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)

RIGHT TIME, RIGHT SPOT

Hi, my name is Scott Rawlings. I am a hobbyist photographer from Yorkshire in the United Kingdom. I was never really into photography at a young age, although I have always been an outside person enjoying wildlife and scenic landscapes.

At the age of 22 I decided it was time to see the world so my fiancé and I left the UK and set off exploring. For the first two years we travelled Canada, United Arab Emirates, Indonesia and New Zealand. Unfortunately for me it wasn't until I arrived in Australia that I decided all these amazing places I visited needed to be captured for others to see. So off I went to the nearest camera shop to buy my first camera.

I suppose the best thing I've learnt from professional photographers is "shoot, shoot, shoot". So I do give it my best shot, meaning I try to take my camera everywhere with me.

This photo is one I'll never forget. I was invited to play golf at Narooma Golf Club on the New South Wales south coast with the lads from work. The lads looked at me strangely as I arrived with my camera and a zoom lens around my neck.

As we stood at the ninth tee an almighty sound from a bunch of kookaburras could be heard. As we looked up into the tree line we saw two kookaburras fighting over a frog. I quickly grabbed my camera and started shooting. Luckily for me the birds must have been hungry as they stayed in that exact position for at least ten minutes, meaning I was able to take many shots, which was fortunate because my first few weren't the best.

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regulars

Suzanne Medway AM
Editor, Australian Wildlife

Sabine Borgis
Sub-Editor, Australian Wildlife

Front cover:
Seals swimming like this are becoming more and more common due to the rising populations since hunting was banned.

Back cover:
This juvenile seal pup had scarring on its right eye and back, possibly from human contact or natural injury.

Read the full story on page 6.

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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Directors 2015

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

Dr David Murray - President

"The case for protecting the caves has broadened to one for protection of the whole river system, and this is what we must now impress upon the government"

Earlier this year I wrote about the Cliefden Limestone caves and how the fauna that depends on caves for habitat was threatened by a proposal to build another dam on the Belubula River. The Linnean Society's Symposium on the Cliefden limestone caves and the Belubula River Valley was held in Bathurst between 7 and 10 September. Both Patrick Medway and I attended on behalf of our Society. Many speakers confirmed the heritage value of the Ordovician fossil sites. These are of outstanding international significance. Leaving that to one side, I am going to reconsider the wildlife perspective following new insights presented at this symposium.

Two speakers, Meredith Brainwood and Caroline Forest, confirmed the occupation of caves by the eastern bentwing bat (*Miniopteris schriebersii oceanensis*, overwintering) and the common horseshoe bat (*Rhinolophus megaphyllus*, maternity). By recording ultrasonic echolocation calls at night they have identified 15 bat species in the area, including three listed as threatened species. Calls were so numerous that they have suggested that the Cliefden karst and adjacent areas comprise a microbat 'hotspot'. Most of these species occupy tree hollows and bark in the riparian vegetation zone along the banks of the Belubula River. This emphasises the need to preserve the river as it is, especially as bats can only drink from still water.

Tom Grant spoke about platypuses in the Belubula River. They generally forage for small invertebrates at depths from only 1 to 5 metres and over coarse riverbed substrates. Several alternative dam proposals would result in a loss of river length amounting to between 13 percent and 25 percent of a length of 165 kilometres. The deep water within a dam would be totally unsuitable as platypus habitat.

Stuart Khan (s.khan@unsw.edu.au) criticised the dam proposal(s) from engineering and environmental perspectives. He confirmed that water would be taken from current downstream users, and that precipitation would be outweighed by evaporation, which supports my "laying water out to dry" comment about dams in general. He recommended that the government adopt water reuse and aquifer storage strategies instead of building another dam.

Earlier I stated that once the cave entrances were inundated, water would be lost just by disappearing through crevices and faults underground. No engineer worth his or her salt would knowingly construct a dam in such unsuitable positions, where substantial loss of water is a predictable consequence. Referring to past unsuccessful dam proposals, Bruce Welch commented that "the unsuitable geology of the area has always caused engineers to reject the site outright".

Australia-wide, prime agricultural land is being alienated for mining and residential developments. The area occupied by any proposed new dam on the Belubula River would displace a number of successful farmers, and deprive them of the opportunity of continuing to make a valuable contribution to food production. This is unfair to the families concerned, some of whom have built up their farms over four generations. It is also contrary to the development of a sound policy on food production in New South Wales, which is something our government ought to be thinking about.

The case for protecting the caves has broadened to one for protection of the whole river system, and this is what we must now impress upon the government.

At the symposium – L to R: Patrick Medway, David Murray and Mike Augee

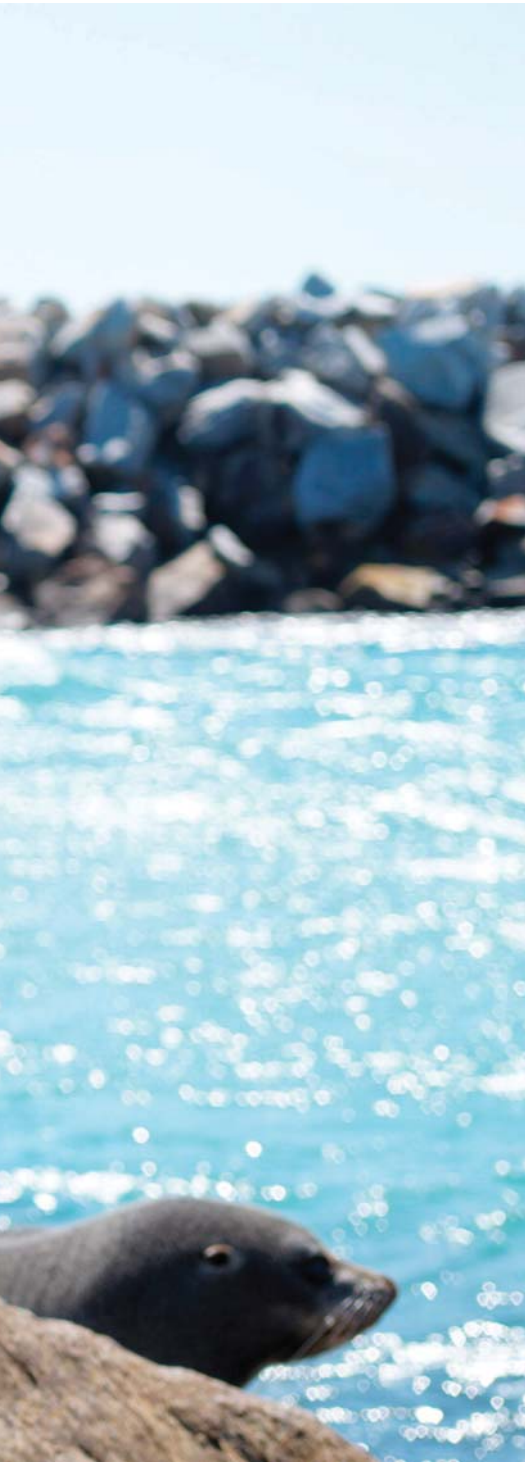
The rise and fall of the Australian

Callum Meney

In the mid-1700s, Australian fur seals (*Arctocephalus pusillus*) were reaching populations of over 200,000 individual animals throughout coastal Australia. The rocky shores and islands that lined our country were a thriving habitat and breeding ground for these large marine mammals. During the later months of October through to December Australian fur seals would give birth to one or two pups causing the population to rise each year.

This all changed in 1798 when a small boat came ashore on Cape Barren Island. This particular island is situated in the Bass Strait and was the first location in Australia where seals were commercially hunted for their pelts (skins). Hunting began that same year and seal pelts became Australia's first commercially exported product. The industry was worth millions and therefore competition was huge among groups of hunters.

Seal pelts were used to manufacture clothing for the wealthier citizens of the United Kingdom and the seal's blubber that is used to insulate them while swimming was used along with whale blubber to create oil for lamps. As hunting began in the Bass Strait, hunters did not venture from that area of Australian waters and coastline until the seal populations were so diminished that they could no longer hunt there. This resulted in an over-exploitation



fur seal

of the Bass Strait by the year 1802. As numbers were critically low all around Tasmania, pelt hunters were forced to move west and north east in search of more seals. Large colonies of fur seals were found on the South Australian coast and, as a result, the area was heavily hunted, causing seal populations in that area to face the brink of extinction.

Seal hunting continued in Australia until 1920 when it was banned and became illegal due to the plummeting numbers. Despite hunting being banned all around Australia, fishermen were legally allowed to kill any seal that was 'interfering with their fishing operations'. It was not until 1983 when killing was officially banned throughout Australia. Since that time, the Australian fur seals' population has doubled. Although the species numbers are climbing, the Australian fur seal is not recovering as quickly as other species that were also hunted at the time, such as New Zealand fur seals and Antarctic fur seals. This is due to one major impact on the species recovery: the fishing industry.

The fishing industry has been the largest hindrance on the Australian fur

Above left: A mother fur seal and its pup rest on rocks along the south-eastern coast of Australia.

Above right: A male Australian fur seal shows off its dominance as I approach with my camera.

Fishing nets and shark nets are the leading non-living cause of fur seal deaths in Australia.

seals' road to recovery and there is no question that without the impact on the fur seals' environment by the fishing industry, there would be many more fur seals swimming in Australian waters by now. Without a doubt, fishing nets as well as shark nets are the leading non-predatory threat to the Australian fur seals' survival with around 66 percent of juvenile seal pup deaths being caused by entanglement in pieces of fishing net or other human contact. Another more indirect, but just as devastating, impact on the species is the overfishing of the prey that the Australian fur seal feeds on, such as leather-jackets, jack mackerel and squid for human consumption. Both these issues combined have slowed the population climb of the Australian fur seal on its road to recovery since being hunted in the 1800s.

The Australian fur seal is an amazing marine mammal and despite the threat from the fishing industry, populations are rising all throughout south-eastern Australia. To see the species truly thrive in Australian waters, larger efforts such as reduced/biodegradable fishing nets and the moderation of the fishing of certain species, needs to be made in order to live in harmony with the Australian fur seal.

Juvenile seals will often freely pass though fishing or shark nets, but suddenly become caught when they grow too large for the gap, resulting in entanglement.

THE AUSTRALIAN PlantBank

SUZANNE MEDWAY

The world-recognised facility at the Australian Botanic Garden, Mount Annan in Sydney, opened its doors in 2013 - and three years later now stores over 5,300 Australian species (many threatened) and a total of 10,400 individual seed packets.

The Australian PlantBank is a science and research facility of the Royal Botanic Gardens and Domain Trust and is located at the Australian Botanic Garden, Mount Annan. It houses the Trust's seedbank and research laboratories that specialise in horticultural research and conservation of Australian native plant species, particularly those from New South Wales.

CONSERVATION IN ACTION

Without plants, life as we know it would cease to exist. The future wellbeing of all species relies on making better choices about the way we manage plants. Scientists at the Australian PlantBank study how plants germinate, grow and reproduce, and how they function within ecosystems. Other areas of research focus on how plants are adapted to their environment and evolve over time, and what causes them to die. Using this knowledge, the Australian PlantBank can begin to use plants more sustainably and preserve plant diversity in the wild.

A MAJOR MILESTONE

The Australian PlantBank has achieved a major milestone in threatened species protection, with a landmark 50 percent of New South Wales threatened flora seeds now in protection and stored in the seed vault.

"The significance of this milestone is immense in terms of plant conservation. While PlantBank is one of Australia's leading science and botanic research facilities, the native seed banking we undertake is crucial in achieving our national targets under the global plant conservation strategy for plant conservation," said Dr Brett Summerell, Director of Science and Conservation, Botanic Gardens & Centennial Parklands.

"Australia has incredible plant diversity which our unique fauna depend on for survival. Sadly the past 200 years of settlement in Australia has had a serious impact on our plant and animal diversity."

"In New South Wales alone there are over 600 plants listed as threatened. Extinction is forever, and at PlantBank we are taking action to safeguard our native plants by collecting, storing and freezing seeds. These can then be germinated in the future when needed, and reintroduced into the wild. It is an important insurance plan for our wild populations on the brink."

Seedbanking is widely recognised as a cost-effective and efficient form of long-term conservation of our flora. Seeds collected from the field are brought to PlantBank, assessed by scientists for perfect germination conditions and for ability to withstand the storage process. Seeds are then placed in freezer vaults.

"Seeds stored under these conditions can last hundreds of years. We still have a long way to go, but to achieve this milestone, and earlier than planned, is a credit to those who conceived and created PlantBank. It truly is Australia's 'Noah's Ark' of the plant world", said Dr Summerell.

PlantBank has been a significant international partner in the Royal Botanic Gardens, Kew Millennium Seed Bank project since 2003, and contributed to over 1,500 New South Wales species to this important global seed conservation program which aims

Above: Some plants are displayed in the open courtyard.

Interior courtyard of The Australian PlantBank.

Cryo-storage involves immersing plant tissues and seeds in vats of liquid nitrogen at temperatures as low as -196°C. Under these conditions, plant tissue ages very slowly and can be kept in storage almost indefinitely. Cryo-storage of plant tissue is an alternative for preserving rainforest species, many of which have seeds that cannot be conserved by drying and freezing in the vault.

Many plant species reproduce by seeds. Seeds come in many shapes and sizes, but inside each one is a tiny embryo, surrounded by structures ensuring the greatest chance of its survival. By studying how different seeds germinate and develop into adult plants, scientists can better understand how plants regenerate and survive. This knowledge helps us to produce more plant species for horticulture and agriculture, and assists in the restoration of damaged ecosystems. For some seeds, germination is simple; it is triggered by warmth and moisture. Other seeds have more complex needs, such as exposure to certain natural compounds or a sequence of different temperatures. To investigate the conditions needed by various plant species, seeds are germinated in the special growth chambers you can see behind this laboratory.

to collect and store 25 percent of the world's flora by 2020.

THE SEEDBANK VAULT

The seed vault is one of the most biodiverse places on the planet. It holds seed collections of many of the 25,000 plant species that occur in Australia. Most of the seeds are from New South Wales species, and some are rare and threatened in the wild. By 2020 all New South Wales species will be represented either here or as living plants growing within the Australian Botanic Garden. The vault has the capacity to store this number of species many times over. It can also house large seed collections for use in the restoration of degraded habitats.

The success of conserving seeds for the long term depends on the collection of good quality seed, correct preparation of the seed for storage and maintaining the collections in dry, cold conditions. The colder the storage temperature, the longer the seeds will last.

DRIED TO PERFECTION

Seeds containing too much moisture will not survive the freezing process so they are prepared for storage by drying them at low humidity in the room next to the vault. The dried seeds are packed in strong aluminium bags to protect them from air and insects. Once packed and labelled, they are ready for storage at -20°C in the vault's freezer.

LIFE EXPECTANCY

Seeds of many wattle (*Acacia*) species are expected to last hundreds of years in storage. Other species, such as waratahs (*Telopea speciosissima*), may have a much shorter lifespan in storage – perhaps only 40 years. These shorter-lived seeds will need to be re-collected frequently. Some plant species, including rainforest plants with fleshy fruits, have seeds that cannot be dried and frozen for storage.

GLOBAL SEED CONSERVATION

Conserving plant species is a shared responsibility. Seedbanks around the world protect their collections by sending duplicate collections to other seedbanks. This spreads the risks associated with losing collections through disasters such as fire, theft or war. Duplicates of many of the Australian PlantBank seed collections are held at the Millennium Seed Bank in the United Kingdom.

WOLLEMI WONDER

The Wollemi pine (*Wollemia nobilis*) is one of the world's rarest and most

threatened tree species. Until recently it was thought extinct, and the wild population is tiny – fewer than 100 adult trees. Scientists here at the Australian PlantBank are studying wild Wollemi pines in their natural habitat and in cultivation. Understanding how this ancient species has survived over millions of years may help to predict how it will cope with environmental challenges in the future.

WHY SO RARE?

Fossil evidence suggests that many millions of years ago the Wollemi pine was widespread, particularly in the southern hemisphere. Over time, the environmental conditions have become much less favourable for this species; now only two small groups of trees remain in a remote canyon in Wollemi National Park. Introduced diseases, invasive weeds and frequent bushfires are likely to continue to threaten the survival of the Wollemi pine.

FROM THE WILD TO THE WORLD

Rare plants can be very attractive to plant collectors. Some species have been illegally harvested and collected to extinction. To protect the small number of Wollemi pines remaining in the wild, a living collection has been established using cuttings. This collection has been used to produce plants for gardens around the world, ensuring the security of the wild plants in their natural habitat.

The Australian PlantBank.

Entrance to The Australian PlantBank.

The seed vault is one of the most biodiverse places on the planet. It holds seed collections of many of the 25,000 plant species that occur in Australia. Most of the seeds are from New South Wales species, and some are rare and threatened in the wild. By 2020 all New South Wales species will be represented either here or as living plants growing within the Australian Botanic Garden. The vault has the capacity to store this number of species many times over. It can also house large seed collections for use in the restoration of degraded habitats.

Staff at the Australian PlantBank collect and store seeds from common as well as rare and threatened plant species. Many different collection and processing methods are used. Each and every seed must be prepared correctly before it can be stored in the seed vault.

Bees

Suzanne Medway

"Remove the bee from the earth and at the same stroke you remove at least one hundred thousand plants that will not survive." *Canadian Bee Journal* 1941, **Albert Einstein**

One in every three bites we eat are from foods that need to be pollinated by insects. Hundreds of essential food sources in the world have the bees to thank for their pollination. Stop and think for a moment about all the flowering plants that require bees for pollination. These include almonds, apples, blueberries, watermelons, cherries, onions, beets, broccoli, cabbage, cauliflower, various chilli peppers, tangerines, coconuts, hazelnuts, cucumbers, lemons, limes, carrots, strawberries, cotton, walnuts, sunflowers, various beans, apricots, plums, pomegranates, pears, blackberries, sesame, eggplant, cocoa, cranberries, vanilla, tomatoes and grapes, not to mention all the countless flowering plants that we don't harvest food from that also require honey bee pollination.

With thousands of species of bees and other pollinators found around the world, you may wonder why we have become so dependent on just a single species. Whatever the reason, the disappearance of honey bees on Earth would most definitely have a huge impact on agriculture and our food supply as a whole and it's not an option we can afford to try.

Honey bees have been found in fossils dating back millions of years!

It's believed honey bees originated in South and Southeast Asia. All but one (the common honey bee found in Australia scientifically known as *Apis mellifera*) of the species are native to that region. Notably, living representatives of the earliest lineages to diverge (*Apis florea* and *Apis andreniformis*) have their centre of origin there.

Above: A tiny 5mm long native bee photographed on a Banksia flower in the bird sanctuary. Tentatively identified as a reed bee which nest in hollow stems, sometimes Lantana species.

Fossils found of the *Apis* bees are dated back to the Eocene–Oligocene boundary (23–56 Mya), in European deposits. The origin of these prehistoric honey bees does not necessarily indicate Europe as the place of origin of the genus, only that it occurred there then. A few fossil deposits are known from South Asia, the suspected region of honey bee origin, and fewer still have been thoroughly studied.

No *Apis* species existed in the New World during human times before the introduction of *A. mellifera* by Europeans. Only one fossil species is documented from the New World, *Apis nearctica*, known from a single 14-million-year-old specimen from Nevada, USA.

"For so work the honey-bees, creatures that by a rule in nature teach the act of order to a peopled kingdom." *Henry V,* **William Shakespeare**

The close relatives of modern honey bees, bumblebees and stingless bees are also social to some degree, and social behaviour seems an historic trait that predates the origin of the genus. Among the extant members of *Apis*, the more basal species make single, exposed combs, while the more recently evolved species nest in cavities and have multiple combs, which has greatly facilitated their domestication.

Most species have historically been cultured or at least exploited for honey and beeswax by humans indigenous to their native ranges. Only two of these species have been truly domesticated, one (*A. mellifera*) at least since the time of the building of the Egyptian pyramids, and only that species has been moved extensively beyond its native range.

The future of bees

The news headlines are constantly talking about the plight of the honey bee and the problems they are facing on a daily basis in every corner of the Earth. Over the past fifty years, bees have suffered greatly and the trend continues to show honey bees face more threats every day. In the 1980s the parasitic verroa mite was found in the USA, and this led to a huge drop

Metallic carpenter bee (*Xylocopa lestis*). These attractive native Australian bees nest in the soft wood of Banksia and Leptospermum species. They are not social insects and do not possess a sting. They nest in a single tunnel over 30cm long. They have the potential to damage exposed timber on houses. This bee also displays 'face-mimicry'.

Found feeding on perennial slug herb (*Murdannia graminea*) this native stingless bee is possibly Trigona carbonaria species.

A large, robust native bee captured on Banksia flower in the bird sanctuary. Carpenter bees are a solitary bee which burrows into dead wood making tunnels. The males do not have a stinger and are important pollinators of open-faced flowers.

A comparison of sizes between two species of native bees. The smaller masked bee is 15mm long and no competition for the huge male carpenter bee.

in bee numbers. Furthermore, honey bee populations took a sharp drop with what came to be known as Colony Collapse Disorder. **Australia remains the only continent in the world to be free of Varroa mite**, however the warnings are significant. Varroa has been found to the north, east and west of Australia, so we are surrounded. Everything must be done to keep this threat out of Australia. Everyone can help, not just beekeepers. You can contribute by making choices in what you buy and by doing very simple things such as:

- Stop using pesticides
- Plant a bee-friendly garden
- Learn more about bees
- Join a local bee club
- Build a native bee house
- Become a beekeeper
- Buy local honey
- Petition your local MP to support bees

Australian native bees

There are over 1,500 species of 'true blue' Australian native bees.

Commercial honey bees *(Apis mellifera)* are not native to Australia. They were introduced from Europe in about 1822.

Australian native bees can be black, yellow, red, metallic green or even black with blue polka dots! They can be fat and furry, or sleek and shiny.

A *Tetragonula carbonaria* hive. *Tetragonula carbonaria* is a stingless bee, endemic to the north-east coast of Australia. Its common name is sugarbag bee. The bee produces an edible honey.

Australia's smallest native bee is Cape York's minute *Quasihesma* bee. It is less than 2mm long.

Australia's largest native bee is the great carpenter bee of the tropical north and northern New South Wales. It is up to 24mm long.

Most Australian bees are solitary bees that raise their young in burrows in the ground or in tiny hollows in timber.

Australia also has 10 species of social native bees (genera *Tetragonula** and *Austroplebeia*) which do not sting! (*Previously called *Trigona*).

Stingless bee honey is a delicious bush food and stingless bees can be good crop pollinators, so stingless beekeeping is becoming increasingly popular.

"The happiness of the bee and the dolphin is to exist. For man it is to know that and to wonder at it."
Jacques Yves Cousteau

Native bees are also important pollinators of Australia's unique wildflowers and are a vital part of our Australian bushland.

The honeybee

The honeybee has been described as the most useful of all insects known to man, because it provides man, as well as other forms of life, with basic services vital to their survival.

Nature has endowed the honeybee with the special organs which enable it to live a peculiar way of life. To understand the creature, a closer study must be made of its anatomical structure which enables it, and it alone, to perform such functions as gathering and ripening nectar, collecting pollen and propolis, producing wax, etc., and incidentally fertilizing flowering plants.

Like all insects, the honeybee has three main parts: head, thorax and abdomen.

1. The bee head – triangular in shape, the head has five eyes, a pair of antennae, and mouth parts consisting, among other organs, of two mandibles, the proboscis, etc.

a) The eyes: The seeing apparatus of the bee consists of a pair of compound eyes and three small

simple eyes, called the ocelli. The compound eyes are composed of several thousands of simple light-sensitive cells, called ommatidia, which enable the bee to distinguish light and colour and to detect directional information from the sun's ultraviolet rays. The eyes of the drone are larger by far than those of the worker or the queen bee, occupying a large proportion of the total volume of the head. They assist him to locate the queen as he pursues her during the mating flight.

"Tart words make no friends; a spoonful of honey will catch more flies than a gallon of vinegar." **Benjamin Franklin**

b) The antennae are a pair of sensitive receptors whose base is situated in the small socket-like membranous areas of the head wall. They move freely in every direction. The antennae's functions are to feel or touch and to smell, and thus to guide the bee outside and inside the hive, to differentiate floral and pheromone odours, and to locate hive intruders.

c) The mandibles are a pair of jaws suspended from the head and parts of the bee's mouth. The insect uses them to chew wood when redesigning the hive entrance, to chew pollen and to work wax for comb-building. They also permit any activity requiring a pair of grasping instruments.

d) The proboscis: Unlike the proboscis of all other sucking insects, that of the honeybee is not a permanent functional organ; it is improvised temporarily by assembling parts of the maxillae and the labium to produce a unique tube for drawing up liquids such as sweet juices, nectar, water and honey. The insect releases it when needed for use, then withdraws and folds it back beneath the head when it is not needed.

2. The bee thorax – the armour-plated mid-section of an insect, the thorax, supports two pairs of wings and three pairs of legs, and carries the locomotor, or 'engine', and the muscles that control the movement of the head, the abdomen and the wings.

There are many types of native masked bees. They have a distinctive yellow spot on the thorax. The bee in the image is gathering from a Banksia flower at Sportsman Creek wildlife refuge. They have a body length of 15mm. This species also displays two yellow patches on the top of the head which it uses to 'face-mimic' and ward-off competition.

a) The legs: Each pair of legs differs in size and shape from the other two pairs and is jointed into six segments, with a pair of claws at the tip which help the insect to cling to surfaces. The leg can be flexed at any of the six joints. Its primary function is to help the bee to walk and run, but various parts also serve special purposes other than locomotion. For example, the brushes on the inner surface of the fifth segment (the tarsus) of the two front legs are used for sweeping pollen and other particles from the head, eyes and mouth parts. The same tarsi of the mid-legs serve as brushes for cleaning the thorax, while the spines found at the end of the fourth sections (tibiae) are used for removing the pellets of pollen and for cleaning the wings. Two important parts to note on the legs are the antenna cleaners on the front legs and the pollen baskets on the hind legs.

i) The antenna cleaner, located on the inner margin of the tibia of the forelegs, consists of a deeply-cut semi-circular

Native bee on Geraldton wax

Australian native blue banded bee one of the solitary bee species.

notch, equipped with a comb-like row of small spines. All three castes – drone, queen, and worker – have this cleaning apparatus.

ii) Pollen baskets: The tibiae of the hind legs of the worker bee carry a special apparatus, called the corbiculae, or pollen baskets, which enables her to carry pollen into the hive. These pollen baskets, concave in shape, are surrounded with several long hairs which bind the contents into an almost solid mass, allowing the worker to carry the load safely home.

b) The wings of the honeybee, like those of most insects, are thin, flat and two-layered. The front pair is much longer than the rear. The worker's wings are used both for flight and for ventilating the hive, while the drone and the queen use theirs for flight only.

3. The bee abdomen – like the thorax, the abdomen is armour-plated. It contains such vital parts as the heart, the honey sac, the stomach, the intestines, the reproductive organ, and the sting. As seen from the outside, only six segments can be observed, but the adult honeybee has nine, while the larva has ten.

4. Internal organs – the interest of the beekeeper is usually focused on those parts of the bee which make it capable of producing honey and wax and performing other duties necessary for its survival. Among these are the hypopharyngeal gland, the wax gland, the scent or pheromone glands, the queen's pheromone glands, and the sting with the passion gland.

a) The hypopharyngeal gland is located in the head of the worker bee, in front of the brain. It starts to mature three days after the bee's emergence, and develops only when the insect secretes royal jelly to feed the young larvae and the queen.

b) The wax gland, located in the lower part of the young worker's abdomen, releases wax between a series of four overlapping plates, called sterna, below the abdomen. The worker begins to secrete wax 12 days after emerging; six days later, the gland degenerates and the worker stops comb-building.

c) Scent glands: The worker bee produces three main scents. The gland beneath the sting produces a special pheromone consisting mainly of isopental acetate, which it sprays around the spot of the sting. The odour stimulates other workers to pursue and sting the victim. A second alarm pheromone, released by glands at the base of the mandibles, has the same function. A third gland, located near the rear of the abdomen, produces a pheromone which, when released by scout bees, attracts swarms of other bees to move toward them.

d) Queen's pheromone glands: In the queen bee's mandibles are located special glands which produce and release pheromones called the queen substances, which enable her to identify members of the colony, to inhibit ovary development in worker bees, to prevent the workers from building queen cells, to help a swarm or colony to move as a cohesive unit, and to attract drones during mating flights. The absence of the queen substance (e.g. when the

queen dies) produces opposite responses, i.e. worker bees begin to develop ovaries and to build queen cells, and a swarm searching for accommodation will not cluster but will divide into smaller groups that cannot support the normal life of a bee colony.

e) The sting of the worker bee is designed to perforate the skin of her enemies and to pump poison into the wound. It has about ten barbs, so that when it is thrust into flesh, the bee cannot pull it back again. It breaks off with the poison sac always attached to it, enabling more poison to penetrate for as long as it remains in the flesh. The bee's sting is lodged in a special sheath and is released only when the need arises. The sting of the queen bee is longer than that of the worker. It is used only to fight and kill rival queens in the hive. The drone has no sting and is totally defenceless.

Why keep bees?

Bees are under threat worldwide and Australia as an island is currently protected from many of the issues affecting bees worldwide. Einstein said that if the bee population suddenly died out, humans would have only four years to live.

"Concerning the generation of animals akin to them, as hornets and wasps, the facts in all cases are similar to a certain extent, but are devoid of the extraordinary features which characterize bees; this we should expect, for they have nothing divine about them as the bees have." **Aristotle 384 BC**

Bees pollinate plants and without plants we wouldn't have food. The whole of life on earth relies on bees. By becoming a bee keeper you are helping the local population of bees to be maintained in a managed way that will help ensure the bees survive should some of these global issues arrive on our shores.

Keeping bees is a truly fascinating hobby for all ages that can easily be practised no matter how small your house block. If you have a vegetable garden it will greatly benefit from the extra pollination from your own hive and you also get the benefit of making your own raw honey... it's delicious fresh produce.

The possible health benefits of honey

The possible health benefits of consuming honey have been documented in early Greek, Roman, Vedic, and Islamic texts and the healing qualities of honey were referred to by philosophers and scientists all the way back to ancient times, such as Aristotle (384–322 BC) and Aristoxenus (320 BC).

Honey has high levels of monosaccharides, fructose and

Sugarbag bee

glucose, containing about 70 to 80 percent sugar, which gives it its sweet taste – minerals and water make up the rest of its composition.

Honey also possesses antiseptic and antibacterial properties. In modern science, we have managed to find useful applications of honey in chronic wound management.

However, it should be noted that many of honey's health claims still require further rigorous scientific studies to confirm them.

Honey has been consumed for thousands of years for its supposed health benefits. Modern science is finding that many of the historical claims that honey can be used in medicine may indeed be true. In the Bible (Old Testament), King Solomon said, "My son, eat thou honey, for it is good", and there are a number of reasons why it may be good.

1. Acid reflux. Professor Mahantayya V. Math, from MGM Medical College, Kamothe, Navi Mumbai, India, explained in the BMJ (*British Medical Journal*) that, as it is 125.9 times? more viscous than distilled water at 37 degrees Celsius (body temperature), honey may be helpful in preventing GERD (gastroesophageal reflux).

2. Infantile gastroenteritis. E. Haffejee and A. Moosa reported in the BMJ on a clinical study in which they used honey in oral rehydration solution in children and infants with gastroenteritis. Their aim was twofold – determine whether honey might affect the duration of acute diarrhoea and to evaluate honey as a glucose substitute in oral rehydration. They found that honey shortens the duration of bacterial diarrhoea in infants and young children. They added that honey does not prolong non-bacterial diarrhoea duration, and "may safely be used as a substitute for glucose in oral rehydration solution containing electrolytes".

3. Healing wounds and burns. There have been some cases in which people have reported positive effects of using honey in treating wounds. A review published in *The Cochrane Library* indicated that honey may be able to help heal burns. The lead author of the study said that "topical honey is cheaper than other interventions, notably oral antibiotics, which are often used and may have other deleterious side effects". However, it should be stressed that there is a lack of evidence to fully support this claim. In fact, a study published in *The Lancet Infectious Diseases* concluded that applying medical grade honey to wounds of patients has no advantage over normal antibiotics among patients undergoing dialysis.

4. Honey for treating allergies. There is some research to suggest that honey may be useful in minimising seasonal allergies. *The Guardian* reported that honey even "beats cough medicine" at alleviating and reducing the frequency of cough. One placebo-controlled study, which included 36 people with ocular allergies, found that participants responded better to treatment with honey compared to placebo. However, a third of them reported that eating a tablespoon of honey every day was hard to tolerate due to its overly sweet taste.

"The bee is more honoured than other animals, not because she labours, but because she labours for others." **Saint John Chrysostom, Archbishop of Constantinople 347–407**

5. Fighting infections. In 2010, scientists from the Academic Medical Center at the University of Amsterdam reported in *FASEB Journal* that honey's ability to kill bacteria lies in a protein called Defensin 1.5. A study published in the journal *Microbiology* revealed that Manuka honey is effective at treating chronic wound infections and may even prevent them from developing in the first place. Dr. Rowena Jenkins and colleagues, from the University of Wales Institute, reported that Manuka honey kills bacteria by destroying key bacterial proteins. Some studies have revealed that a certain type of honey, called 'Manuka honey', may even be effective for the treatment of MRSA infections. Methicillin-resistant *Staphylococcus aureus* is a form of bacterial infection that is resistant to numerous antibiotics including methicillin, amoxicillin, penicillin and oxacillin, thus making it challenging to treat the infection successfully.

Illawarra Beekeepers Association

Illawarra Beekeepers Association's aim is to support and provide education and fun meetings for people interested in beekeeping and related activities.

Generally they meet on the second Thursday evening of each month at 7.00 p.m. and on the last Sunday of each month 10 a.m. at the Beegarden at Sutherland. Visitors are most welcome to attend a club meeting or do some work with some beehives on a field day.

The club has wonderful facilities including a club room, club store, apiary site and honey extracting room at Sutherland. They provide lectures for school groups and others about bees and beekeeping.

If you want to get started in bees and don't know who to turn to, what equipment to buy, where to get bees from or just want to find out if bees are for you, joining the club will give you access to apiary equipment and the expertise of experienced beekeepers. It will also provide you with low-cost third-party insurance for beekeeping activities.

Save Our Bees Australia

Save our Bees Australia is focused on promoting the health and longevity of our native bees, honey bees and in Australia focusing on the Sydney and the Sutherland Shire. They aim to do this by raising the awareness of bees amongst our neighbours and sharing ideas of what our local community can all do to ensure bees are around for a long time.

Sportsman Creek Conservation Area

Sportsman Creek Conservation Area is a gazetted property registered as a non-profit business. Its mission statement is to preserve the natural habitat corridor on a section of Sportsman Creek and to restore and maintain the remainder of the property; protect a full range of native flora and fauna and their habitats; protect and respect the Aboriginal values associated with the Bundjalung Aboriginal Nation; ensure a wildlife corridor is maintained to the neighbouring Southern Richmond Range group of Nature Reserves and Conservation areas. They are committed to ongoing survey work to increase the flora and fauna knowledge of the area and to increase all ecological and management requirements in regard to introduced plants and animals.

Sportsman Creek is located at 2954 Summerland Way Dilkoon, via Grafton, *Far North Coast of New South Wales Australia*. Website http://sportsmancreek.org/

The photos in this article were kindly supplied by Sportsman Creek Conservation Area.

Disappearing dugongs

Sara Mizzi

Photo by Fergus Kennedy

"Everyone has a passion for something, wants to change something – I believe in nature, wildlife, culture, conservation and ensuring that future generations are able to see the beauty and nature that we see today."

Australia remains one of the last places on earth where dugongs can still be found in significant numbers, with over three-quarters of the overall population residing here. They spend most of their day grazing on seagrass in the shallow, tropical waters, yet it is these shallow waters that endanger their very existence.

There was a time when traditional hunters saw dugongs as an inexhaustible resource. Hundreds of herds could be seen in many places across the dugong's range in the shallow waters from East Africa to the Western Pacific Islands. Today is sadly not that time as the IUCN Red List has listed dugongs as vulnerable to extinction with population numbers worldwide becoming increasingly fragmented.

Dugong, which means 'lady of the sea', is a species of a marine mammal and the only entirely vegetarian marine mammal on the planet whose prime food source is seagrass. They are a passive and gentle species, sometimes referred to as the 'sea cow' as, like cows, they move slowly, grazing on underwater grasses day and night. Dugongs may be seen to resemble whales (if viewed from behind), a largely overweight sea lion or possibly a face resembling that of a dolphin, yet they are more closely related to elephants than to any of these marine mammals, while their closest living aquatic relatives are manatees.

Professor Helene Marsh from James Cook University and one of the world's experts on dugongs says that dugong threats vary depending on that particular area at question and that there are still some places where dugong numbers are still relatively unaffected. "There are places like Torres Strait, which is the dugong capital of the world and probably has been the dugong capital of the world for 7,000 years as there is just a lot more habitat there than anywhere else. Our long-term data would suggest that the population in this area is stable."

Australia remains one of the last places on earth to have a large proportion of the remaining dugong population, making it the largest and globally most important refuge for the dugong. However, there are still certain population numbers in this part of the world that are also suffering and in decline.

Marsh explains that those areas on the urban coast of Queensland where there are cities and towns provide evidence of a significant decline in the dugong population. "The decline is complicated but it involves loss of habitat, animals being caught in shark nets, boat incidents, animals being caught in bycatch for commercial fisheries, and hunting."

Extreme weather in Queensland over the past decade, namely storms and cyclones, has also had a large impact on the availability of seagrass, which has led to an increase in dugong deaths from malnutrition and ill health.

Photo by Great Barrier Reef Marine Park Authority

"When you get extreme weather events, you get the soil washing into the oceans, which become more turbid. The seagrass can't grow so there is a really hard problem to address", said Marsh.

Andrew Simmonds, the Great Barrier Reef Marine Park Authority's project manager for species conservation, says that some of dugongs' life-history traits make them "all the more vulnerable". Although dugongs can live up to 70 years, they have a delayed sexual maturity and a very low reproductive rate which is largely dependent on the availability of food and other individuals. "Their reliance on inshore habitats further increases their exposure to human-related and land-based threats", said Simmonds.

Coastal developments along the Great Barrier Reef have also had an impact on the dugong population due to direct disturbance and loss of seagrass habitats, which they are extremely dependent on.

"There is quite a lot of work being done on trying to allow humans to live alongside dugongs and the rest of the marine ecosystem but I don't think we have solved the problem. There is certainly concern about the loss of seagrass from grazing land in particular as well as a water quality problem that is being affected by increased sediments, nutrients and pesticides in catchment runoff", said Marsh.

Simmonds believes that the best thing we can do to help protect the dugong population is to reduce pressures on our oceans. This can

Fact Box:

Animal Type: Mammal

Group name: Herd

Location: A large proportion of the world's dugong population is found in northern Australian waters from Moreton Bay in the east to Shark Bay in the west.

Total number of population: Unknown but at least tens of thousands

Classification: Vulnerable to extinction on the IUCN Red List

Closest relative: Steller's sea cow that was harvested to extinction within 27 years of being discovered

Closest living aquatic relative: Manatee

Diet: Herbivore, seagrass

Duration underwater: Generally only a few minutes but up to 12 minutes

Sexual maturity age: 6–17 years for females

Gestation period: 13–15 months

Number of calves: 1 every 2.5–5 years

Maximum life span in the wild: 70 years

Size: 2.5 to 3 metres

Photo by Great Barrier Reef Marine Park Authority

be done in the form of preventing debris from entering coastal waters; abiding by local zoning rules which stipulate how and where you can fish; abiding by boat speed limits to avoid boat strikes; and reducing run-off nutrients, pesticides and sediments from the land, which will help improve the health of seagrass meadows. "If each individual threat is looked at separately, some can seem relatively small, but once you combine them the pressures can have a substantial impact."

In the Great Barrier Reef Marine Park, measures have now been stepped up to protect dugongs. Restrictions have been imposed in 16 Dugong Protection Areas on the type of fishing gear that can be used and prohibiting the use of some types of fishing nets. Dugong habitats are also taken into account in the Great Barrier Reef Marine Park Zoning Plan, which determines how and where certain activities can take place out on the water. As a result, about 96 percent of high conservation value dugong habitats are protected from extractive industries such as fishing. In addition, the Queensland Government has also changed many of its shark control nets to drumlines so as to reduce the number of incidental capture of dugongs. But is this enough? Projections say that if dugongs continue to decline at the current rate, they will become extinct within the next forty years.

Simmonds believes that if dugongs were to disappear from our planet, it may have a range of cascading impacts on seagrass meadows and marine ecosystems more broadly. "The grazing of seagrass by dugongs plays a role in determining the abundance and species composition of seagrass meadows. They are an important component of the wider reef ecosystem, as not only is seagrass the main food source for dugongs and green turtles, it also provides nursery habitat for many fish, it can capture large amounts of carbon and helps trap and stabilise large amounts of sediment."

The future for these gentle giants appears to be fragile, with population numbers taking many years to recover. Australia therefore forms a crucial part of this species' survival, as if they were to disappear from these waters they will, most probably, disappear altogether.

Sara Mizzi is an international freelance writer. Her true passion lies in nature and wildlife conservation as her aim is to give a voice to species that can't. She also has a passion for travel and culture and has written a number of articles on the places that she has visited.

Sara continues to write articles for international magazines and newspapers in hope of spreading the word on what she has seen and what each of us can do to help.

She is a member of the Royal Geographic Society and the Environment Trust, where she regularly attends talks and communicates this back to the wider public. Sara has written a number of articles on numerous species for international magazines and newspapers including that of the National Wildlife Federation, Africa Geographic, Wild Magazine and The Sunday Times.

Follow Sara's writing on her website at www.sara-mizzi.com and on Twitter @MizziWildlife

A QUARTER CHICKEN and

Chrissy Banks

If you were to ask what my favourite time of year is I would probably answer, "I'm a four seasons kind of girl". I love the outdoor life of summer, the crisp change of autumn and the colours it brings to the trees. I love my winters cold and blustery, and happily welcome spring, in which the sun is warm, the breeze cool and the world around me is alive with new life. Then I get to thinking about it and realise that while I enjoy all the seasons, spring brings a smile to my face, an energy to my body and a general inability to sit inside for long because the day outside is so gorgeous (I'm practically chained to my chair as we speak). Could it be that I'm actually, for all its worth, a spring chicken? Haha, sorry, bad pun, but you'll recover.

The more I think about it, the more comfortable that idea sits and I'll tell you why: evidence of refreshed life is everywhere. Gardens are exploding into colour, the air is heady with the scent of wildflowers, the buzz of bees hangs lazily in the air, ladybugs are appearing, butterflies seem to rise from the ground in amazing diversity, reptiles are creeping out into a sunny spot to warm their bones and the air is full of the sound of birds singing and raising young. Even now I can hear the tentative chirping of a new wattlebird begging its parents for food. Spring is a haven for a new generation of all things and it's evident everywhere you look. It's truly magical and sometimes a little of that magic entwines directly with our lives and gifts us with an experience we'll never forget. For me that experience was born from a simple act of kindness.

Coming home from an afternoon walk with the family I found a very young New Holland honeyeater on the ground near my feet. Barely covered in feathers, this poor little thing was huddled between the path and a neighbour's fence, shivering. It was truly the tiniest bit of life I'd seen in

CHIPS

ages. Ever so carefully I scooped it up. Two things happened immediately: the little chick pooped on me and I was bombarded by its panicky parents. To be honest, I wasn't in a great deal of danger. These birds are diminutive to be sure, but the last thing I wanted to do was contribute to their obvious stress for longer than needed. Hubby took it carefully from me and placed it in the fork of the closest tree, a mature paperbark. The parents flew in, scolded us hugely and went about their parental duties.

Now, while we can't be utterly certain it was the same three birds, two days later a family of New Holland honeyeaters appeared in our backyard – and this is where the adventure really began. The first I knew of them I was enjoying a cuppa out back. A flicker of movement drew my eye and I nearly slopped my tea in surprise. A New Holland honeyeater chick was clinging to my bamboo fencing. In the citrus tree beside sat a very cranky parent bird. That it was scolding its offspring was undoubtable, I've used the same tone myself. I could almost project every word: *Why won't you stay put? I go for two minutes to find you bugs and you're off. Seriously! Stay in the nest!!!*

From where I sat it looked as though the chick had its foot stuck so I carefully approached. Before I got within a metre of it, the tenacious little bird flitter-fluttered back to the tree and managed to stick a landing. With its offspring safe above it, the parent fell silent and sat fluffed and tense. "That's a high maintenance chick you have there", I told it and *that* turned out to be a huge understatement. From that point on things got a little more ridiculous.

But before I regale you with that tale, let me introduce you formally to the New Holland honeyeater (*Phylidonyris novaehollandiae*). A streamlined, pretty bird growing up to 20 cm (head to tail tip), the New Holland honeyeater is found in south-eastern and south-western Australia and Tasmania. Primarily black and white with bright yellow markings on wings and tail, they have white tufts below each ear, on either side of the face and a small white cap on the head. A thin wisp of white hairs sit beneath a jet-black beak and they view the world from intelligent black-and-white eyes. Full of beans from the crack of dawn to the end of day they rarely sit still, busily feasting on high-energy nectar from grevilleas, banksias and other nectar-producing plants. They also dip their long slim beaks into fruits and zip after unlucky insects or spiders making them omnivorous. Nests are placed anywhere from ground level to approximately six feet in trees or shrubs. Nests are cup-shaped and built from bark and grasses bound by spider web. Soft materials line the inside and both parents tend the eggs and feed the hatchlings. A mating pair can raise two to three broods a year. While visibly identical, the female tends to be slightly smaller than the male, and juveniles are brown with brown eyes.

By nature this little bird has cheekiness in abundance and is downright tenacious. Curious of humans, I've also seen them drive off birds as large as ravens and smaller raptors, and dive-bomb cats and dogs with single-minded determination. This is a mini-bird with big attitude. Rarely alone, these birds are highly social within their own species communicating all day with high-pitched whistles and chirrups. When annoyed they made a rapid *chic-chic-chic* sound very similar to that of the willy wagtail. Often they can be heard early mornings and/or evenings congregating in groups to chatter noisily together. This is called a corroboree and I've personally witnessed this with nine in a row on our back fence. A very entertaining and endearing cacophony it was too.

So back to our little mischief-maker. Over the following days and into weeks we learned that even in the bird world there exist individuals destined to push the boundaries of safety. For a bird this size you'd think its main agenda would be to stay alive long enough to grow plumage worth bragging about. Not so with this little chappie. He spent so much time trying to fly before his time and falling out of his tree I began to wonder if he wasn't a little bit simple. One morning we watched as it attempted a crossing of eight metres from one citrus tree to another and landed on the ground halfway in between. "Oh, you're a quarter chicken and chips, you are", hubby said dryly, which was rather generous I thought, as it wouldn't have made a decent mouthful except for a cat, which was a very real possibility as the feline from over the fence was a regular visitor in our yard. Fortunately for Q-Chips, as the chick was dubbed, the cat remained oblivious.

There came a day, however, when the cat wised up, not because he'd looked up into the trees, but because Q-Chips had tried and failed another citrus crossing with the cat around.

From inside I heard the kafuffle and instantly knew what was going down. The cat had the baby bird! I burst out the back door and sure enough, Q-Chips was pinned down beneath the cat's paws – and for the first time

Above: New Holland honeyeaters are quick and intelligent birds with stunning plumage and a feisty nature.

Juveniles are tended to by both parents. Offspring beg for incessantly for food keeping parents busy sunrise to sunset.

Q-Chips fully fledged with a peeking of downing showing through enjoys the social time of late afternoon.

Enjoying a diet of high-energy nectars, insects, spiders and fruits, these birds rarely sit still long enough to be admired.

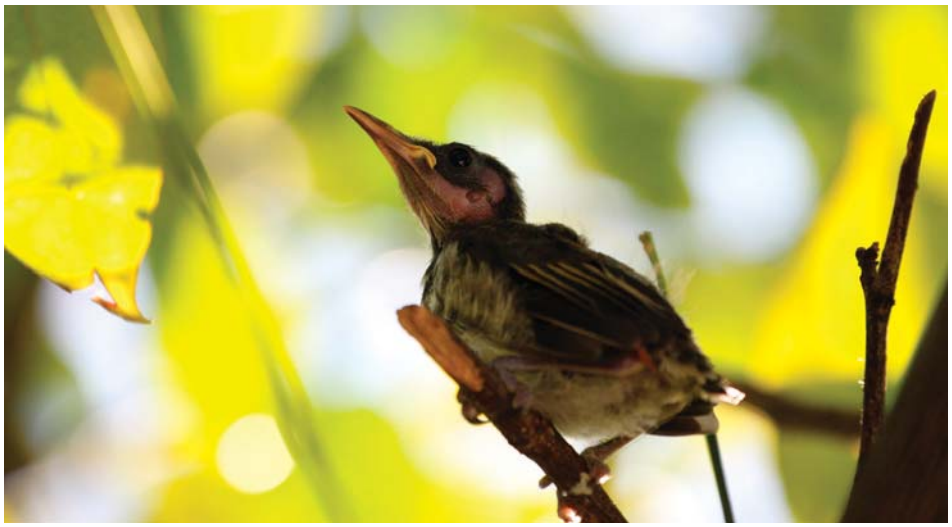
since I'd known it, the cat looked intelligently animated. In the tree above me one of the parent birds was shrieking madly. I didn't take time to think things through, I just grabbed the cat and tossed it over the fence (fly kitty, fly). Q-Chips skittled toward the base of a potted plant, clearly in shock, but before I could do anything to help it, the cat was back and shot by my legs hot on its not yet fully grown tail. Panicked, I did the only thing I could: I crash-tackled the cat. It wasn't pretty or elegant, or even clever. I grazed my elbows, the cat's eyes just about popped out of his head and a reasonable, calm part of my mind was making wisecracks – *nice tackle, needed a little more height though, you didn't quite manage to flatten the cat*. But the cat was okay, in fact it was kicking to get free and I was struggling to hold it. "Mum, here!" My son had the back door open and I flung the cat through and he slammed the door shut. Then I remembered the cat flap in the dining room door. Now that cat had never shown interest in the door before, but then he'd never looked so 'alive' before either. I raced to block the 'paws door', too late to stop the cat. He hit it head on at determined speed. The door was locked. The cat kind of concertinaed up on himself, hung like a crushed can for a second then flopped to the floor. To the sound of my son hooting with laughter I went looking for the bird.

To be honest, I thought it wouldn't survive that attack. Little birds frighten easily and often keel over under stress, but then I was learning this wasn't any ordinary little chick. Q-Chips was breathing hard by the potted plant, but very much alive. The moment it saw me approach it shot for the tree and made a huge effort to half climb, half fly its way to a safe branch by its mum. I looked at her. She sat in shock, not moving, barely even breathing and suddenly I was worried more for her. She wouldn't respond to any movement I made and the chirping of her chick got no response either. "You've killed her", I grumbled at the baby. The male bird flew in. The female stirred, then snapped out of it. Hoping she'd survive I went inside and looked at the cat-fiend. "I thought you were a total pansy and couldn't hunt", I announced. He was, after all, a rag doll and had shown no real interest in instinctive cat behaviour in the past.

He just blinked at me with huge blue eyes. My son was still laughing at the cat's misfortune. "Mum, you totally tackled a cat", he cackled. "It was awesome!"

The tackled cat was free from injury and released from the house via the front door a couple of hours later, but now I had a problem. He knew the baby bird was there and spent a good portion of time sitting at the base of the tree. Why didn't he climb the tree to get the bird, you ask? He was literally too uncoordinated to manage that. Seriously. If the baby bird fell to the ground then 'game on', but for that cat to actually climb a tree he'd have needed an elevator. So, as long as the little one stayed high in the tree he was safe(ish) – as the skies are full of ravens, magpies, hobbies and goshawks around our home, just to name a few. It's a dangerous world for a little bird, which is why Q-Chips ought to have stayed in his tree.

As it turned out, the little one managed a whole week without another major incident. It was this next scenario that truly astounded me. Sorting out cooking books in the dining room I became aware of frantic chirping and I have to admit I wondered, "What has that little thing gotten up to now?" Then a bird flew at the window. Startled, I looked. Sitting on a branch of their home tree,



Secure deep within the branches of an orange tree, the young bird must keep an eye out for potential dangers while parents are absent.

Evidence of a pugnacious character is evident in this little one that attempts a flight of at least ten metres and fails abysmally. He can be seen tenuously clutching our fence line while a parent chitters crossly in the tree above.

The yellow stripe is a distinctive feature of the New Holland honeyeater. These birds will feed alone, but prefer to dine socially.

One potential threat baby birds face are domestic pets. This unfortunate crash-tackled feline became obsessed with the baby bird.

staring at me and calling insistently was one of the parents. I blinked. It flew at the window then back to the tree. Its calling intensified. I went outside and it flew to where I was, then back to the tree, still calling. "You want my help?" I asked with a sense of wonder. It flew to the fence line, looked into a thick bush, then flew back to the branch and chattered at me. "No way", I breathed. I couldn't really believe this was happening. You read about animals seeking human help, but I didn't ever expect to experience it myself. The bush in question was a bird of paradise but on the neighbour's side of the fence (not the cat neighbour, by the way). I could hear the little thing in there, fluttering about, but even after trespassing and trying my best I couldn't get to it. In the end I looked up at the parent on the fence and shrugged. I hated leaving the little one in that predicament, but I was realising by now that if any little bird could find its way back into its tree, it would be this one. Sure enough, the next morning, there it was safe and sound. "You're turning us all grey", I told it.

From then on the excitement died down. The little one grew more feathers and as time went on graduated from flying citrus tree to citrus tree, to making bigger expeditions. One day the family was gone. Truth be told we were all a little bummed, but then one early evening three New Holland honeyeaters alighted on our shed roof for a sing and bug-snatching session – and one of them still had signs of youthful downing. "So you're still alive", I announced with genuine pleasure.

There are often New Holland honeyeaters in our yard in spring and maybe one of them is our little Quarter Chicken and Chips all grown up and raising a clutch of his own. I hope so, because that's the joy of spring, isn't it? Now as summer arrives I see fledglings of all bird species about the place and find myself grateful for the miracle of spring. New life. New hope. And new wonders to behold. Magic.

They often hop along the ground in search of bugs. New Holland honeyeaters are classified as secure. Enemies are nest raiders and domestic pets (mostly cats).

Austracantha minax

AUSTRALIA'S CHRISTMAS ARACHNID

KIT (AMY) PRENDERGAST (BA & BSC (HONS)), ZOOLOGIST AND CONSERVATION BIOLOGIST

As the warmth of December heralds the approach of our summer Christmas in Australia, many of us will commence decorating a Christmas tree with jewel-like decorations in preparation. Across Australia jewel-like ornaments are also appearing to decorate native vegetation, yet unlike the kitsch decorations we place on Christmas trees, the sculptured colourful adornments appearing around native vegetation are arguably even more spectacular... for they are alive! Closer inspection of these jewel-like critters festooning spaces between vegetation will reveal they are spiders – specifically, *Austracantha minax*, aptly known by the common name of the Christmas spider or jewel spider.

What *A. minax* lack in size they make up in other aspects of their appearance. Against the drab brown/black of many spiders, *A. minax* is a colourful creature. Like all spiders, its body comprises the cephalothorax (head and thorax, bearing the mouth parts and eyes, and the legs), and the opisthosoma, or abdomen. The cephalothorax is black with a metallic sheen and has small white setae (hairs). Typical of spiders, they have eight eyes arranged in two rows. It is the opisthosoma that really sets these spiders apart. The hard black shiny upper part – the carapace – is adorned with yellow, white and orange patterns. The brownish/black ventral surface also bears a yellow pattern. These spunky spiders have another amazing feature regarding their shape: their opisthosoma is sculpted with circular depressions, and is ornamented with three pairs of spiny projections. Their remarkable spikes have earned the species to also be referred to by the common name of the six-spined spider and spiny spider.

Interestingly, in late autumn, melanistic (solid dark brown or black) *A. minax* individuals may be observed. These melanistic *A. minax* morphs appears to be a result of adaptive change within individuals triggered by the environment, whereby colder months trigger individuals to become a melanistic morph which aids in absorbing heat (rather than the melanistic spiders representing a distinct different genetically based morph).

Unlike in the bird and mammal world we are most familiar with where males are larger, in *A. minax*, as in most in spiders, the females are the bigger sex. At 7–10mm long, mature females are roughly twice the size of the 3mm long mature males. Apart from size differences, sexual dimorphism also is present in other features: females have sharper, longer spines than the shorter, blunter spines of the males, and have a more squarish carapace than the more cylindrical abdomen of the males. Females have legs that are yellow/orange in colour with black tips, whereas the males have mostly black legs with brownish tips. As with all spiders, sexually mature males are identifiable because they feature enlarged pedipalps (the first pair of

Above: *Austracantha minax* are also known by the common names of 'six-spined spiders' and 'spiny spiders', denoting the spine-like projections on the opisthosoma. Photo by Kit (Amy) Prendergast

appendages before the first pair of legs that border the chelicerae, or fangs), which are used to transfer sperm packets to the female during mating.

The chelicerae – the first pair of fang-like appendages in front of the mouth that are a defining feature of arachnids – are black and are used in subduing prey by injecting venom into their prey. However, these small spiders are harmless to humans. When under threat, *A. minax* opts for a flight rather than fight strategy, escaping perceived threats by scurrying along the support threads of their web into more concealing surrounding vegetation, or drops to the ground. Although this species is not aggressive, they may bite if handled. Their bites are apparently only mildly painful. Temporary reactions such as redness, swelling or itching may be experienced at the bite site.

The binomial scientific name *Austracantha minax* derives from the Latin *auster*, meaning south (regarding the species' distribution on this southern continent), and from the Greek *akantha*, meaning thorn (denoting its 'thorns' on the opisthosoma) for the genus epithet, and from the Latin *minax*, meaning 'projecting' (denoting its projecting spines on opisthosoma), for the species epithet.

As a whole, this adaptable species occurs throughout Australia, from temperate to tropical regions, as well as on various offshore islands (Tasmania, Barrow Island off Western Australia, and the Montebello Islands). It has earned its common name the Christmas spider owing to how this species becomes most abundant around Christmas time (December and January).

When using a common name to refer to this species, I prefer to call *A. minax* the Christmas spider rather than its other frequently used common name of the jewel spider to avoid confusion with another spider of a different species in North America that also is known commonly as the jewel spider. Despite being located on the other side of the world, the North American jewel spider *Gasteracantha cancriformis* has a similar appearance to our jewel spiders: it likewise bears a colourful, ornamented carapace studded with six spines. The two jewel spiders are phylogenetically related, both being orb-weaver spiders (family Araneidae). In fact, the Australian jewel spider was classified within the same genus as the North American jewel spider when first described by the arachnologist Tamerlan Thorell back in 1859, hence was assigned the scientific name *Gasteracantha minax*. This classification was revised in 1974 by the arachnologist Michel Emerit, recognising Australian jewel spiders were distinct enough to be assigned to their own genus. The *Austracantha* genus is monotypic, meaning *A. minax* is the only species in this genus, sharing it with no others. There are five recognised subspecies of *A. minax* which can be distinguished based on distribution, spine shape, and colouration patterns:

- *A. m. minax* is the nominate subspecies, meaning that the first described individual of the species overall was based on a specimen of this subspecies. *A. m. minax* is found throughout Australia as well as on surrounding islands including Tasmania.
- *A. m. astrigera* is found on the mainland; the subspecific name *astrigera* derives from the Latin *astriger*, meaning starry.
- *A. m. lugubris* is also found on the mainland. Its subspecific name is from the Latin *lugubris*, meaning 'mournful/gloomy', denoting how this subspecies lacks the bright colourful abdominal markings in the other subspecies, and instead has a mostly dark opisthosoma.

Austracantha minax typically will be observed sitting in the centre of their web. Photo by Kit (Amy) Prendergast

- *A. m. hermitis* is confined to the Montebello Islands, and its subspecific name refers to Hermit Island, one of the islands in this archipelago.
- *A. m. leonhardii* occurs in central Australia. This subspecies was named after the anthropologist Moritz von Leonhardi, from whose spider collection the subspecies type specimen was obtained from.

A. minax is a member of the large family of spiders commonly known as orb weavers and correspondingly constructs orb-shaped webs. Orb web spiders can produce up to seven different silk types, each synthesised and produced from a particular gland. However, unlike most orb-weavers that consume the web and then rebuild it again daily, *A. minax* do not reconstruct their webs. The webs of *A. minax* are circular, with a dense spiral pattern woven around 20–30 rays, which are attached to a central ring. Among other functions, the spider's web serves to capture unsuspecting insect prey, especially effective at capturing small flying insects. *A. minax* has a fairly general diet, feeding upon flies and mosquitos that become entangled in their webs.

A. minax spin their vertically orientated orb webs in gaps between low-lying shrubs, located about 1–2m above the ground. A single web is about 0.45–1m in diameter and is attached to adjacent vegetation (or other webs) with support threads.

Juveniles construct webs, but interestingly once sexually mature the females are the ones that are the major web architects, whereas the males slack off, ceasing to spin webs and instead rest on nearby vegetation. The bold females in contrast rest in the centre of the web, head facing downwards, and only retreat when under threat.

When courting a female, a male *A. minax* starts by constructing a 'mating thread' – a loveline! – connecting the edge of the female's web to surrounding vegetation where he waits in the wings. He then positions himself about halfway along the mating thread and begins to strum it with his first and second pair of legs to get his love's attention. The female, so enticed by his titillating vibrations, will alight onto the mating thread. The male then meets his mate-to-be and ensnares her in a tight embrace, then proceeds to insert his spermatophore (a silk packet containing sperm) into the female's epigyne (external genital structure) using a pedipalp, thereby transferring his sperm into the female's spermathecae (receptacle where sperm is stored after mating). A female will mate with more than one male while she is receptive during a reproductive cycle if given the opportunity. However, from the point of view of a male spider this is not desirable at all, for it sets up the potential for sperm competition and runs the risk that his sperm may be ousted by that of a rival male to fertilise the female's eggs. In order to secure paternity, the male typically guards the female for a while both before and after a successful mating with her, actively driving away other amorous males until the female is no longer sexually receptive for further copulations, which occurs about an hour to a day after a successful mating attempt. After this, the female wants nothing to do with any males seeking to copulate with her and will herself aggressively attack males that attempt to court her.

A female deposits her fertilised eggs in an egg sac made from closely woven silk. The reddish brown, variably shaped egg sacs are 15–35mm long and are deposited on vegetation near the edges of the web. Once the baby spiders – known as spiderlings – hatch, they overwinter within the safe confines of their camouflaged egg sac, to then

With a beautiful colouration, pattern and body form, these 'jewel' spiders look like Christmas ornaments. Photo by Kit (Amy) Prendergast

emerge to face the big wide world when spring arrives. Whilst the mother provides no further care after she deposits her egg sac, *A. minax* females tolerate juveniles (whether their own or that of another female's) and females and juveniles often occur in facultative aggregations. *A. minax* males reach sexual maturity around mid-December, whereas the females become sexually mature a bit later around mid-January.

Whilst individual spiders may occur singly, they also may be found living together in associations, hence they are considered 'facultatively gregarious'. Although *A. minax* occur most frequently solitarily, more than 50 percent of spiders tend to inhabit aggregations, with the mean group size being about two spiders, but groups may comprise over thirty webs (comprising more than 30 spiders in total since males and web-less females may also be found in these communal webs), with the result being that their overlapping webs in such large aggregations can blanket entire shrubs. The individual webs are connected to each other by the silk support threads.

Suggested by the facultative nature of aggregated webs, there are both costs and benefits associated with being part of a group versus solitary. A study (Lloyd & Elgar, 2007) investigating these trade-offs found that females in aggregations suffered lower predation rates. The main predator of *A. minax* are pompilid wasps. Whereas over the study period only six percent of female spiders in aggregations were predated, of *A. minax* living a solitary existence 34 percent were eaten by predators! Hence, there is almost a six-fold increase in the risk of being predated for *A. minax* females that are solitary compared with those that live in aggregations. This reduced predation in aggregated webs may arise because of i) a dilution effect, where the chance of any single individual being predated is 'diluted' in a group situation; ii) the larger number of support threads in aggregated webs may help act as a barrier deterring a predator from accessing a spider; and/or iii) there is a higher likelihood that an individual in an aggregation will detect a predator and respond via silk vibrations, therefore warning the others in the aggregation of the predator's approach so that overall the rate of predation is reduced since spiders can respond to the threat and flee in time.

Although a spider in an aggregation did not capture more prey than one that built a solitary web, spiders in aggregations had higher foraging efficiency because, by spinning a web within an existing aggregation of webs, a spider has to produce less silk overall since it can attach support threads to those of other webs, exploiting the silk threads already produced by neighbouring spiders, and thereby reducing its individual investment and energy into silk. A further advantage of aggregations is that multiple webs allow them to span wide gaps between trees, enabling them to access areas to catch prey that a single web would be unable to.

Another benefit was that larger aggregations of females attracted more males, compared with their solitary counterparts. Not only are larger aggregations of females easier to locate for males seeking a mate, but there may also be an added benefit for females because by attracting more males, this gives them a greater choice of mating partners so that they can mate with only the fittest, and it also increases the potential for male–male competition, similarly helping to ensure only the 'best' males of the lot fertilise the female's eggs.

With these benefits of being in aggregations, why do many *A. minax* choose to be solitary? Well, the above study revealed that there was also a cost involved in this living situation: egg sacs in aggregations had higher rates of parasitism compared with solitary egg sacs. Parasitoids – primarily mites or wasps – lay their eggs in *A. minax* egg cases and when the parasitoids' larvae hatch, they consume the *A. minax* eggs. It was found that egg sacs around *A. minax* aggregations suffered a 51 percent parasitism rate compared with a 42 percent rate for egg sacs deposited by solitary females.

A. minax are not very loyal to a particular locality and instead individuals frequently move between sites. In the 2007 study by Lloyd & Elgar cited previously, over a three-week period, 20–30 percent of females moved between websites. Whilst females do not remake their webs daily, when moving a female consumes the silk before she leaves, therefore recycling the valuable proteins and energy that she had invested into the web.

A trait shared by some other orb-weaver spider species, *A. minax* are known as 'web decorators': their webs feature silken decorations in the form of silken white tufts attached to particular radii and the support threads of their webs at about 20mm intervals. This seems to represent a paradox: given these decorations make the web more visible, shouldn't this be maladaptive since webs are meant to be inconspicuous traps to ensnare unsuspecting prey that, failing to see these silken traps, fly unassumingly into them? A number of explanations have been proposed for the function of these web decorations. For the silk tufts adorning *A. minax* webs, studies have supported the hypothesis that these silken tufts function as an adaptive web protection or advertisement signal, preventing larger animals (non-prey or predators) from accidentally crashing into the webs and damaging them. Extensive damage to a web caused by an animal inadvertently blundering into it represents a high cost to the web's architect: producing silk requires time, energy and nutrients, and so a damaged web means a spider has to invest in time and energetic and nutritional resources to repair it, and also is prevented from capturing prey and obtaining food during the interim. Spiders may also be more prone to predation when reconstructing their web or if forced to relocate. Whilst making the web more apparent protects it from damage by non-prey animals, such 'non-prey' may include visually hunting predators! It may be that this web-advertisement behaviour is nevertheless maintained because the benefits of preventing the cost of damage to a web outweigh the risk of the decorations attracting predators, and studies have provided support for silk tufts being an adaptive warning signal to protect the web from organisms stumbling into it and destroying it.

The initial evolutionary origin of this paradoxical web-decorating behaviour has also been proposed to be explained as a result of physiological processes in how silk is produced: known as the 'silk regulation hypothesis', it posits that owing to the wrap-attack prey-capture of orb-weaver spiders, they must constantly keep their silk glands active because otherwise the silk-glands which they require to wrap up prey to subdue it – critical given their chelicerae and venom is relatively weak – will become inactivated. By keeping the silk glands active to maintain the glands in a productive state, excess silk can be then deposited temporarily on the web, giving rise to the silken web 'decorations'.

2015 University Student Grants Scheme winners

The Australian Wildlife Society's University Research Grants are scholarships offered to honours or postgraduate students at Australian universities. Each year, ten grants of $1,000 are awarded. Grants are available for research projects of direct relevance to the conservation of Australian wildlife; plant or animal. Grants may be used for the purchase of equipment and consumables, travel expenses related to field research, or attendance at conferences at which you are presenting your work.

The Australian Wildlife Society is delighted to announce the winners of the ten grants of $1,000 each to honours or postgraduate students conducting research that will contribute to the conservation of Australian wildlife. The winners for 2015 are:

Bianca Amato - School of Natural and Built Environments, University of South Australia
Project: The contribution of native flower visitors and their hosts plants to crop pollination on the Yorke Peninsula, South Australia

Benjamin Arthur - Marine Science, University of Tasmania
Project: Changing climate and the winter foraging ecology of Antarctic fur seal populations

Matt Christmas - University of Adelaide
Project: Climate adaptation of the hop bush, Dodonaea viscosa, along an environmental gradient

Amanda Edworthy - Research School of Biology, Australian National University
Project: Dispersal and genetic structure of forty-spotted pardalotes across fragmented landscapes: conservation of an endangered songbird

Christine Evans - Flinders University
Project: The hidden costs of extra pair paternity: implications for survival and reproductive success in an endemic woodland bird

Sarsha Gorissen - University of Sydney
Project: Conserving the endangered fauna of highland swamps

Emily Gregg - School of Biosciences, The University of Melbourne
Project: No water, no hope: the on-ground feasibility of a waterless barrier to prevent the spread of cane toads in Western Australia

David Hamilton - Department of Biological Sciences, University of Tasmania
Project: Contact networks and transmission of facial tumour disease in the Tasmanian devil

Harry Moore - School of Life & Environmental Sciences, Deakin University
Project: By supressing both the abundance and activity of invasive mesopredators in arid environments, could dingoes have a positive influence on native mammal species

Estibaliz Palma - The School of Bio Sciences and the Faculty of Sciences, University of Melbourne
Project: Plant invasion ecology: relationship between species traits and demographic dimensions of invasiveness

In this issue of *Australian Wildlife*, articles on the winners' projects are featured.

Dispersal and genetic structure of the forty-spotted pardalote across fragmented landscapes: conservation of an endangered songbird

Amanda Edworthy,
Research School of Biology,
Australian National University

The forty-spotted pardalote is a small, but tenacious songbird found on islands and remnant mainland patches of eastern Tasmania. These birds are one of Australia's most endangered species, having declined by 60 percent within the past 18 years. Unlike their close relatives, striated and spotted pardalotes, they are year-round residents of Tasmania, and are uniquely adapted to the cold, wet winters of the state. Forty-spots glean insects and manna (a sugary exudate of *Eucalyptus viminalis* trees), helping to keep forest canopies healthy. However, forest clearing and fragmentation has led to contraction of their distribution to just 4,500 hectares in southeastern Tasmania.

Tasmanian land managers and residents are increasingly interested in planting *E. viminalis* trees to help restore forty-spotted pardalote habitat, and several small-scale planting efforts have attracted forty-spot pairs over the past 15–20 years. Currently, both Maria Island National Park and Murrayfield Farm, which manage nearly three quarters of remaining forty-spot habitat, are actively engaged in using nest boxes and *E. viminalis* planting to provide habitat for forty-spots. However, we lack information about whether seedlings are best used to form corridors or to expand existing patches and create large areas of unbroken habitat.

In addition to expanding existing habitat, Tasmanian biologists are also considering translocation of the species to isolated patches of habitat where forty-spots are close to extirpation (e.g., Finders Island). Because the Flinders population has been long separated from other Tasmanian populations, it will have adapted to its environment and diverged genetically. For reintroduction, source birds should be taken from the population that most closely resembles the remaining Flinders Island birds; genetic analysis of population structure across regions will enable us to select the birds most likely to succeed in the Flinders environment.

Translocation and restoration of habitat connectivity are both important strategies for protecting and increasing abundance of forty-spotted pardalotes. However, to do

Above: Amanda Edworthy in Tasmania. Photo by Linda Edworthy

A banded forty-spotted pardalote

these well, we need to understand meta-population dynamics and genetic structure of forty-spots at the landscape scale. New DNA sequencing methods can detect large amounts of genetic variation across individuals and populations, which allows us to analyse patterns of dispersal and genetic relatedness among habitat patches and regions.

My project uses genetic markers to assess rates of forty-spot dispersal among habitat patches in relation to patch size, isolation, and habitat matrix (e.g., native forest, paddock, water channels, or residential development). I will also determine the degree of genetic relatedness among populations at Maria Island, Bruny Island, and mainland Tasmania near Bruny Island in comparison to samples from Flinders Island, as groundwork for a translocation program.

Like many hollow-nesters and habitat specialists across Australia, forty-spotted pardalotes are vulnerable to loss and fragmentation of forests. However, strategic revegetation of continuous habitat and corridors can restore healthy, interconnected populations. We hope that greater knowledge of how forty-spots move through the landscape will enable us to protect and restore critical areas of habitat, and to ensure long-term survival of the species.

Amanda Edworthy in the field. Mist nets allows us to catch, band, and collect blood samples from forty-spotted pardalotes. Photo by Angi Kim

Habitat is fragmented at Bruny Island. Photo by Linda Edworthy

A forty-spotted pardalote provisions its nestlings with manna (white clump visible in bill). Manna is the main food source for nestlings, and is only produced by E. viminalis among the forest species of southeastern Tasmania. Photo by Sam Case

Banding a nestling, soon to disperse. Colour bands allow us to identify and monitor movement of individual birds in conjunction with genetic methods.

Checking a Malaise trap and swapping over the collection jar so I can collect nocturnal invertebrates.

The contribution of native flower visitors and their host plants to crop pollination on the Yorke Peninsula, South Australia

Bianca Amato,
School of Natural and Built Environments,
University of South Australia

Land clearing, primarily for agriculture, is the most extensive cause of environmental degradation in Australia. Fragmentation has resulted in the loss of biodiversity and ecosystem services. I will be conducting my field work on the Yorke Peninsula, South Australia, a region that has been extensively cleared for livestock and cereal production. Only 13 percent of the original native vegetation remains, and most native vegetation patches are too small to retain their original biodiversity and functionality.

Remnant vegetation provides valuable habitats for Australian native bees, including species from the genera *Megachile, Amegilla, Homalictus*, and *Lassioglossum*. Native pollinators such as these bees play a vital role in maintaining natural ecosystems. Declines in pollinator diversity and abundance can adversely affect plant communities, with subsequent reductions in resources for other animal species.

In Australia, agricultural pollination services are predominantly provided by the European honeybee *Apis mellifera*. *A. mellifera* populations worldwide have declined as a result of colony-collapse disorder, viruses, the overuse of pesticides and the ectoparasitic mite *Varroa destructor*. These issues will reach Australia soon. However, several of Australia's 1,647 described native bee species may contribute to crop pollination, but their services have generally been overlooked by the agricultural community, and their roles in crop pollination are mostly unknown.

My project aims to determine the role of native pollinators and their supporting native vegetation on canola pollination. Native vegetation that favours healthy invertebrate communities may have a positive effect on agricultural productivity. Demonstrating the contribution of native pollinators on canola yield could lead private landholders to adopt conservation practices and protect native vegetation, especially in areas where few patches remain.

The ecology and population trends of the majority of native bee species are poorly documented.

Thanks to the support from the Australian Wildlife Society, I have been able to make 27 Malaise traps to sample invertebrates in canola crops and surrounding patches of native vegetation. These traps will not only help to determine the abundance and distribution of native flower visitors in an agricultural landscape, but may reveal areas of native vegetation that support specialist pollinator species found nowhere else.

A Malaise trap positioned in remnant native vegetation is able to collect hundreds of invertebrates every day.

No water, no hope:

The feasibility of a waterless barrier to stop cane toad spread in Western Australia

Emily Gregg
School of Bioscience,
University of Melbourne

For the past eighty years the cane toad (*Rhinella marina*) has been spreading rapidly through northern Australia, causing significant impacts on native wildlife such as the northern quoll (*Dasyurus hallucatus*) and reptile species including the king brown (*Pseudechis australis*) and the yellow spotted goanna (*Varanus panoptes*). The dogged and speedy proliferation of this species is as infamous as its deliberate and misguided human introduction.

Today, cane toads are established in the east Kimberley in Western Australia, and the invasion front is currently moving westward, before it is likely to turn south towards the Pilbara. Unlike the humid northern regions currently occupied by toads, areas south of Broome are arid, and it is hypothesised that toad survival here will rely on the presence of artificial water sources, such as pastoral dams. These artificial water sources provide hydration and breeding sites for toads in the dry season in areas where natural water sources are not available.

Fortunately, the toad's likely dependence on these artificial water points may give us a means to prevent their further expansion. By preventing toad access to these water sources we could create a waterless barrier to stop them moving any further west andsouth. By installing above-ground water tanks we could limit shelter available to cane toads and still maintain infrastructure vital for pastoralists. The barrier must simply be wide enough to ensure that toads will not be able to survive the journey during the wet season, so this infrastructure development need only be applied to a specific locale.

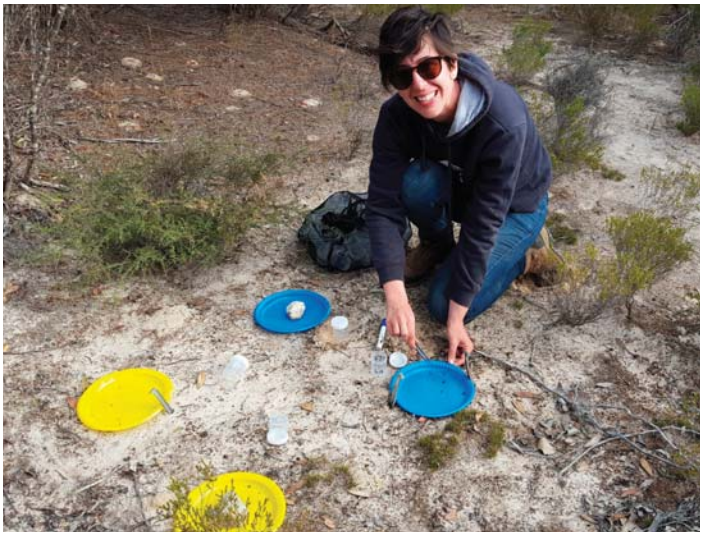
The groundwork for the waterless barrier idea is extensive. Earlier work has shown the importance of artificial water bodies to cane toad survival and modelling has identified areas in which a waterless barrier may prove most effective. My master's research focuses on the next obvious step: testing whether toads can survive in the barrier region without access to artificial water. So, over the past couple of months, a field assistant and I have released and radio-tracked 78 male toads north of Port Hedland and collected data on their water loss and movement rates, as well as the locations where they shelter during the day.

In the coming months, I will be analysing my field data as well as toad occurrence and biosecurity data from around Australia. Toads are occasionally found in areas ahead of the invasion front, having hitched a ride in shoes, camping gear or landscape supplies, for example. Because of this, it is important to investigate the risk posed to any barrier by hitchhiking cane toads.

A barrier north of Port Hedland could safeguard the Pilbara, a region renowned for its landscapes and unique wildlife. The Pilbara may, for example, be the last mainland stronghold of the northern quoll, a species whose populations have suffered greatly from the toxic toad's presence in the Northern Territory. The barrier could provide a simple, cost-effective and humane way of preventing the arrival of toads in the Pilbara, and my research is firmly aimed at assessing the feasibility of such a barrier.

I thank the Australian Wildlife Society for their support of my project.

Cane Toad



Emily Gregg testing in the field

Spatial and temporal interactions between predators in semi-arid Australia

Harry Moore,
School of Life and Environmental Science,
Deakin University

Over the last 100 years, the persecution of dingoes has occurred in a variety of landscapes throughout much of Australia, due mainly to conflict with livestock farmers. Nowhere is this more apparent than in south-eastern Australia, where the species has been exterminated from vast areas. Now, throughout many regions, the reduced dingo presence has facilitated the invasion of mesopredators, or medium-sized predators, such as foxes and feral cats, which prey upon native animals. Such mesopredators are one of the major causes of Australia's shocking record of mammal extinctions, with 30 species becoming extinct within the last 200 years. Control of mesopredators via traditional techniques such as baiting, shooting and trapping, has come at a substantial and sustained financial cost.

Currently there is much as debate over the role that dingoes can play in conservation. Evidence suggests that dingoes do suppress both red foxes and feral cats in arid and mesic environments. However, few studies have distinguished between spatial and temporal segregation of mesopredators by an apex predator, nor considered how these interactions affect small mammals.

My study aimed to address this knowledge gap by investigating how predators interact in space and time,

The Mitchell's hopping mouse is one species predicted to suffer should dingoes be eradicated from the Big-Desert Wyperfeld region. Photo by Tim Doherty

in Victoria's Big Desert-Wyperfeld region, as well as predict how this may affect small mammal species such as the Mitchell's hopping mouse. Thanks to funding provided by the Australian Wildlife Society, I was able to deploy motion-detecting camera traps across 7,000 km² of the Big Desert Wyperfeld region, in an attempt to address these aims.

Using data collected from the camera traps I was able to show both foxes and feral cats were indeed segregated from dingoes in terms of their distribution and their temporal activity. This finding supports a growing body of research documenting mesopredator release of foxes and cats when dingoes are reduced in their abundance or extirpated.

Whilst the precise mechanism by which dingoes supress feral mesopredators remains unclear, one possibility is that dingoes, red foxes and cats compete for the same resources, such as food. Other studies have demonstrated that in response to competition, dingoes often kill or evict other predators within their home range.

Given the proposed suppressive effects of dingos on feral predators, we also wanted to highlight possible flow-on effects that may occur following typical management interventions (i.e. wild dog/dingo poisoning). Using scenario-based modelling, we predicted the removal of dingoes from the Big Desert-Wyperfeld region could trigger a negative trophic cascade, whereby pressure on feral cats and foxes would be released. This would most certainly have dire consequences for the area's small mammals, including the Mitchell's hopping mouse which has already suffered greatly in other regions due to predation by foxes.

These results would suggest future predator management needs to consider both the costs and benefits to native species, and highlights the need for detailed and holistic ecosystem conservation and management approaches. Whilst the findings of this study may well be useful in terms of understanding the importance of apex predators in ecosystem dynamics, carefully designed natural experiments should be a priority for future work in order to gain a more comprehensive perspective.

Big Desert National Park (study site)

A dingo detected using camera traps partly funded by the Australian Wildlife Society.

A fox detected using camera traps partly funded by the Australian Wildlife Society.

Landscape genomics of the narrow-leaf hopbush along an environmental gradient

Matthew Christmas,
University of Adelaide

The threats posed to species by increasing global temperatures and more extreme weather conditions resulting from human-induced climate change are being ever more realised. Changes to species distributions, including shifts across the landscape in line with a shifting climate as well as reductions in species' ranges, are evident across the globe. Such changes are likely to become more and more pronounced, particularly as carbon emissions worldwide continue to rise, exacerbating the warming problem. How species, and particularly plant species, will adapt to such changes has been the broad topic of my PhD at the University of Adelaide and, along with two co-authors, I have recently had a review on the topic published in the journal *Conservation Genetics*, titled 'Constraints to and conservation implications for climate change adaptation in plants'.

For my PhD, I have used revolutionary genomic techniques to understand the demographic and evolutionary processes that have shaped the current population distributions and genetic patterns in the narrow-leaf hopbush, *Dodonaea viscosa* ssp. *angustissima*, a widely distributed species that is commonly used in restoration and revegetation plantings. It can be found in a range of habitat types, from rocky outcrops on mountain ranges to sandy plains. How it has been able to adapt and thrive in such a wide variety of conditions interests me greatly, and any answers to this question can help to inform on the adaptability of species under climate change. Specifically, I am interested in whether genetic adaptation to local conditions is

Dodonaea in flower: Narrow-leaf hopbush in flower in the Northern Flinders Ranges. The narrow leaves are an adaptation to aridity.

prevalent within this species and whether there is sufficient gene flow among populations for the movement of adaptive genes as climate conditions shift across the landscape.

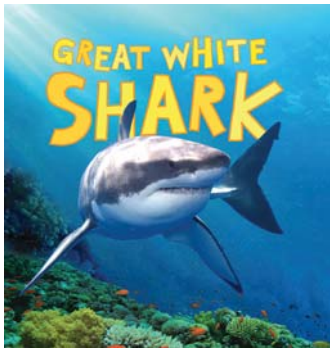
We have focussed on a latitudinal gradient throughout the Adelaide geosyncline region, traversing from Kangaroo Island in the south, along the Flinders Ranges and into the Gammon Ranges in the north. There is a steep temperature and rainfall gradient along this transect, with hot, dry conditions in the north and cooler, wetter conditions in the south. We made field collections of leaf samples from 17 populations throughout this region. We then used a number of genomic techniques to generate genetic data for analysis, including transcriptome analysis (sequencing the RNA in order to look at which genes are being expressed), and targeted sequencing of specific genes. Some of this work has recently been published in the journal *BMC Genomics* in a paper titled 'Transcriptime sequencing, annotation and polymorphism detection in the hop bush, *Dodonaea viscosa*'.

These data were used to address two questions: 1) is there any genetic structure among the populations across this region, and 2) can we identify any signatures of selection for specific genes, potentially indicating local adaptation? We have found that there are three distinct population clusters across the region: a Kangaroo Island cluster, a Flinders Ranges cluster, and an Eastern cluster. The genetic data indicate that there is very little gene flow between these clusters, suggesting that they are quite genetically isolated from one another. We have also discovered evidence of selection acting on a number of genes related to water stress along the gradient and it appears that this is driven by water availability. These outcomes help to draw a picture of the future adaptive potential of this species under a changing climate, as well as informing on seed collection strategies for restoration.

Thanks to the support I received from the Australian Wildlife Society through their University Student Grant Scheme, I was able to present my findings at a large international conference in Manchester, United Kingdom, hosted by the Society for Ecological Restoration in August last year. I gave a 15-minute presentation to an international audience and also had many opportunities to discuss my work with a variety of academics and practitioners. It was an incredible opportunity and there was a lot of interest in how genomics can be used to inform conservation and restoration practice.

Dodonaea viscosa is dioecious, meaning there are male and female plants as shown here. The female plant holds purple seed capsules, which mature during early summer Photos: Nick Gellie.

Book Reviews



***Discover Sharks: Great White Shark* by Camilla de la Bedoyere**

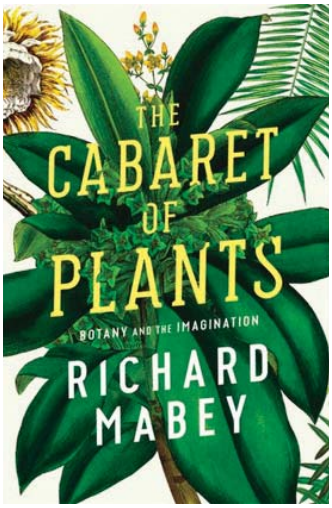
This delightful children's book is the perfect introduction to sharks. Explore the underwater world of these majestic creatures without getting wet! Dive down beneath the waves and catch a glimpse at some of nature's greatest predators. Check out the super strength of the great white, the taunting taste buds of the tiger shark, the bizarre head shape of the hammerhead and the human-friendly nature of the whale shark.

Publisher: Allen & Unwin
RRP: $9.99

***Top Wildlife Sites of the World* by Will and Natalie Burrard-Lucas**

This beautifully illustrated book on the world's best sites for watching spectacular wildlife will be a valuable addition to the bookshelf of any wildlife enthusiast. Top nature photographer and inveterate traveller William Burrard-Lucas has spent years visiting the far-flung corners of every continent, capturing thousands of breathtaking images along the way, and is therefore the perfect author for this title. Fifty sites are covered in this astounding book, each with a locator map, several photographs, a fact file of information such as 'best time to visit' and 'key species and spectacles' and a beautifully written evocative account of what it's like to go there.

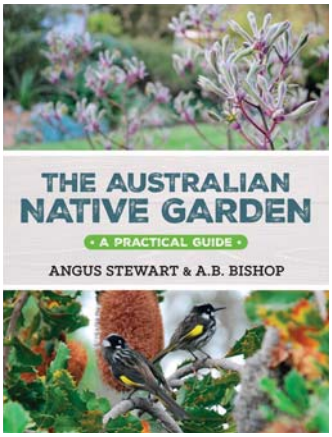
Publisher:
New Holland Publishers
RRP: $35.00



***The Caberet of Plants: Botany and the Imagination* by Richard Mabey**

In Richard Mabey's characteristically lyrical and informative tone, *The Cabaret of Plants* explores plant species which have challenged our imaginations, awoken that clichéd but real human emotion of wonder, and upturned our ideas about history, science, beauty and belief. Picked from every walk of life, they encompass crops, weeds, medicines, religious gathering-places and a water lily named after a queen.

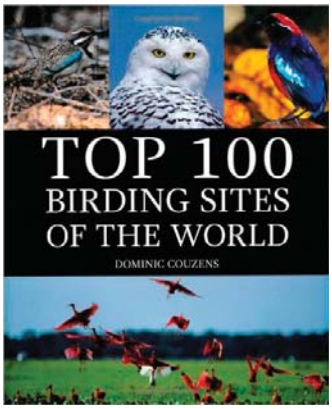
Publisher: Allen & Unwin
RRP: $45.00



***The Australian Native Garden: A Practical Guide* by Angus Stewart & A.B. Bishop**

This authoritative and practical book focuses on growing and using native plants in the home garden. It provides expert information on the fundamentals – soils, cultivation techniques, pruning, fertilising and maintenance – and looks at different styles of garden design, using Australian plants not only for aesthetic reasons but for creating drought-proof gardens, fire-resistant gardens, and environments attractive to native fauna as well.

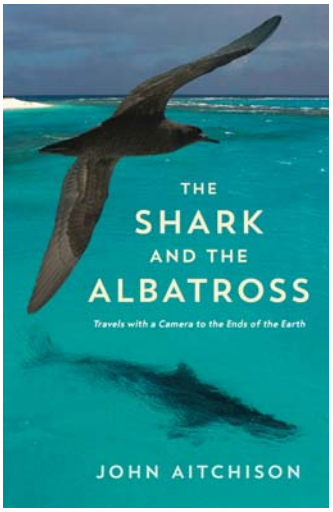
Publisher: Murdoch Books | RRP: $49.99



***Top 100 Birding Sites of the World* by Dominic Couzens**

If you have ever dreamt of seeing king penguins in Antarctica, cassowaries in Queensland or cocks-of-the-rock in Peru, then this book is for you. *Top 100 Birding Sites of the World* features detailed accounts of the best bird watching sites in the world, giving background and first-hand experience of what you can find there. The expertly written and very readable text is backed up by lavish photos of the birds and scenery at each of the chosen hot-spots, including rare images of amazing species

Publisher: Bloomsbury
RRP: $49.99



***The Shark and the Albatroos: Travels with a Camera to the Ends of the Earth* by John Aitchison**

For twenty years John Aitchison has been travelling the world to film wildlife for the BBC and other broadcasters, taking him to far-away places on every continent. *The Shark and the Albatross* is the story of these journeys of discovery, of his encounters with animals and occasional enterprising individuals in remote and sometimes dangerous places. This is natural history writing at its absolute best, evocative, informative and gripping from first to last.

Publisher: Allen & Unwin
RRP: $32.99






Bequest Program for wildlife conservation work

The Society has a Bequest Program to assist with their wildlife conservation work across Australia. Interested members are invited to complete the bequest form on page 46 in this issue of "Australian Wildlife" and send it to the National Office for processing.

In recent times much of the Bequest Program has been dedicated to our Society's environmental education programs, which are designed to educate the next generation of young Australians about our precious native wildlife in all its forms. There is an urgent need for further wildlife conservation work in this field.

Many families have already included a bequest in their personal last will and testament dedicating funds to the ongoing wildlife conservation work of the Society. You might like to consider including a bequest to the Society in your own will.

Friends of Australian Wildlife Society

The Society has been dramatically expanding its conservation and environmental work program and has embarked on an exciting new chapter in its history of wildlife conservation in Australia.

You can be a part of the Australian Wildlife Society's conservation future by becoming a 'Friend'. Application form is available from our national office.

University Grants Scheme

The Society already offers Wildlife University Research Grants of $1,000 each for honours/postgraduate students currently studying at any university in Australia, but the new award is aimed at a more significant level and for potentially a larger sum of funding to study wildlife conservation at the University of Technology Sydney.

The aims of this scholarship are: 1) to benefit the preservation of Australian wildlife by supporting applied scientific research with a wildlife conservation focus; 2) to further the Society's commitment to environmental education by supporting science students with a research interest in conservation; and 3) to increase awareness of, and attract new members to, the Wildlife Preservation Society of Australia and its wildlife conservation work.

We can also name a University Wildlife Education Scholarship after any person who is prepared to make a significant donation to this innovative program. We currently have ten national scholarships and a major university scholarship scheme at the University of Technology Sydney. We would be pleased to provide further information to members at any time.

Please contact the National Office at any time for further details of the Bequest Program, the Friends of Australian Wildlife Society and the University Grants Scheme.





Be a part of the Australian Wildlife Society's conservation future






To commit to being a part of our future, please complete this form. You may cancel your donation subscription at any time by notifying the national office.

Australian Wildlife Society
PO Box 42
Brighton Le Sands NSW 2216
Tel: (02) 9556 1537
Fax: (02) 9599 0000
Email: accounts@aws.org.au

You may also commit by visiting www.wpsa.org.au and registering online

All donations of $2 or more are tax deductible.

Australian Wildlife Society
Conserving Australia's Wildlife since 1909

Your Details

Name: Dr / Mr / Ms / Mrs / Miss

Address:

State: Postcode:

Phone: Home Work

Email:

☐ I want to join the Friends of WPSA and give by automatic deduction each month to help protect our unique native wildlife and its important habitat

I will give via: Credit Card (please complete authority form below)

Credit Card Payments

I am paying by: ☐ Visa ☐ MasterCard Card Security Code (CSC) __ __ __ __

Card No. __/__/__/__/ __/__/__/__/ __/__/__/__/ __/__/__/__/ Expiry date ___ /___

Name on card Signature

Regular Payment can be made by EFT

BSB: 062000
Account No: 1043 2583
Account Name: Wildlife Preservation Society of Australia

I will give:

☐ $10 per month ☐ $15 per month ☐ $25 per month ☐ $50 per month

☐ My choice of $ per month _____

Signature Date

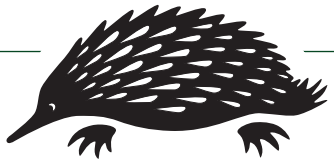
This authorisation is to remain in force until cancelled by the donor and in accordance with the terms described in the Agreement below.

Deduction will be made on 15th of each month.

CREDIT CARD AUTHORITY

1. The Donor will be advised 14 days in advance of any changes to the Credit Card Authority arrangements. 2. For all arrangements relating to the Credit Card Authority arrangements, the Donor will need to call AWS on (02) 9556 1537 or write to PO Box 42, Brighton Le Sands NSW 2216 or email info@wpsa.org.au. 3. Account details should be checked against a recent statement from your Financial Institution. 4. It is the donor's responsibility to ensure sufficient funds are available when the payments are due to be drawn. 5. If the due date for payment falls on a non-working day or public holiday, the payment will be processed on the next working day. 6. For returned unpaid transactions, the following procedure will apply: AWS will advise the Donor of the unpaid transaction and request alternative arrangements to be made for payment if possible. 7. All Donor records and account details will be kept private and confidential to be disclosed only at the request of the donor or Financial Institution in connection with a claim made to an alleged incorrect or wrongful debit. 8. This authorisation is to remain in force until cancelled by the Donor.

Membership Form



WILDLIFE PRESERVATION SOCIETY OF AUSTRALIA LIMITED

PO Box 42 Brighton Le Sands NSW 2216

Membership

Become a member of the Wildlife Preservation Society Limited
Simply fill out this form.

Name:.....

Address:.....

City/Suburb:..... Postcode: .....

Telephone:..... Fax: .....

Email: .....

Membership category (please tick)

- ☐ Individual: $55
- ☐ Family: $70
- ☐ Concession (pensioner/student/child): $50
- ☐ E-mag (emailed as PDF, no hardcopy will be sent): $30
- ☐ Associate (library, school, conservation groups): $85
- ☐ Corporate: $125
- ☐ Life: $1,000

(Includes postage within Australia. Add $40 for overseas postage)

Three year membership (please tick)

- ☐ Individual: $150
- ☐ Family: $190
- ☐ Concession (pensioner/student/child): $135
- ☐ E-mag (emailed as PDF, no hardcopy will be sent): $81
- ☐ Associate (library, school, conservation groups): $230
- ☐ Corporate: $340

(Includes postage within Australia. Add $60 for overseas postage)

Payment details (please tick)

☐ Direct Debit ☐ Cheque ☐ Money Order ☐ Mastercard ☐ Visa

Card Security Code (CSC) __ __ __ __

Card Number:

Name on Card: .....Expiry:.....

Signature:.....

Amount $.....

Donation $.....

Total $.....

Mail to the: **Wildlife Preservation Society Limited**
PO Box 42, Brighton Le Sands NSW 2216.
Email: accounts@aws.org.au Website: www.wpsa.org.au

Direct debit: **BSB:** 062 235
Account No: 1043 2583
Account Name: Wildlife Preservation Society of Australia

Note: All cheques to be made out to the Wildlife Preservation Society of Australia

Consider - A Bequest

Another way which you can support the work of the Wildlife Preservation Society of Australia (Australian Wildlife Society) is to remember us in your will.

If you would like to make a bequest, add the following codicil to your Will:

> I bequeath the sum of $..... to the Wildlife Preservation Society of Australia for its general purposes and declare that the receipt of the Treasurer for the time being of the Society shall be complete discharge to my Executors in respect of any sum paid to the Wildlife Preservation Society of Australia Limited.

"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.