow each species to be confidently identified. The colour photographs are presented in blocks of four to a page which, although variably spread throughout the text, are usually found in close proximity to the relevant species account.

Of particular value are the detailed spot distribution maps and the broad coverage of photographs (all referenced with the locality). These maps provide a level of resolution otherwise only available in scientific publications, and are extremely effective at portraying fragmented or restricted distributions–features that tend to be lost in generalised 'broadbrush' maps. The localities associated with identification photographs are a resource that is somewhat taken for granted. As the pool of published photographs gradually increases, so will the level of coverage of widespread species, providing a valuable source of information on geographic variation.

The only criticism to be made of the text is that remarks on biology or variation in colouration are not referenced, hence there is no way of knowing whether all or only some of the comments made are the author's original observations. Outside of this comment, Paul Horner's handbook sets the standard for this type of publication, and hopefully it will be just the first in a series on the reptiles of the Northern Territory.

—Ross A. Sadlier
Australian Museum

Encyclopaedia of Australian Animals

Series edited by Ronald Strahan.
***Birds** by Terence R. Lindsey, 469pp. $49.95.*
***Reptiles** by Harald Ehmann, 495pp. $49.95.*
***Mammals** by Ronald Strahan, 184pp. $29.95.*
***Frogs** by Michael J. Tyler, 109pp. $29.95.*
Published by Collins Angus & Robertson, NSW, 1992.

I have said, *ad nauseum*, that when I first came to Australia (in 1961) there was scarcely a book to be bought on the Australian fauna and, those that were available, were old-fashioned and of little use. In the last 20 years, however, that gap has been filled, and one of the most enthusiastic gap-fillers has been Ronald Strahan, now of the National Photographic Index of Australian Wildlife.

Over the years, the National Photographic Index has accumulated thousands of excellent photographs of Australian mammals, birds, reptiles and frogs. These spawned, among other books, the *Reader's Digest book of Australian birds* and the Museum's *Complete book of Australian mammals*. Both remain superb references but, as new vertebrates are discovered, current species are split or lumped together, genera and species are renamed, and some species disappear, updates are required from time to time. These four volumes (mammals, birds, reptiles and frogs) do just that.

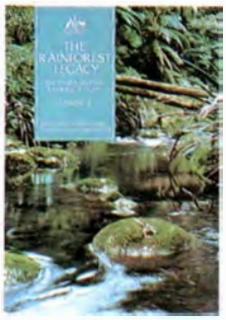
All known species at the time of writing are included with a photograph from the index and about 200–300 words on the biology, habitat, dimensions, distribution, level of abundance and status. One new idea is an attempt to give each species an 'official' common name. It's praiseworthy but, in my opinion, names like the 'Orange-tailed Finesnout Ctenotus' are not as catchy as *Ctenotus leae*, although it is better than that given to one common English moth ('Sebaceous Hebrew Character'). A better idea was to translate the scientific names, and show how they are pronounced.

The introductions explain the useages within the volumes, but anyone who buys all the books should note that the abundance of reptiles is determined differently from those of other animals.

The production and the photographs are excellent, apart from the fuzzy Barn Swallow. The prices too are reasonable, partly owing to the generosity of sponsors, and the four volumes can be bought independently.

As Strahan should have taught me to say, back in his Oxford days, "Good on yer Ron".

—Arthur Woods
University of New South Wales



The Rainforest Legacy Vol. 3: Rainforest History, Dynamics and Management

Ed. by Garry Werren & Peter Kershaw. Australian Government Publishing Service, Canberra, 1991, 309pp. $24.95.

This volume completes the publication of the proceedings of a workshop held at Griffith University to discuss the geological and contemporary history, ecosystem dynamics, and conservation issues of Australian rainforests.

There are 28 chapters in Volume 3, covering rainforest origins; pollen and fossil evidence; geological history of southern cool temperate and warm temperate rainforests; disturbance impacts and regeneration; management of production forests, national parks and reserves; nursery techniques for rainforest regeneration; recreational usage and management policy; and impacts of herbivores on leaf production.

Given that the workshop was held in 1983, my initial feeling, when viewing Volume 3, was that events both political and biological had probably dated most of the papers. While this is at least partly true for those chapters dealing specifically with rainforest conservation policy and conflicts (although these have historic interest), the majority of papers contribute much new information or reinforce data and statements elsewhere in the accumulating Australian rainforest literature.

As a result of the prevailing paradigm of Aboriginal culture living in simplistic environmental harmony, several chapters make for compelling reading. Chapter 1, in addressing the origins and evolutionary significance of Australian rainforests, confronts the impact of Aboriginal burning on continental rainforest distribution and composition. McPhail, in Chapter 4, provides further evidence of probable burning impacts by Aboriginal use of fire on Tasmanian cool temperate rainforests. When the impacts of Aboriginal burning practices on plant communities are added to their probable impacts on the Australian megafauna, we see a culture "fashioning a new environmental harmony", not one necessarily coexisting in romantic tranquility with the ecosystems and the biota upon which they progressingly stumbled.

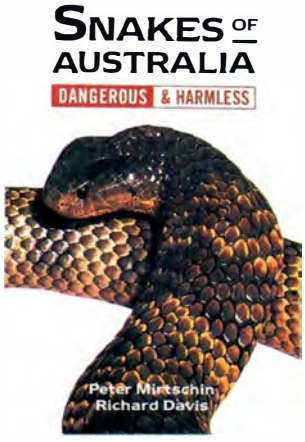
Werren and Sluiter, in Chapter 3, review the history of Australian rainforest origins and emphasise its autochthonous development rather than being an invasive, impoverished and attenuated version of South-East Asian rainforests. This early concept of Australian rainforests being the poor cousins of the tropical rainforests to our north is long overdue for burial.

Of equal interest is the departure from the view that Australian rainforest persists in some archaic, primeval condition. Marked oscillations in the nature and extent of rainforest are evident throughout the continent. In Chapter 6, for example, McPhail notes that cool temperate rainforest in Tasmania did not begin establishing in its modern form until approximately 10,000 years before present. By the measure of longevity of some tree species, this has not allowed for many generations of trees to have passed. How have such dymanic expansion–contraction cycles and the reassigning of plant composition and dominance within communities

influenced the establishment and maintenance of rainforest plant–animal relationships?

However, change is not always reliably dynamic and Nan Nicholson's reflection in Chapter 22—that, for all the public awareness of rainforest, there has been only miniscule rainforest replanting and rehabilitation, and that rainforest on private land remains subject to degradation—still holds true. These comments, made approximately one decade ago, need little qualification.

—Geoff Williams
Australian Museum



Snakes of Australia

By Peter Mirtschin & Richard Davis. Hill of Content Publishing, Vic., 1992, 216pp. $24.95.

Australia has one of the richest reptile faunas in the world, with more than 530 lizards, 175 snakes, and new species still being discovered each year. This abundant fauna has inspired a bounty of colourful and attractive books, of which this is one of the most recent.

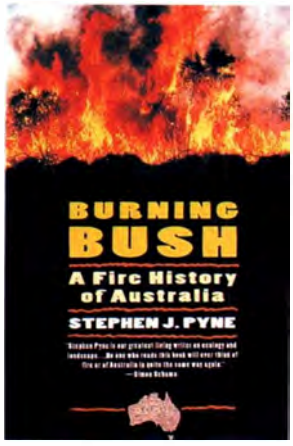
Snakes of Australia is a compact field guide that illustrates each snake with a colour photo, text and distribution map, all on the same page. The guide is almost comprehensive but omits most of the blind snakes (Typhlopidae) and many of the sea snakes, and a few obscure land snakes are described but not illustrated. The text includes detailed descriptions and information on habits that is sometimes comprehensive and interesting, but in other cases very brief and cursory, depending on the authors' knowledge. There are also brief chapters on snakebite treatment and conservation.

This book has two major shortcomings. To cut costs, the publishers have printed all the photos the same tiny size—most should have been printed much larger for easier identification. They do not always show clear facial markings, often a helpful guide to identification.

Also, the issue of toxicity is poorly handled. Most Australian snakes are venomous, but very few can kill. The majority deliver a bite that, on humans, produces only tingling, stinging, or no symptoms at all. The authors do not explain this. Each snake is given a rating (usually "venomous") but without any interpretation. This rating fosters the impression that Australia's snakes are more dangerous than they really are. Snakes in the genus *Simoselap* and *Furina*, listed here as "venomous", are in fact completely harmless. I used to play with them as a child!

Snakes of Australia is nonetheless an attractive and informative book, providing a good overview of Australia's snake fauna in an accessible format. It is an expansion of the authors' earlier book, *Dangerous snakes of Australia*, published by Rigby in 1982.

—Tim Low



Burning Bush: A Fire History of Australia

By S.J. Pyne. Allen & Unwin, NSW, 1992, 520pp. $19.95.

Pyne gives Mark Twain, a fellow American, the opening words of his book. "[Australian history] does not read like history, but like the most beautiful lies." After reading *Burning bush*, one could easily be convinced that previous Australian histories have missed the truth, and that a great proportion of history's beauty is encompassed in this work.

Burning bush is history through the eyes of an ecologist, and its great strength is that it examines the Australian people and their land through the relationship of fire. All histories should perhaps begin with a description and analysis of the land where the action occurs, and Pyne gives us a wonderful account of the evolution of the Australian continent and its biota, and of the role that fire has had in shaping it. One leaves this early segment of the book in awe of the extraordinary differences between Australian ecosystems and those elsewhere. It reinforces the view that it is the very poverty of Australian ecosystems that has allowed fire to dominate. Were our ecosystems richer, they could have supported sufficient numbers of large herbivores to consume vegetation through grazing and browsing. Fire would then perhaps not have been so dominant.

Some of the most fascinating insights in the book come from accounts of the use of fire by Aborigines and early Europeans. Fire was the only means of shaping the landscape in the early days, and whoever controlled the fireband controlled the means of production. Pyne skilfully outlines how fire, used in various ways, could benefit either European stock or the natural ecosystems.

Much of the rest of the book is a detailed history of how Australia's various forestry services have tried to cope with fire. Pyne outlines how Australia has gone down what is essentially a one-way street as far as fire is concerned. For fire can only be fought with fire, and each successive burn leads to increasing dominance of fire-promoting plants. It seems that we are stuck with the great tragedies, such as Ash Wednesday, that periodically race through this continent's south-eastern fire flume.

In style, the book is somewhat repetitive and wandering, which is a pity. It is, however, a fascinating book that should be on every high school reading list. It is, in my mind, the definitive history of our continent. I only wonder why it took an American to write it!

—Tim Flannery
Australian Museum

Just Published

May 1993

Australian Indigenous Orchids Volume 1 Part 2
By Alick Dockrill. Surrey Beatty & Sons, NSW. $78.00.

Cycads of the World
By David L. Jones. Reed Books, NSW. $45.00.

Wildlife of Gondwana
By Patricia Vickers-Rich & Thomas Hewitt Rich. Reed Books, NSW. $49.95.

Justice and the Earth
By Eric T. Freyfogle. Maxwell Macmillan, NSW. $32.00.

June

The Moral Sense
By James Q. Wilson. Maxwell Macmillan Publishing, NSW. $36.95.

July

Reader's Digest Illustrated Guide to Australian Places
Reader's Digest, NSW. $70.00.

August

Birds of Prey of Australia
By The Australian Museum & Penny Olsen. Angus & Robertson, NSW. $95.00.

Light on Australia
By Barry Slade. Angus & Robertson, NSW. $39.95.

Myrtaceae
By John Wrigley & Murray Fagg. Angus & Robertson, NSW. $85.00.

A Field Guide to Frogs
By Martyn Robinson. Reed Books, NSW. $19.95.

THE DIRECTORY

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Anthropological Society of WA
c/o Anthropology Dept, University of WA, Nedlands, WA 6009
Phone: (09) 444 5752

Contact: Irene Ham, Hon Secretary

BIRDS

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PO Box A313, South Sydney, NSW 2000. Phone: (02) 688 0861

Contact: Dr Graham Ronald, President

BOCA, Bird Observers Club of Australia
PO Box 185, Nunawading, Vic 3131. Phone: (03) 877 5342

Contact: Mrs Zoe Wilson, Manager

Branches and representatives Australia wide; Information on request. Participation welcome in current BOCA projects "Birds and Wattles Survey" and "Winter Food of Pied Currawongs".

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Contact: Michelle Rice, Development Manager

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Contact: Mr L Horder

National Parks Association of NSW
PO Box A96, Sydney South NSW 2000. Phone: (02) 264 7994

Contact: Carol Davies, Office Coordinator

The NPA is a non-profit, community organisation working for a system of reserves that protect the complete range of habitat, features and cultural items.

CONSERVATION

Coast and Wetlands Society
Box A225, PO, Sydney South, NSW 2000. Phone: (02) 697 2076

Contact: Dr Paul Adam, President

Promotes appreciation and conservation of all aspects of coast and wetland ecosystems; conducts research; advises other agencies; promotes ecological principals in conservation, development and utilisation.

Conservation Council of SA
120 Wakefield St, Adelaide SA 5000. Phone: (08) 223 5155

Contact: Michelle Grady, Admin Officer

Oatley Flora and Fauna Conservation Society
PO Box 52, Mortdale 2223

Contact: Keith Underwood

Queensland Conservation Council
PO Box 12046, Elizabeth St, Brisbane, Qld 4002
Phone: (07) 221 0188

Contact: Ms Nicky Hungerford, Project Officer

QCC is a non-profit, non govt. community conservation group. We coordinate conservation groups throughout Queensland as well as work on environmental issues and campaigns.

WWF, World Wide Fund for Nature Australia
Box 528, GPO Sydney, NSW 2001. Phone: (02) 247 6300

Contact: Ms Jacquie Ashton, Communications Manager

Join WWF in actively helping to conserve and protect our natural environment. Projects include threatened species, reducing pollution, establishing reserves, protecting Antarctica, ending illegal smuggling.

Tasmanian Conservation Trust
102 Bathurst St, Hobart, Tas 7000. Phone: (002) 34 3552

Statewide voluntary organisation working on protecting our historic and natural heritage; threatened species; saving soils, coastline; cleaning up rivers, beaches and air; and scientific research.

ENVIRONMENTAL

Gold Coast & Hinterland Environmental Council
PO Box 344, Palm Beach, Qld 4221. Phone: (075) 34 1412

Contact: Brian Talbot

GEOGRAPHIC

The Royal Geographical Society of Queensland
112 Brookes St, Fortitude Valley, Qld 4006. Phone: (07) 252 3856

Contact: Kath Berg, Administrator

The Society organizes an interesting program of lectures and trips; maintains a library; publishes a newsletter & journal; supports geographical education and research.

INSECTS

The Society for Insect Studies
c/o Entomology Dept, Australian Museum, 6-8 College St, Sydney 2000. Phone: (02) 339 8348

Contact: CE Chadwick, President

Meets in Peppermint Room, Australian Museum, every second month, commencing February. Lectures, demonstrations, colour slides on entomological subjects. Visitors welcome.

MUSEUMS

TAMS, The Australian Museum Society
Australian Museum, PO Box A285, Sydney South, NSW 2000.
Phone: (02) 339 8225

Contact: Susan Bridie

Society members enjoy free admission to the Museum, their own magazine, lectures, seminars, field trips, films, excursions and expeditions.

Friends of the Queensland Museum
c/o PO Box 15, Beaudesert, Qld 4285

Contact: Virginia Enright

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PO Box 21, Borden, WA 6338
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Contact: Mrs Amelia Moir, Hon Secretary

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QUESTIONS & ANSWERS

COMPILED BY
JENNIFER SAUNDERS

JEAN-PAUL FERRERO / AUSCAPE INTERNATIONAL

Cane Toad: predator or prey?

Tasty Toads?

Q: ***In our area (Gympie • Queensland) the Cane Toad grows to a maximum length of 100 millimetres. The number of toads over the last few years has fluctuated due to weather conditions but are still numerous. Two years ago I noticed the Sacred Ibis eating the small toads up to 50 millimetres in length. I assumed the birds would die. This year the ibis have had a limited food supply and again the Cane Toads are on the menu. And it is not just the occasional toad that is eaten—one bird visited our garden twice daily to feed until there were no toads left. Why is it that these birds seem able to eat the toad with no ill effect? Are there other animals that are also able to do this and does this predation now mean that the toads will not be the problem we thought they first would be?***

—C. Pickering
Gympie, Qld

A: Although I have not personally observed Sacred Ibis feeding on Cane Toads, I have received similar reports. Sacred Ibis can apparently tolerate the toxins that are present in the Cane Toad venom. They are not alone in this ability, as a few other native species also appear to be able to cope with toad toxins. The Keelback Snake *(Tropidonophis mairii)* can apparently consume toads with no ill effect, as can some freshwater tortoises, frogmouths and crayfish.

Other native animals consume toads by avoiding their toxins altogether. In some areas, Water-rats *(Hydromys chrysogaster)* are voracious predators on Cane Toads by turning the toads over and attacking their ventral side, thereby avoiding the toxic dorsal skin. My students and I have observed large numbers of toads eaten in this way by the Water-rats. Common Koels, Black Kites and crows have been observed attacking toads in this way. Meat ants sometimes attack and consume small metamorphic Cane Toads as they emerge from dams. (At other times and places they ignore the toads, and it may be that ants in particular populations have learned to avoid consuming toxins while eating toads.)

There are also, unfortunately, many native predators that do not seem to be able to either detoxify toad venom or avoid eating the dorsal skin. Goannas and many snakes often fall victim to toad venom, particularly in areas recently colonised by Cane Toads. Quolls ('native cats') may also be poisoned by toads, as may many other predators. Interestingly, snakes and goannas living in areas where toads have been present for some time are apparently seldom poisoned by them. Either natural selection has led to instinctive avoidance of toads, or young animals try to eat small toads and are made ill, thus learning to avoid them.

The eggs and larvae of toads are also toxic and may affect many aquatic invertebrate predators, as well as the tadpoles of native frogs, many of which opportunistically prey on other frog and toad eggs. We are currently doing research to discover the extent of these effects. Fortunately, all fish we have tested are able to detect the toxins and avoid eating toad eggs and tadpoles.

In summary, many native animals can deal with the toads, by detoxifying their venom, eating only the nontoxic parts, or avoiding them altogether. We do not yet know enough about how Cane Toads affect native animals to be certain how they affect native ecological systems.

—Ross Alford
James Cook University, Qld

PAVEL GERMAN

PIC TEASER

Do you recognise this? If you think you know what it is, then send your answer to Pic Teaser, ANH Magazine. Please don't forget to include your name and address. The first correct entry will win a $20 gift voucher from the Museum catalogue. Autumn's Pic Teaser was a mite *(Pheroliodes* sp.). These animals live in the soil and help recycle organic matter.

ESTHER BEATON

Satin Bowerbirds have a distinct preference for the colour blue.

Courting with Colour

Q: The Satin Bowerbird has always intrigued me. Why do they collect blue items? I've heard that they will deliberately remove red objects from their bower. Is this true?

—Katie Flanagan
Wyong, NSW

A: Male Satin Bowerbirds *(Ptilonorhynchus violaceus)* are very selective builders when it comes to constructing a bower and collecting objects in order to attract females for mating. Although a liking for the colour blue vastly predominates in their collection of display objects, four other minor colours are sometimes included. These colours are yellow, green and, rarely, brown and grey—no departure from this scheme is tolerated. It appears that the more blue items the male displays in his bower, the more females he will be able to attract. When objects of other colours are introduced to the bower (including red), they are rejected by the bird. Bowerbirds choose objects that they find attractive not only in colour, but in shape and size. Other species of bowerbird have different colour preferences. The Great Bowerbird *(Chlamydera nuchalis)*, for example, collects white objects such as bones, old snail shells and broken glass.

—Walter Boles
Australian Museum

Answers to Quiz in Quips, Quotes & Curios (page 13)

1. A deep-sea chimney out of which pours hot water laden with metal sulphides.
2. Paul Davies
3. Male
4. Kiwis
5. They were raised by wolves.
6. Either the Leatherback Turtle or Saltwater Crocodile (both can weigh over 900kg).
7. Originally published as *Australian Museum Magazine* in 1921; name changed to *Australian Natural History* in 1962.
8. Gouldian Finch
9. Great Artesian Basin, now known as the Great Australian Basin.
10. Eight

Why make desperate attempts to save endangered organisms when core areas of biodiversity remain vulnerable?

IS CONSERVATION BIOLOGY THE DISMAL SCIENCE?

BY DAVID M.J.S. BOWMAN & PETER J. WHITEHEAD

"RARITY, AS GEOLOGY tells us, is the precursor to extinction." So wrote Charles Darwin on page 153 of *The origin of species* (1859).

What would the greatest naturalist of all time make of the current eleventh-hour attempts to pull back numerous 'threatened', 'rare' and 'endangered' organisms from the brink of oblivion? We think he would be utterly unsurprised at their plight, but probably amazed at the futile attempts to resist the inevitable. Once an organism has been *made rare*, be it through natural means or intentional or unintentional human activity, it is probably too late to secure the species' evolutionary future. Darwin elaborates his blunt message on page 323 of the *Origin:* ". . . that to admit that species generally become rare before they become extinct—to feel no surprise at the rarity of a species and yet to marvel greatly when it ceases to exist, is much the same as to admit that sickness in the individual is the forerunner of death—to feel no surprise at sickness, but when the sick man dies, to wonder and suspect that he died by some unknown deed of violence".

To conserve biodiversity in the long term we must follow Darwin's dictum and ensure that organisms we wish to conserve don't decline to the status of threatened rarities. Practical experience clearly shows the best way to achieve this is to ensure that habitats are not destroyed or degraded. In Darwin's parlance this means treating the illness before it becomes terminal, rather than depending on heroic efforts and a range of artificial life-support systems to prolong the patient's final gasps.

There is no doubt that numerous organisms are shortly going to cease to exist in the wild. Their demise is an inevitable outcome of expanding human populations with an attendant desire for good living standards. It is equally clear that the money available for nature conservation will not be congruent with the scale of the problem nor permit a species-by-species approach. For example, despite access to the resources of the richest country in the world, attempts to rescue the California Condor have culminated in the capture of the last surviving wild birds to supplement captive breeding programs (see ANH Autumn 1993). Given the extent of habitat deterioration, it is unlikely that this species will ever survive as a self-sustaining wild population, and is destined to see out whatever time is left to it as a zoological curiosity.

Obviously conservation priorities have to be set. Should we spend valuable resources in desperate attempts to save endangered organisms, while the core areas of biodiversity remain outside formal reserves and thus remain vulnerable to substantial modification? Just because organisms in these 'core' areas are not under threat at present does not mean they will not join the queue to oblivion in the future. In relation to nature conservation, campaigners for 'wilderness' (that is, large tracts of land unmodified by industrial civilisations) had it partly right, although their motivation was often more aesthetic than biological.

Currently the Australian Federal Government allocates more than $4 million annually to endangered species programs. State and Territory agencies also devote substantial proportions of their tight budgets to the same or similar projects. At existing land prices an equivalent program of expenditure in the Northern Territory could add thousands of square kilometres to the current biogeographically unrepresentative reserve network, and contribute significantly to its management costs.

We recognise that such monetary comparisons are invidious: they can be seen to put dollar values on the products of evolution, which are universally accepted as priceless. Nonetheless, funds are finite and threats manifold. Habitat protection of a quality and quantity that provides for self-sustaining populations should be the ultimate goal of any wildlife conservation program. But even with such a goal, overzealous and uncritical pursuit of the conservation of a few species may be ultimately self-defeating: diversion of resources away from effective management of core areas will contribute to the ongoing creation of new problems, in turn placing additional strains on nature conservation agencies. Meeting the habitat needs of a few of our more charismatic fauna will do little for the majority of the species, but might contribute more to the preservation of governments. Endangered species programs provide unusually attractive decoys that distract attention from a failure to address more fundamental land management issues.

The first step towards setting priorities should be to define core areas of biodiversity by analysing existing information about the distribution and abundance of wildlife at a broad biogeographic scale. We need a similarly broad overview of available conservation funding, uncluttered by artificial subdivision into programs reflecting today's fads and fleeting political imperatives, and re-appraisal of how those funds could best be used to optimise *long-term* conservation benefits. Without such basic re-assessments of local and national options, conservation efforts will increasingly treat only the most spectacular symptoms of the current biological transaction that is substituting people and 'progress' for biodiversity.

Darwin's thoughts on extinction were directed at understanding evolutionary processes: to invoke his authority in the context of our current difficulties could be seen as misguided or, worse, as misleading. But Darwin clearly understood the role of humans as an agent of scarcity. Most biologists recognise that their science continues to depend fundamentally on his profound insights and analysis. His writings on the consequences of rarity remain as relevant today as they were more than 130 years ago. ■

Dr David Bowman and Peter Whitehead are wildlife research officers with the Conservation Commission of the Northern Territory. Their views expressed here do not necessarily reflect those of the CCNT.

An alternative point of view regarding the issue of conservation priorities will be presented in the next issue of ANH by fellow CCNT friend and colleague John Woinarski.

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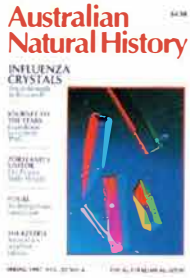

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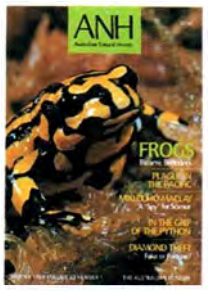

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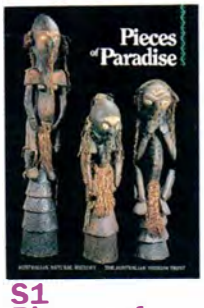

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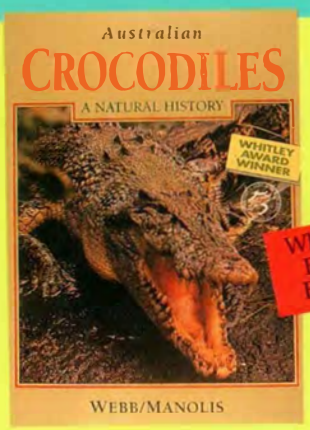

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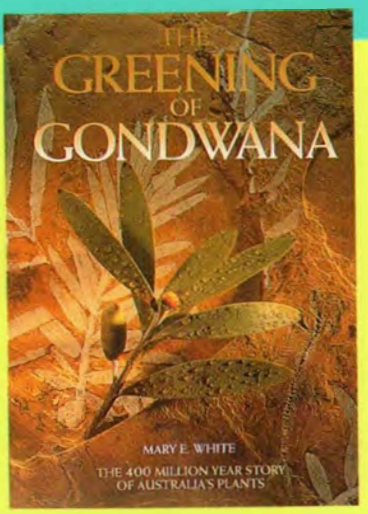

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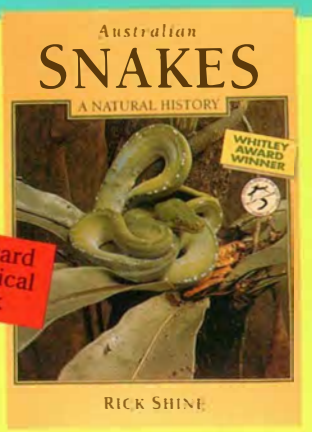

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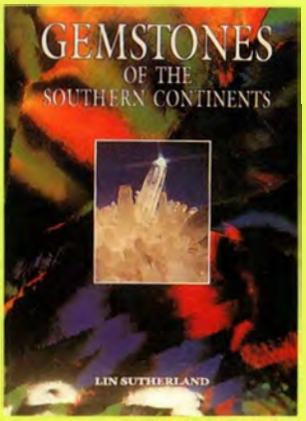

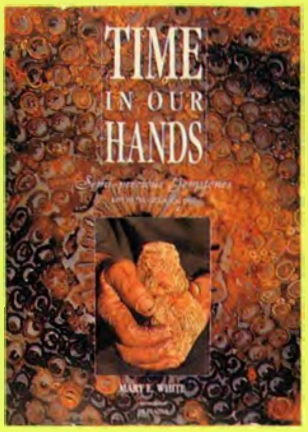

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