



AUSTRALIAN

Wildlife

SPRING Vol: 4/2014

\$10 (non-members)



Celebrating a new century of wildlife preservation in Australia

Journal of the Wildlife Preservation Society of Australia Limited

(Founded 1909)

The remarkable birdlife of Sydney's northern beaches

Photography by Michael Hanvey



Black swan (*Cygnus atratus*), Narrabeen Lagoon. Photo: Michael Hanvey.



Barking owl (*Ninox connivens*), Narrabeen Lagoon. Photo: Michael Hanvey.

Contents

features

6 Australian Wildlife Society Research Scholarship awarded

8 The Remarkable birdlife of Sydney's northern beaches - *Michael Hanvey*

13 Real dragons of the sea: plant-like marine mimics - *Kit Prendergast*

19 2014: The year of the western quoll

21 Endangered koalas of Hawks Nest and Tea Gardens - *Ian Morphett*

25 Back from the brink: The saga of the Lord Howe Island stick insect

29 Gary Woodfield: A unique wildlife artist

31 2014 University Student Grants scheme winners

32 *Freda Nicholson*

33 *Yaara Aharon-Rotman*

35 *Blanche D'Anastasi*

36 *Jonas Bylemans*



7



8



11



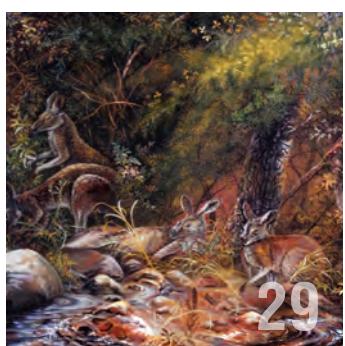
16



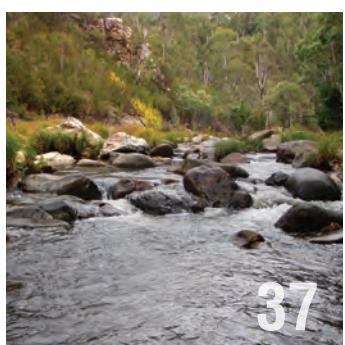
19



21



29



37

regulars

5 From the President's desk

38 Book reviews

39 Community Wildlife Conservation Award

40 The Serventy Conservation Medal

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

42 Membership form



Front cover:

Sacred kingfisher, Narrabeen Lagoon. Photo: Michael Hanvey.

Back cover:

Nankeen kestrel (*Falco cenchroides*), Long Reef Golf Course. Photo: Michael Hanvey.

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Australian Wildlife Society

Conserving Australia's Wildlife
since 1909

Australian Wildlife

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

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

Print Post Approval No: PP243459/00117

ISSN 0155-266X

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Notice to our members

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

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

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

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

Our Mission

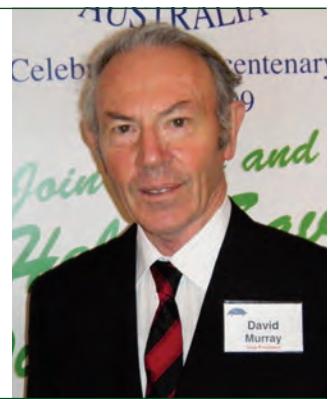
The Australian Wildlife Society (Wildlife Preservation Society of Australia Limited) is an independent, voluntary, non-profit conservation organisation, formed in 1909, and is committed to the preservation of Australia's precious flora and fauna. We act as a watchdog and provide advice to government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

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

From the President's desk

Dr David Murray - President

Back on the 2nd July our Board held a Strategic Planning Day. By way of introduction I spoke about a range of current issues, pegging them to the ancient Greek elements of Earth, Air, Fire and Water.



Competition for space on land frequently leads to habitat destruction for wildlife. We see a prime example in what is happening to koalas, where habitat is lost for inappropriate residential and road development, and also where plantation forests of koala food trees are felled without proper protection of any resident koalas. We may know all there is to know about koala food preferences, but if habitat containing these plants is not given special protection, koalas will become extinct. This is not a prospect to be proud of. Another kind of organism suffering extinction is the lowly snail, mainly through land clearance in Queensland. According to an expert interviewed recently on ABC Radio, hundreds of native species have become extinct already.

Air pollution has been an environmental concern for at least 50 years. I can remember questions about the effects of fluoride emissions from aluminium smelters on grape vines in the Hunter Valley, while a more recent survey found diesel fuel to be the major culprit for deadly microparticulate emissions from traffic. Nothing has ever been done about diesel, as our standards are lax compared to Europe's. Chief among air pollutants of current concern is carbon dioxide, the carbon substrate for photosynthesis, and the main gaseous product of respiration and combustion. The release of carbon dioxide from human activities unfortunately outweighs photosynthetic productivity. The resulting global warming leads to an increased frequency of extreme weather events. In Australia, days with maximum temperatures above 40 degrees Celsius have had catastrophic effects on some fauna, such as bats, which literally fell dead in their thousands in 2009 and 2013. Eventually elevated carbon dioxide will have a drastic impact on leaf composition,

reducing nitrogen and sulphur contents in favour of indigestible carbon-rich products. This will have deleterious consequences for every organism that eats leaves, ranging from insects to koalas.

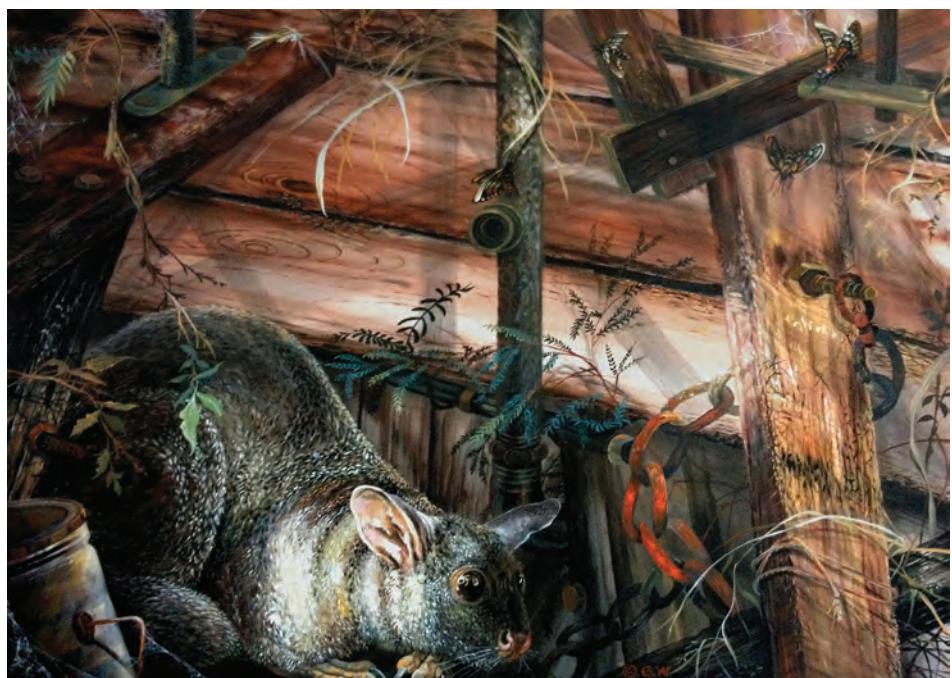
Fire is a normal part of vegetation cycles in Australia. Management of fires though fails to protect biodiversity when their frequency exceeds more than once every seven years (approximately). And an increased frequency of fires is encouraged by the carbon dioxide problem mentioned above.

With water, we need to consider rivers, groundwater and oceans. Mining is the single most drastic activity for the destruction of streambeds and pollution of both running water and aquifers. For example, old coal mines in the Blue Mountains pollute streams with excessive quantities of zinc that nobody wants to remediate. This kills species normally present in the

water. And the chemicals used in the extraction of coal seam gas should not be permitted to pollute water and groundwater – it's that simple. Access to pure water is a basic human right, which our governments should be protecting.

Dredging to create new ports close to the Great Barrier Reef will impact photosynthetic productivity in general and corals in the reef in particular. Encouraging increased boat traffic near the reef with its potential for toxic spills is utterly stupid. Sometimes I wonder why our species isn't called '*Homo non-sapiens*' – that would be closer to the truth.

Finally, we must find a way to reduce floating plastic waste, which has such disastrous effects when swallowed by marine life, such as pelicans and turtles. Container-deposit legislation has been practised in South Australia for many years, and is long overdue in the rest of Australia.



PESKY INTRUDER - After a severe flood, a curious possum snoops among the neglected items in an old abandoned shed. See more of Gary Woodfield's art on page 29.

Australian Wildlife Society Research Scholarship awarded



Dr Clive Williams presenting Sofietje with her scholarship certificate.

The 2014 Australian Wildlife Society (AWS) Wildlife Ecology Research Scholarship has been awarded to UTS School of the Environment PhD candidate Sofietje Voerman. Given the nature of her project, the scholarship will provide essential extra funding for experimental design and specialised equipment.

“My research focuses on the native marine seaweed *Caulerpa filiformis*, which has become very well adapted and is spreading. The problem with this species is that it is highly chemically defended and structurally very different to other important coastal seaweeds so it has the potential to have wide-ranging effects on the high biodiversity of marine organisms that call these habitats home”, Sofietje said.

“Studying these underwater systems brings many challenges, and one crucial requirement to enabling high quality research is having suitable equipment and diving materials. These can be expensive and often



Caulerpa filiformis covers the rocky reef like a thick and very dense green carpet. Also some habitat-forming kelp (*Ecklonia radiata*) is present. Bronte, Sydney. Photo: Sofietje Voerman.

need to be custom-built, for example sediment traps which will withstand strong ocean currents. This generous scholarship will have a big impact on my research and I hope will lead to a better understanding of Australia's astonishing, yet largely hidden, marine biodiversity", she said.

Head of School, Professor William Gladstone, said that Sofietje was a "passionate advocate for marine conservation and an outstanding young scientist".

Dr Paul Gribben – Sofietje's former principal supervisor now based at Massey University in New Zealand – said the research was very significant because the results would help develop management strategies for our biodiverse coastal ecosystems.

"We live in an era of intense global change, particularly in highly urbanised regions such as Sydney. Sofietje's research is providing valuable insights into how and why species respond to global change", he said.

Sofietje would like to continue her involvement in marine literacy education so that the results of her research reach as broad an audience as possible.

"I am convinced that even a slight increase in understanding will have such a positive effect on every person and creature visiting or living in our coastal systems. My passion is to learn, and share with and inspire others about this almost secret, largely unrecognised but very vulnerable underwater world and the AWS scholarship will help me achieve these goals", she said.

Sofietje was presented with the scholarship at the recent UTS Faculty of Science Annual Prizes Ceremony by Dr Clive Williams, Vice-President, Australian Wildlife Society.

The Wildlife Ecology Science Research Scholarship is aimed at supporting Higher Degree by Research students undertaking research projects with direct relevance to the conservation of Australian native wildlife – flora and fauna. The research scholarship promotes the conservation of Australian wildlife and is open to UTS postgraduate research students to support projects with outcomes that will help conserve Australian native fauna and flora.



Sofietje Voerman working in Bronte in beautiful clear conditions. Photo: Sofietje Voerman.



Dive officer Rochelle Johnston helps out with setting up an experiment in Wollongong. The blue hose connects the air drill to a scuba cylinder. Photo: Frederic Cadera, volunteer.



Juvenile black-shouldered kite (*Elanus axillaris*),
Long Reef Headland. Photo: Michael Hanvey.

The remarkable birdlife of Sydney's northern beaches

Michael Hanvey

Stark and steep, North Head rises from the sea, a massive sandstone sentinel guarding the northern approaches to Port Jackson and Sydney Harbour. Where the cliffs confront the open ocean, they reach heights of more than 90 metres. Declared a nature reserve in 2007, and with a road link to its beachside suburb of Manly, North Head's coastal heath and woodland provide important habitat for several animal species, many native plants and nearly 100 species of birds. Particularly on days when the wind barges in from the sea, the North Head platform gives intrepid observers the chance to view an impressive variety of seabirds. Sighting records here include at least five species of albatross, an impressive array of shearwaters and petrels, gannets, skuas, jaegers and fairy prions.



North Head and Manly mark the start of a truly spectacular section of Sydney coastline that runs for some 18 kilometres to the north, culminating at Barrenjoey Head and its iconic lighthouse, located in the suburb of Palm Beach. This 18-kilometre area takes in a string of

magnificent beaches, several municipal council regions, and a variety of beachside suburbs. Sydneysiders simply refer to the area as 'the Northern Beaches'. Make no mistake, those beaches are glorious. But there is far more than sun and surf to be found here. There are also delicate reef systems, protected marine reserves, wetlands and estuaries such as Narrabeen Lagoon, Pittwater and Dee Why Lagoon. The mighty Hawkesbury River is close at hand; the river opens to the sea at Broken Bay. Northern Beaches residents also enjoy easy access to numerous bushland reserves, walking trails and the huge Ku-Ring-Gai National Park.

This diversity of land and marine habitat makes for a truly stunning diversity of birdlife. Some of this is readily apparent even to casual observers. But much of it is not. Uncovering its scale requires considerable self-education about local bird species. I have found this to be a wonderfully rewarding pursuit, particularly when coupled with bird photography. Purchasing a good field guide on Australian birds is an excellent place to start. Joining a local birding group helps immensely and you will meet some great people. Perhaps, most importantly, one needs to take the time to look and to listen. You will be stunned at the number of bird species that you never knew existed, often within a very short walk or drive.

That said, knowing where to look is pretty important. Over the page are a few of my favourite Northern Beaches spots for birding and bird photography.



Noisy pitta (*Pitta versicolor*), Irrawong Reserve. Photo: Michael Hanvey.



Red-necked stint (*Calidris ruficollis*), Long Reef Point. Photo: Michael Hanvey.



Red-browed finch (*Neochmia temporalis*), Dee Why Lagoon. Photo: Michael Hanvey.

Dee Why Lagoon

Declared a Wildlife Refuge in 1973, Dee Why Lagoon is a small coastal estuary found just behind the sand dunes at the northern end of Dee Why Beach. The lagoon itself covers up to 30 hectares of surface area with marshy bushland and heath predominating elsewhere. A walking track traverses part of the Refuge at the rear of the beach sand dunes. Dee Why Lagoon is considered extremely significant habitat for both local and migratory birds. One may encounter species such as black swan, red-necked avocet, black-fronted dotterel, white-faced heron, great and intermediate egret, Australasian darter, several types of cormorant and a variety of ducks. Of the raptors, both eastern ospreys and black-shouldered kites are common. In the trees along Richmond Avenue, rainbow and musk lorikeets can be found, noisily proclaiming their presence. Smaller bush birds include red-browed finch, red-whiskered bulbul, silvereye, various honeyeaters, superb fairy-wren, variegated fairy-wren and welcome swallow.

Long Reef Headland and Aquatic Reserve

Long Reef is one of the best birding sites on the Northern Beaches. Dominated by a superb seaside golf course that can be circumnavigated by a walking track, the lookout at the clifftop commands majestic views of the coastline to the north and south. Whale-watching and hang-gliding are popular pursuits. Frequently buffeted by strong winds, Long Reef is favoured by raptor species that often hunt along the clifftops and over the reef. They include Nankeen kestrel, black-shouldered kite, white-bellied sea eagle and eastern osprey.

The reef itself – part of a declared Aquatic Reserve – is of enormous importance in sustaining a variety of migratory shorebirds, many of which are showing declining global populations due to shrinking habitat and other threats. These migratory visitors arrive during the spring in Australia; some – such as the tiny red-necked stint – after a truly epic journey from their Arctic breeding grounds. Around mid-autumn the shorebirds depart to undertake the long return journey. In the meantime, to build up strength for that arduous return leg,



Brown gerygone (*Gerygone mouki*), Warriewood Wetlands. Photo: Michael Hanvey.

they need all the rest and nourishment that they can get. Among other shorebirds commonly sighted at Long Reef in the warmer months are Pacific golden plover, grey-tailed tattler, sooty oystercatcher, ruddy turnstone, and red knot. Less frequent sightings include sharp-tailed sandpiper and even oriental plover, with double-banded plovers turning up in the winter months from New Zealand. Colonies of great crested terns are seen throughout the year.

The coastal heath around the cliffs and the golf course at Long Reef shelters a host of smaller birds, with fairy-wrens – both superb and variegated – particularly abundant. Red-whiskered bulbuls, little wattlebirds, red wattlebirds and grey butcherbirds are common here. Glossy black cockatoos are occasionally seen, sometimes feeding amongst the casuarinas.

Narrabeen Lagoon

With its sea entrance at North Narrabeen Beach, Narrabeen Lagoon is the largest estuary system on the Northern Beaches. Half of its catchment area is bushland, home to

roughly one third of Sydney's birdlife as well as providing habitat for a range of other fauna. The lagoon – together with its surrounding Crown bushland – was declared a state park in April 2014. A multi-use trail that will circumnavigate the lagoon is due for completion late this year.

A walk around the bushland foreshore of Narrabeen Lagoon (be alert for legions of cyclists) can produce sightings of some great birds. Waterbirds here include black swans, egrets, white-faced herons and cormorants. I have frequently sighted acrobatic Caspian terns overhead as they dive for fish. Of the raptors, eastern ospreys are often seen and white-bellied sea eagles are not uncommon. An extremely incomplete list of bushland species at the lagoon would include sacred kingfisher, king parrot, laughing kookaburra, golden whistler, eastern yellow robin, Lewin's honeyeater, brown gerygone, red-browed finch, silvereye, noisy friarbird, grey butcherbird and sulphur-crested cockatoo. A barking owl – pretty unusual in Sydney – has been one of the lagoon's more celebrated residents,

its preferred roosting spots well known to both locals and birders. Barking owls sound just like a dog and one could quite easily find this one by simply listening for the 'woof-woof' of its call. I am not aware of any recent sightings so perhaps the owl has now decamped.

Warriewood Wetlands and Irrawong Reserve

A gem of a birding site despite its relatively small size of 26 hectares, Warriewood Wetlands is set amidst intense housing development, a major shopping centre and busy traffic. Once within the wetlands, one quickly forgets about the urban surroundings. Together with the adjacent Irrawong Reserve, which contains lilly pilly closed forest habitat, Warriewood Wetlands supports at least 150 species of birds. Among its key habitats are areas of now rare swamp mahogany woodland. The winter flowering of the swamp mahogany attracts many species of honeyeater and other birds. Rose robins are another prized winter arrival. In summer, one may see sacred kingfisher, azure kingfisher, and dollarbird. Other avian residents are

spotted pardalote, brown gerygone, golden whistler, grey fantail, white-browed scrubwren, white-browed treecreeper, silveryeye and various thornbills. Rainbow lorikeets are abundant; musk, scaly-breasted and little lorikeets are spotted less often. Sulphur-crested cockatoos and laughing kookaburras are frequently seen. In the open wetlands section, regular sightings include Pacific black duck, grey teal, chestnut teal, hardhead, Eurasian coot, royal spoonbill, Australian white ibis and welcome swallow. Normally elusive spotless crakes are also known to turn up at the wetlands from time to time as are Nankeen night herons. Raptor sightings include grey goshawk, brown goshawk, osprey and whistling kite.

The adjoining 4.5-hectare Irrawong Reserve, with waterfalls and rainforest habitat, has a number of interesting avian visitors, including a colourful noisy pitta that frequents the area in winter. Other species found here include superb lyrebird, eastern whipbird, eastern yellow robin, spangled drongo, black-faced

cuckoo-shrike, black-faced monarch, Australasian figbird and scarlet honeyeater. There are also frequent close sightings of powerful owl.

Chiltern Trail

This 1.5-kilometre rock-gravel track off Chiltern Road in the suburb of Ingleside is well known to local birders and deserves mention. The Chiltern Trail threads into bushland of Ku-Ring-Gai National Park. In early winter this year, several regent honeyeaters were spotted here. One of the most critically endangered species in Australia, these beautiful honeyeaters are extremely rare, especially in Sydney. Birders and bird photographers, myself included, hastily converged on the site. Winter also brings many other honeyeaters to Chiltern including yellow-faced, fuscous, white-naped, scarlet, and yellow-faced, joining the more commonly seen species such as New Holland and white-cheeked honeyeaters. The banksia that grows along the verge of the track attracts other species such as eastern spinebill, silveryeye and wattlebird. The tiny

and beautiful spotted pardalote is common here – their nesting burrows sometimes built into mudbanks at the edges of the track. Sightings of raptors are not unusual. Brown goshawk, collared sparrowhawk, little eagle, wedge-tailed eagle, square-tailed kite and whistling kite are just some of the local species.

The above sites only scratch the surface. There are amazing birds and superb birding spots throughout Sydney's Northern Beaches. If you are local and are interested in birdlife, I hope that you will find some of this information helpful. If you are not local, I encourage you to come to the Northern Beaches for a visit. I do not think that you will be disappointed.

Michael Hanvey is a freelance writer and keen bird photographer. He has been a resident of Sydney's Northern Beaches since 2006.

To view more of Michael's bird photography, please visit his Flickr photostream: <https://www.flickr.com/photos/45000553@N05/>



Spotted pardalote (*Pardalotus punctatus*), Chiltern Trail. Photo: Michael Hanvey.



Real dragons of the sea

plant-like marine mimics

Kit Prendergast, wildlife writer, zoologist and conservation biologist

Many people believe that dragons are make-believe fantasy creatures – mythical beasts of the imagination, to be found only within the pages of a fairy-tale or the inner mysterious mists of one's inventive mind. However, real live dragons exist and thrive beneath the waves of Australia's mysterious marine waters around the south of the continent, camouflaged within jungles of kelp and seagrass.

Exquisitely camouflaged within fronds of gold-green kelp, only the most perceptive eye may discern the shape of one of the most beautiful, ornately camouflaged creatures, the leafy seadragon. The body and colouration of these dragons of the sea has evolved to mimic the seaweed forests within which they drift serenely. Their gossamer foliaceous appendages adorning their bodies make leafy seadragons virtually indistinguishable from the seaweed fronds and kelp formations they live amongst. Along with their physical appearance, their behaviour of floating suspended amongst the seaweed means the leafy seadragons' remarkable resemblance to marine plants and algae confers effective protection against being spied by predators.

Rather than being reptilian beasts, seadragons are actually species of bony fish, classified in the class Actinopterygii, within the family Syngnathidae. Syngnathidae also includes the seahorses (subfamily Hippocampinae) and the pipefish (Syngnathinae). Seadragons are also classified within the subfamily Syngnathinae and are thus most closely evolutionarily related to pipefish rather than seahorses. The name Syngnathidae refers to the trait of fused jaws that characterises all species within this family: the word *Syngnathidae* is derived from Greek words *syn* meaning fused, and *gnathus* for jaws. Along with fused jaws that produce their distinctive elongated tubular snout, seadragons also share

the diagnostic features characterising the Syngnathidae of thick plates of bony armour covering the body, eyes that can move independently of each other, and the absence of pelvic fins. Like their closer relatives the pipefish, but unlike seahorses, the thin tails of seadragons are not prehensile, and so they are unable to wrap their tails around to grip onto structures such as coral or seaweed. This renders seadragons susceptible to the whims of strong tides. Being unable to anchor themselves during strong storm surges, the bodies of dead seadragons often end up strewn upon beaches.

The leafy and the weedy

Real marine dragons are represented by two species: the leafy seadragon (*Phycodurus eques*, also known as Glauert's seadragon) and the weedy seadragon (*Phyllopteryx taeniolatus*, also known as the common seadragon or as Lucas' seadragon). Each species, being the only member representative

Above: Leafy seadragons with their beautiful golden bodies adorned with foliaceous appendages are an absolutely stunning sight.

of its genus, is unique. As monotypic taxa, this makes each seadragon species of high priority in terms of conservation and evolution.

The olive-tinted foliage-like appendages that decorate the body of a leafy seadragon are much more numerous and branching, and thus more extravagant and prominent, than the 'weedy' protrusions adorning the weedy seadragon. The weedy seadragon has a dark red, orange or brown-coloured body adorned with numerous yellow, white and purple spots and markings, and iridescent blue stripes across the chest.

Weedy seadragons grow to an average body size of 30 centimetres, however they can reach lengths of 47 centimetres. Interestingly growth rates, survival rates, maximum size, and maximum lifespan vary with latitude. A general trend among fish, Tasmanian weedy seadragons inhabiting the colder waters of more southerly latitudes have lower growth rates, higher survival rates (up to 25 percent greater) than weedy seadragons that inhabit the

waters around New South Wales, and have maximum lifespans of eight years, versus six years for New South Wales seadragons, which is a consequence of the effects lowering temperature has for many ectothermic animals (animals whose body temperature and metabolism depends on environmental temperature, unlike mammals and birds whose body temperature is regulated at a fairly high constant temperature by internal heat production enabled by regulating a high metabolic rate). However, weedy seadragons break the general trend, known as Bergmann's Rule, that proposes body size increases with increasing latitude. When it comes to patterns in body size and latitude, weedy seadragons from the higher latitudes of Tasmania are actually smaller than those from New South Wales. Weedy seadragons in the more southerly colder waters also have longer gestations, resulting in later birth dates, than those in New South Wales.

The leafy seadragon is slightly smaller, with an average body size of 28 centimetres, but they may reach 35 centimetres in length. The leafy

seadragon features brown or blue vertical stripes and is greenish-gold or brownish-gold in colour, however colouration can vary depending on age, diet, mood, stress level or location. This remarkable ability to change colour is a trait shared with many other seahorse species.

For both species, every seadragon can be individually identified because, once mature, a seadragon has facial markings unique to it. This is extremely useful for scientists when conducting studies on population size, movement, growth rates, survival and other demographic information. In addition, the patterns of wear and tear of their leafy fronds can aid in individual ID'ing in the short term. Another innovative new technique for ID'ing involves using marking each individual with unique Visual Implant Fluorescent Elastomer markers.

Rare endemics

These beautiful oceanic dragons are flagship species for marine conservation, emblematic of the often unrecognised biological diversity and



Weedy seadragon.

richness of Australia's southern cool, coastal waters. Found nowhere else in the world, both of these iconic, rare species are endemic to Australia's southern coastal waters. They occur at depths of 3–50 metres in the temperate to subtemperate marine waters around Australia's south coast. The weedy seadragon's distribution extends from Port Stephens, central New South Wales, down to Victoria and Tasmania, around the south coast of Australia, up to Geraldton in south-western Western Australia. The range of the leafy seadragon is less easterly and more restricted than that of the weedy seadragon; its range extends from Jurien Bay and Geraldton, Western Australia, in the west, to Bellarine Peninsula and Wilson's Promontory, Victoria, and Kangaroo Island at the eastern end of its range.

Masquerade masters

Seadragons' exquisite camouflage conferred by cryptic colouration and leaf-like appendages is further enhanced by how their movements mimic the gentle swaying of the seaweed. As they drift in the water, these leafy or weedy mimics bear a remarkable semblance to the swaying seaweed, enabling them to avoid predation. In addition to their camouflage, seadragons are afforded protection by a number of defensive spines along the sides of the body. Their leafy appendages serve exclusively for camouflage and do not function in locomotion. Rather, seadragons propel themselves serenely through the water via rippling undulations of their transparent dorsal fin (located along the spine), whilst using their small translucent pectoral fins located on their heads to steer. Bizarre among fish, they lack a tail fin. Their powers of locomotion are limited and they mainly drift along with the ocean currents like seaweed flotsam. However, their brilliant disguise makes speed to escape predators unnecessary. And, despite being weak, slow swimmers, they can control their movements with high precision.

Residency on the reef

Whilst their non-prehensile tails mean they cannot attach physically to reef structures, both seadragon species are amazingly 'attached' to their 'home patch'. Studies have revealed they show remarkable site fidelity, remaining in the same home range throughout life. Each weedy seadragon's home range



Serenely drifting with the currents, the golden-hued leafy seadragons with their kelp-like appendages are masters of camouflage, masquerading as strands of floating kelp that characterise the habitats they prefer to occupy.

is both horizontally and vertically restricted, always less than 50 metres wide, and they move only 2–4 metres vertically, typically remaining at depths of around 9 metres.

Unlike most other reef fish that stake out a permanent residency on the reef, seadragons do not appear to be territorial and have overlapping home ranges. Whilst typically solitary, they can also be found in groups of varying size (maximum seven) and consisting of both males and females, as well

as juveniles. The exception to this 'home body' behaviour is during the breeding season when pregnant males migrate to shallower waters that serve as birthing and nursery ground: a study by Sanchez-Camara and Booth (2004) tracked one male who travelled over 550 metres back to his home range after giving birth in 3-metre deep shallows.

Leafy seadragons likewise are very site-attached in well-defined home ranges measuring 35–82 metres across. Individuals tend to hover in the same



Whilst not strictly social, leafy seadragons are not aggressive and will happily tolerate being in the company of other individuals in aquariums, such as this pair of beautiful specimens at AQWA in Western Australia.

locality for extended durations (up to 68 hours or so), only intermittently engaging in short bursts of more rapid movement, which is expected given their extremely weak swimming ability. Like weedy seadragons, leafy seadragons only migrate longer distances when the pregnant males travel to shallower, less exposed, sheltered waters to give birth in nursery grounds. These depths also are ideal to give the young a good head start since they coincide with depths where their fundamental mysid prey are most abundant.

Representing a trade-off between camouflaging protection against predation afforded by kelp, and maximum densities of their primary mysid prey that occur over sand patches, weedy seadragons prefer to inhabit areas of kelp bordering sand. The exception to this habitat preference is seen in pregnant males carrying their precious cargo of developing babies, who prefer to hide within the safety of kelp.

Whilst leafy seadragons also inhabit macroalgae-covered reefs, unlike weedy seadragons, leafy seadragons prefer to reside in meadows of seagrass.

Hoovering up lunch

Adults feed on zooplankton, such as small crustaceans and larva fish, with a special predilection for mysid shrimps (sea lice), and a seadragon will

consume up to 1,000 mysid shrimps per day. With a rapid snap of its small terminal, toothless mouth, a seadragon uses a powerful suction force generated by expanding a small joint at the base of its fused jaws to suck up these small prey items through its long, tubular snout. Interestingly, like other syngnathids, seadragons lack a functional stomach, which necessitates constant foraging for food to survive.

Leafy love, weedy weddings, and 'sex role reversal'

Like in other syngnathids, it is the male seadragon that performs the parenting duties by brooding the egg mass containing the developing baby sea horses. However, unlike in seahorses, where the female deposits her eggs in a special brood pouch (marsupium) that the male seahorse possesses, male seadragons lack a marsupium. Rather, the underside of the male seadragon's tail bears a special spongy brood-patch that develops during the breeding season. Owing to this unique pattern in syngnathids where males become 'pregnant' and brood the female's eggs and perform all parental duties, and because females can produce more eggs than can be accommodated in the brooding patch of the male, this creates a reversal to the typical pattern where a female seadragon's reproductive success is limited by the male, rather than the reverse. This 'reversed' sexual selection

likely explains the reversal of general patterns of sexual dimorphism in animals: female leafy seadragons are generally larger and deeper-bodied than the often darker-coloured males. In weedy seadragons, males and females are quite hard to distinguish except during the breeding season when the male's brood patch develops and the female's abdomen becomes swollen with growing eggs; however, males tend to have more elongated bodies than the compressed, deeper-bodied females, and have thicker tails.

Prior to mating, seadragon pairs perform elegant courtship dances. When ready to mate, the tail of a male leafy seadragon turns bright yellow. The breeding season of the leafy seadragon runs between March and October and two broods may be produced. Whilst the actual mating event has never been observed in leafy seadragons, it can be inferred that the mating process involves a female seadragon depositing her round, bright-pink eggs, numbering from 100 up to 250, onto the underside of the male's tail, with each egg being deposited in a special cup of blood-rich tissue. During this transfer, the eggs are fertilised and are then incubated by the father for four to eight weeks, the length of incubation depending on environmental conditions. Over the incubation period the initially bright-pink eggs turn a ripe purple or orange. The highly vascularised cups of the male's brood-patch provide a high blood flow allowing efficient transfer of oxygen from the father's oxygen-enriched circulation to support the growth and development of the baby seadragons inside the eggs nestled in each cup. Once the baby seadragons have completed development, the clutch of hatchlings emerges over several days. The father assists the babies to hatch by pumping, shaking and rubbing his tail against structures. At hatching, the baby seadragons are immediately independent and swim off to brave their watery world, fending for themselves with no further parental care provided. The newly emerged hatchlings are minuscule – only 20 millimetres long. However, they are fully formed – there is no larval, pre-metamorphosis phase. Whilst differing in colour – newly emerged leafy seadragons differ from adults in sporting black and white markings – the hatchling seadragons otherwise resemble miniature adults.

For their first few days of life, the baby seadragons derive sustenance from the yolk remains of their egg sacks. They then feed upon tiny plankton, such as copepods and rotifers, until they have grown large enough to pursue an adult diet, hunting larger crustaceans such as mysids.

Whilst sexual maturity is reached at about 24 months of age, most seadragons do not breed until their second year, when full maturity is reached.

The breeding season of the weedy seadragon falls within early summer. Start of the breeding season is signified by seadragons showing courtship behaviour, characterised by pairs curling their tails away from each other, and sexual dimorphism, and corresponds to when the number of sunlight hours exceed 12.5 hours and water temperatures rise above 14° centigrade. Only one brood per season is produced by the male, but females may lay up to three clutches of eggs. Whilst she therefore mates with more than one male in a breeding season, a female weedy seadragon is faithful during any one breeding attempt: if she is approached by two suitors aiming to win her affection, she will choose only one as her beau, indicating her preference by curling her tail away from her chosen mate – typically the larger male since he will be able to bear more of her eggs. The rejected male will take the cue and then depart, leaving the pair to begin courtship. Males are also monogamous, and will not attempt to mate and acquire eggs from more than one female.

Courtship is an extended affair, lasting two to four weeks before a pair actually breeds! Weedy seadragons appear to be morning lovers: the tail-curling courtship behaviour is most active during morning hours when courting pairs curl their tails 15–20 times per hour. About two weeks after a pair begins courting, and just before breeding, the tail of the male becomes soft, swollen and changes from light pink to deep red, associated with an increase in size and numbers of capillaries (blood vessels) that provide nutrients and gas transport to the developing embryos embedded in the tail's brood patch.

In the lead-up to the breeding event, tail-curling becomes more intense between the lovers, and three to four



Weedy seadragon with eggs (male).

days before mating, a female's response to her mate's tail-curling changes: she swims upwards in the water column, pursued by the male. The pair then moves in to become more intimate. This behavioural repertoire is repeated continuously over the next three to four days, once again mainly in the morning. Finally, mating occurs by the male positioning his brood patch in front of the female's cloaca, resulting in the female releasing about 110 bright-pink round eggs arranged in chains of 15–25 eggs onto the male's brood patch. Numbering 75–100 eggs, not all eggs that a female produces are successfully transferred, with the number of eggs that fail to attach depending on how large the male is and hence how many eggs his brood patch can accommodate. The male then releases sperm so that the eggs are fertilised.

Initially adhering to the male's tail with a sticky mucus coating, the tissue of the brood patch then forms a cup around each egg so that each egg is securely embedded and supplied with important osmoregulatory tissue for the 35–42-day incubation period. Hatching occurs as a result of the juveniles squirming within their eggs,

eventually thrusting their tails through the egg capsules to emerge and face the big wide watery world.

Compared with most species, the development of a seadragon is unique: unlike most fish species, whose babies hatch as planktonic larvae only millimetres long, dispersing with the currents until they select a habitat and then metamorphose into juveniles, seadragons undergo their larval phase still within the egg under the protection offered by being attached snugly in the brood patch of their father. This pattern of parental care enables baby seadragons to already hatch in their juvenile form, which for weedy seadragons is remarkably large, at about 3 centimetres in length. Juvenile weedy seadragons have well-developed fleshy appendages which end in club-shaped tips, and are less colourful than adults with bodies that are deeply pigmented in black, brown and silver. Interestingly, a pair of fleshy appendages hanging below the snout that began to bud during the larval period and are retained throughout the juvenile phase fall off at six months of age; this event is considered to signify that juveniles have become sub-adults. About 20 percent

of weedy seadragons fail to survive from the juvenile to adult stage. Seadragons are considered adults when they begin to show mating behaviours.

Facing life's challenges

Life is tough for baby seadragons. They are extremely vulnerable to predation by fish, crustaceans, hydroids and sea anemones. A mere five percent survive to maturity (reached at two years of age). Once fully grown, adult seadragons represent the pinnacle of evolutionary crypsis: owing to their superb camouflage enabling them to seamlessly merge with their environs, they are virtually free from being killed by potential predators, who are fooled by the illusion of floating seaweed these dragons enact.

They are relatively long-lived, and leafy and weedy seadragons in captivity will live for up to 10 years.

Seadragons – not quite so invincible

Unfortunately however, even these masters of disguise are not immune to threats imposed by humans, including illegal collection, and degradation and pollution of their marine habitats. These delicate creatures are also easily damaged if handled. Both the leafy and weedy seadragon are listed as Near Threatened on the IUCN Red List of Threatened Species due to a limited extent of occurrence and ongoing decline of suitable habitat. Concerningly, the coastal waters these rare species inhabit are increasingly suffering from degradation owing to the harmful effects of urban and agricultural run-off (e.g. from fertilisers), industrial pollution, and other anthropological activities. Habitat loss and degradation are regarded as the greatest threat to these species. Fortunately, both species are afforded full legislative protection in Australian waters by both federal and state governments. Owing to their weak swimming ability and lack of a dispersive egg phase, seadragons have a limited ability to escape from local threats. This underlines that devising locations of Marine Protected Areas based on these species' occurrences is both very important and will certainly provide effective benefits to safeguarding these amazing species via this conservation strategy.

Climate change is also a key threat. Increasing water temperature over the past two decades has been linked to significant declines of the kelp habitat that weedy seadragons depend upon.

Many unique characteristics make seadragons highly vulnerable. Despite having relatively long life spans and high growth and survival rates compared to most fish, they have low reproductive rates and occur at low densities, even for syngnathids: leafy seadragons occur at densities of less than 60 individuals per hectare, and weedy seadragons occur at even lower densities (10–70 individuals per hectare in New South Wales, and 15–34 individuals per hectare in Tasmania) – one to three orders of magnitude less than pipefish and seahorse species.

Because they produce few offspring and exist at low population densities, this also makes seadragons extremely vulnerable to over-exploitation. Despite legal protection prohibiting collection and harvesting, this does not afford them protection from being killed as by-catch. Notably, fisheries' trawling can cause considerable damage to their critical habitat and kill these beautiful creatures. It is thus imperative that action be taken to ban fishing activities from all regions where seadragons occur.

Their lack of a dispersive larval stage, limited mobility and consequently small home ranges restricted to threatened habitats, low migration rates and low colonisation rates mean they have little power to escape localised threats or disperse to new favourable habitats. The habitats which support both seadragons and their primary prey (mysids) are coming increasingly under threat from multiple assaults, including fishing of keystone predators, pollution, climate change, and eutrophication, sedimentation and run-off from land-based activities.

Due to seadragons' strong dependence on good-quality macroalgae and seagrass habitat, and sensitivity to water quality and temperature, along with their highly localised distribution, these fragile species can serve as indicator species. Monitoring the distribution and abundance of seadragon populations can provide an index of the water quality and health of the overall marine community at a site.

Just as we are beginning to uncover and learn about the ecology, distribution and abundance of these amazing creatures, the first results are concerning. The first study on numbers over ecologically relevant timescales of weedy seadragons conducted by Sanchez-Camara *et al.* (published in

2011) found significant declines in the three out of five sites (two-thirds in New South Wales, and half in Tasmania) monitored over 2000–2009. Whilst a 'boom-bust' cycle for this declining trend (e.g. if researchers just happened to take the initial survey during a particularly favourable year, followed by natural mortality and low recruitment) cannot be ruled out, unfortunately environment and habitat changes appear to be the most likely candidates to explain this worrying decline. Not only are weedy seadragons highly susceptible to water quality, salinity and temperature, they also appear to suffer from disease. Botany Bay is becoming increasingly industrialised with detrimental effects such as pollution on the surrounding marine environment, and is also a 'hot spot' region for impacts of climate change. At this site, where declines were particularly marked, 16 percent of weedy seadragons were found to be suffering ulcerations and lesions on their skin. This is likely due to poor habitat conditions increasing seadragons' susceptibility to disease and favouring a disease-causing parasite which has caused similar skin lesions, culminating in death, in captive seadragons.

Discovering dragons

Australia's dragons of the sea are almost as mysterious as those of fiction; very little is known about their lifestyles, habits, lifespan or population numbers, and scientists are only just beginning to unlock the mysteries of these enigmatic creatures. Before 2006, despite the high likelihood of these species' biological characteristics indicating they warranted protection and conservation efforts be directly applied to these species, both seadragon species were listed by the International Union for the Conservation of Nature (IUCN) as 'Data Deficient' – a classification applied to species when there is simply insufficient information for adequate management.

It is unknown what biological or environmental cues trigger reproductive activity. Consequently, captive breeding has achieved limited success: weedy seadragons have been successfully bred only a handful of times in a few special aquarium facilities (such as at the Melbourne Aquarium), whilst leafy seadragons have thus far never reproduced in captivity. Much remains to be discovered about these wondrous, rare dragons in their underwater realms.



2014: The year of the western quoll

1st April 2014 was not your ordinary April Fool's Day.

In fact, this April day was the date of a remarkable achievement for Australian wildlife when the western quoll came back to arid Australia after an absence of over 130 years.

The return of the western quoll or Idnya to the Flinders Ranges was the result of a unique partnership, and the outcome of seven years of dogged persistence by one of Australia's most visionary conservationists, Dr David Peacock.

David was a ranger in the Flinders region of outback South Australia in the 1990s and witnessed firsthand the devastating impact of rabbits on the vegetation and the landscape. David helped establish Operation Bounceback, a successful government

ecological recovery program, that in 20 years has achieved amazing vegetation recovery over approximately 220 km² of open country by reducing the numbers of foxes, rabbits and goats and mechanically destroying the area's many rabbit warrens.

Some years on, and now working as Biosecurity Research Officer for Biosecurity SA, David and his colleagues observed that even at very small numbers (less than one rabbit per square kilometre) rabbits were still preventing some species of important native vegetation from establishing new seedlings. David proposed the return of the western quoll, a native predator long extinct in the region, and with a track record as a rabbit predator, as a natural solution to the problem of these few but very damaging rabbits.

When David came to us with his idea, the Foundation for Australia's Most Endangered Species (FAME) was inspired not just by the opportunity to help a unique Australian species, but also by the opportunity to restore a key predator to a damaged ecosystem and witness the flow-on effects to other species and the landscape in general.

FAME entered into partnership with the South Australian Department of Environment, Water and Natural Resources to bring back the quoll. A budget of \$1.7m over four years was set, and in 2012 FAME embarked on the biggest and one of the most important projects in its 20-year history – and the first private-

Above: Female western quoll 'Cassie' at Flinders Ranges National Park.



These tiny pouch young demonstrate that three months after translocation the female western quoll are breeding, a crucial milestone for establishment of the population.



Members of the Adnyamathanha tribe held a traditional blessing ceremony to acknowledge the return to country – after more than 130 years – of an important totem animal, the Idnya or western quoll.

public partnership for a species reintroduction in South Australia's history was born.

With the cooperation of the Western Australian government and the national Chuditch (western quoll) Recovery Team, 38 quolls were translocated from Western Australia in April 2014. They were welcomed by not only FAME and the local community, but also by members of the Adnyamathanha aboriginal tribe, for whom the quoll is an important totem not seen by any living Adnyamathanha.

The quolls translocated from Western Australia to the Flinders Ranges have settled in and begun to breed. Their movements and behaviour are closely monitored through the use of radio collars and occasional trapping. These animals and their progeny will be supplemented by further releases over the next few years.

The biggest problem for the quolls, especially in the early stages, is predation by feral cats. We know from our West Australian colleagues that quolls and cats can coexist, but it will be important to build up the numbers before a sustainable population can be assured. Several quolls have been lost in the first few months since translocation, and cat control strategies are in place to give the quolls their best possible chance of survival.

For more information about FAME's Western Quoll Reintroduction Project and how you can help, go to: <http://fame.org.au/projects/western-quoll>



The traditional name for western quoll in Western Australia is 'chuditch'. When they were flown in to the Flinders Ranges in April 2014, translocated quolls became 'Idnya', the traditional Adnyamathanha name.



Male western quolls are known to hold their own against feral cats in Western Australia but must have fox-free habitat like the Flinders Ranges National Park to survive.



Backyard visitor.
Photo: Ian Morphett.

Endangered koalas of Hawks Nest and Tea Gardens

Ian Morphett, Secretary, Myall Koala and Environment Group

Hawks Nest and Tea Gardens are two small towns on either side of the Myall River and on the northern shores of Port Stephens in New South Wales. There are extensive white sandy beaches facing the Pacific Ocean as well as Port Stephens. Just off the coastline are a number of islands, including Broughton Island (New South Wales's largest coastal island) and Cabbage Tree Island, the home of the Gould's petrel, only recently taken off the critically endangered threatened species list.

The towns are about a two and a half-hour drive from Sydney and an hour north of Newcastle. The extensive Myall Lakes National Park is only a short 15-minute drive away (or a three-hour boat trip up the narrow and winding Myall River). The total permanent population of the two towns is less than 4,000 people but, because of the coastal location, this swells to over 15,000 in the busy summer holidays and at Easter.

Urban koalas

Hawks Nest and Tea Gardens are home to a small population of koalas living in an urban environment. As a result of a koala habitat research project in 1989 by Professor Ian Hume from the Zoology Department of Sydney University, a local community group was formed to help protect this population of koalas as well as the Myall Coast natural environment in general. This group is called the Myall Koala and Environment Group (Koala Group). The Koala Group was instrumental in assisting Professor Hume in his observations of koalas in the two towns, particularly after his research project funding was prematurely cut short. The Koala Group is still very active today.

At the time of Professor Hume's project, it was estimated that the number of koalas in the towns was at least 21 individuals. By 1999 the population had declined to about 12 animals based on the Koala Group's

ongoing data collection of sightings reported by members of the public. Agitation by the Koala Group led to the Hawks Nest-Tea Gardens koala population being officially declared endangered by the NSW Scientific Committee in 1999. Pittwater is the only other koala population in New South Wales declared endangered and it is believed that this population has subsequently become extinct.

Recovery plan

By 2003, the NSW National Parks and Wildlife Service (NPWS) had prepared a Recovery Plan for the Hawks Nest and Tea Gardens Endangered Koala Population. The primary threats to the Hawks Nest and Tea Gardens koala population were identified as habitat loss and fragmentation, habitat degradation, dog attacks (domestic and wild dogs), road kills, disease (particularly chlamydia) and fires.

A Koala Working Group (KWG) was formed to manage the Recovery



Plan. The KWG is chaired by Mat Bell, Senior Ecologist at Great Lakes Council and consists of representatives from NPWS, the Koala Group, the Catchment Management Authority, Essential Energy and Midcoast Water.

Activities

The major activities undertaken by Great Lakes Council, federal and state governments and the Koala Group to recover the population have been:

- Obtaining a Commonwealth EnviroFund grant of \$11,500 in

2004 to remove invasive weeds from the Jean Shaw Koala Reserve in Hawks Nest.

- Obtaining a six-year NSW Environmental Trust grant of \$234,500 in 2012 to restore koala habitat and corridors in Hawks Nest.
- Erecting koala signage throughout Hawks Nest and Tea Gardens, including 'Please slow down, koalas cross here' signs in two high risk traffic locations.

- Ongoing give-away of 200 koala food trees every year for past nine years at the annual Myall River Festival, plus hundreds of native plants.
- Establishing a Koala Telephone Hotline (02 4997 0878) for the public to report koala sightings, including advertising the Hotline number in the local paper in spring.
- Ongoing collection of koala sightings statistics.



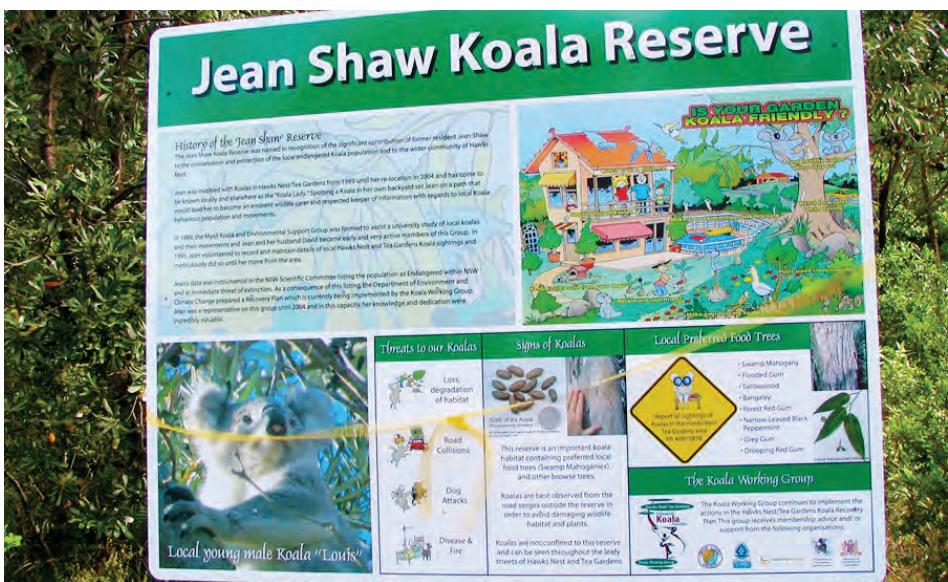
Mother and baby. Photo: Bob Howard.

- Communicating koala issues to the community via regular local newspaper reports, maintaining a noticeboard and giving presentations at the Hawks Nest Wildside Festival each year and talks to schoolkids at the local primary school.
- Distributing 2,000 fridge magnets promoting koala protection issues including the hotline and wildlife rescue telephone numbers.
- Establishing an avenue of 11 different specimen koala food trees in Sanderling Avenue, Hawks Nest.
- Planting more than 2,500 koala food trees in public open spaces.
- Establishing the 'Bitou Busters' – a monthly community weeding group.
- Great Lakes Council modified planning instruments to require developers to include koala impact assessment in applications, erect 'koala friendly' fencing and replace removed trees with koala food trees.
- Carrying out koala and other wildlife rescues as needed.
- Lodging submissions to council and state government on development applications considered inappropriate for koalas or the environment in general.

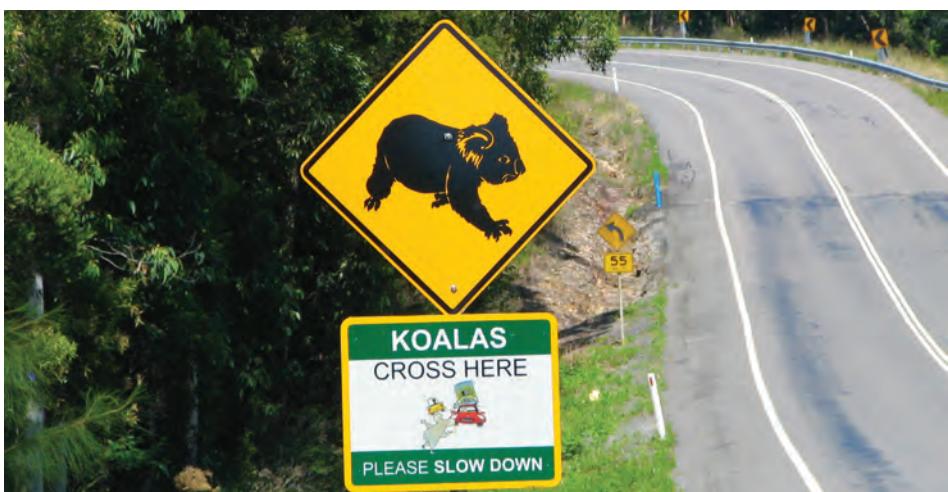
A key objective of the recovery effort has always been to connect and maintain vegetation corridors, both within the townships and connecting with forested areas to the north (Myall Lakes National Park), north-



Bitou Busters. Photo: Jill Madden.



Local signage.



Local signage.



Hawks Nest and Tea Gardens. Photo: Ian Morphett.

west (North Shearwater and Monkey Jacket) and south-west (Pindimar and Bundabah). Clear and unbroken vegetation corridors are vital to enable koalas (and other wildlife) to freely move within the towns and to and from other populations and food sources.

Recovery

The most important achievement in the 10 years since the recovery plan was established is that the population has not declined further and is slowly recovering. It is estimated that the population has increased to about 22 animals. The main indicator used in the towns to show the growth in the population is the number of mothers with babies seen each spring. For example, in the past five years the numbers seen have been: three in 2009, four in 2010 and 2011, five in 2012 and 2013. Spring 'back-babies' were, in fact, born the previous summer. Because they are marsupials, koalas are very immature when born after only 34–36 days gestation. Infants don't appear at all from their mother's pouch for at least six months. After that they emerge from mum's rear-facing pouch with increasing frequency and duration until they are up to 18 months old when they eventually separate from their mother to establish their own territory or 'home range'. This separation is often the result of an adult male wanting to mate with the mother. Because of this extended nurturing period, female koalas don't have their first baby until two years of age and rarely have a baby more frequently than once every couple of years until they are 10–12 years old. Hence, at best, a female can rear perhaps six offspring in a lifetime. For this reason, at least here in the Myall Coast region, it is a very slow process to recover a depleted population such as ours.



Back from the brink

the saga of the Lord Howe Island stick insect

David Roots had no inkling of the controversy he would spark within entomological circles when he presented his slides of wildlife on Balls Pyramid to a meeting of staff at the Australian Museum in Sydney in mid-1966.

The 33-year-old geologist and accomplished rock climber had made the trip to the windswept spire in the Tasman Sea just south of Lord Howe Island with a group of Rover Scouts in December 1964. The remnant volcano, rising vertically to a height of 562 metres above the waves, is the tallest sea stack in the world. The climbing party aimed to be the first to reach the summit. Adverse weather foiled the attempt, but Roots had found time to take snaps of the surroundings – mainly the prolific bird-life, some lizards, rocky soil and sparse vegetation.

Flicking through his presentation to the group of Museum scientists, some of whom had been on research visits to Lord Howe – but never Balls Pyramid – the image of a dead fat-bodied, cricket-like insect appeared on the screen. Roots didn't know what it was. He'd photographed it because it looked interesting. The audience gasped.

"That's *Dryococelus australis*, the Lord Howe Island stick insect. They are extinct – have been for 30 years."

"I very much doubt it", Roots said. "The ants were still eating this one."

Thus began the remarkable resurrection of an insect made extinct from its only known habitat on Lord Howe Island a few years after rats came ashore from a shipwreck in 1918. The revival wasn't immediate though.

Despite confirmation of identity by the Australian Museum's entomologists and subsequent announcements in scientific journals worldwide, Roots' discovery was greeted with a mix of astonishment and scepticism. In some cases there was outright denial and disbelief of the existence of a live colony on Balls Pyramid. How could a flightless insect get across 23 kilometres of ocean, let alone survive on the rocky outcrop? An environment less like its original lush subtropical home on Lord Howe would be hard to find.

Thirty-seven years went by before a scientific expedition was mounted to investigate the possibility. Even then it was with negative intent.

The Pyramid had been placed off-limits (with some strictly controlled exceptions for scientific purposes) during the 1980s as part of the World Heritage status proclaimed for Lord

Howe and its surrounding islets. Even so, the rock spire remained a magnet for rock climbers.

David Priddel, Principal Research Scientist with NSW National Parks and Wildlife Service (now the Office of Environment and Heritage), was responsible for dealing with applicants wanting to climb Balls Pyramid on mock scientific grounds, many of them using the search for the stick insect as an excuse. He decided the only way to halt the flow of requests was to lead a team of scientists to Balls Pyramid specifically to prove that the Lord Howe Island stick insect was not, and could not, be there. The two-day expedition took place in February 2001.

The party of four spent the first afternoon in baking heat scouting the most likely habitat – a stand of stunted melaleuca bushes on a 60 degree slope about 100 metres above sea level. Entomologist Margaret Humphrey detected possible evidence in the form of frass (excreta), but couldn't give a positive identification. The insect was nocturnal and the only way to know for certain was to climb back up at night.

National Parks scientist Nicholas Carlile and Lord Howe Island ranger Dean Hiscox volunteered for the dangerous

Above: Adult Lord Howe stick insect on melaleuca bush. Photo: Rohan Cleave and Melbourne Zoo.



Aerial view of Lord Howe with Balls Pyramid in the far distance. Photo: Ian Hutton.

night climb. The exploit, culminating in the sighting of three female stick insects on a single melaleuca bush illuminated by their headlamps, is now etched in the annals of the NSW Wildlife Service. Carlile described how they scarcely contained their excitement and the impulse to dance wildly on the dangerous steep slope. Against all odds the Lord Howe insect lived.

A year later, Hiscox and fellow rangers paid another night-time visit and counted about 20 individuals spread among several of the melaleucas in the stand. Clearly, though, the habitat was exposed and fragile. A severe storm or prolonged drought conditions could wipe out the whole colony. After consultation with the New South Wales and Lord Howe authorities and

local islanders, David Priddel made the decision to establish two captive colonies on mainland Australia.

Dean Hiscox made a third ascent of the Pyramid in 2003 to collect two mating pairs. One pair was given to private insect breeder Stephen Fellenberg in Sydney; the other to Patrick Honan, head of the invertebrate department at Melbourne Zoo in Victoria. No one, including Fellenberg and Honan, anticipated the dramas to follow. But they did realise they had to start from scratch.

There was little in the scientific literature about the lifestyle and breeding cycle of the insect, certainly nothing after 1916. The two entomologists would have to rely on their experience and follow their instincts.

Honan named his pair Adam and Eve. He placed them in a glasshouse with potted melaleuca plants as food and mimicked Lord Howe conditions using an electric urn simmering 24 hours a day to produce a steamy humid atmosphere. Experimenting with day-time refuges he eventually found the insects preferred a plain, well-weathered bird nesting box.



The jagged tooth-like Balls Pyramid with Lord Howe Island in background. Photo: Ian Hutton.

Honan had prepared his family for the fact that he would be observing the insects' activity in the glasshouse from dusk till dawn, but admitted later to becoming a little paranoid in the Zoo at night. The smallest sound was amplified and scary, especially to someone suffering from lack of sleep. His vigil was rewarded after a week, however, when Eve laid a series of nine eggs.

That joy turned to alarm when, during the second week, Eve stopped feeding and became distressed. Honan desperately tried to find what was wrong – diet, humidity, egg-laying medium, was Eve egg-bound? Nothing worked. Eve became sicker and sicker to the point he knew she would die if he didn't act, and act quickly. The whole captive breeding project was on the line.

Purely on instinct Honan made up a concoction of ground melaleuca leaves, glucose, distilled water and calcium. Using an eyedropper and a microscope he dripped the solution on the insect's mouth parts. Gradually it absorbed the liquid. An hour later, Eve stirred. After another hour she suddenly came to life and walked around the glasshouse as if the past days of drama had not happened.

Honan couldn't believe his eyes. Feeling light-headed with relief, but with no one around to share his news, he stepped outside and began telling the possums staring at him moon-eyed from the surrounding trees. To this day he has no idea why his concoction worked or why Adam remained healthy throughout Eve's ordeal.



Stick insect nymph hatching. Photo: Rohan Cleave and Melbourne Zoo.

In Sydney, Stephen Fellenberg did not fare so well. His original pair died a month after being taken into captivity, but not before the female had laid 21 eggs. After several months he was relieved to see that seven of those hatched and grew into adults. Importantly, four of the first generation males in this batch made a vital contribution to the eventual success of Melbourne Zoo's captive breeding program. They were sent to Melbourne in 2004 to address what Patrick Honan suspected was a lack of genetic variation resulting in in-breeding depression of the Zoo colony.

The transfer brought immediate relief in that succeeding generations at

the Zoo showed no further signs of abnormality. By 2005/2006 the colony had risen to 600 individuals at any one time and Honan felt sufficiently confident about the viability of the population to begin more detailed lifestyle experiments such as mating choices and plant food preferences.

In the last few years those studies have become the subject of Masters research projects in cooperation with the University of Melbourne's Zoology Department. More detailed work is also planned in genetics in an attempt to determine if the Balls Pyramid colony differs from the original Lord Howe population and whether environment has a bearing on morphology.



David Roots photographed flora and fauna while on Balls Pyramid in 1964. Photo: David Roots.



Masters student Haley Lambert gathers data in Melbourne Zoo greenhouse colony. Photo: Rohan Cleave and Melbourne Zoo.



The Balls Pyramid stick insect's melaleuca habitat on a 60 degree slope.
Photo: Lord Howe Island Board.



Invertebrate specialist Patrick Honan. Photo: Patrick Honan.

At government level, thoughts have turned to the possibility of returning the stick insect to its natural environment on Lord Howe. To do that successfully there needs to be complete eradication of rats and mice from the island. A \$9 million aerial baiting program has been prepared and funded. Consultations with the local community are in progress.

In the meantime a second viable captive colony has been established on Lord Howe and plans are afoot to set up similar captive colonies in America and Europe to ensure the security of the species. The captive breeding program has drawn the admiration of world renowned naturalists like Dame Jane Goodall and Sir David Attenborough, both of whom have been to Melbourne Zoo to make personal contact with the insects and their keepers.

The Lord Howe stick insect's revival is a rare event that runs against the rising global tide of species extinctions. It has created an unlikely icon in the world of conservation.

Rick Wilkinson is a geologist turned journalist and author with a keen interest in palaeontology, zoology and natural history. His geological background, combined with his travels around the world, particularly through Australia, has given him first-hand experiences and appreciation of the natural environment, its varied landforms, mineral resources and unique plants and animals.

During the course of his career as a resources writer for Australian newspapers and international magazines, Wilkinson has also gathered information about surprising and unusual projects to preserve and, in some cases, revive the natural world.

As a result he has written five children's books, including two novels set in northern Australia and an acclaimed non-fiction book about helping to save endangered animals. He has also penned a number of publications about Australian resources industry history.

His latest book, *Return of the Phasmid – Australia's rarest insect fights back from the brink of extinction*, was published in June 2014 and reviewed in the winter edition of *Australian Wildlife*.



Gary Woodfield a unique wildlife artist

I like to think of my art as one continuing mural depicting a never-ending story of wildlife scenarios. I feel more connected to my paintings when I am actually portraying a wild habitat surrounding my chosen subject matter. I get a lot of inspiration from my local rugged wilderness, which for me is very fortunate for my research into various forms of wildlife. NO BRUSHES are used to create my artworks. I practise ancient traditional techniques such as etching and scratching onto my canvas.

Using an earthy colour palette allows me to visualise a unique perspective similar to that of animals that see colour in restricted vision. It is these techniques which draw an audience into the depth of my work creating that instant 'eye contact'. I rely on natural found objects such as bark off trees, pine needles from branches and various other items such as sponges, skewers, and cotton buds to create my artworks rich with detail.



Above: YOUNG REBELS - Dingoes playfully scamper through rugged bushland during a swelteringly hot day.

Top of the page: BUSH GANGSTERS - A thirsty mob of kangaroos hog a shallow creek bed on a sweltering summer's day.



CAUGHT NAPPING - Lingering smoke alerts a dingo of possible danger in dense bushland.



DAY WALKER - A master of deception, the emu tiptoes through rugged bushland blending in with the harsh surrounding environment.

2014 University Student Grants Scheme winners

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 2014 are:

Amy Northover - School of Veterinary and Life Sciences at Murdoch University.

Project: The ecology of parasite transmission in fauna translocations.

Freda Nicholson - La Trobe University.

Project: Do juvenile hormone analog insecticides disrupt amphibian lifecycles?

Kimberly McCallum - University of Adelaide.

Project: Influence of the spatial arrangement of plants in revegetated systems to gene flow, natural regeneration and long-term viability.

Rebecca Peisley - Charles Sturt University.

Project: Ecosystem services provided by birds in agricultural landscapes.

William Geary - Deakin University.

Project: Carnivores in flames: Predator ecology in a fire-prone landscape.

Jaimie Cleeland - University of Tasmania and the Australian Antarctic Division.

Project: Macquarie Island albatrosses: Assessing the environmental and anthropogenic influences on population and demographic status and trends.

Mark Wong - The Australian National University.

Project: Fine-scale geographic variation in a newly described Australian funnel-web spider (*Atrax sutherlandi*).

Yaara Aharon-Rotman - School of Life & Environmental Sciences, Deakin University.

Project: Migratory shorebird populations are under threat and thus of particular conservation concern.

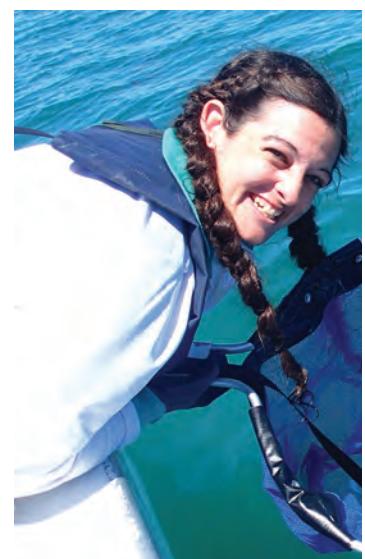
Blanche D'Anastasi - James Cook University.

Project: The conservation status of Western Australian true sea snakes: Are species disappearing before they have been discovered?

Jonas Bylemans - University of Canberra.

Project: Spawning site identification of Macquarie perch (*Macquaria australasica*, C. 1830) using environmental DNA.

In the following two issues of *Australian Wildlife* articles on the winners' projects will be featured.





Pesticides - a pest for amphibians?

Investigating the hormone disrupting effects of pesticides

Freya Nicholson,
Department of Agricultural Sciences,
La Trobe University

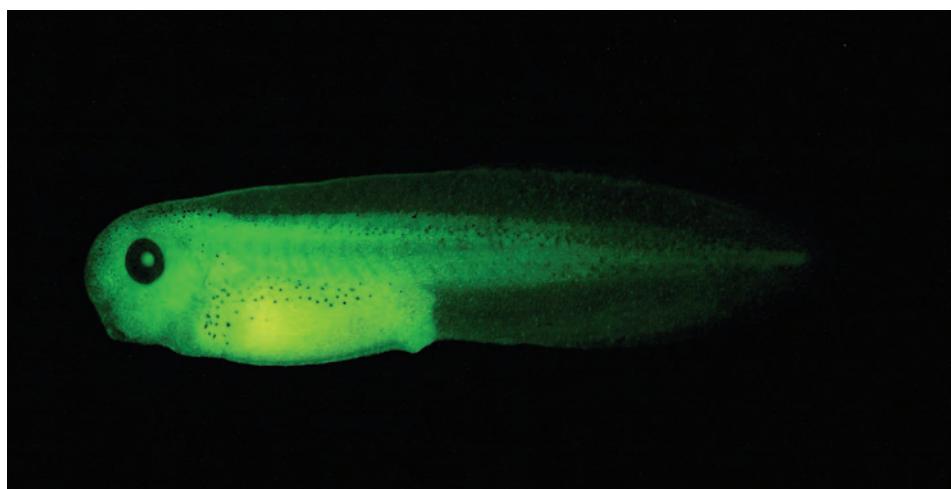
Earth is currently experiencing its sixth mass extinction and amphibians are among the worst affected: almost a third of amphibian species are extinct or threatened (categorised as Vulnerable, Endangered or Critically Endangered by the IUCN). Drivers of this biodiversity crisis are numerous, with human activities being largely responsible. Apart from habitat destruction, threats from invasive species and the spread of disease, a likely contributing factor is pollution by chemicals we release into the environment. Major sources of exposure include agricultural runoff and wastewater, so there is a high risk to aquatic organisms in particular. Amphibians are exceptionally vulnerable due to their permeable skin and aquatic habitat during sensitive embryonic and larval stages.

Environmental pollutants need not be lethal to affect the survival of wildlife. Over 800 substances are suspected to be endocrine-disrupting chemicals (EDCs): they act by disturbing the hormonal systems of animals, consequently impacting development, growth, immune defences and reproduction. Some developmental life stages are more sensitive to the effects of endocrine disruption because of the critical role that hormones play during these periods. For example, a correct progression of metamorphosis in amphibians is dependent on timed increases and interactions of thyroid hormones and stress hormones (corticosteroids). Despite well-documented endocrine-related effects in wildlife and increasing EDC exposure to populations worldwide, the vast majority of chemicals in current commercial use have not been tested for endocrine disruption. Moreover, most EDC research has focused on the reproductive system, leaving other hormonal systems under-investigated.

Agricultural pesticides are a major source of endocrine disrupters in the environment. My Honours research centres on a class of pesticides known as juvenile hormone analogs (JHAs) that disrupt insect development by mimicking the action of insect juvenile hormone. In Australia, JHAs are routinely used in agriculture, and ecologically significant concentrations of JHA were detected in southeast Australian stream sites. These areas are home to several frog species, including the growling grass frog (*Litoria raniformis*) which is already listed as Endangered. While considered to be safe to non-target organisms (including mammals and amphibians), the endocrine-disrupting properties of JHAs in higher animals have never been tested. We suspect that JHAs interfere with the amphibian thyroid hormone system. This hypothesis is based on the fact that JHAs closely resemble thyroid hormones in chemical structure, to the extent that thyroid hormones and their metabolites mimic JHA effects in insects. As mentioned above,

thyroid hormones are critical for amphibian development, particularly metamorphosis. Exogenous chemicals which mimic, block or modulate endogenous thyroid hormone action could produce adverse developmental effects, compromising individual survival, with potentially disastrous consequences at the population level.

My research is a pilot study which aims to investigate the thyroid hormone-disrupting capacity of selected JHAs. The greatly appreciated support of the Australian Wildlife Society allows me to perform multiple laboratory tests to examine the many modes of action by which JHAs could potentially disrupt amphibian thyroid hormone systems. This project could lead to further research investigating evidence of adverse effects in wildlife and possible synergisms with other stressors, ultimately dictating whether the continued use of JHAs is ecologically sustainable. Adequate testing of agricultural pesticides and development of safer alternatives could well help lessen the impact that human activities are having on the world around us.



Fluorescent *Xenopus laevis* tadpole, as part of a screen for thyroid hormone disruption. Photo: Museum national d'Histoire Naturelle.



Contribution to the conservation of long distance, high-Arctic migratory shorebirds

Yaara Aharon-Rotman,
Centre for Integrative Ecology,
Deakin University

Worldwide, migratory shorebird populations are under threat and therefore of particular conservation concern. Migratory shorebirds use distant habitats and cover the distance between these habitats in long flights that often span across continents and hemispheres. There is particular concern of declining shorebird populations along the East Asian–Australasian flyway (EAAF). Besides the importance of protecting their populations, migratory species may also have great effect on the ecosystems of which they form part, warranting our concern. Their dynamic distribution pose a

great challenge to develop sound conservation strategies for such intercontinental migrants.

The aim of my thesis is to shed more light on some of the factors associated with global change processes that have been considered to explain the decline of waders along the EAAF. I am thus studying (i) the effect of Arctic lemming cycles on the reproductive success of waders, (ii) the flexibility of shorebirds in response to changes in their stopover habitats using stochastic dynamic programming, (iii) differences in quality of non-breeding sites in

Australia (i.e. the birds' 'wintering' sites) using stress biomarkers to understand why some individuals fly further south to winter than others, and (iv) levels of industrial chemicals in migratory birds along the EAAF.

Our results show that lemming cycles in some parts of the Arctic have changed in the last decades, and may be responsible for faltering periodicity in wader breeding success along the flyway. These changed conditions, however, have so far not resulted in any marked changing trends in breeding success across years. Declining numbers of waders



The cannon net in action, flying over the surprised birds. Photo: Roger Minton.



Ruddy turnstone (*Arenaria interpres*) contributing few feathers for stress analysis. Photo: Roger Minton.



The rain will not stop us! Simeon and Yaara processing birds in the back of the field car. Photo: Rob Patrik.

along the EAAF are therefore more likely a result of changing conditions at stopover and wintering sites than changing conditions on the breeding grounds.

Preliminary model results show the crucial importance of good quality wintering sites in Australia for population maintenance. Due to a latitudinal gradient in food availability, it may be beneficial for these long-distance migrants to fly the extra distance to the southern end of Australia rather than to stay the winter at the top end. Although thus covering a longer distance, this detour may ultimately result in a more successful migration back to the breeding grounds. Higher stress levels measured by white blood cell counts in ruddy turnstone (*Arenaria interpres*) in north Western Australia compared with wintering habitats in South Australia and Tasmania, as well as low corticosterone content in feathers of birds from these southern sites, support these findings. Hampering the quality of these sites (e.g. lower prey abundance, human disturbance) may severely affect the ability of these athletes to repeat their annual migration and reproduce in the harsh Arctic environment.

I would like to thank the Australian Wildlife Society for their generous contribution, and all the volunteers from the Australian Wader Study Group and my lab mates for making this project possible. The project is still continuing and we look forward to reporting our results to the Australian Wildlife Society.



Preparing the cannon net on the beach before the waders are coming.



The conservation status of Western Australia's sea snakes:

Are species disappearing before they have been discovered?

Blanche D'Anastasi,
James Cook University

True sea snakes are a highly diverse group of live-bearing marine reptiles that act as both predator and prey in tropical marine ecosystems. Australia is a biodiversity hot spot for sea snakes, containing more than half of the 62 described species, including 11 endemic species. Western Australia is particularly important for sea snake biodiversity as it is home to 21 of Australia's 35 sea snake species, including five restricted-range endemics that occur predominantly on coral reefs. In 2010 three Western Australian endemics were listed as Critically Endangered or Endangered by IUCN, due to severe declines in abundance over the previous decade, however reasons for these declines are not known. To date these are the first sea snake species listed as threatened with extinction by IUCN. Many other

species are currently listed as Data Deficient due to a lack of basic data about taxonomic status, range extent, population size and connectivity, which are essential to evaluating conservation status.

My PhD research aims to fill some of these knowledge gaps for sea snakes in coastal Western Australia, where almost no sea snake research has been conducted. To date I have been able to collect habitat, use observations and tail clips from 150 sea snakes, from five species in Shark Bay. My research has demonstrated that species ranges are poorly defined, as I discovered new records on the range extent of two species, which will be published shortly.

The next phase of the project is to evaluate the level of genetic

connectivity between populations of the small-range, endemic Shark Bay sea snake (*Aipysurus pooleorum*) and the endemic olive-headed sea snake *Hydrophis major (Australo-Papuan)*. Using a powerful, cutting-edge population genomics approach which uses thousands of genetic markers (called single nucleotide polymorphisms or SNPs), I will examine the level of genetic connectivity and genetic diversity between shallow sea grass beds in the Western Gulf and the Stromatolite Reefs of the Eastern Gulf of Shark Bay. The genetic connectivity data obtained from this research will provide information that is critical to managing and conserving sea snakes in the Shark Bay World Heritage Area.



Releasing a large female Shark Bay sea snake from a sea-wall in the Western Gulf of Shark Bay. Photo: Tara Fullston.



This is *Aipysurus pooleorum*, the Shark Bay sea snake. My research represents the first major study on this small-range, endemic species and will provide data that is critical to assessing its conservation status.



Spawning site identification of Macquarie perch (*Macquaria australasica*) using environmental DNA

Jonas Bylemans,
Institute for Applied Ecology,
University of Canberra

The nationally endangered Macquarie perch (*Macquaria australasica*, C. 1830) is a fish species endemic to south-eastern Australia. Historically this species was highly abundant and widespread throughout the Murray-Darling Basin, but its current distribution is restricted to the cool, upper reaches and only four self-sustainable populations remain (Abercrombie River, upper

Murrumbidgee, Cotter River and Dartmouth Dam). The historical and continued decline of the Macquarie perch is the result of detrimental interactions with invasive alien species and anthropogenic habitat modification (clearing of vegetation, construction of dams and weirs). Spawning takes place from October to December. Adults migrate from lakes into tributaries where they spawn

at the foot of pools and eggs drift downstream into the riffles until they get stuck into the gravel.

In order to ensure the long-term persistence of the remnant populations it is of critical importance to protect habitats that are essential for the completion of their life cycle. Macquarie perch spawn from October to December. Adults migrate from lakes into



Adult Macquarie perch caught at Kissops Flat (NSW). Photo: Ben Broadhurst.

tributaries where they spawn at the foot of pools and eggs drift downstream into the riffles until they get lodged into the gravel. Although limited information on migratory movements, spawning and nursery grounds is available, the identification of exact spawning periods and spawning habitats is relatively unknown. Current methods rely on acoustic tags to track the movements of adult fish (acoustic telemetry) during the proposed spawning period or the collection of downward-drifting eggs in rivers. However, acoustic telemetry only provides information on fish movements during the proposed spawning period and does not provide information on when, where and whether the adults actually spawn. Egg collections are a more direct measurement of spawning but they are often unfeasible since species identification is difficult and several fish species burrow their eggs in the gravel or attach them to aquatic vegetation.

Recent advances in environmental DNA (eDNA) technologies offer new opportunities since they rely on

non-invasive sampling methods and circumvent and/or reduce limitations and biases associated with conventional monitoring tools. Species detection and monitoring using eDNA relies on the fact that all fish species secrete DNA into the water through faeces, urine, gametes and the shedding of skin cells. The general workflow of eDNA-based species detection involves sampling water, extracting eDNA, amplifying a DNA fragment through species-specific polymerase chain reaction (PCR) and a positive amplification is then considered as a positive detection. All currently published studies have relied on the amplification of mitochondrial DNA fragments since they are relatively easy to extract from environmental and degraded samples compared to nuclear fragments. However, during spawning, large amounts of nuclear DNA will be released into the water in the form of gametes thereby significantly increasing the quantity of detectable nuclear eDNA fragments. Consequently, we hypothesise that the relative abundance of both nuclear and mitochondrial eDNA fragments can be used as a direct

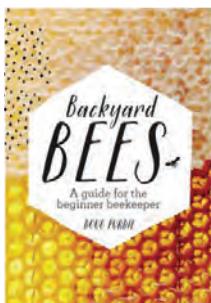
indication of spawning activity and would be suitable for the identification of important spawning habitats. The proposed hypothesis will be initially tested under controlled conditions using aquarium-based experimental trials with Macquarie perch. Following this proof of concept, a small-scale field survey will be conducted in the Cotter River (ACT) in order to validate the method. During this survey, water samples will be collected and the relative abundance of mitochondrial and nuclear eDNA fragments will be determined. In addition, downward-drifting eggs will be collected using larval drift nets and the results of both monitoring tools will be compared.

I would like to thank the Australian Wildlife Society and the Fisheries Scientific Committee (NSW Department of Primary Industries) for providing funding towards this research. Additionally, I would like to acknowledge Dr Dianne Gleeson, Dr Elise Furlan, Mr Mark Lintermans, Mr Ben Broadhurst and Mr Rhian Clear for their input and advice on outlining the proposed research project.



The Cotter River (ACT), which holds one of the only four self-sustaining Macquarie perch populations. Photo: Rhian Clear.

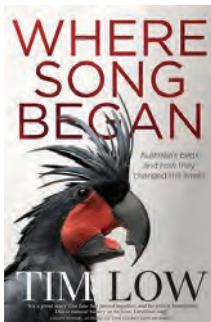
Book Reviews



Backyard Bees - A guide for the beginner beekeeper by Doug Purdie

Backyard Bees is the ultimate guide to installing and maintaining a hive through the seasons. Learn how easy it is to keep happy, healthy bees, and how and when to harvest the liquid gold. Including extensive advice on choosing a hive and the equipment you need; case studies and anecdotes from beekeepers from all walks of life; and 20 delicious recipes for all that honey, from Toasted Honey Granola to Bees Knees Cocktails.

Publisher: Murdoch Books | **RRP:** \$35.00



Where Song Began - Australia's birds and how they changed the world by Tim Low

One of the main achievements of Australian biologist Tim Low in his impressive new book, *Where Song Began*, is to turn the world upside down when it comes to how we regard Australian birds.

Renowned for its unusual mammals, Australia is a land of birds that are just as unusual, just as striking, a result of the continent's tens of millions of years of isolation. Compared with birds elsewhere, ours are more likely to be intelligent, aggressive and loud, to live in complex societies, and are long-lived. They're also ecologically more powerful, exerting more influences on forests than other birds.

But unlike the mammals, the birds did not keep to Australia; they spread around the globe. Australia provided the world with its songbirds and parrots, the most intelligent of all bird groups.

Publisher: Viking | **RRP:** \$32.99



Glimpses of Australian Birdlife by Peter Slater and Sally Elmer with Raoul Slater

Glimpses of Australian Birdlife features stunning photos of small and large bush-birds and waterbirds, as well as a brief passage about how the photo was taken.

Authors Peter Slater and Sally Elmer share a passion for birds and have spent their lifetimes painting and photographing them.

This beautiful book contains a collection of their favourite photographs, taken over the past 65 years, capturing the variety and brilliance of Australian birds in their natural habitat.

A visual delight, *Glimpses of Australian Birdlife*, would make a wonderful gift for nature lovers or those interested in nature photography.

Publisher: New Holland Publishers Australia | **RRP:** \$35.00

Great oaks from little acorns grow

When our Director, Clive Williams, learned that William Ryan, publican at the Harold Park Hotel in Sydney, was collecting 5 cent coins in his business, Clive approached him to consider saving them for our Society. William was taken by the link between the echidna on the coin and the echidna we have as our Society's emblem and readily agreed. Not only that, he arranged for Clive to speak to other hotels and businesses in his area. As a result we now have several businesses collecting coins on our behalf.

We have provided signs and collection boxes for those that required them.

The Society has now decided to invite all of you, our members and friends, to participate in this fundraising process. We have purchased collection boxes which we will mail to those of you who request them. Use them at home or at your place of work, invite friends and colleagues to take one and invite your friendly local businesses to join in. By this means small individual efforts can lead to a grand achievement. The proceeds will be used for the Society's programs, such as the university grants.

Once the collection box has been filled, just take it along to your nearest Commonwealth Bank. All the deposit details are printed on the bottom of the box. Once the coins have been banked, let us know your details and how much has been banked and we will send you a tax deductible receipt.

Email us at info@wpsa.org.au for your collection box.





Australian Wildlife Society

Community Wildlife Conservation Award

The Australian Wildlife Society Community Wildlife Conservation Award is an annual award to a community conservation group that is making a major contribution to wildlife preservation in Australia.

Our Society is very conscious that we need to join together with other conservation groups to save and protect all native Australian wildlife populations in all its many and varied forms across Australia.

The Australian Wildlife Society wants to recognise and help these conservation groups continue with their good work on behalf of the whole community. Our Society knows that many organisations and thousands of volunteers are already working tirelessly to save our threatened species, as well as the humble and more common Australian species, and the precious wildlife habitat in which they live.

The Award

Our Society will present a crystal trophy and a cash award of \$2,500 to the winning conservation group that is helping to save our precious Australian wildlife.

Nominations

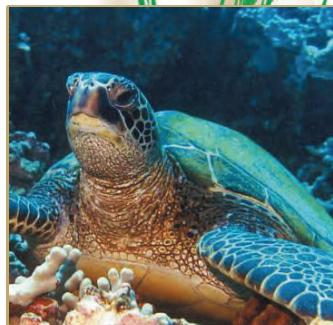
Nominations for the Australian Wildlife Society Community Wildlife Conservation Award should be made in writing to be received by our Society by 31st December. Nomination forms can be downloaded from our website at www.australianwildlife.net.au. Completed nomination forms can be sent to the Australian Wildlife Society by email to info@australianwildlife.net.au or faxed to 02 9599 0000 or mailed to PO Box 42 Brighton Le Sands NSW 2216

Selection Procedures

The decision on the granting of each year's award will be decided by a full meeting of the Council of the Australian Wildlife Society.

For further information, please contact the National Office on Tel 02 9556 1537.

Founded in 1909 and dedicated to the conservation of Australia's unique wildlife





Australian Wildlife Society

The Serventy Conservation Medal

The Australian Wildlife Society created the Serventy Conservation Medal in honour of three members of the Serventy Family.

In memory of Dr Vincent Serventy AM, who was a member of the Wildlife Preservation Society of Australia for more than fifty years, President for thirty years and was the President of Honour. Over the sixty years of his environmental work in Australia, and internationally, Vin worked to realise his vision of a world whose people understand that we do not own this earth, but are trustees for its future, and that we should live in harmony with nature. He has justly been called the '*father of conservation in Australia*'.

In memory of Lucy Serventy who seventy years ago became a Life Member of the Society and so began a lifetime interest in conservation.

In memory of Dr Dominic Serventy, who as the elder of the eight strong Serventy clan, played a leading part in encouraging their interest in natural history. He is regarded as among the world's greatest ornithologists.

Our intention is to award the medal to those who labour as a volunteer in the conservation field for a love of nature and a determination that is should be conserved.

Medal Design

The medal has been designed by Australia's foremost sculptor Stephen Walker. The Australian Wildlife Society also gives a cash reward of \$1,000 to the winner. Many conservationists in the past have suffered financially for their devotion to the cause. This cash award will be some tribute for their dedication. The bronze medal will be a constant reminder that the conservation movement has remembered their work in the past, just as history will remember the same achievements in the future.

Nominations

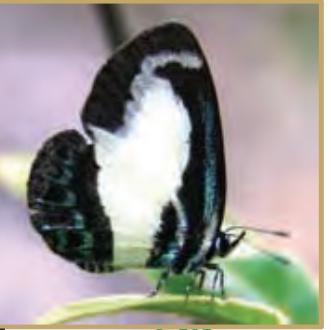
Nominations for the ***Serventy Conservation Medal*** should be made in writing to be received by our Society by 31st December. Nomination forms can be downloaded from our website at www.australianwildlife.net.au. Completed nomination forms can be sent to the Australian Wildlife Society by email to info@australianwildlife.net.au, or mailed to PO Box 42 Brighton Le Sands, or by fax 02 9599 0000.

Selection Procedures

The decision on the granting of each year's medal will be decided by a full meeting of the Council of the Australian Wildlife Society.

For further information, please contact the Secretary of the National Office on telephone 02 9556 1537 or by email info@australianwildlife.net.au

*Founded in 1909 and dedicated to the
conservation of Australia's unique wildlife*



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

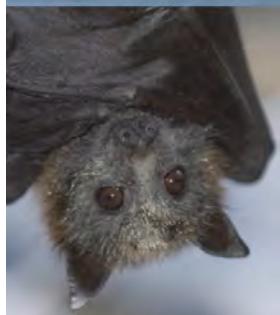


To commit to being a part of our future, please complete this form. You may cancel your donation subscription at any time by notifying the national office.

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

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Australian Wildlife Society

Conserving Australia's Wildlife
since 1909

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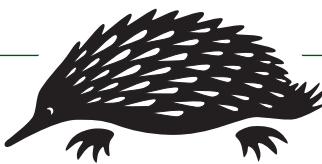
This authorisation is to remain in force until cancelled by the donor and
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Deduction will be made on 15th of each month.

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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.

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Address:.....

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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)

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Name on Card: Expiry: Donation \$.....

Signature: Total \$.....

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

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.

The remarkable birdlife of Sydney's northern beaches

Photography by Michael Hanvey



The critically endangered regent honeyeater (*Anthochaera phrygia*), Chiltern Trail. Photo: Michael Hanvey.



Yellow-faced honeyeater (*Lichenostomus chrysops*), Chiltern Trail. Photo: Michael Hanvey.

