AUSTRALIAN Wildlife

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Celebrating a new century of wildlife preservation in Australia

Journal of the Wildlife Preservation Society of Australia Limited
(Founded 1909)

Blue tongue lizard

Photos by Chrissy Banks

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What it's all about. Losing the Tasmanian devil is not an option. Devils bred at Devil Ark will repopulate Tasmania when necessary.

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Australian Wildlife Society
Conserving Australia's Wildlife since 1909

Australian Wildlife

is the official journal of the Australian Wildlife Society (Wildlife Preservation Society of Australia Limited).

Founded in 1909, the Society is dedicated to the conservation of our unique Australian wildlife in all its forms.

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Notice to our members

The Australian Wildlife Society (Wildlife Preservation Society of Australia Limited) is managed and controlled by an elected board of ten volunteer directors. The Society is a registered company limited by guarantee with ASIC and is responsible for complying with all its regulations.

Any member who might like to consider serving as a director of the Society is invited to contact the national office for more details. The most important qualification to serving as a director is 'a commitment to and love of Australian wildlife'.

The Society holds regular monthly meetings on the first Wednesday of each month in Sydney.

The Editor would like to feature a member's profile in the fortnightly email newsletter and occasionally in our quarterly magazine. Members are invited to consider submitting a short article with a photograph for possible publication.

Our Mission

The Australian Wildlife Society (Wildlife Preservation Society of Australia Limited) is an independent, voluntary, non-profit conservation organisation, formed in 1909, and is committed to the preservation of Australia's precious flora and fauna. We act as a watchdog and provide advice to government agencies and institutions regarding environmental and conservation issues concerning all aspects of wildlife preservation. Our mission is to conserve Australia's fauna and flora through education and involvement of the community. We are dedicated to the conservation of our unique Australian wildlife in all its forms through national environmental education programs, political lobbying, advocacy and hands on conservation work.

Our Society has always known that a conservation battle is never really won until the victory is enshrined in legislation. We have always tried to convince politicians of the necessity to include the preservation of Australia's precious wildlife and its vital conservation habitat in all their planning and environmental issues and discussions.

From the President's desk

Suzanne Medway AM - President

Australia can be a harsh land for its native wildlife inhabitants, dealing with heat, cold, flood, drought and bushfires on a daily basis to survive

Over the past months we have heard many stories in the media about the effects of devastating bushfires on people and their homes.

Occasionally we hear or read a story about rescued wildlife, but not very much is publicised about the wonderful wildlife volunteers that work so hard to rescue hundreds of animals injured in bushfires and the hours of their time they spend having to voluntarily euthanize injured wildlife that are beyond recovery.

We do not hear of the hundreds of injured, starving and thirsty native animals emerging in burned areas or of the wildlife shelters struggling to cope with the influx of seriously injured animals after the fires.

We do not hear of the rescue and recuperation work that continues in the aftermath of bushfires for weeks and months on end.

We do not hear of the starvation effects because there is no grass anymore for the animals to eat.

We do not hear of the residents that do all they can for injured wildlife, even though they may have lost their homes, properties, buildings, fencing, livestock and pets.

Through our Facebook page you can post a message to these wonderful people saying thank you for their tremendous efforts in helping to save our precious wildlife.

The future

It is hard to believe that our Society just celebrated its 105th Annual General Meeting. It is also hard to believe that I have served in the role of President since 2010. I joined the Wildlife Preservation Society in 1988 and became a Councillor of the Board in 1990. In 1995 I became the Honorary Secretary of the Society, membership officer and editor of the quarterly magazine *Australian Wildlife*. To this day, I am responsible for all publications, leaflets and newsletters, as well as maintaining the Society's website.

It will be a sad occasion when I step down as President at the May 2014 meeting of the Board of Directors, but I am very excited about Dr David Murray becoming the newly elected President. I am sure he will do an admirable job leading the Society forward into its 106th year.

A full report of the 105th Annual General Meeting and the AGM Luncheon will be featured in the winter edition of *Australian Wildlife* magazine.

A new-born common brushtail possum. Find out more on page 11.

Western pygmy-possums

Australian bush survivors

Sophie Petit, University of South Australia

"With my ability to lift heavy things and your skills in research, we can't fail," said former Australian Commando Damian Morrant, trying to boost his morale at the start of our difficult project. Damian Morrant, a hefty and tall blond Australian, is not just a remarkable set of muscles; he also has a commendable brain and an infinite series of army sayings and stories for every occasion. His stamina, skills, and sensibility made him the perfect candidate to complete an ambitious project: to find out how the elusive western pygmy-possums were spending their time in a place where most other mammal species had become extinct.

Western pygmy-possums, *Cercartetus concinnus* (Burramyidae), weigh only about nine grams and fit in the palm of your hand. They are marsupials and the females carry their newborn in a ventral pouch before they are old enough to be left alone in a nest, a cavity furnished with selected leaves. They feed mostly on nectar and pollen.

The very strong bias in captures during the summer at Innes National Park (southern Yorke Peninsula) was intriguing. Were the possums moving away, dying off during the winter, or using torpor? Few suitable flowers were available in winter. What were pygmy-possums eating at that time? The fact that they are small and nocturnal made the study of their activities rather difficult. Who could run through dense South Australian bush all night, in all temperatures, and carrying heavy packs of gear, better than a former Australian Commando?

Damian Morrant thought he had seen it all in his international career in the Army. He had enough of the sleepless freezing or torrid nights, carrying whatever he would need to stay alive through inhospitable landscapes. He returned to university studies to become what he was deep inside meant to be: a proper tree hugger. Selected as a high achiever to complete an Honours research year, he naively accepted to investigate the movements of pygmy-possums as a function of flowering plants. Damian Morrant had not seen it all.

"It compares well with Commando training," he gasped a couple of months later as we were crawling through our third kilometre of thick native pine bush one cold and damp

Above: Torpor, a form of deep sleep that minimises waste of energy, is undoubtedly an important factor in the survival of pygmy-possums when conditions are unfavourable; the animals roll themselves up into a tight ball and may not wake up for days. All photos were taken by Sophie Petit.

night, equipped with radio-tracking antennas, receiver, head torches, and heavy backpacks. Our stamina had been tried, but not beaten. What we learned that night made us understand that there was a lot more to pygmy-possums than was thought possible: they were amazing, magical, and utterly endearing creatures. We were hooked on one of the earth's remarkable mammals and no amount of suffering could distract us from this fascination and the desire to know more.

Our objectives were to capture pygmy-possums and radio-track them to determine their movements as a function of flower availability. Capturing pygmy-possums is not a simple task, and many pitfall traps (buckets in the ground) were used and checked before daylight. We fitted transmitters to the back of pygmy-possums with veterinary glue and released the animals after sunset. Because of their small size, the transmitters had a low-power and short-lived battery, meaning that we had to stay close to our target animal so as not to lose it. Hand-picked quality volunteers were crucial to the success of the project, and Ashley Walker, a technical man, spent much time at Innes with Damian, leading Damian's fiancée to refer to Innes as "Brokeback National Park".

Like most pygmy-possums, the very first we released with a transmitter sat on my open hand on the ground for a moment, contemplating her options before climbing a tree. If I climbed a tree to find my way, something that could only be envisaged if a crane lifted me up, I would most likely look down at the landscape around me. Pygmy-possums look up at the sky and stars. Damian and I have little doubt that they use stars for navigation. Once she had localised her position, our possum took off. And so did we.

We were engulfed by dense native pine immediately. That night our possum travelled several kilometres, obliterating the theory that the home range of pygmy-possums is limited to a few tens of metres in each direction. "At least we have made a major discovery on the first night," panted Damian, known as Pollyanna. We alternated between sprints ("at least the mosquitoes don't have time

Western pygmy-possum carrying a 0.035-g radio-transmitter

Pygmy-possums travel both on the ground and in the canopy of trees; when the canopies of two trees are close together, the pygmy-possums simply wait for the right puff of wind to bring a branch of the next tree within reach, and they switch hosts.

It is possible to capture pygmy-possums in pitfall traps because they travel on the ground; at the best of times, capture rate at Innes is about two percent, which means that many buckets have to be dug into the ground!

At the end of the project, all *Eucalyptus rugosa* trees wore pink flags in this habitat, indicating that they had been visited by a pygmy-possum we followed.

Damian Morrant radio-tracking pygmy-possums

Treading carefully, Damian Morrant looks for a pygmy-possum that has disappeared into a nest in the ground.

to catch up with us") and crawling bouts through the embrace of the native pine, dragging our cumbersome antenna and our heavy equipment, having at no time the slightest idea of where we were ("at least we can't run fast in this environment"). We had few opportunities for a sip of water and for exchanging equipment (the field notebook for the radio-tracking gear and the GPS), but the possum finally found a tree with flowers to her satisfaction. Just after the first birds started vocalising for their early morning warm-up, she inserted herself into a tiny hole in the ground and retired for the day. We were exhausted. We were ecstatic.

The next week led Damian and Ashley all over the park, and a particularly fast and long sprint took place through hugging melaleucas in a dry salt marsh. Damian had to climb trees to recover the transmitter's signal. The men ended up far away from the car, at the foot of a tree that our first possum found particularly appealing, to their relief. Having forgotten their beanies in Adelaide, they sat in the winter weather, soaked in sweat, and with underwear on their head. I try never to think about where it came from.

Over a year we followed 15 pygmy-possums (two to nine consecutive nights). Some remained in their original patch of capture, spending most of their time in *Eucalyptus rugosa* trees, others travelled long distances, occasionally climbing a tree with great speed, and finding shelter before birds became active. We were the only ones lost out there in the dark. The possums never were. When we downloaded our GPS points, taken regularly during the tracking, we were stupefied to find perfectlyy straight lines for our long-distance travellers. During a period with particularly few flowers, one possum travelled nearly 8eight kilometres over two nights. We lost the signal of another possum after one night, but found him again the next day by following a straight line; he had travelled nearly five kilometres in one night. There was not a night that was not an adventure and a source of amazement. "Cool!," said with thrilled wonder, was a prevalent expression in our conversations.

It was inevitable. Damian Morrant fell in love. He captured her on Valentine's Day and named her Sarah, after his fiancée. Sarah was a particularly exquisite pygmy-possum, and although she dragged us through a patch containing ecologist-hungry ticks, she also taught us a lot because we recaptured her two months later. She had gained weight and the patch of hair on her back where the transmitter had been glued had grown back. Damian recognised her immediately, even before reading her number. I don't think she was as thrilled as we were to see her. We also recaptured another healthy possum three months after tracking him, indicating that our methods were not detrimental to the possums.

Several of the possums we tracked seemed to like Damian particularly. They would look at him regularly and proceed with their activities very close to us; one possum even chose to nest in a hole between Damian's gigantic military feet. It appeared to us that the possums were using us as predator detractors, and most of them became used to our presence immediately.

They spent most of their "tree time" feeding in *Eucalyptus rugosa*. During tracking, we marked every tree visited by a pygmy-possum with a pink flag; at the end of the study, the *Eucalyptus rugosa* forest was an enchanted pink land, where no tree was left undecorated. Other eucalypts and melaleucas also took on a lesser role in the diet of the animals, as the plants' flowers became available throughout the year. To cope in times with low flower abundance, pygmy-possums appear to chew the bark of some trees so as to extract sap, a strategy used by other species of possums and gliders. Some trees that did not provide food resources were used, sometimes extensively, for resting, grooming, and maybe contemplating the meaning of life.

We were able to record evidence of torpor in the wild for a pygmy-possum during an intolerably long and cold night. The animal simply rolled himself up into a ball, lowered his ears, and held on to his tidily rolled tail, as pygmy-possums do when they sleep, and proceeded to stay in this shallow cavity in a sedge clump for 13 days, as witnessed by a small leaf placed on his body. He only rose to

Damian Morrant radio-tracking pygmy-possums

This pygmy-possum is checking out Damian Morrant while sitting on a delicious treat of *Eucalyptus rugosa* nectar (Photo by Damian Morrant).

Pygmy-possums have long whiskers that must be crucial to their success as a species.

Pygmy-possums investigated their options carefully, and if escape was not one of them, they went to sleep.

forage once during this time for one hour. The ability of pygmy-possums to enter prolonged torpor, by which they decrease their metabolic rate dramatically, is a significant survival tool.

Possums used a variety of nest sites, from holes in the ground to tree hollows and even bird nests. The possums' ability to nest in different structures, feed on flowers and sap, enter torpor, and travel efficiently and extensively through the canopy of trees and on the ground have permitted their survival in a very difficult time for Australian mammals.

On the Yorke Peninsula of South Australia, at least 18 ground-dwelling mammal species have become extinct since European settlement. Pygmy-possums are fair dinkum survivors. They are also lovable bush fairies, pollinating several species of significant native plants and adding magic to the star light. Their intelligence is evident and their capacity to amaze is enchanting.

Project sponsors were: National Geographic Society, Nature Foundation of South Australia, Field Naturalists Society of South Australia, Department for Environment and Heritage Northern/Yorke region, and University of South Australia.

Pygmy-possums use their prehensile tail to travel through the canopy; it acts as an extra hand to minimise the risk of falls.

COMMON BRUSHTAIL POSSUMS

Australia's native pals or pests?

Kit (Amy) Prendergast

The common brushtail possum (*Trichosurus vulpecula*) is one of Australia's most common marsupials and has the widest distribution of any native Australian mammal. The various subspecies are distributed over much of the continent, as well as on a number of Australia's offshore islands. The species' diet, behaviour, reproduction and ecology vary across its wide distribution, reflecting its ability to exploit diverse habitats and its highly adaptable nature. Opinions diverge amongst Australia's human residents, however, regarding attitudes towards the brushtail possum, colloquially known as 'brushie.' Some adore this possum, which sports a fuzzy pelage, large puppy-dog eyes, a sweet pink nose, and a big, brushy black tail. Others, however, have a far-from-friendly attitude toward brushtail possums, viewing them as pests. This is because brushtails tend to take up residency in people's homes and, being nocturnal, can create quite a racket whilst they go about their activities at night when we diurnal creatures try to sleep. Additionally, they can cause economic damage for commercial plantation industries.

There are five subspecies of common brushtail possum:

- *T. v. vulpecula*
- *T. v. arnhemensis*
- *T. v. eburacensis*
- *T. v. johnsoni*
- *T. v. fuliginosus*

The subspecies differ not only in distribution but also vary in certain aspects of their appearance and morphology. Coat colours can be silver-grey, brown, black, reddish-brown to cream. There is even variation in coat colour within each subspecies. Whilst most common brushtails have silver-grey coats, coat colour takes on various red shades amongst races of the northern Queensland subspecies (*T. v. johnsoni*), and lighter grey to almost black morphs can be found in Western Australia. In Tasmania the Tasmanian subspecies (*T. v. fuliginosus*) is typically black but animals inhabiting wet forests have darker coats than those in dry forests, likely reflecting adaptation to better camouflaging in these different habitat types. A rare golden form also occurs, caused by a genetic mutation that results in low levels of melanin (a pigment molecule that gives mammalian skin and hair its colour).

Whilst attracting much attraction from the public (the recent birth of an extraordinary golden-coated common brushtail at the WILD LIFE Sydney Zoo has received much media attention and this new golden baby has become quite a celebrity!), a golden coat is more of a bane than bonus in the wild. Because this coat colour renders golden individuals more conspicuous hence prone to predation, along with being a product of a rare mutation, golden brushtail possums are exceptionally rare in the wild. They tend to only be found in small pockets in the Tasmanian wilderness where few predators (especially foxes) exist.

There is a distinct cline in body size and fur thickness resulting from adaptation to different climatic environments. Tasmanian brushies have particularly thick, woolly coats and larger bodies, weighing 3.75 kilograms. This increases their insulation and reduces heat loss against the chilly conditions in the southern latitudes. In contrast, brushies in northern Australia are relatively sparsely furred, and weighing 1.5 kilograms are more than only half the size of their southern counterparts.

Australia's human population hasn't made life easy for brushtails. Starting with Aborigines, common brushtail possums were hunted for their food and furred pelts out of which were fashioned rugs and small items of clothing. However, hunting by Aborigines was fairly low-scale.

Early Europeans saw great value in the common brushtail possums' dense, soft, insulating fur, which rendered these possums a target for the fur industry and historically the species was hunted extensively for its valuable pelts. Fortunately commercial exploitation presently is largely prohibited in most states, however is still allowed seasonally in Tasmania, and is a full-scale industry in New Zealand. The possum pelts, prized for their softness and warmth, are mainly exported to overseas markets in China and Taiwan. Furthermore, these countries also have a culinary interest in the carcasses and there is a market for possum meat. Due to economic damage common brushtail possums can mete out by defoliating pine, eucalypt and orchard plantations, by

Above: A rare beautiful golden-pelted form of the brushtail possum

Pouch-young joey: this very young baby brushtail illustrates how, like all marsupials, brushtail possums give birth to young that are virtually embryonic! At this early stage, the joey is permanently attached to the mother's teat.

posing livestock health risks by acting as carriers of bovine tuberculosis, and damaging suburban house ceilings and gardens, permits are issued allowing killing the animals in an attempt to control the species where it is regarded as a pest.

Today humans directly and indirectly continue to assault common brushtail possums with a cocktail of potentially threatening processes including habitat clearance and degradation, 1080 poisoning, trapping, road mortality, recreational shooting, crop protection shooting, illegal shooting, fox and feral cat predation, and dog attacks.

Against all odds, however, 'brushies' continue to thrive, being the most widespread of marsupials, occurring in most states and territories, including Tasmania, and are the most commonly encountered of marsupials. Unlike most marsupials which are notoriously hard to even get a glimpse of and to even get a chance to encounter them often require you to travel out into remote wilderness, brushies can be found in most residential areas, including urbanised centres like Brisbane and semi-urban areas surrounding Perth.

Pouch-young brushtail possum joey: a marvel to behold!

Common brushtail possums are able to exploit a wide range of habitat and food types. Being versatile in their requirements, this natural flexibility and broad dietary spectrum explains their wide distribution, inhabiting diverse environments across the continent, and their (over) successful introduction to New Zealand; this has also "pre-adapted" this species to be able to still utilise and exist in the new environments humans have erected, unlike many other marsupials that have specialised habitat and food requirements and have been unable to cope with changes wrought by humans.

Being nocturnal, possums forage at night and retreat to their dens during the day. Whilst preferring to nest in tree hollows or hollowed-out logs, in more urban environments they seek out shelter wherever it can be found, which often ends up being in the attics or eaves of people's houses. Similarly, whilst preferring to feed on foliage of native trees such as *Eucalyptus*, common brushtails will exploit and thrive on whatever food sources can be found, and will include not only leaves and shoots from a diverse range of plants, but also grass, flowers and fruits, and they may even occasionally feed on insects, bird eggs and carrion. They have adapted to eating the otherwise toxic and unpalatable shoots of plants, including foliage and pinecones, making brushies unwanted visitors to pine plantations. In addition, much to the chagrin of gardeners and agriculturalists, they will feed on ornamental and orchard plant species. Due to their catholic tastes, possums can become nuisances, raiding rubbish bins and making a mess. This is not only undesirable for us humans, but also ingesting human scraps can cause brushies to fall sick and even die. To prevent this, as well as to deter unwanted night-time bin raiders, make sure any food scraps are not left outside and lids of your rubbish bins are securely fitted.

Being mainly tree-dwelling, brushies feature a number of adaptations suited to this arboreal lifestyle. Their black brushy tail has a hairless ventral patch and is prehensile, meaning it can wrap around and grip onto branches thus acting as a "fifth limb." Their

muzzle sports highly sensitive vibrissae (whiskers or tactile hairs). Their feet are also adapted for grasping as they clamber amongst branches whilst foraging. Whilst their preferred route of travel is through the treetops, if forced to cross open ground they use a four-gaited walk, switching to a comical bounding gait at greater speeds.

There are few sights more heart-melting than that of a joey brushie piggy-backing its mother. Common brushtail possums typically give birth to one joey, however on rare occasions twins can be produced. Depending on locality, only one young is produced per year, typically in autumn, but in favourable conditions common brushtail possums can breed again in spring, whilst in northern parts of Australia they breed year-round and have no defined breeding season. Like all marsupials, after a very brief pregnancy (only 16-18 days long in common brushtail possums), brushtail possums give birth to a joey at an essentially embryonic stage of development. Newborn joeys are tiny (13 millimetres crown-rump length), being born at a minuscule weight of only 0.2 grams. The little joey spends its first few months within its mother's warm, protective pouch, nourished by her rich milk. At four months of age when it has grown its insulative fur coat and is more fully developed, it then travels around with its mother on her back for about six weeks. By six months the young possum is fully weaned (no longer feeds on its mother's milk) and is independent, and between eight to 18 months of age the juveniles disperse. This dispersal phase is associated with very high levels of mortality (75 percent), especially for males which tend to disperse further away to try to establish a territory of their own, whereas females will often remain within their mother's home range. Common brushtails live about seven years in the wild. Whilst largely solitary, during the breeding season females will often be accompanied by a male consort, and although having fairly fixed home ranges, home ranges of individuals will often overlap, especially in areas where animals occur at high densities (the exception being between home ranges of dominant males). An ability to breed throughout the common brushtail's relatively long lifespan, to reproduce at the end of the first year of life, and a fairly promiscuous mating pattern means this species has a high lifetime fecundity. This contributes to explaining how

Illustration of brushtail possum mother "piggy-backing" her joey

most populations are thriving, and unless there are food limitations, numbers can increase very rapidly. The main constraint on population growth is the availability of den sites, for under den site limitations this leads to high mortality during the dispersal stage when youngsters fail to find a den.

When considered problematic, residents often try to get their unwanted housemates translocated and reintroduced into other habitats. However, this solution often fails. Because common brushtails have a strong bond to their homes, rather than staying in the sites they are translocated to, they tend to simply return. Also, many times the evictees, left homeless, are unable to establish territories in new habitats, causing them to die, or suffer mortality when attempting to return to their original homes. Installing nest-boxes in large trees will discourage them from taking up residency in your roof. No one likes seeing the mangled body of a poor possum fallen victim to being hit by a car, so be extra vigilant when driving around areas where possums are likely to occur. Also, roadkills are much more likely when animals are forced to cross roads in search of new homes and when their trees that they live in are felled and preferred route of travel through native vegetation has been cleared in the way of urban development. Therefore, it is desirable, not only for possums but also for us humans, to ensure tracts of native

Brushies: who can resist those liquid-brown eyes staring back at you?

Nap-time! - during the middle of the day, brushtails tend to snooze in tree-hollows

vegetation are left intact and trees are retained so possums are not forced to put themselves at risk of being run over or forced into taking up residence in your roof or attic.

Often regarded as "vermin" due to the damage they cause to agricultural ventures, this also highlights the necessity to protect and conserve native vegetation. Methods to dissuade possums from damage to crops, gardens and plantations include not only providing nesting boxes in suitable areas, but also trying to lure them away from areas where they are unwanted by putting out possum-friendly food.

As Australians, we should consider ourselves lucky that against the odds these endearing, stalwart marsupials are able to brave the serious obstacles we impose upon our native fauna. Unlike most of our endemic marsupials that have been rendered extinct or have fled from the noise, hustle and bustle of our man-made artificial environments, these adaptable possums are able to continue to coexist with us, providing us with unique close encounters with these sweet-faced members of our native fauna. Although they can pose problems, we should seek out ways to harmoniously coexist with them rather than driving them out. Not only do we lose the opportunity to experience and observe these charming creatures, but also in many cases evicting them from what was originally this species' real estate is unsuccessful. Rather than view them as backyard pests, I think it better to regard possums in the backyard as pals. With little natural habitat remaining, by adopting and implementing practices promoted by "reconciliation ecology," we can live side by side amicably with Australia's original inhabitants. After all, it's not their fault we've invaded and destroyed their homes, leaving them no option other than to try to co-inhabit ours!

It's a different story, however, with regards to common brushtail possums in New Zealand. Common brushtail possums are not native to New Zealand, and were introduced there in 1840 under greedy motives of setting up a fur industry there. Because the island fauna of New Zealand has evolved in the absence of mammals, they were ill-adapted to this mammalian intruder and have suffered. Brushtails threaten New Zealand's wildlife by ravenously consuming many native plant species that have not coevolved with these browsing herbivorous mammals, and the possums also eat vulnerable fungi, snails and eggs of native birds. Brushtails are not only an environmental pest but also pose a risk to livestock, because in New Zealand (but not in Australia) possums are carriers of the highly contagious disease bovine tuberculosis. However, despite being an invasive species that causes severe ecological damage to New Zealand's native biota and posing a health risk to cattle, a few points must be stressed. Firstly, their unwanted arrival to New Zealand is solely the fault of humans: if it was not for their human-wrought importation brushtails never would have been able to cross the oceans and invade this island to cause a problem in the first place. Secondly, despite the annual culling of brushtail possums in their thousands, such control attempts appear largely unsuccessful, likely because this practice is essentially harvesting them and releasing the animals from density-dependent controls on population growth, such that increased mortality rates through culling are compensated by increased birth rate. Also, despite being an invasive pest, this is no excuse for inhumane methods of control. Current methods of trapping and poisoning can violate animal welfare and also have the potential to kill non-target animals. Humane, sustainable, species-specific biocontrols (hormone-toxins and immunocontraceptive vaccines) aimed at reducing fertility hold great promise. Unfortunately these biocontrol techniques and associated delivery methods have yet to be fully developed and implemented, and are also constrained by high costs in their initial development and delivery to such a large number of animals. The common brushtail possum is one of many examples manifesting the detrimental consequences of humans introducing species into regions outside of their native distributions.

Whilst not currently recognised as threatened with extinction, ongoing land clearing and urbanisation, habitat degradation and gratuitous persecution means the future of these adorable marsupials is not indefinitely secure. Although common brushtail possums appear to be still doing well, the cumulative effects of potentially threatening processes, along with ongoing climate change, means an ongoing thriving persistence is not certain. We should adopt eco-friendly lifestyles, involving planting native trees; installing highway cross-overs (overpasses and underpasses) to prevent roadkills; installing nesting boxes; appropriately managing our domestic pets by keeping cats indoors with belled-collars; ensuring rubbish bins are well-secured; preserving pockets of native vegetation, especially those with large old-growth trees containing cavities; and controlling foxes. By embracing "reconciliation ecology", we can ensure these now common possums we are not deprived of encountering these endearing marsupials who we share our country with, enabling them to co-exist with use rather than being driven scarce, or even extinct like most of their less-adaptable marsupial relatives.

A **little bit** of **blue**

Chrissy Banks

When my phone chimed not so long ago it was a friend saying she'd rescued a western blue-tongue lizard after it had suffered a feline attack, and would I like to photograph it. Crazy question, that! Grabbing camera kit and kids we headed over. When we arrived, the lizard was buried deep within bark and leaf litter, safe within a temporary home closely mimicking its natural environment. We gently extricated it from its bed and took it outside to warm up.

An aesthetically stunning reptile, it has the large triangular head, distinctive of all blue-tongues, and brown dragon-like eyes. There is a significant black marking behind each eye and dark brown bands stripe horizontally over a fawn-coloured back from neck to tail. The undercarriage is creamy and soft. For a long-bodied lizard it has four slim little legs with delicate clawed feet. These legs are strong, however, and can easily support the lizard in the classic high-step walk. Due to smooth, glossy scales the lizard is quite soft to the touch.

Part of the reptilian family Scincidae, genus *Tiliqua*, the western blue-tongue lizard (or skink) wears the scientific name of *Tiliqua occipitalis*. Despite the name they are not endemic to Western Australia. This species also resides in the very southern regions of the Northern Territory, is separated into western and eastern populations in South Australia, and inhabits a small north-western corner of Victoria that spills over into south-western New South Wales, where a tiny pocket also exists near the middle of the state. In Western Australia, the species can be found throughout the south-west (excluding the far western tip), right to the South Australian border and up as far as the Gascoyne and mid-west regions.

In looks the western blue-tongue couldn't be more of a contrast to one of my favourites: the armour-plated, stocky *Tiliqua rugosa*, or as it's more commonly known, the bobtail. The first recorded description of the bobtail was by British zoologist and naturalist John Edward Gray in 1825. He gave the lizard the scientific classification *Trachydosaurus rugosu*, but it was later re-classed into the blue-tongue lizard family as *Tiliqua rugosa*. This decision was based on the fact that its molecular chemical composition is virtually identical to other blue-tongues, however it has been a hotly debated decision. Some in the scientific community believe the bobtail should retain its own genus of *Trachydosaurus*. The argument is supported by some very obvious differences between it and other members of the *Tiliqua* genus, namely difference in scales, absence of ear lobules and divided lamellae (thin scales) on the toes of the hind feet. As it stands, however, the bobtail is generally accepted as part of the genus *Tiliqua*. For now.

Like the western blue-tongue, the bobtail is not endemic to Western Australia, in fact its range is the largest of all blue-tongues in Australia. Found throughout drier parts of South Australia, New South Wales and Queensland, it is rarely found anywhere near the eastern seaboard (with a few exceptions). It extends along the southern seaboard wrapping right the way around the west coast up to the Gascoyne region.

Above: Blue-tongues have a wide gape, big hiss and an impressive mouth to frighten off predators.

Most commonly known as the bobtail or shingleback, other popular names include boggi, stump-tailed skink, sleepy lizard and the pinecone lizard.

In appearance bobtails can be summed up in one word: sturdy. They too have the classic triangular head of the *Tiliqua* genus, though broader, and are considered the most robust of the species, even known to grumpily survive an accidental whipper-snipping. This hardiness is due to armour-like scales that are ridged and rough in texture. Like other members of the genus, bobtails have little legs that seem mismatched to its cumbersome body. The common name of bobtail comes from the thick, bluntly-rounded tail end.

Unlike the fairly standard pattern and colour of the western blue-tongue, bobtails range in colour design from straight brown, to mottled grey and brown, to black and grey, caramel and in the few subspecies endemic to Western Australia they have an eye-catching mix of red and orange, while on Rottnest Island they dress in a stunning mottled mix of brown, black and yellow.

So apart from obvious differences in size and appearance, what differs between the western blue-tongue and the bobtail? First perhaps a rundown on what they have in common.

There are seven known species of blue-tongue in Australia: the eastern blue-tongue, the central blue-tongue, the blotched blue-tongue, the northern blue-tongue, the western blue-tongue, the bobtail (of which there are four subspecies recognised including the western shingleback), and the lesser known pygmy blue-tongue (only 90mm full-grown). Except for the latter, which is more skink-like in appearance, all share similar body proportions: large head, long thick body, short tail, thin legs.

Blue-tongues in your garden will keep the snail/slug population down eliminating the need for dangerous poisons.

Like all reptiles, blue-tongues are cold-blooded, meaning they are incapable of generating stable internal temperatures as warm-blooded animals do. Thus they rely heavily on the environment to raise or lower body temperature as required. Their muscular structure relies on chemical reactions – quick when hot, slow when cold – so they must bask to raise their internal body temperature and give their metabolism a boost. By lying perpendicular to the sun's direction they maximise the amount of sunlight on their skin. To further assist the process they expand their rib cage to increase surface area and darken skin shade to better absorb heat. In antithesis, if the lizard becomes too hot, it will lie parallel to sunrays, find shade, open the mouth wide and lighten skin colour, all of which 'pulls the plug' on heat in its body. Generally, blue-tongues hibernate during winter although this is not true hibernation, as on warmer winter days or in early spring they will stir to catch some rays. Increasing body temperature is essential for the blue-tongue's lifecycle. It needs to be warmed to hunt, defend itself and reproduce. Its core body temperature is about 30-35 degrees when active.

Due to being cold-blooded, blue-tongues are not at great risk of infection by bacteria or viruses as these organisms require a nice warm environment to survive, however in the unlikely case of infection, will lower their body temperature to be rid of unwelcome viruses. Reptile ticks and mites *are* a real problem. They feed off blood and in great numbers will cause anaemia. Ticks are responsible for transmitting various protozoan parasites to the blood and have been known to cause intestinal diseases. Reptile ticks (non-paralysing) will attach under the scales and in the ear canal. Nematode worms are another parasite blue-tongues can carry, and evidence of these can be identified in pellet droppings if the lizard carries them.

Blue-tongues don't just sunbathe for energy. Vitamin D is essential for health. It maintains (or builds) strong immunity, bones, muscles and assists in the absorption of essential minerals such as calcium. Some research suggests that a trigger within the lizard's brain fires a compulsion to sunbathe when vitamin D stores drop too low.

Natural predators of the blue-tongue include snakes, raptors and monitors. Introduced predators such as red foxes and feral cats will quickly devastate lizard populations and within the suburban backyard domestic animals pose a threat. While dogs can do spinal damage to a blue-tongue by stepping on it, generally they are cautioned away by the lizard's impressive defensive display. Cats, however, are creatures of stealth and are impeccable hunters. They will go for the kill every time, not to eat, just to kill. Humans also pose threats, both intentionally and unintentionally. Lawnmowers and cars are a major cause of suburbanised lizards' deaths, while development projects destroy natural habitat. The worst of the damage we do is in illegal trafficking. Blue-tongues are easily captured and are in great demand on the black market circuit. The animals are drugged, stuffed in tubes or boxes and smuggled to their destination. Many simply die of starvation or dehydration before reaching their destination.

Facing a seemingly insurmountable amount of dangers, the blue-tongues have very little natural defence. They are slow-moving, so flight is not an option. What they're left with is bluff. A threatened blue-tongue will turn and tilt its body at right angles to the threat and flatten its ribs to appear larger. Inhaling, it reduces the aperture of the tracheal opening and forces out air in a great hiss through a massive bright pink gape. It contrasts dramatically with the blue tongue that in defence is flattened out into a wide blue ribbon. Coupled with the loud hiss, it is designed to shock the predator into leaving. If this tactic isn't dissuading, the lizard will empty its bowels, as a last-ditch attempt to spoil the predator's dinner. Blue-tongues will deploy both of these methods against humans as well – it's happened to me, so be warned.

Interestingly, bobtails have one more trick up their sleeve. They will curve their body into a U-shape so the tail appears to predators as another head.

Monitors are a ferocious natural predator of the blue-tongue.

Hopefully the predator will be confused enough to attack the tail. Like all blue-tongues, bobtails can drop their tail if required, however it is an act of pure desperation as the tail contains their fat and water store. Tails can take up to a year to re-grow, so to survive its loss, a blue-tongue needs to have a good source of food and water nearby. Being at the lower end of the food chain aside, blue-tongues live peaceful, solitary lives, coming together only to find a partner during mating season. Preferred habitat is in open areas with sufficient cover of long grasses, leaf litter, places to sun on and sufficient hidey-holes such as under rocks and logs, and even abandoned rabbit burrows.

Diet is omnivorous and includes snails (a favourite), crickets, carrion and plant matter that includes fungi, herbs, flowers, berries and fruits. They have powerful jaws and big teeth for crushing the likes of snail shells and beetles. They will eat smaller lizards if they can catch them. However, as slow-moving reptiles they generally prey on slow-moving food.

It is at the onset of pairing season (October-November), that violence erupts amongst them. Males fight viciously for females, often causing great harm to their rivals. Male *T. occipitalis* (western blue-tongue) roam an area equivalent of 15 suburban

Blue-tongues love to bury under bark and leaf litter.

Western blue-tongues grow to approximately 27 centimetres, while bobtails can reach 45 centimetres.

house blocks, and within this area will interact with multiple females, courting and attempting to mate with each. Mating is a rough affair often leaving females with scratch marks from claws and teeth.

Successful mating leads to a five-month gestation period and young are born around April. A common number of young is a clutch of five to ten. What is fascinating about blue-tongue reproduction is that they are ovovivipary. Ovoviviparous animals produce fertile eggs within their body that hatch while still inside. The young eat the yolk of the egg for nutrition until they are born live. In most cases they receive no food from the mother's body, but this is where bobtails may differ.

Some reports suggest that the mother has a rudimentary placenta that passes food from her to her offspring. Bobtails only produce a small clutch of one to two young, however the size of the young (60-140 grams compared to the 10-20 grams of other *Tiliqua* species) is believed to reduce risk of predation and ensure survival during winter months. The young of both species are precocious and self-sufficient, ready to go their separate ways within days of birth.

Interestingly, bobtails are widely accepted as being monogamous, lifelong pairs recorded as lasting up to 20 years. Almost unheard of in reptiles, they pair in late spring and spend up to two months together (courting) before mating, rarely leaving each other during that season. They can be seen wandering about with the male following his mate approximately a metre behind, seizing his chance whenever she is receptive. Research has shown that if another female is put between the pair, the male would attempt to mate with her on his way to catching up with his partner. When *T. rogusa* and his partner do go separate ways they find one another again the next mating season with unerring accuracy. And their sense of direction is faultless. In a recent study a male was taken a kilometre from his territory and released. He turned straight back around and headed for home range without going astray.

Evidence of tick infestation is quite obvious and if you happen across an infected wild blue-tongue, gently apprehend it and take it to your local wildlife carer/vet for treatment.

These are fascinating, complex and intelligent creatures – and once again we've hurt them. Sadly, on the conservation status, the western blue-tongue is near threatened (NT) and the western shingleback (*T. rugosa konowi*) is listed vulnerable (V). It is estimated that between 1997 and 1999 in Queensland alone, 89 million reptiles were killed due to land clearing. That's a heartbreaking massacre in two years of human progress and many of those will have been blue-tongues. They, along with other reptiles, face decimation at our hand. So it should be by our hand that we save them. There are practical ways to do this, including by making donations to habitat restoration organisations, and hosting reptile experts in our schools to raise awareness of the creature and why it needs our care, but my favourite way is to make your garden blue-tongue friendly. They aren't going to hurt you, so if you already have one in your garden, read up on it, find out what it likes and needs and give it a great home.

As I sat and watched my son interact with a perfectly wild western blue-tongue that day not so long ago, I was struck again how amazingly diverse, beautiful and precious our wildlife is. I guess whether you prefer the gentle western blue-tongue or the sturdy, robust bobtail, these lizards are laid-back, harmless and willing to co-exist. Let's give them that chance and do what we can to help them survive.

Many thanks to Michael Lynch (WAHS – West Australian Herpotological Society) for a fabulous insight into the lives of these fascinating reptiles.

Visit the Australian Wildlife Society website at www.aws.org.au to find out the latest on what is happening in our fight to preserve Australia's unique wildlife

Devil Ark Giving hope to the Tasmanian devil

John Weigel AM

When I first heard about the 'Devil Facial Tumour Disease' (DFTD) in 2002, I had no idea how serious the epidemic would prove to be, and how it would threaten the very existence of the iconic Tasmanian devil. How could the marsupial world's number one tough-guy succumb to some punk newcomer disease? Devil numbers were estimated to be as high as 150,000 – and the fighting character of the world's largest (and most charismatic) carnivorous marsupial was legendary – providing inspiration for the popular Warner Brothers cartoon character.

But within a few short years the survival of the Tasmanian devil was far from certain. As the horrible truth about DFTD emerged, predictions of extinction were increasingly being made, while researchers frantically scrambled in search of hope. The inevitable association between the declines of Tasmanian devils with the earlier loss of the Thylacine seized the attention of the Australian public and a range of relevant government and conservation agencies. Wildlife biologists worried about a broader and potentially catastrophic flow-on effect to come in the wake of the DFTD juggernaut. The success of feral predators in Tasmania has been hitherto suppressed by the devils through competition and perhaps predation. The predicted readjustment in numbers of feral dogs, cats and possibly foxes in the rush to fill the ecological void left by the devils could place perilous pressure upon a handful of additional marsupial species such as eastern barred bandicoot and eastern quoll for which Tasmania has up until now provided a last-stand stronghold.

For many in the Australian zoo industry, the gloomy forecast for the wild population, combined with the simultaneous extirpation of the cause of the extinction, made the establishment of a representative insurance population a once-in-a-career priority. In 2005 my organisation – the *Australian Reptile Park* (ARP), along with other members of the *Zoo & Aquarium Association* (ZAA) began working with the overarching Tasmania-based *Save the Tasmanian Devil Program* (STTDP) with the aim of providing a mainland 'insurance population' of healthy Tasmanian devils – away from the disease front. This vision of a genetically robust population of captive or semi-captive devils that could be post-apocalyptically returned to the wild was by and large accepted by all relevant government agencies and stakeholders by the end of that year. In 2006 the Reptile Park received the first insurance population devils for this combined effort following an onerous quarantine process in Tasmania to guard against the risk of shipping DFTD-infected devils. A year later we imported additional founder animals, while an equal number were received by a combination of other mainland zoos.

Above: Devil Ark is an initiative of the Australian Reptile Park on the Central Coast of New South Wales, and has been developed with the support of Zoo and Aquarium Association, the Foundation for Australia's Most Endangered Species (FAME), the NSW State Government, and the Save the Tasmanian Devil Program. The land at Barrington Tops was generously made available for the project by the James Packer family.

A big idea

Because of the dangerous aggressiveness of Tasmanian devils towards one another when maintained in confined enclosures, traditional husbandry methods involve keeping mature individuals in separate pens for extended periods, bringing small groups together for periods of socialisation or brief periods of mating. This level of keeper interaction raises the costs. In addition to poor cost efficiency, we felt that natural behaviour was very much suppressed, suggesting the long-term risk of genetically based 'captive adaptation' – the bane of small population breeding programs that excessively interrupt natural ecology and social behaviour of a species. Although breeding success within our 'intensively' managed complex of 40 pens was highly successful, the apparent deficiencies made it unsuitable for a much-expanded project involving hundreds of devils maintained for a period of up to 50 years.

Instead, my team and I began contemplating a 'big systems' approach – one that would be as cost-effective as it would be inductive to the preservation of wild-type behaviour. By early 2007 we were talking to our zoo partners about clusters of 'free-range environmental enclosures' that would be spacious enough, and contain sufficient environmental variation - including potential den sites, to support a mixed social grouping of say, six to ten relatively unrelated devils each. In 2008 we presented the 'Devil Ark' concept at a four-day IUCN workshop in Hobart dedicated to finding a coordinated approach to saving the Tasmanian devil, where enthusiastic support was received from the participants, including most if not all relevant stakeholders such as researchers, wildlife managers, zoos and government representatives. But as often occurs with breaks from traditional thinking, idea itself can be the relatively easy part, while effective implementation of the idea requires a whole lot more work! It took another two very busy years to overcome a seemingly endless range of practical and bureaucratic impediments before construction of Devil Ark could be reasonably contemplated.

High on the list of challenges was the daunting task of finding a suitable property. Physically, the property needed to be big enough – at least

Construction begins

Spacious 'managed environmental enclosures' (MEEs) contain social groups of eight to ten devils. High security perimeter fencing surrounds clusters of equally escape/entry proof pens of three to six hectares. The current population of approximately 180 devils needs to double before 2016 to maintain planned expansion – but this now depends upon finding the necessary financial support.

Built on an elevated (1,300 metre) 500 hectare wooded property at Barrington Tops, New South Wales, Devil Ark will eventually contain enough large pens to house up to 1,000 Tasmanian devils – the minimum population required to retain the prescribed genetic diversity required to ensure long-term survival after re-release to the Tasmanian landscape after extinction in the wild.

300 hectares, and of such a nature that digging many kilometres of 600 millimetres deep trenching in association with escape-proof fencing was possible. Ideally, the environment would be 'Tasmania-like' in climate and character. But the overriding consideration that trumped all others was that it had to be available at a miraculously low cost. This overriding requirement certainly narrowed the range of choices! In fact, in the end there was only *one* choice – a heavily timbered property positioned high in the Barrington Tops of New South Wales. The 500 hectare site was generously provided by the James Packer family at the kingly rental rate of $1 per year for a starting period of 30 years. A lucky break for an unlucky marsupial species.

Construction of 'Stage 1' of Devil Ark commenced mid-year in 2010 and was completed by the end of the year. An initial 30 hectare complex was defined by three kilometres of high security perimeter fencing, and included within it a dozen escape-proof enclosures of varying sizes, including six breeding enclosures of approximately four hectares each. A bank of ten small (100m2) holding pens was built to accommodate single devils on an as-needed basis. The works were conducted using contracted machine operators and fencing contractors, with all planning, direction and support labour provided by ARP.

Devils back on the ground in NSW – a half-millennium later

In January 2011 the completion of the first stage of the Devil Ark project was signalled by the arrival of the first 47 'founders' – a mix of wild-caught devils post-quarantine, and strategically chosen progeny from the Australian Reptile Park's in-house breeding program – where numbers had swollen to 65 devils. The first group of founders took to their spacious Devil Ark pens with apparent zeal and, for the first time for many, began behaving like wild Tasmanian devils. This marked the first time in hundreds of years that the species had a taste of at least semi-wild existence on the Australian mainland, where it had previously been widespread and abundant. The popular belief is that mainland 'Tasmanian' devils and Thylacines were out-competed, and perhaps preyed upon by the introduced dingoes.

Initially, three breeding enclosures were stocked in configurations of six or eight mature devils in equal sex ratios. The social dynamics that unfolded in the pens were monitored nightly by infrared cameras and electronic sensing devices. By the end of the first breeding season it was apparent that properly functioning social groups had taken shape in each of the enclosures. Eight of the ten mature females produced young that first year, and all 20 resulting joeys survived through the weaning process unscathed. In fact there were no significant injuries to any devils in any of the established social groups – a very encouraging start!

In 2012 two additional breeding pens were deployed, increasing the number of reproductive-aged females in social groups to 18. Of these, 14 produced litters, yielding a total of 36 joeys. The

Media frenzy upon the momentous opening of Devil Ark on January 18, 2011. Following three highly successful breeding seasons and ongoing expansion of the facility, Devil Ark is emerging as the likely lynchpin of the so-called Insurance Population component of the national 'Save the Tasmanian Devil Program', with potential to hold up to 1,000 Tasmanian devils in the remote Tasmania-like facility for decades to come, ready for re-release at the appropriate time.

influx of joeys and additional founders contributed to a population of 140 Tasmanian devils prior to the 2013 breeding season. In the 2013 season, 15 of the 23 mature female reproductive devils successfully raised young with a total of 28 joeys. It is a frustrating reality that ongoing expansion of Devil Ark can only keep pace with fundraising success, and can only keep expanding with public support.

The numbers game

Despite the best efforts of a range of researchers and wildlife managers – and a peppering of encouraging news releases of 'break through' discoveries over the past decade, the spread of DFTD continues unabated. Predictions of disease resistant devils to the west were dashed when the disease demonstrated an ability to rapidly adapt to overcome all challengers. At least a dozen strains of DFTD were identifiable by 2009.

With up to 90 percent of the pre-disease population already gone, and no feasible 'silver bullet' on the horizon, increasing hope is extended to the STTDP Insurance Population Strategy. STTDP consultant research geneticist Professor Kathy Belov wrote in ABC Science in August 2012:

"Vaccine development takes time, and time is something the devils don't have. The best thing we can do now is to support the captive insurance program. This program holds and breeds devils free from the disease in zoos and fauna parks – both in Tasmania and on the mainland – with the long-term goal of returning disease-free devils back into Tasmania."

Around 25 joeys are born after a 19-21 day gestation period, but only the first four that attach to the mother's teat will live, so it's survival of the fittest right from the start.

Dinner time at the Ark. The mission of Devil Ark is to provide a highly cost-effective alternative to current Tasmanian devil husbandry practices within the highest standards of animal welfare; to ensure through provision of a natural environment and appropriate social opportunities the retention of 'wild-type' traits - both genetically and behaviourally, and to sustain a very large population of devils over a very long period while retaining at least 95 percent of the genetic diversity of the founder population.

Now, a year later, the insurance population is now comprised of over 500 Tasmanian devils, with more than a third of these held at Devil Ark. At first blush this sounds quite positive, given that the program population geneticists are prescribing an 'effective population' of 500 devils to adequately retain the targeted level of genetic diversity over a period of up to 50 years. Unfortunately, there is a big difference between 'census population' – the actual number of Tasmanian devils held in captivity and on Tasmanian islands and (proposed) peninsulas, and the corresponding 'effective population' that they represent. Wikipedia provides a definition of effective population as "*the number of individuals in an idealised population that has a value of any given population genetic quantity that is equal to the value of that quantity in the population of interest*". In principal, population geneticists assign a given small population a co-efficient of effectiveness value based on the extent of influence extended to the planning and coordination of pairings to best preserve genetic variation within that population. Within the varied husbandry models currently in practice or under consideration within the Tasmanian devil insurance population, a relatively high effectiveness score is afforded to the most intensively coordinated pairings of devils (i.e. within the intensive holdings in zoos where the devil-per pen methodology provides ultimate control over the composition of pairings). In this instance a genetic effectiveness value of 0.5 has been estimated. This means that zoo holdings of say, 200 devils, would be equivalent to an effective population of 100. If not for the relatively high costs of maintaining devils in this manner, coupled with the likely drain of natural behaviours over time, this husbandry model might be an insurance population panacea.

Enthusiastic one-year old devils can be inspected, weighed and micro-chipped. Blood samples are taken to determine paternity and to indicate genetic appropriateness for next-generation pairings.

On the other end of current and proposed small population management systems for devils, islands such as Maria Island east of the main island, where a high profile release of captive-bred devils was recently undertaken, as well as 'virtual islands' such as large free-range enclosures or the proposed fenced-off peninsulas in Tasmania provide little or no scope for strategic pairings and are accordingly assigned an effectiveness value of only 0.1 – wherein the proposed sustainable population on Maria Island of 150 devils represents an effective population of only 15.

The Devil Ark model, wherein an intermediate degree of genetic coordination is provided, is regarded as having an effectiveness coefficient of 0.25, so that in effect, the current population of 180 devils presents an effective population of 45 – three times greater than the eventual potential of Maria Island at the tiniest fraction of the cost of implementation. In its three short years of operation Devil Ark has proven to be far and away the most cost-effective element of the insurance population with regards to both census population and effective population size. This cost efficiency and underlying practicality of the modular Devil Ark model – where the number of spacious pens containing eight mature devils can be adjusted upwards as needed is a fundamentally important consideration when weighing the prospective long-term roles of the various husbandry models that are shaping up within the broader insurance population.

What price the devil?

The goal for the first stage of the Devil Ark project was to establish a cost-effective working model comprised of a complex of functional social groups of devils that breed readily while retaining wild-type behaviour. This has been accomplished with resounding success, and the existing facility can accommodate an ongoing population of 180 devils at a cost of approximately $1,300 per devil per year. This level of operational costing stands in stark contrast to the experience of other existing husbandry models, including the 'intensive' mainland facilities, which can exceed $10,000 per devil per year. The envisioned second stage of development for Devil Ark is to expand the complex to accommodate 360 devils by 2017. There is sufficient land at the spectacular Barrington Tops site to expand as needed to accommodate a population of well over 1,000 Tasmanian devils (an effective population of 250) for as long a period as required. Improved operational efficiencies at this population would see the annual cost per devil reduced to an estimated $900.

The Devil Ark team remains positive about its potential role in securing a future for the Tasmanian devil with an eventual reintroduction program after DFTD literally consumes itself to death. The new and effective system for maintaining large numbers of the cranky marsupials in modular environmental pens is working well, perhaps with scope for further improvement. The Devil Ark model is identified in the STTDP Meta-population Strategy review as the most appropriate format for large-scale expansion of the insurance population when required. The critical 'when required' refers to the point in time when the disease has spread to the west coast of Tasmania – an event predicted to occur within the next three to five years.

Having demonstrated scope to maintain half of the insurance population into the future in naturalistic conditions for less than $1M per year, it remains an urgent imperative to find the funding required to continue building and populating Devil Ark.

I remain personally confident that the establishment of a successful insurance population is achievable, and that Devil Ark can play a linchpin role to this end. This means that even if the on the ground efforts to curtail the spread of DFTD fail, the overarching conservation mission to save the Tasmanian devil is refreshingly 'winnable' in comparison to the plights of many mainland species for which either habitat loss or predation by feral pests are critical factors.

Joeys at age of approximately 106 days. Nursing mothers have four teats, but the average litter size carried to term is about three. Joeys remain loyal to one teat for the duration of their time in the pouch, so it's easy to determine how many joeys the mother has had based on how many active teats she has.

Devil Ark Inc is an independent charitable organisation with tax deductible gift recipient status. Professional fundraising staff has been retained to more aptly pursue the essential resources required. A managing Board of Directors conducts the business of Devil Ark, while the Devil Ark Advisory Committee - comprised of industry representatives and experts from both the mainland and Tasmania, meets two to three times a year to steer the on-the-ground development and management of Devil Ark. For more information or to make a donation go to: http://www.devilark.com.au/

The rarest rainforest

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Much like any other tropical rainforest the first thing that hits you when you enter the Mabi rainforest is life. By life I mean a plethora of animal and plant species unrivalled in any of the other terrestrial ecosystems of the planet, all going about their daily business with a buzz here and a raucous screech over there.

In fact the forest is so busy it invokes the feel of a large green city, populated by thousands of plant and animal inhabitants all going about their daily business. And similar to some large cities the inhabitants don't care what I'm up to, as currently attested to by the numerous small birds darting past my face, racing from fruiting shrub to fruiting shrub, a mere black flash and excitedly repeated chirp the only indicator that you just missed getting hit by the Mabi's version of a yellow cab.

However, unlike many other rainforests to be found around the world, there is a distinct and dense undergrowth of shrubs and forest floor herbs here, making your view in any direction an impeded one. Many of these shrubs reverberate with the call of multiple bird species attempting to advertise their wares, in this case their distinct territories and mating availability, much like some ornithological middle-eastern bazaar. In fact 114 species of birds are known to call this forest type home – more than is known to occur in any other plant community within the wet tropics bioregion, itself among Australia's most biologically diverse real estate.

The overabundance of shrubs and cacophony of bird sounds exists because this forest is not a "standard" tropical rainforest. In fact, it is one of the rarest forest types in Australia and indeed the world, currently comprising less than four percent of its' pre-European extent.

Mabi forest is exceptional in that it is located on the edge of the acceptable rainfall zone a rainforest can tolerate and still survive. One means by which it achieves this (and a characteristic trait of the Mabi) is the ability of many of the large trees to drop their leaves during dry spells – thereby drastically reducing their water requirements. Inadvertently, this lets the shrub layer flourish through taking advantage of the now – abundant sunshine.

In fact the deciduous phase is the current state in which I find myself walking

Above: Sunset viewed from a Mabi forest remnant patch atop Halloran's Hill (Atherton) gives a clear picture as to the extent of clearing the Mabi forest has endured.

through the forest, crunching through fallen leaves as though I were walking on corn flakes; the bare branches of the trees above revealing a piercingly blue sky and the warm sun filtering through.

The Mabi forest and its demise

On 4 June 1875 when European explorer James Venture Mulligan and his five travelling companions passed through the current day Atherton area, home to the Ngadjon-jii and Yidin-ji aboriginal tribes, little could he have known that his offhand observation of "the best description of soil we have come into contact with" would foretell the demise of the great expanse of rainforest through which they travelled.

Whilst, the extremely fertile volcanic soils would lead to the eventual decimation of the Mabi forest through clearing for agriculture, it was the early timber getters who were the initial European settlers to "Mabi country". These hardy bushmen roamed throughout the region hunting for the extremely valuable and at that time abundant hardwood rainforest timbers. The voracious European demand for the wood from these species was so strong that by 1900 just one species – red cedar (*Toona ciliata*), then commonly referred to as red gold, accounted for 75 percent of Queensland's total export earnings!

After the early timber getters, European settlement of the Mabi area began in earnest throughout the late 1800s and into the early 1900s and with it a concerted effort to log and clear the forest and replace it with agriculture began. This process was accelerated through soldier re-settlement schemes implemented by the government post World War I and by the 1920s it was estimated that over 80 percent of the Mabi forest was already gone. The Mabi now existed at only a miniscule proportion of the previous ~20,000 hectare extent, to be found as many isolated remnant patches scattered amongst the farms and often restricted to very rocky soils.

Due to this extensive clearing of Mabi forest (also known as Complex Notophyll Vine Forest 5b or Queensland regional ecosystems 7.8.3 and 7.3.37) it is now listed as an Endangered Ecosystem under the Queensland Governments' Vegetation Management Act 1999 and as a Critically Endangered Ecosystem under the Commonwealth government's Environment Protection and Biodiversity Management Act 1999.

The dazzling red bloom of the Waratah tree (*Alloxylon flammeum*) contrasts starkly with the dark green of its surrounding canopy

A green ringtail possum (*Pseudochirops archeri*) peers back inquisitively through the rainforest canopy.

A miniature red pumpkin-like fruit of the Mabi forest endemic "Atherton Sauropus" (*Sauropus macranthus*)

Current Mabi extent and protection

Approximately 1,050 hectare of Mabi forest remains today scattered amongst 62 or so small, isolated patches ranging in size from less than .5 hectare to 271 hectare. However, Mabi forest occurring along watercourses (regional ecosystem 7.3.37) has been declared "virtually extinct" with less than eight hectares to be found spread over three small forest patches. Of the current Mabi forest patches 73 percent are smaller than 5 hectares in size whilst the greatest remaining portion is to be found residing in the two large fragments of Curtain Fig National Park and Conservation Area (271 hectares) and Wongabel State Forest (267 hectares), whose combined forest area contains 56 percent of the total remaining Mabi.

About 58 percent of the current extent of Mabi Forest on the Atherton Tableland has some form of protected tenure however only 185 hectares has the more secure protection of a National Park designation whilst 35 percent receives international protection through its occurrence within the boundaries of the Wet Tropics World Heritage Area. Importantly for any conservation strategy, 32 percent of the remaining Mabi forest occurs on private land.

My Wongabel walking track tour guide also known as the Northern fantail *(Rhipidura rufiventris*)

Current Mabi conservation endeavours

Although considerable efforts still need to be made if Mabi forest is to be bought back from the brink of extinction, many small scale conservation efforts are afoot. Much of the current Mabi conservation effort is being driven by local community groups often working in concert with government partners through entities such as the Mabi Forest Working Group which has focused on the status of Mabi forest, and more recently a Mabi Forest Action Group which has been performing on ground actions such as weed management and revegetation of remnant Mabi patches. An additional pertinent example of joint community and government conservation success was the recent (May 2013) gazettal of the privately owned Mount Quincan Nature Refuge. This new nature refuge protects 46 hectares of critically endangered remnant and regrowth Mabi forest on an extinct volcanic scoria cone.

In recent years, the environmental conservation awareness of residents within the Mabi region has increased considerably. Much of this increase is due to the tenacity and dedication of the members of local community conservation groups such as the Tree Kangaroo and Mammal Group and Trees for the Atherton and Evelyn Tablelands (a local revegetation group) who regularly disseminate information to the general public and provide presentations to local landholders. Concurrently, ecotourism business ventures are increasingly becoming an important revenue stream for the Atherton tablelands region with affiliated local businesses (e.g. accommodation providers) also deriving considerable economic benefit. This tourism driven amplification of economic prosperity appears to be the major impetus for a current increase in many of the local residents' perception of the value of the remaining patches.

An adult male Lumholtz's tree kangaroo (*Dendrolagus lumholtzi*) makes a quick foray to the ground whilst travelling between trees.

Threats

The Mabi forest faces a myriad of threatening processes all conspiring to degrade and destroy its delicate green patches. One of the more insidious threats is that of feral plant and animal incursion. To date, of the more than 550 plants species found to occur within Mabi forest 79 species or ~14 percent are invading exotic weed species; all competing with the resident native species for scarce resources. Analogously, feral pigs (*Sus scrofa*) and both domestic and wild dogs (*Canis lupus familiaris*) also regularly invade Mabi patches where they wreck havoc, attacking both the floral and faunal components of the Mabi ecosystem in their chase for satiation. What's more, the feral pigs are notorious for their ability to churn the ground to lifeless muddy slurry as they hunt for edible insects and plant tubers/roots promoting both erosion and further weed incursion.

Many ecological processes occurring within the Mabi forest patches are also presently under substantial pressure. There are three major detrimental factors impacting these ecological processes: edge effects, patch isolation and dispersal limitation:

1. Edge effects are the changes in biological and physical conditions that occur at an ecosystems' edge. These edge effects are particularly menacing to long and thin shaped Mabi patches such as Tolga scrub (two kilometres long and only 100 metres wide) as they alter the forest microclimate, increase wind damage (especially during cyclonic events), cause a loss of available internal patch habitat and increase large tree mortality. Internal patch fragmentation can also cause severe edge effects such as those occurring in Wongabel State Forest; the second biggest remaining Mabi forest patch. Perversely, the internal fragmentation at this site is not due to some historical clearing event but is the direct result of 213 hectares of government endorsed commercial timber compartments (ie forestry plantations within the patch) as well as their constituent forestry roads.

2. Mabi patch isolation is damaging as it can restrict inter-patch dispersal and breeding of the resident plant and animal species potentially leading to inbreeding. Additionally, small patch size and isolation increase the vulnerability of resident rare species to localised extinction through stochastic events (eg cyclones). The Mabi forest patch at Halloran's Hill is a current germane example of this being restricted entirely to the crater of a small extinct volcano surrounded by residential estates.

3. Dispersal limitation within Mabi patches also threatens the resident biota. For instance, the current extinction of the southern cassowary (*Casuarius casuarius johnsonii*) and musky rat kangaroo (*Hypsiprymnodon moschatus*) from Mabi forest threatens the seed dispersal of many of the large and fleshy fruited plant species who may now no longer be able to adequately disseminate their heavy fruited potential future offspring.

Finally, surrounding land use practices can have a major impact on the remnant Mabi patches. For example, the deciduous habit of Mabi forest makes it particularly vulnerable to fire incursion during dry periods as the abundant leaf litter provides an ample and highly combustible fuel source. The fire sensitive nature of many Mabi plant and animal species means that any fire incursions through incorrectly managed burning off of surrounding properties may significantly damage and degrade patches as well as causing both plant and animal death.

Conclusion

But finally, why the name Mabi? Mabi is the Yidin-ji name for the Lumholtz's tree kangaroo (*Dendrolagus lumholtzi*), one of the more peculiar residents of this unique forest. This name is particularly apt in that the Mabi forest type supports this amazing and threatened creature at their highest known population density (one to two individuals per hectare).

As well as kangaroos that live in trees a walk through the Mabi forest provides an Alice in wonderland-esk experience of some of Australia's most rare and endangered plants and animals – from the miniature red pumpkin like fruit displayed by the Mabi endemic Atherton Sauropus (*Sauropus macranthus*), and the dazzling flame like red blooms of the Waratah tree (*Alloxylon flammeum*), through to a green (ringtail) possum (*Pseudochirops archeri*), all hanging on to existence in this forest of wonders.

As I draw to the end of my walk through the Mabi a northern fantail *(Rhipidura rufiventris*) leads me along the remaining path, past the many large and heavily buttressed tree columns vaulting the open canopy above. My final thoughts as I exit Mabi country, wishing my small avian friend good bye, is to wonder what Mr Mulligan and his crew beheld upon their Mabi passage not so long ago and to hope that the next 100 years will be kind to this forest and its myriad inhabitants so that visitors of the future may experience the majesty of Mabi life.

Response to and recovery from heat stress: thermal tolerance of Australian arid land vegetation

Ellen Curtis, PhD Candidate, School of the Environment, University of Technology, Sydney

Arid and semi-arid regions (deserts) in Australia represent more than 70 percent of the continent. This expansive area is a region rich in floral and faunal diversity and endemism, and plants here may be most vulnerable to increased heat stress as they live already on the upper threshold of what many biological tissues and processes can withstand. We now also know that these regions play a far more important role in carbon sequestration than previously thought[1-3]. With this in mind, a number of studies have indicated that increases in temperature could alter the dominance of plant functional and photosynthetic types in arid and semi-arid environments, which could have a profound influence on regional productivity[4, 5]. Such community compositional changes are thought to depend on species-specific threshold parameters, such as to temperature, and species responses to the type and rate of change[5]. Research predicts that high temperature events will increase in frequency and intensity with global climate change[6, 7]. Long-term climate trends for Australian ecosystems are already showing an increase in temperature anomalies, due in part to more frequent and longer-lasting heat waves that are occurring out of season. Additionally, studies expect wind stilling (lulls in air movement) to also increase[8], which could have considerable consequences on the ability of plants to maintain leaf temperatures below their thermal tolerance thresholds[9].

My study is centred on understanding how arid plants respond to and recover from heat stress, with the broad objective of better understanding which species may be potentially most at risk during critical heat wave events. I have spent much of the past 12 months visiting and conducting seasonal research *in situ* at the Australian Arid Lands Botanic Gardens (AALBG) located in Port Augusta, South Australia. It is hoped that the data collected from the current study may improve environmental models and be used to predict plant survival and distributions under different climate scenarios.

A key component of my study is measuring the fine-scale variation in environmental gradients within a canopy. I am particularly interested in understanding how environmental gradients within the canopy correspond to variation in the ability of the photosynthetic apparatus in plants' leaves to cope with temperature extremes. I will measure potential differences of the above by sampling leaves from various positions within a canopy and obtaining the thermal tolerance threshold of these samples using a protocol I developed in the early stages of my study. I will then be able to relate physiological measurements to environmental measurements, which are being recorded using specialised field equipment. A substantial portion of the funding provided by the Australian Wildlife Society Research Scholarship (AWSRS) has been used to purchase forty small field capable data loggers (known as i-buttons) and accessories, which are currently deployed within the AALBG and programmed to record ambient temperature and humidity across the canopy of the exemplar Australian arid species, *Acacia papyrocarpa* (Western Myall). The remaining funding from the AWSRS was used to help fund the travel of a volunteer science student to assist with the experiments.

My final field campaign is planned for summer 2013/2014. This trip will include collecting data for two final experiments, one of which is the canopy analysis briefly outlined above. I anticipate that equipment acquired with the AWSRS will be used intensively over numerous years beyond my study to provide environmental information for future research projects. The equipment could also be applied as an educational tool, such that where applicable students could learn to develop research questions, for which the data loggers may then be used to help find the answer. In this way students will learn how to use a new piece of equipment whilst developing also necessary skills in data interpretation.

Many thanks once again to the Australian Wildlife Society for supporting my research through the AWSRS.

Above: Ellen on site at the Australian Arid Lands Botanic Garden in Port Augusta installing data loggers in the canopy of *Acacia papyrocarpa* plants (Photo: Andrea Leigh, 2013)

Small data logger unit with shading, ready to be placed out into the field (Photo: Andrea Leigh, 2013)

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Acacia papyrocarpa on the Nullabor Plains, South Australia (Photo: Andrea Leigh, 2011)

Feral horses in the Australian

Peter Hardiman

Feral horses in the Snowy Mountains

The Society has become aware of the serious environmental damage being done by feral horses in the Snowy Mountains area of the Australian Alps. We asked Society Director Peter Hardiman to look into the problem and to make some recommendations on what we may be able to do to slow or prevent further serious environmental damage to the mountain regions and its fragile vegetation and soil coverage which is subjected to such extreme weather conditions.

Horses were first introduced into Australia in 1788 (Dobbie *et al*. 1993). They adapted well to Australian conditions and numbers rose rapidly. Between 1830 and 1850 horses increased from an estimated 14,000 to 160,000 largely by natural increase. Horses were first recognised as potential feral pests in Australia in the 1860s. Australia has some of the highest number of wild horses in the world (Dobbie *et al*. 1993).

They occur mostly in remote, usually rugged, semi-arid areas and the largest populations are on unfenced pastoral country in the Northern Territory and Queensland. The major concentration of wild horses in New South Wales and Victoria are now found in the Australian Alps (Dobbie *et al*. 1993) where all reports indicate they are causing serious environmental damage to the native vegetation and soil erosion.

It has been estimated that there are in excess 10,000 feral horses roaming

unabated in the Kosciusko National Park in New South Wales and the Alpine National Park in Victoria.

The NSW and Victorian Governments are both failing to protect our alpine parks from severe damage by feral horses. The general public seems to have a romantic link with horses in years gone by, but notwithstanding this fact, damage to the national parks by wild horses will become unimaginable in the future with beautiful grasslands being grazed to extinction, with the result that hundreds of horses will die of starvation. Because of opposition from the 'brumby lobby', these governments have been unwilling to reduce or cull the horse numbers.

During the time of the legend of the Man from Snowy River, it is believed there were only ever about 200 wild horses in the Alps. Feral horses now number over 10,000 in the alpine parks, and this number has been increasing by about 20 percent each year, even with a trapping program in place. This means that without new action, the population doubles about every five years. Over time, horse density, their range and damage will escalate, making future control more difficult and expensive.

Feral horses trample and eat large amounts of alpine and sub-alpine plants, foul wetlands, erode streams, spread weeds, create a vast network of tracks, and threaten the safety of motorists. Because of the short summer growing season, damaged and depleted alpine plants recover very slowly.

There is only one practical and humane solution. A large-scale horse removal program in the Australian Alps is essential to prevent continued exponential population growth and to save sensitive alpine habitats for future generations of young Australians.

Most government agencies appear to be undecided as to what should be recommended to solve this problem. Unless something is done to reduce the number of feral horses, the native bushland will continue to be trashed, native wildlife will suffer and die, and many unique native plants will be trampled and grazed to extinction.

It is also predicted that at by the year 2020 at least 8,000 feral horses will die of starvation each year.

There is a solution to the problem

Due to the prolific numbers of feral horses in our iconic national parks, immediate action needs to be taken to prevent further damage. Because of the enormity of the problem, only a state or federal government having the will and the necessary funding to meet the challenges of such a project will avert an impending environmental disaster.

The following should also be taken into account.

The projected number of feral horses roaming unchecked in our alpine national parks is estimated to be about 10,000.

A substantial number of these roam wild in the Australian Alps.

Hard hoofed animals cause severe impacts such as causing erosion and trample sensitive alpine vegetation, waterways and wetlands, they consume large amounts of plant vegetation every day, impacting on the food supply for wombats, wallabies and native herbivores.

Feral horses have no natural predators. It is known that horse numbers increase at 20 percent or more, meaning they can double in less than five years.

It can be certain there will always be wild horses running wild in Australia, as there is no hope of eradication and not many native predators to the feral horse.

What is not certain is whether governments can move beyond their fear of media scrutiny and they can be upfront with the public about the serious impacts of feral horses and the necessity of aerial shooting.

Aerial shooting is not the sinister solution that some like to suggest, but an answer to a serious problem. A fondness for the feral horses should not shape government policy in allowing the trashing of our national parks.

A recent report estimated the damage to be as bad as the worst historic grazing impact to the high mountain catchments that triggered the 1940 removal of stock grazing from these national parks.

Attempts to reduce horse numbers by trapping have been a failure because the rough terrain of the area and denies easy transport access. This is another reason and the solution for helicopter aerial horse culling program/s to be introduced, approved and funded.

In support of aerial culling, over the last few years land managers working closely with the RSPCA have refined aerial shooting techniques for the large-scale removal of horses and camels. In northern Australia animal welfare is now being better addressed by utilising close involvement of vets to monitor the shooting operation from a second observation helicopter. The veterinary officers supervise the operations to ensure that death is quick and suffering of the horses is minimised. This is a great innovation and step forward for aerial culling.

In the event that a culling program is approved, suitable arrangements should include the prompt removal of the dead horse carcasses to prevent disease.

The Victorian Government is preparing a draft horse management plan for the Alpine National Park, where last year there was an estimated 9,000 feral horses, about half of the total population of people in the Alps.

Unfortunately the Victorian Government is yet to set a reduction target or seriously consider the benefits of aerial culling on its merits, despite the fact 40 percent of people surveyed support this cost effective humane method as an option.

Research shows that the NPWS had began to review its horse management plan over 10 years ago and their findings are that they have failed as yet to reduce feral horse numbers.

Perhaps our environmental ministers might not be so remiss to consider looking at all reports, and the culling programs already in place. In other words examine all aspects to reduce feral horses to an acceptable level in our iconic parks and reserves.

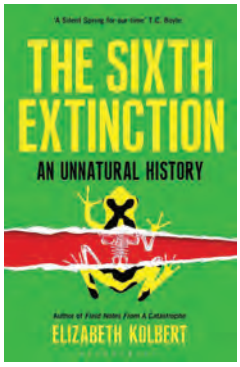
All available options should be laid on the table to be studied to assist them in making profound decisions to control limited numbers of feral horses allowable in our national parks and at the same time have due regard for saving our environment because of the undeterminable damage to the environment caused by the continual unchecked rapid growth of feral horses.

These measures will only apply to some 79 rural and regional parks out of 799. These 79 parks which have been identified for assessment to permit volunteer workers with the appropriate stringent controls in place ensuring compliance, the measures are to be managed by the National Parks and Wildlife Service. These requirements are to be subject of approval by the Minister for the Environment.

In the meantime the remaining 720 National parks and Reserves are being left abandoned, wildlife generally through their instincts will continue to breed unabated and as they do not recognise boundaries drawn on a map will cross these boundaries an invade and enter agricultural land causing degradation to property.

Only two national parks and reserves have been chosen to form part of the culling trial program which was expected to commence in October 2013, and is subject to a review as to its effectiveness at this initial stage and a report is to be prepared and submitted back to the government before any roll out of the program.

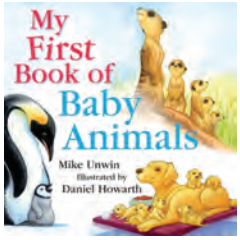
Book Reviews



The Sixth Extinction - An Unnatural History by Elizabeth Kolbert

A major book about the future of the world, blending intellectual and natural history and field reporting into a powerful account of the mass extinction unfolding before our eyes. The first half of the book covers how we came to understand the history of mass extinction. The second half probes the human role in the current sudden rise in animal and plant extinctions - especially through our role in driving global warming and ocean acidification.

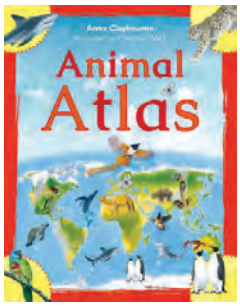
Publisher: Bloomsbury | RRP: $29.99



My First Book of Baby Animals by Mike Unwin. Illustrated by Daniel Howarth

A gorgeous book packed full of fantastic illustrations and fun facts that every child will love. From cuddly polar bear cubs to curious kittens and playful puppies, this book is a must for anyone who simply cannot get enough of baby animals.

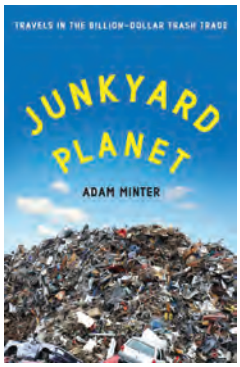
Publisher: Bloomsbury | Ages: 5-7 | RRP $15.99



Animal Atlas by Anna Claybourne. Illustrated by Christina Wald

Find out about all the different habitats they animals live in, from polar bears in the freezing Arctic to orangutans in the steamy rainforest. Packed with delightful illustrations, brilliant facts and informative maps, learn, explore and be amazed by animals living all over the world.

Publisher: Bloomsbury | Ages: 5-7 | RRP $22.99



Junkyard Planet by Adam Minter

When you drop your soft drink can or yesterday's newspaper in the recycling bin, where does it go? Probably halfway around the world, to people and places that clean up what you don't want and turn it into something you can't wait to buy. A very interesting book about globalization and environmentalism at their complicated intersection. Many readers will be vaguely aware of the recycling/reuse industry, but the author puts forth a fascinating exploration and explanation.

Publisher: Bloomsbury | RRP: $29.99

Seven Flowers and How They Shaped Our World by Jennifer Potter

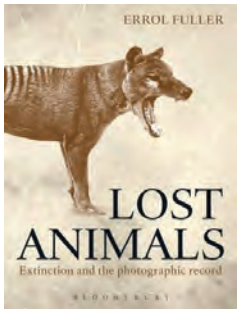
The lotus, lily, sunflower, opium poppy, rose, tulip and orchid. Seven flowers: seven stories full of surprise and secrets. Where and when did these flowers originate? What is the nature of their power and how was it acquired? What use has been made of them in gardens, literature and art? This book features both histories and detective stories, full of incident, unexpected revelations, and irony. All seven stories demonstrate the enduring ability of flowers to speak metaphorically - if we could only decode what they have to say.

Publisher: Allen & Unwin | RRP: $45.00

Nest - The Art of Birds by Janine Burke

Part natural history, part folklore, part exploration of art and aesthetics, part memoir, a beautiful book that will appeal to bird lovers, readers of literature, and art lovers. As an amateur naturalist and nature lover, Janine Burke, art historian and author, has spent many years observing birds. Here is the story of her passion, a personal, wide-ranging, and intimate book that will appeal to all those who love nature, literature, and art. What are nests if not art created by nature?

Publisher: Allen & Unwin | RRP: $24.99



Lost Animals - Extinction and the photgraphic record by Errol Fuller

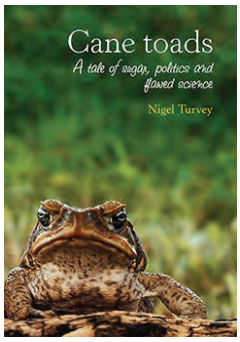
A book dedicated to extinct animals with very evocative old black-and-white photographs. A book dedicated to dead animals and filled with such images is always going to rate highly in the poignancy stakes. Even the animals seem sad. Perhaps they were: is there any more moving an image than that of the Tasmanian tiger in the Hobart Zoo? Despite the subject, this is a beautiful book and will hopefully raise awareness of the plight of much of our remaining wildlife. Not all the photographs are black and white - some are in colour and record more recent extinctions.

Publisher: Bloomsbury | RRP: $49.99

Going Going Gone - 100 Animals and Plants on the Verge of Extinction

100 conservation groups around the world were asked: 'if you could pick one species that epitomises your work, which would it be?' From the RSPB to WWF to the Cheetah Conservation Fund, and many, many more, the answers came rolling in. Each provided a synopsis of the threats faced by their selected species. This book showcases 100 plants and animals around the globe that are threatened with extinction. Compelling full-colour images of each species is complimented by a one-page write-up with a general overview of the species, basic data on remaining numbers/lifespans/threats along with efforts underway to save it along and information on what individuals can do to help.

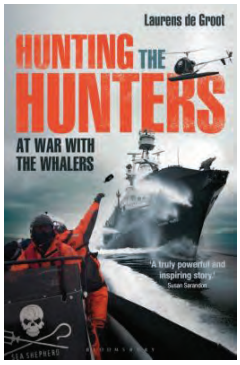
Publisher: Bloomsbury | RRP: $39.99



Cane toads - A tale of sugar, politics and flawed science by Nigel Turvey

This story is about good intentions, unintended consequences and of simple acts leading to catastrophic outcomes. It is about scientists so committed to solving a problem, serving their country, their leaders and the industry that employed them, that they are blinkered to adverse impacts. There are lessons to learn from the toad's tale. And as the tale shows, we still come perilously close to repeating the mistakes of the past.

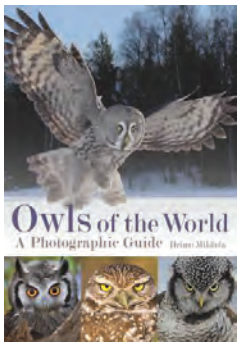
Publisher: Sydney University Press | RRP: $35.00



Hunting the Hunters - At War With the Whalers by Laurens de Groot

This is an action-packed and timely account of one man's extraordinary life, as well as an ongoing battle against a powerful nation determined to get its way no matter the cost. It's an important subject, one that a lot of people care about, and as Laurens tells the story in his own words this is a compelling and insightful book.

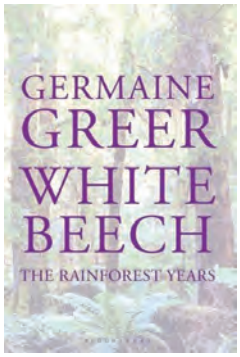
Publisher: Bloomsbury | RRP: $69.99



Owls of the World - A Photographic Guide by Heimo Mikkola

A wonderful and lavishly illustrated photographic guide to all the known owl species in the world, all 249 of them. If you love birds and especially the personable owls of the bird world, you will want to see this book.

Publisher: Bloomsbury | RRP: $69.99



White Beech - The Rainforest Years by Germaine Greer

This is Greer's account of her half-million-dollar investment in planting trees on an abandoned dairy farm that had earlier been used as a banana plantation and for logging timber. "The hero of this story," she writes, "is a tree or rather a species of tree", the white beech, or Gmelina leichhardtii. By the beginning of the 20th century, most of the white beeches in Queensland had been logged. The rugged terrain of Cave Creek meant that it was one of the very few places where they survived, though at the time of Greer's purchase there were fewer than a dozen mature specimens on the property. For Greer, the beech became the totem of her rehabilitation project, and of Cave Creek as a "Gondwanan refugium". This excellent book is well constructed and detailed and is also a timely and frank account of Australian History.

Publisher: Bloomsbury | RRP: $39.99

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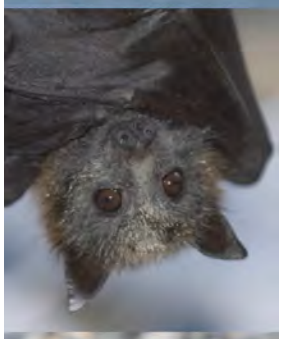


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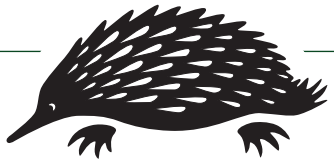

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- ☐ Associate (library, school, conservation groups): $85
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"The challenge to the present adult generation is to reduce the increasing pressures on the Earth and its resources - and to provide youth with an education that will prepare them emotionally and intellectually for the task ahead.

SUZANNE MEDWAY AM
President

Andrew McInnes Photography

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Top: Cape Barren goose
Photo: Andrew McInnes

Middle: Cape Barren goose
Photo: Andrew McInnes

Bottom right: New Holland honeyeater
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