SEGments

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Scientific Expedition Group Inc.

Cover Photo: Native bee, *Leioproctus maculatus,* on a flower of a Sida sp at Arkaroola: Photo Sam Gordon

Rear Cover Photo: A pair of red barred dragons *Ctenophorus vadnappa* photographed near the Ridgetop Track gate, Arkaroola by Sam Gordon.

The Scientific Expedition Group is a not-for-profit organisation which began in 1984. SEG undertakes several expeditions each year to record scientific information on wildlife and the environment in many parts of South Australia.

A major expedition to conduct a biodiversity survey occurs each year over two weeks. Scientific experts lead volunteers in surveying mammals, reptiles, invertebrates, vegetation, birds and physical geography. The data collected on each survey are archived with the relevant State scientific institutions to ensure they are available to anyone interested in our State's environment.

In addition to the major expedition, a number of trips for the Vulkathunha-Gammon Ranges Scientific Project are organised annually. A long term study of rainfall on the ranges and of water flow in arid-zone creeks is undertaken. All data are supplied to the Department for Environment and Water and to the Bureau of Meteorology and are available for analysis.

SEG conducts four-day biodiversity surveys at eight different sites each autumn and spring in the Heritage Area of scrub on "Minnawarra" farm near Myponga. Data collected are entered into the Biological Data Base of SA. SEG also conducts mallee fowl monitoring in the Murraylands.

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EDITORIAL

Astute readers of SEGments, which I am sure you all are, will have noticed a preponderance of photographs taken at Arkaroola Wilderness Reserve both in the this and the last issue. There are several reasons for this. A first is that we had some excellent photographers on the Expedition. I particularly mention Bernie Haase, Sam Gordon and Piers Brissenden. The quality of their photos is very good for a printed publication. Secondly, we had very good weather for the whole trip. Thirdly, and possibly the most important, Arkaroola is such a photogenic locality. At every turn there are magnificent vistas and the birds and animals are accessible.

Overall, even though the dryness reduced the expected catch at Arkaroola during the recent survey, I think that this expedition was a success.

One particular reason why the Expedition was successful was the extreme generosity of the Arkaroola management in donating the accommodation in the Greenwood Lodge and elsewhere as well as all breakfasts and dinners in the Native Pine Restaurant. Thank you in particular Doug Sprigg and Vicki Wilson.

This generosity allowed us to concentrate on fieldwork.

I also thank Helen Owens for her all her work in organizing and running the scientific aspects of the Expedition.

Following the success of the Arkaroola Expedition I am pleased to report that it will be followed this year by a return to Dhilba Guuranda-Innes National Park to monitor progress in that park since our last biodiversity survey in 2019. This year's survey will be in Spring in October or early November. Final dates have not been confirmed.

It is planned that some accommodation will be at Stenhouse Bay Hall with overflow available in campsites around the Hall. It is proposed to do 14 sites in DGINP and Warrenben Conservation Park.

More details will be sent to members as planning is intensified.

As in any survey there will be a limited number of positions for members to attend and I would like to ensure that a number are made available to young people who are the lifeblood for the future of SEG..

With respect to State Government legislation, on behalf of SEG I prepared and lodged a submission on the draft Biodiversity Bill, particularly in relation to the composition of the Biodiversity Council. If anyone would like to see a copy of the submission please contact me.

On a different matter, Rebecca Anderson has recently joined the SEG Committee and has rather bravely agreed to take over the position of Membership Officer. I say bravely because after Graeme Oats resigned as Treasurer I somewhat vaguely thought that the new Treasurer would handle it but no one actually told him, and it isn't the Treasurer's job. I muddled on with it but things like membership reminders were not sent out. All my fault as Administration Officer. Now Rebecca has taken the job she has remedied the situation so that some of you may have received notices checking your membership status and contact details. Old email addresses have been deleted and there is hope that things will work more smoothly in the future. Thank you Rebecca for taking a messy set of spreadsheets and getting things back in line.

Alun Thomas
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CURIOSITY, SCIENCE KNOWLEDGE, ECOLOGY, NATURAL HISTORY COLLECTIONS, CONSERVATION GENOMICS AND SCIENCE COMMUNICATION

HELEN JOHNSON

Don't you just love it when curiosity is acted on and leads to a trail of interesting 'discoveries' that SEG and others gain from! Arkaroola, Witchelina, the South Australian Museum, the greater stick-nest rat, conservation research at the University of Adelaide, and SEG's 40th AGM Guest Speaker, ecologist Peter Copley, all feature in this story.

I was delighted to see the photo of the greater stick-nest rat with a *Ptilotis obovatus* plant brushing its fur on the cover of SEGments Sept 2024. I first heard the name stick-nest rat from Garry Trethewey at Arkaroola in 2011. I thought they were extinct. The greater stick-nest rat (*Leporillus conditor*) driven to the brink of extinction since European arrival is a rodent about the size of a guinea pig with soft brown fur and rounded ears.

Greater Stick-nest Rat Photograph Jannico Kelk

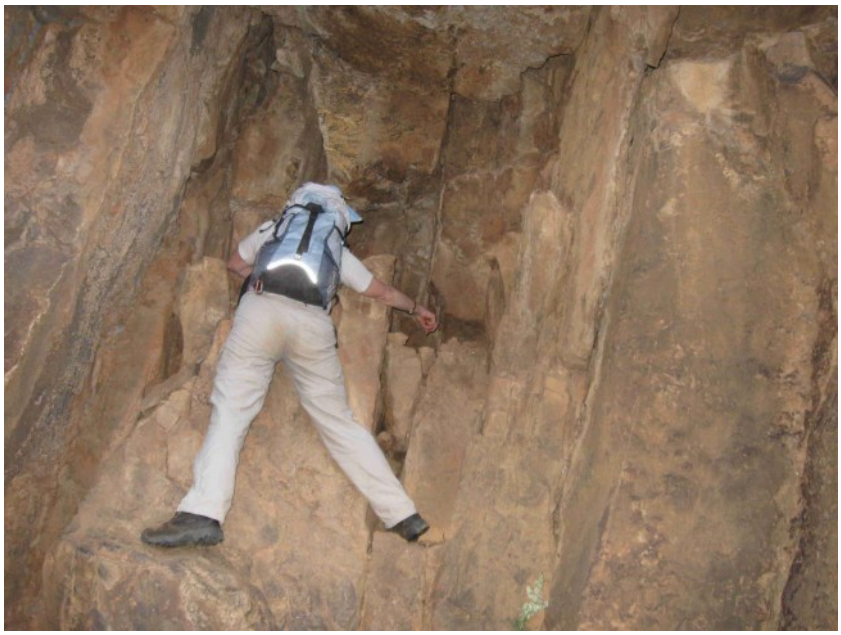
In her article "Conservation Genetics and Adaptive Management of the Greater Stick-nest Rat" (SEGments September 2024) Isabelle Onley writes "As the name suggests, the species is characterized by its architectural abilities. Using sticks, grass, and a special ingredient – extremely sticky urine – greater stick-nest rats build communal nests that can reach sizes of 2m wide and 1.5m high and are so strong they can last for thousands of years. The species has also been observed nesting beneath rocky outcrops and sheltering in the warrens of other species, such as the burrowing bettong. "

Garry Trethewey's curiosity, eye for detail and conversations with SEG member Graham Medlin, Honorary Research Associate in Mammal Section, SA Museum led to an interesting article in SEGments in March 2012. Quoting directly (with Garry's permission):

"Caves at Arkaroola" Garry Trethewey

"Having read Graham Medlin's "Field Guide to Chambers Gorge, Flinders Ranges", I'd always been interested in what sort of relics and remnants might be found in caves. I'd envisaged large tidy picture-book walk-in caves, with fascinating bones of diprotodonts and thylacines lying on display on the floor, probably with labels attached. I was also fascinated with the idea of rare traces of the extinct stick-nest rat, and apparently huge deposits of amberat, (dried urine solids) containing DNA, sticks, and other traces."

"On our SEG 2011 Arkaroola trip I got a chance to poke around in some holes & cracks, and found that the reality is a bit different, and if anything, even more interesting. Number one, it's not hard to find interesting things. It seems that just about any tiny crack in any rock is likely to hold something interesting. Two, you don't just find one sort of thing. It seems that a huge number of tiny animals use all sorts of holes, cracks, openings and shelters for a huge number of purposes. So, what did we find?" *On the first foray, Garry and Lohene hunted in caves, holes and overhangs near Ochre Wall.*



Lohene up a cliff face. Photograph Garry Trethewey

"I noticed a fresh owl pellet on the floor, so had a look. In the back were a couple of cracks, a tiny overhang, a shallow depression, lots of dirt and broken stone, and a beautiful basin for some lucky animal to sit in on hot days. Off to the side were some tiny bones covered in dust. With a bit of scratching around, we found that the best, that is, most abundant and intact, were in a tiny pocket, about 10cm high, and protected from the larger animals."

Garry and other SEG members returned on a second day, digging, sieving, and putting things in bags. "Later at home, Graham Medlin helped me with his more professional sieves, and retrieved many rodent bones. What I found most interesting was a Greater Bilby jaw. Bilbies have been extinct in the Flinders Ranges since the European invasion."

At Arkaroola "We'd already tentatively identified some amberat (dried accumulations of stick-nest rat urine) at the cave at SEG Site 7, and at Wooltana Cave, so I had at least an idea of what it looked like. So, when I poked in a tiny cave half way up a cliff, I was pleased to find a small amount of amberat, seemingly deposited over a long time as the roof collapsed, and so coating the top and bottom surfaces of flat plates of rock. One interesting find was a number of short 2-3cm diameter sticks tucked into a pocket at the back of the cave."

"Michelle, Amber, Duncan & I went to look at a small valley full of rocky outcrops and caves that we'd seen near Siller's Lookout. Once again, big photogenic walk-in caves proved bereft of interesting things. But nearby, on a long but shallow overhang, we found several deposits of amberat. Lots more clambering and looking into & under things, until we chose a cave with a view for lunch, and found a pillow-sized lump of amberat tucked behind a fold of rock."

"On the way back to the car, Amber found a shallow "crawl in and get your head stuck with no room to move your arm or camera" cave with the remains of a stick nest, cemented together with amberat." Next day, Michelle and Amber found a similar "break your arm to get it around the bend" opening in a cliff near SEG Site 4, with a similar deposit…. Then Michelle told me that she'd found three collections of amberat on the big rock that overlooks SEG Site 9, the Jasper Twins. Just goes to show how much we all miss by not looking."

Moving on from 2011 to 2016, when SEG did a second survey at Witchelina. Quoting from SEGments December 2016:

"What We Did on Our Holidays" Garry Trethewey

"Graham Medlin from the South Australian Museum has turned us on to sub-fossils; old bones that are not yet fossils, but 100 or 1000 years old. Michelle took a few minutes off from a picnic, poked her head into a bit of a cave and found some amberat, plus pollen, hair, dust and other indications of the past. Very exciting. Duly GPS'ed, photo-ed, notebooked, and discussed."

"Later we took the opportunity to check out a likely looking cave that I'd noticed on a previous goat-shooting trip, but hadn't had time to investigate. After lying down in, and scrabbling around in, and digging and sieving damp goat shit for a couple of hours, we had accumulated a small handful of fairly broken and degraded tiny little jaw bones and the odd detached teeth."

Garry laid these bones on a saucer and after dinner in the Witchelina shearers quarters we had a 'show and tell' with strict instructions not to touch.

Graham Medlin identified the bones, and it turned out some are of animals that have been extinct for well over 100 years! Graham wrote an article describing the Witchelina bones which was printed in SEGments along with Garry's article (December 2016).

RESULTS OF THE ANALYSIS OF A COLLECTION OF SMALL BONES FROM A CAVE ON WITCHELINA NATURE RESERVE DURING THE SEG EXPEDITION IN SEPTEMBER 2016

Graham Medlin

During September 2016 the Scientific Expedition Group (SEG) carried out a biological survey (BS 1028) of the northern and north-eastern sections of Witchelina Nature Reserve. In addition to the normal opportunistic searching, pitfall searching, cage traps and spotlighting at night, some cave sites were searched for signs of stick-nest rat nests and middens and bones from old owl roosts. Michelle Trethewey located a cave with preserved amberat (solidified stick-nest rat urine) and Garry entered another cave with small bones from an old owl roost, which he had previously found in 2013.

Amberat, sticky stick-nest rat urine. Photograph Garry Trethewey

The coordinates of the locations are shown below:

Coordinates of stick-nest rat midden: Easting 221835, Northing 6681610. Map Zone 54.

Lat. -29° 57' 53.6" S, Long. 138° 07' 3.1" E. Datum: WGS84. Date recorded: 19-09-2016.

Coordinates of the old owl roost site: 30 m S of Easting 211882, Northing 6684052. Map Zone 54. Lat. -29° 56' 26.1" S, Long. 138° 00 54.6" E. Datum: WGS84.

Collector: Garry Trethewey. Date of collection: 20-09-2016.

The following small mammals and two reptiles were recorded from the old owl roost, including three species now extinct in Australia.

1. Lesser Stick-nest Rat (*Leporillus apicalis*). [1 left dentary.] **EXTINCT**

2. Greater Stick-nest Rat (*Leporillus conditor*). [1 left dentary.]

3. Either the Spinifex Hopping-mouse, (*Notomys alexis*) or the Dusky Hopping-mouse (*Notomys fuscus*). Difficult to separate these two species on skull characteristics alone. [3 right maxillae, 2 right dentaries.]

4. Long-tailed Hopping-mouse (*Notomys longicaudatus*). [1 left maxilla, 2 left dentaries.] **EXTINCT**

5. Western Barred Bandicoot (*Perameles bougainville*). [Fragment of 1 right dentary.]

6. Plains Mouse (*Pseudomys australis*). [1 right maxilla, 1 left dentary.] This species has already been recorded for Witchelina.

7. Gould's Mouse (*Pseudomys gouldii*). [3 left and 4 right maxillae, 6 left and 3 right dentaries.] **EXTINCT.**

8. Either Bolam's Mouse (*Pseudomys bolami*) or the Sandy Inland Mouse (*Pseudomys hermannsburgensis*). Skulls of these two species are very similar and without the diagnostic M^1 (missing in this case) they cannot be separated. [1 right maxilla with M^1 missing, 1 left and 1 right dentary.]

9. Long-haired Rat (*Rattus villosissimus*). [4 left and 2 right maxillae, 3 left and 3 right dentaries.]. This species has already been recorded for Witchelina.

10. Either the Fat-tailed Dunnart (*Sminthopsis crassicaudata*) or the Stripe-faced Dunnart (*Sminthopsis macroura*). [2 left dentaries without teeth.]. Unable to identify to species because the diagnostic teeth were missing. Both species have already been recorded for Witchelina.

11. Rabbit (*Oryctolagus cuniculus*) [Single grooved upper incisor only.]

12. Large dragon lizard, not identified to species. [1 left maxilla, 1 right dentary and frontal bone from the skull.]

13. Small skink not identified to species. [1 left maxilla, 1 right dentary.]

It's amazing what you can find in a handful of small bones, provided that you have pieces of the upper (maxillae) and lower (dentaries) jaws.

Graham Medlin Honorary Research Associate in Mammal Section, SA Museum

Moving forward to September 2024, and on the cover of SEGments that gorgeous photo of the greater stick-nest rat, which I thought was extinct everywhere in Australia, but apparently not on some of our offshore islands, as Isabelle Onley explained in her article. Isabelle used museum records from Western Australia, South Australia and Victoria in her research. 199 partial and whole greater stick-nest rat skulls were measured from 34 locations across the species' former range, including Flinders Lofty Block. Isabelle used conservation genomics to understand the historical diversity of the species, morphological variation across species range, and sociality and dispersal behaviours in order to develop translocation and adaptive management strategies for the threatened greater stick-nest rat.

Natural history collections of specimens and records remain in museums around the country as excellent resources for research students in their search for answers…again curiosity.

It was fitting that SEG was on its third biodiversity survey at Arkaroola in September this year, 15 years after our first survey, when we received the conclusions of Premier Malinauskas' 'Review into the South Australian Museum's Restructuring', commissioned in April 2024. At Arkaroola we celebrated that night because the government reported it would **stop** the proposed strategic plan that would have affected the museum's research capabilities and institutional knowledge, **and** it would **boost** the museum's funding. Peoplepower!

But the story doesn't end there! Serendipitously, who should be our guest speaker at SEG's 40th AGM but Peter Copley who from as early as the mid-1980s was searching Australia's southern arid and semi-arid landscapes across WA, SA, NT and NSW for signs of the greater (and lesser) stick-nest rats and their characteristic nests. The only remaining population of greater stick-nest rats was in fact found on the South Australian Franklin Islands off Thevenard, near Ceduna. In 1988, about 500 adult rats were estimated to be on each of the two islands, East Franklin and West Franklin.

National Parks and Wildlife Service SA (NPWS) wanted to establish more populations of at least 500 mature rats on offshore islands or within predator-proof safe havens on the mainland where predation by cats and foxes, and competition from rabbits and livestock, could be controlled. The aim was to increase numbers from about 1000 to at least 5000 individuals and to spread the populations across as wide a range as possible. In the late 1980s thirteen adult greater stick-nest rats from one of the Franklin Islands and 18 adults from the other were placed at Monarto Safari Park in a captive breeding program. It hadn't been established whether the rats moved between the two islands, so approximately even numbers of

founders were taken from each island to ensure that the best representation of genetic diversity could be included in any future populations.

On the Franklin Islands rats live under relatively dense bushes and among boulders along the coastline and do not build stick nests. Provided with sticks at Monarto, the rats immediately constructed stick nests.

In 1990, sixteen rats were introduced to Reevesby Island in Spencer Gulf. NPWS staff radio-tracked and monitored these animals and after the first year found new island-born individuals as well as some of the original founders still alive. Young are born fully-furred and are dragged around hanging onto their mother's teats for their first 3-4 weeks of life. By 1996 there was a population of greater than 1000 estimated on Reevesby Island.

In 1993 greater stick-nest rat were introduced to St Peter Island in Nuyts Archipelago Conservation Park, south of Ceduna. The population on St Peter Island established effectively. The total population is currently estimated to be about 5000 on the South Australian islands. Black tiger snakes and Barn owls are the rats' main predators and influence their numbers in each population.

In 1998 Arid Recovery sourced 8 greater stick-nest rats to establish successful breeding and survival, and then sourced 99 more rats from Reevesby Island and the population established in the arid environment of the reserve. So, the greater stick-nest rat (*Leporillus conditor*) was back on the Australian mainland after nearly 100 years, the last sightings having been on the Nullabor Plain in the 1930s. Unfortunately, after 12 years of apparent success, with many litters born and numerous stick-nests constructed the stick-nest rats at Arid Recovery began a steady decline due to competition from an unpredicted booming population of burrowing bettongs combined with drought/dry seasons and predation by an increasing number of local sand goannas, owls and, later, introduced western quolls. By 2019, the rats were extinct at Arid Recovery.

Fortunately, there are three successfully established additional populations of these unique rodents: on Reevesby (SA), St Peter (SA) and Salutation (Shark Bay, WA) Islands and there are three other populations (2 mainland safe havens (WA; NSW); 1 island (WA)) that are being monitored with hopes for successful establishment.

So here we have it: the value of ***curiosity*** on SEG expeditions and interested members willing to crawl around in caves after sometimes climbing precipitous rock-faces; sorting, sieving and taking "finds" to the SA Museum for a ***science researcher*** to **expertly** sort and identify; researching and reintroducing populations of greater stick-nest rats to SA's offshore islands and to the mainland arid area by an ***ecologist*** with NPWS SA; and the PhD research in ***conservation genomics*** using ***natural history collections*** to advise how translocation programs of greater stick-net rats should be managed. Equally important is that all this information is available because people ***communicated*** it in articles in SEGments and in SEG's AGM-Guest Speaker presentation.

This has been the 'easiest' article I have ever scribed because I had help from Garry Trethewey, Graham Medlin, Dr Isabelle Onley and especially Peter Copley who added much detail to my brief notes scrawled at his presentation "Scientific Expeditions of a Threatened Species Ecologist".

Contact: kdolphin@internode.on.net

Tali Moyle holding a Greater stick-nest rat at Arid Recovery in 2009. Photograph Helen Crisp.

SEG INTERNSHIP 2024
ANNABELLE MATTHIAS

My name is Annabelle Matthias and I have just (in November 2024) finished a Bachelor of Marine and Wildlife Conservation Biology at The University of Adelaide. In my final semester I chose to apply for an internship with the Scientific Expedition Group Inc. for which I also gained credits for toward my degree. In July of 2024 when I was declared the 'SEG Intern' I was so excited to have the opportunity to gain real-world experience working in ecology.

The aim of the internship was to assist SEG with preparation, attendance and management of survey results on a biodiversity survey at Arkaroola Wilderness Reserve in the Northern Flinders Ranges.

In the first few weeks of the internship, I worked closely with SEG Scientific Leader, Helen Owens, to produce summary tables of previous Arkaroola survey records and started entering some of the raw vegetation data from an earlier SEG Arkaroola survey in 2011 into Excel. During this time I also helped with the ethics applications for the survey and visited the herbarium and the museum. At the herbarium I assisted Ben McCallum (with the little veg knowledge I had at the time) with sorting through the previous veg samples that were collected by SEG in Arkaroola.

Annabelle and a bearded dragon who joined us for lunch

Setting up a pit line

Visiting the South Australian Museum was very cool. Staff here showed me around and Helen, Stuart and I picked up specimen containers, ethanol and other supplies to bring up to Arkaroola.

When the Arkaroola trip came around I felt a mix of emotions, mostly excitement but also slightly nervous due to not knowing most people on the expedition and not knowing how SEG trips typically run. Prior to leaving Adelaide I had only met a small handful of SEG members, however once I met everyone properly in Arkaroola my nerves were put at ease. Everyone made me feel extremely welcome and comfortable and I knew I was in for a good 10 days.

The first few days of the survey were spent setting up traps, which involved setting up the pit lines, Elliot traps, funnel traps and cage traps. For some sites, the pit holes had to be dug as these were not permanent sites. On the Tuesday I went up the Ridgetop Track to set up sites ARK005 and ARK007. This was definitely a highlight for me as the landscape and views along the track were unlike anything I have ever seen. I was lucky enough to be in Garry Trethewey's car on this day, which meant I felt very safe and also learnt so much from

Bynoe's Gecko found during a site search

him about the track and the landscape – he is an encyclopedia when it comes to Arkaroola.

The following days consisted of checking traps and doing site searches, and I occasionally helped out with the vegetation surveys. Checking traps was very exciting. We never knew what we would find. Some days there were dunnarts, lizards and snakes and other days we just had ants in the traps. A highlight for me was on the Friday when I checked ARK011 in the morning with Julie Scofield, Alun Thomas and Kathleen Cunningham and we found two stripe-faced dunnarts, a gecko and a skink!

Working with such knowledgeable people who have worked or volunteered in ecology for so long was so beneficial to my learning. I learnt something different from everyone on the expedition whether I was working in the field with them or just having a conversation at the dinner table with them.

The Sunday before leaving was one of my favourite days. We went out as a big group to do some site searches at sites that were not being formally surveyed this time around. We went to ARK013, 014, 015 and 016, ending the day at the Bolla Bollana Spring. This was the first waterhole I had seen the whole trip and one of the most beautiful spots in the area in my opinion. The waterhole itself was full of little frogs and skinks, and we also spotted a number of emus and an echidna in this area – no Yellow-footed Rock Wallabies unfortunately. On the Sunday night, Bernie and Jenny presented us with beautiful pictures they had taken of birds on both this trip and some from previous trips. It was exciting to see some of the rarer species that they spotted and how close they were able to get to some. I have to say my appreciation for birds definitely grew while being in Arkaroola.

After the Arkaroola survey I spent a day in Helen Owens' office at the Department for Environment and Water on Waymouth Street entering the opportune records from Arkaroola. This was another cool experience that I got out of

the internship, as it was interesting to see the office and what a career could look like for me in the future.

Overall, my internship experience with SEG has been an unforgettable experience and has taught me so much about how surveys run and what a career in ecology could look like for me. It has made me feel more career ready and has boosted my confidence to enter the workforce. I am so grateful to all of the SEG members on the trip for giving me their time and patience to explain things to me and for making me feel so comfortable in an unknown environment. I also want to give a special thankyou to Helen and Piers for their guidance and support throughout my internship. I truly felt part of the SEG community during this time and hope to continue work with them in the future.

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Bolla Bollana Spring

LISTING OF AMPHIBIANS, BIRDS, MAMMALS AND REPTILES TRAPPED OR OBSERVED AT ARKAROOLA DURING THE 2025 SURVEY

CLASS NAME	SPECIES	COMMON NAME
AMPHIBIA	Crinia flindersensis	Northern Flinders Ranges Froglet
AVES	Acanthagenys rufogularis	Spiny-cheeked Honeyeater
AVES	Acanthiza apicalis	Inland Thornbill
AVES	Acanthiza uropygialis	Chestnut-rumped Thornbill
AVES	Accipiter fasciatus fasciatus	Brown Goshawk
AVES	Aegotheles cristatus cristatus	Australian Owlet-nightjar
AVES	Amytornis merrotsyi merrotsyi	Flinders Ranges Short-tailed Grasswren
AVES	Aphelocephala leucopsis leucopsis	Southern Whiteface
AVES	Aquila audax audax	Wedge-tailed Eagle
AVES	Artamus cyanopterus	Dusky Woodswallow
AVES	Artamus minor	Little Woodswallow
AVES	Barnardius zonarius	Australian Ringneck
AVES	Cacatua sanguinea gymnopis	Little Corella
AVES	Chalcites basalis	Horsfield's Bronze Cuckoo
AVES	Chalcites osculans	Black-eared Cuckoo
AVES	Colluricincla harmonica	Grey Shrikethrush
AVES	Coracina novaehollandiae	Black-faced Cuckooshrike
AVES	Corvus bennetti	Little Crow
AVES	Corvus coronoides	Australian Raven
AVES	Cracticus torquatus leucopterus	Grey Butcherbird
AVES	Dicaeum hirundinaceum	Mistletoebird
AVES	Dromaius novaehollandiae	Emu
AVES	Emblema pictum	Painted Finch
AVES	Epthianura albifrons	White-fronted Chat
AVES	Epthianura tricolor	Crimson Chat
AVES	Falco berigora	Brown Falcon
AVES	Falco cenchroides	Nankeen Kestrel
AVES	Gavicalis virescens	Singing Honeyeater
AVES	Geopelia placida placida	Peaceful Dove
AVES	Gymnorhina tibicen	Australian Magpie
AVES	Malurus assimilis assimilis	Purple-backed Fairywren
AVES	Manorina flavigula	Yellow-throated Miner (complex)
AVES	Melanodryas cucullata	Hooded Robin
AVES	Melithreptus brevirostris	Brown-headed Honeyeater
AVES	Melopsittacus undulatus	Budgerigar
AVES	Merops ornatus	Rainbow Bee-eater

AVES	Ninox boobook	Australian Boobook
AVES	Ocyphaps lophotes lophotes	Crested Pigeon
AVES	Oreoica gutturalis	Crested Bellbird
AVES	Pachycephala rufiventris rufiventris	Rufous Whistler
AVES	Pardalotus striatus	Striated Pardalote
AVES	Petrochelidon nigricans	Tree Martin
AVES	Petroica goodenovii	Red-capped Robin
AVES	Phaps chalcoptera	Common Bronzewing
AVES	Podargus strigoides	Tawny Frogmouth
AVES	Pomatostomus superciliosus	White-browed Babbler
AVES	Psephotellus varius	Mulga Parrot
AVES	Psophodes cristatus	Chirruping Wedgebill
AVES	Ptilotula penicillata	White-plumed Honeyeater
AVES	Ptilotula plumula	Grey-fronted Honeyeater
AVES	Pyrrholaemus brunneus	Redthroat
AVES	Rhipidura leucophrys leucophrys	Willie Wagtail
AVES	Smicrornis brevirostris	Weebill
AVES	Tachybaptus novaehollandiae	Australasian Grebe
AVES	Taeniopygia guttata	Zebra Finch
AVES	Teal sp.	Teals
AVES	Todiramphus pyrrhopygius	Red-backed Kingfisher
MAMMALIA	*Capra hircus	Goat (Feral Goat)
MAMMALIA	Macropus (Osphranter) robustus	Euro
MAMMALIA	Macropus (Osphranter) rufus	Red Kangaroo
MAMMALIA	*Mus musculus	House Mouse
MAMMALIA	*Oryctolagus cuniculus	Rabbit (European Rabbit)
MAMMALIA	Petrogale xanthopus xanthopus	Yellow-footed Rock-wallaby
MAMMALIA	Sminthopsis macroura	Stripe-faced Dunnart
MAMMALIA	Tachyglossus aculeatus	Short-beaked Echidna
MAMMALIA	*Vulpes vulpes	Fox (Red Fox)
REPTILIA	Cryptoblepharus australis	Desert Wall Skink
REPTILIA	Ctenophorus vadnappa	Red-barred Dragon
REPTILIA	Ctenotus pantherinus	Leopard Skink
REPTILIA	Ctenotus robustus	Eastern Striped Skink
REPTILIA	Delma sp.	
REPTILIA	Demansia psammophis	Yellow-faced Whipsnake
REPTILIA	Diporiphora nobbi	Nobbi
REPTILIA	Egernia striolata	Eastern Tree Skink
REPTILIA	Eremiascincus richardsonii	Broad-banded Sandswimmer
REPTILIA	Gehyra versicolor	Eastern Tree Dtella
REPTILIA	Heteronotia binoei	Bynoe's Gecko
REPTILIA	Lerista punctatovittata	Spotted Slider
REPTILIA	Lerista timida	Dwarf Three-toed Slider
REPTILIA	Liopholis personata	Flinders Ranges Rock Skink
REPTILIA	Menetia greyii	Dwarf Skink
REPTILIA	Morethia boulengeri	Common Snake-eye
REPTILIA	Pogona vitticeps	Central Bearded Dragon
REPTILIA	Strophurus elderi	Jewelled Gecko
REPTILIA	Suta suta	Curl Snake
REPTILIA	Tiliqua rugosa	Sleepy Lizard
REPTILIA	Varanus gouldii	Sand Goanna

Top Photograph: Grizelda Hill, Arkaroola, at sunset. Bottom photograph: Arkaroola Village from Grizelda Hill. Both photos by Piers Brissenden

Helen Owens frog catching at Bararranna Gorge Waterhole, Arkaroola. Photo by Piers Brissenden.

Short-tailed Grasswren, Arkaroola. Photograph by Sam Gordon.

BIODIVERSITY LOSS 2025

DR JOHN WAMSLEY

Introduction.

This report updates my paper 'Biodiversity Loss 2022' pages 18-22[1], incorporating added data for the last three years. I define biodiversity, give a measurable definition of biodiversity loss and then develop a trendline over time for biodiversity loss in Australia. This is extended to show that the present trend is unsustainable and set out some suggestions that may alleviate the problem.

Definition of Biodiversity.

Every hectare on earth evolved as a **unique community** of living organisms, each dependent on the Community and with the Community dependent on each organism. A community is made up of sub-communities and collections of communities make larger communities. Each one is unique, like fingerprints. Sometimes this is called the 'web of life'. We have somewhere between 3 million and 100 million species of living organisms living within these communities. About 3 million are described and named while the rest are neither described nor named. The collection of all these communities, the organisms within them and the links between the different organisms, all together give us this amazing thing we call **biodiversity (biological diversity)**.

The health of Biodiversity.

We do not have a measure of biodiversity as such, but we can measure **Biodiversity Loss.** As the links binding these organisms together are broken, some species lose their place and reduce in numbers. When this occurs, for a species, across many communities, the number of this species decreases dramatically. It loses the niche it evolved to fill, and we class it as **threatened with extinction.** We define **biodiversity loss, for a class of organisms,** as **the percentage of species, within the class, threatened with extinction.**

Whereas we may not know the total number of species threatened with extinction within a class, we can get a fair estimate of the percentage threatened simply by taking a sample and looking at the percentage of the class that is threatened with extinction, as we do with polling to guess who is going to win an election.

An Example.

At the commencement of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) the list of threatened species, ecological communities and threatening processes consisted only of those previously listed under the Endangered Species Protection Act 1992.

Under the EPBC Act new categories have been added for listed threatened species and ecological communities. Critically endangered, conservation dependant and extinct in the wild have been added to the previous categories of endangered, vulnerable and extinct for threatened species and critically endangered and vulnerable have been added to the previous category of endangered for ecological communities. The definition of a species under the EPBC Act includes sub-species and distinct populations that the Minister has determined to be species for the purposes of the Act.

New nominations for species and ecological communities will be assessed under the EPBC Act by the Threatened Species Scientific Committee (TSSC) according to the criteria for the new categories and listed accordingly. The TSSC will reconsider the status of the initial list of threatened species and communities in line with the new refined EPBC categories as information is updated and made available for assessment. [2]

This gives us a complete list of Australian Land Vertebrates that were threatened with extinction, each year from 2000 to 2024. This list is set out in Table 1 below.

Giving these numbers to EXCEL and asking it to give you a trendline you get the chart shown as Chart 1 over the page.

The mathematical formula for the trendline is:

$y = 188.5e^{0.032x}$ or

$y = 188.5*1.0325^{x}$.

The important bit is the 1.0325 which means the value for y is doubling every 21 years and 8 months. That demonstrates that the trendline for the numbers given by the Australian Department of Environment shows the numbers of Australian Vertebrates threatened with extinction is doubling each 21 years and 8 months.

Exponential Growth.

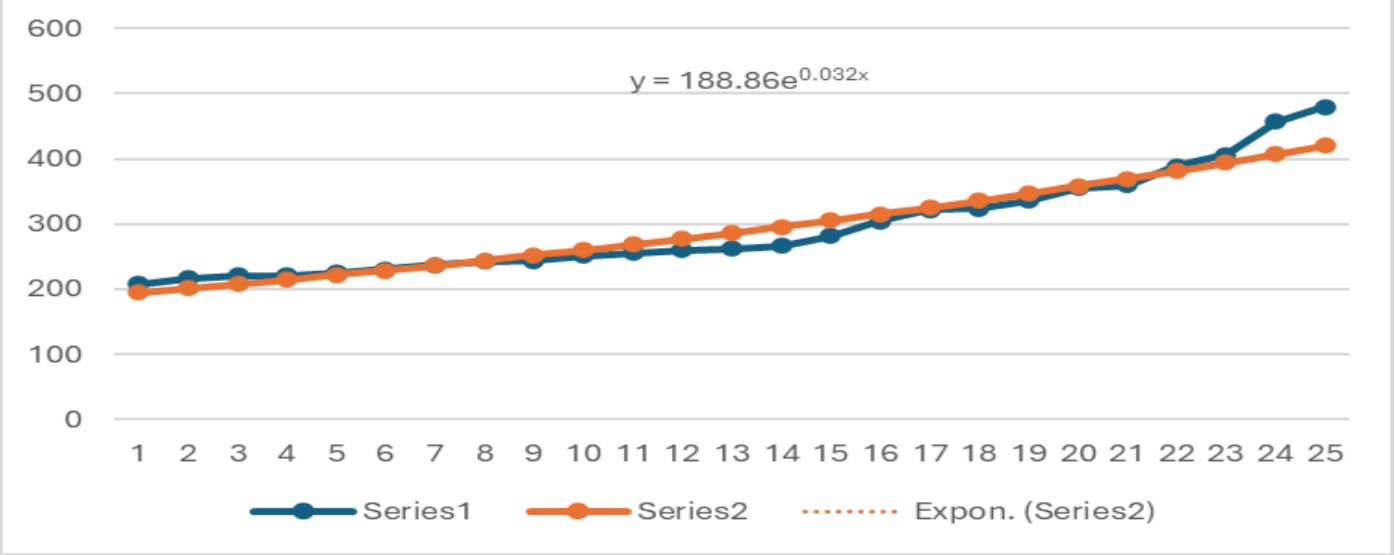
To better understand the gravity of Biodiversity Loss, there is a need to understand **Exponential Growth.** Every living organism is capable of exponential growth if the environment suits it. It is only because external forces control its growth that we have the feeling of stability. In 2005, Ray Kurzweil published his book titled "THE SINGULARITY IS NEAR" [3] consisting of 600 odd pages trying to explain exponential growth to non-mathematicians. I will attempt to do it in one page.

An example of exponential growth is fully defined by giving its doubling period, together with one data point. We start with the classic water lily puzzle [4], which asks the following question .

Table 1

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
208	217	221	221	225	231	237	242	244	251	255	260	262	266	281	304	322	324	336	355	359	389	406	457	480

Chart 1



Question: In the middle of a round pool lies a beautiful water lily. The water lily doubles in size every day. After exactly 20 days, the lily will cover the complete pool. After how many days will the water lily cover half of the pool?

Answer: Because the water lily doubles its size every day and the complete pool is covered after 20 days, half of the pool will be covered one day before that, i.e. after 19 days.'

We can extend this puzzle to any example of exponential growth. Every example of exponential growth is associated with a doubling period. We can therefore take our time scale as the number of doubling periods. Since we live on a finite earth any exponential growth must reach a limit. If we designate this limit as 1 we can use fractions of I (the limit) as our measure of the size. In addition, we can take our time as zero when we are at the limit.

By doing this, every example of exponential growth is given by one example as shown below.

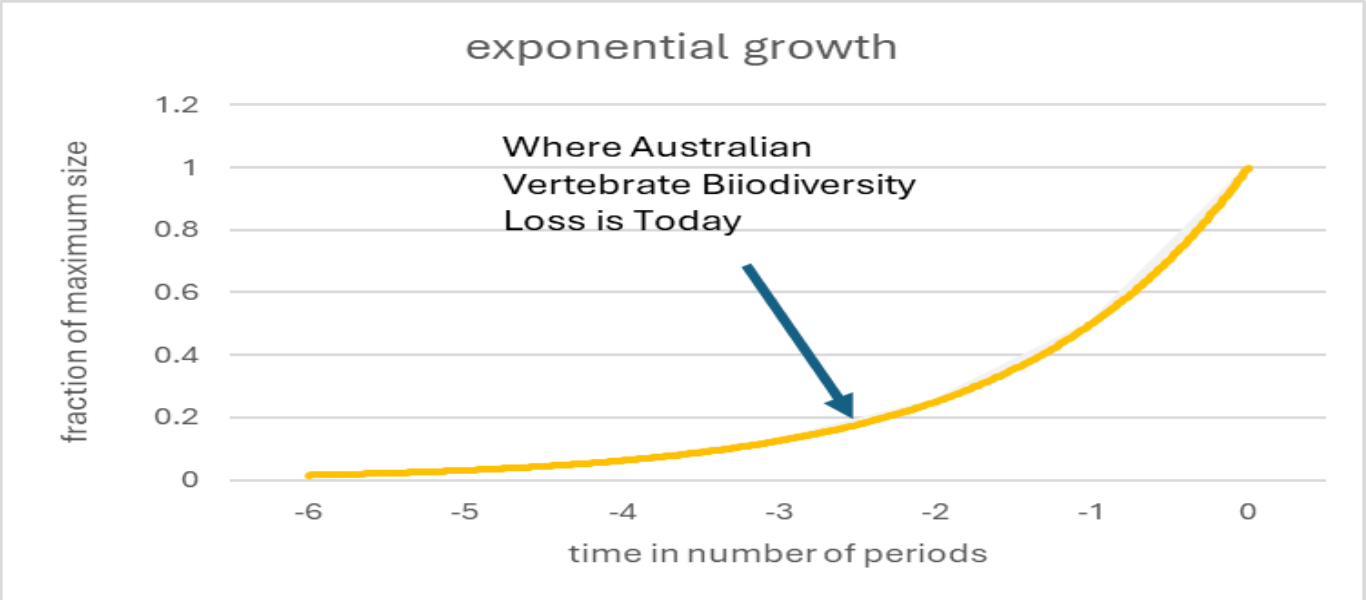
Every example of exponential growth is given by Chart 2.

In the example given above the doubling period is 21 years and 8 months and at present we have 20% of our Land vertebrates threatened with extinction. **So! If the present trend continues, we will be at 100% by 2074.**

The important point here is that we do not need to know the total number of threatened species in a class. We just need to know the percentage of the class that is threatened with extinction. To find this out, we simply take a random sample. The size of the sample can be found simply by going to the Australian Bureau of Statistics' website [5]. A sample size of 250 will probably give you suitable accuracy.

One interesting point is that the trend in biodiversity loss for Australian Land Vertebrates correlates exactly with the growth in Australia's GDP. So, when our Treasurer tells us that he expects 3% growth next year. He is telling us that he expects the number of threatened Land Vertebrates in Australia to increase by 3%. It is as simple as that. Biodiversity is totally caused by Human Activity. It is not caused by farmers and miners. It is caused by you and me. Of course, our farmers

Chart 2



and miners are causing the damage, but we are demanding they do it.

What we know.

If we look at the world stage. According to the International Union for Conservation of Nature (IUCN) [6], 18% of the 63,761vertebrates they have evaluated are threatened with extinction. 23% of the 27,906 invertebrates they have evaluated are threatened with extinction and 28% of the total number they have evaluated are threatened with extinction. If the present trend continues, and there is no reason to believe it won't, then in 40 years 100% of the world's vertebrates will be threatened with extinction. See Table 1a below. Although IUCN states :

> "Where <80% of species within a group have been evaluated, figures for % threatened species are not provided because there is insufficient coverage for these groups. It is only possible to provide reliable figures for % threatened species for those groups that are completely or almost completely evaluated (e.g., mammals, birds, amphibians and gymnosperms."

Insects.

Quoting from a United Nations Report of 2019 [7]:

> "Insects make up about half of all known living organisms. They play key roles in, pollination, nutrient cycling, food chains for birds and other insectivores, and are one of the pillars of our ecosystems.
>
> "Across the world, more than 40 per cent of insect species are declining and a third are endangered, the analysis found. **The rate of extinction is eight times faster than that of mammals, birds and reptiles."**

Therefore, if 40% were declining 5 years ago, we can assume 80% are declining today. Or! In a recent article I wrote, "There ain't no insects no more" pages 24-26 [8].

See Chart 2.

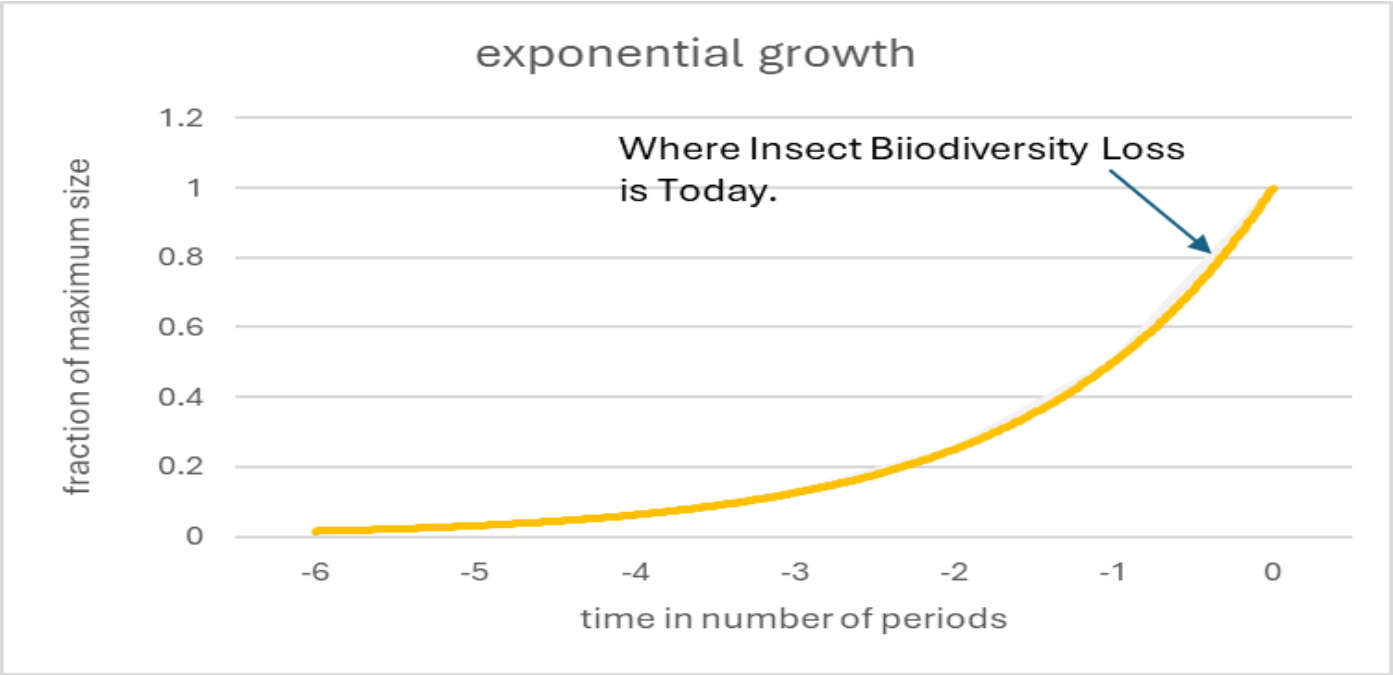
If the United Nations figures for insect loss are correct, and there is good reason to believe that they are, then not only do insects have the general problems affecting all other living species, but they are especially affected by climate change, and we wage a relentless war against insects. We have actively targeted them. We have already successfully exterminated so many of them.

The most widely used groups of insecticides in recent years have been the organophosphates which include parathion methyl, chlorpyriphos, dimethoate, profenofos and diazinon. Around 5,000 tonnes of active ingredients from this group, which comprises around 30 identifiably distinct

Table 1a: Number of species evaluated in relation to the overall number of described species, and numbers of threatened species by major groups of organisms.

	Estimated Number of described species[1]	Number of species evaluated by 2024 (IUCN Red List version 2024-2)	% of described species evaluated by 2024 (IUCN Red List version 2024-2)	Number of threatened species[2] by 2024 (IUCN Red List version 2024-2)	Estimated % threatened species in 2024 (IUCN Red List version 2024-2)[2,3,4]		
					Lower estimate (threatened spp. as % of extant evaluated species)	Best estimate (threatened spp. as % of extant data sufficient evaluated species)	Upper estimate (threatened and DD spp. as % of extant evaluated species)
VERTEBRATES							
Mammals [5]	6,736	5,991	89%	1,354	23%	27%	36%
Birds	11,195	11,195	100%	1,311	12%	12%	12%
Reptiles	12,263	10,311	84%	1,845	18%	21%	33%
Amphibians	8,776	8,009	91%	2,873	36%	41%	47%
Fishes	36,953	28,255	76%	4,017		*Insufficient coverage*	
Subtotal	**75,923**	**63,761**	**84%**	**11,400**	**18%**	**21%**	**31%**
INVERTEBRATES							
Insects	1,053,578	12,747	1.2%	2,423		*Insufficient coverage*	
Molluscs	87,254	9,127	10%	2,456		*Insufficient coverage*	
Crustaceans[5]	90,820	3,213	4%	748		*Insufficient coverage*	
Corals	5,641	927	16%	334		*Insufficient coverage*	
Arachnids	95,966	787	0.82%	283		*Insufficient coverage*	
Velvet Worms	222	11	5%	9		*Insufficient coverage*	
Horseshoe Crabs	4	4	100%	2	50%	100%	100%
Others	156,447	1,090	0.70%	177		*Insufficient coverage*	
Subtotal	**1,489,932**	**27,906**	**2%**	**6,432**			
PLANTS [7]							
Mosses [8]	21,925	327	1.5%	181		*Insufficient coverage*	
Ferns and Allies [9]	11,800	822	7%	322		*Insufficient coverage*	
Gymnosperms	1,113	1,061	95%	450	42%	43%	44%
Flowering Plants	369,000	71,253	19%	27,197		*Insufficient coverage*	
Green Algae [10]	14,151	17	0.1%	0		*Insufficient coverage*	
Red Algae [10]	7,690	78	1.0%	9		*Insufficient coverage*	
Subtotal	**425,679**	**73,558**	**17%**	**28,159**			
FUNGI & PROTISTS [11]							
Mushrooms, etc.	157,648	818	0.5%	340		*Insufficient coverage*	
Brown Algae [10]	4,756	18	0.4%	6		*Insufficient coverage*	
Subtotal	**162,404**	**836**	**0.5%**	**346**			
TOTAL	**2,153,938**	**166,061**	**8%**	**46,337**			

Chart 2



chemicals, have been used annually in Australia. The next most significant group of insecticides are the acetyl choline esterase inhibitors, comprising various carbamates, of which about 3,000 tonnes have been used each year. Metham sodium is the most highly used carbamate. Over 500 tonnes per annum are used of those insecticides which act as GABA-gated chloride channel antagonists, the most important of these being endosulfan, which is a cyclodiene organochlorine, but which does not build up in the fat of mammals or persist in the environment. Of the remaining insecticides, the twenty chemicals in the pyrethroids and pyrethrins group are the most widely used, totalling up to a couple of hundred tonnes per annum.

Over 1% of Australia is soaked with insecticide every year. Every invertebrate on that 1% is killed every year. The runoff ensures that every invertebrate in every creek from this 1% is also killed.

In addition, most households have a can of fly spray so that any unwary insect venturing into humanity's living space can be quickly dealt with.

The life cycle of many species of insects is driven by climate. For example, the times of hatching of males and females may vary and depend on climate. I have a cabin in the Flinders Ranges and on a recent visit there was a plague of harlequin bugs. There were literally millions of them. But there was none of the normal harlequin bug hanky-panky. They appeared to be all the same sex. No baby harlequin bugs this year.

How Biodiversity Loss is managed in Australia.

The short answer to how Australia manages biodiversity loss is that it doesn't. It monitors some species. If it is decided that a species in threatened, it hands it over to the **'Threatened Species Commissioner'** whose job it is to make sure they do not go extinct. The trend in threatened species shows that nothing, which actually works, is done to stop species from becoming threatened. The result is that sometime between now and the end of the century, all Australian species will be classed as threatened.

What does all this mean?

This would mean that, probably the only species left would be those with links to us (homo sapiens) and weed species. There will be domestic stock, pets, plants grown for food and fibre, garden plants, and of course both weeds and animal pests. And of course there will be Zoos and Botanic Gardens. There will not be this thing called 'the wild', as we now know it, anymore. This probably will not worry most Australians who spend their time in cities, but it certainly worries me.

Some suggested Directions.

Sixty one percent of Australia's land is used for **agriculture**. Therefore! How it is managed plays the biggest role in the loss of biodiversity, but this need not be the case**. Regenerative agriculture** is an evolution of conventional agriculture, reducing the use of water and other inputs, and preventing land degradation and deforestation. It protects and improves soil, biodiversity, climate resilience and water resources while making farming more productive and profitable. **Organic agriculture** also called ecological or biological farming, is an agricultural system that uses fertilizers of organic origin such as composted manure, green manure, or bone meal and places emphasis on techniques such as crop rotation and companion planting. **Natural farming** is an agroecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. These are all improvements on present farming practices which

could greatly reduce biodiversity loss. However! They need to be 'the norm' rather than a minority practice.

The last three years has seen a dramatic increase in biodiversity loss in Australia. Maybe, this can be attributed to climate change. However, that doesn't excuse the disaster we have created. Whatever the Australian government did over the last three years to reduce biodiversity loss, it achieved the opposite. The solution is very clear. For a start**, 30% of Australia must be 'protected' by 2030**. Something Australia has agreed to do. The problem is in their definition of protected. There has to be some sort of scoring used to give a weighting to protected land that is truly protected rather than to so called 'protected land' full of invasive plants and animals. Land is not protected from human activity if it is still suffering from past human activity.

Of course we must become more serious about **sorting climate change**.

Conclusion.

Using the accepted definition of biodiversity, together with data supplied by the Australian Department of Environment, the IUCN and the United Nations Environment Programme, it has been shown that biodiversity has continued to be lost above trend and **will pass, what some experts consider to be the 'Tipping Point' by 2050**.

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VALE PHIL COLE

Philip James Cole 30/1/1949 - 3/01/2025

Phil was an intelligent and committed man who possessed a tremendous love of nature and the environment.

Phil was a member of SEG for a number of years and was a valued committee member. He worked as a scientist on the SEG expeditions to Gluepot in 2000 and Marqualpie in 2008.

Most recently Phil and his partner Jenny Hiscock assisted with the bird survey at Arkaroola late last year.

Phil also was an active worker with the Nature Foundation SA and joined the Nature Foundation Board as a Director in 2022.

He will be missed.

Alun Thomas

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