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ACTHA Inc. News
Apr - May '20
Newsletter of the ACT Herpetological Association Inc.

Diary date - Zoom meeting!

Due to all the current Covid19 physical distancing rules we shall bring you this month's Guest Speaker presentation via Zoom on-line technology, in the comfort of your own home!

The presentation will take 40 minutes, starting at **7.30pm SHARP, Tuesday 21 April 2020**.

If you are interested in being part of the Zoom group Meeting please email Margaret Ning at: margaretning1@gmail.com **ASAP**, and you will be sent an invitation to the Zoom meeting.

You **MUST** get Margaret's email invite to take part!

If this is your first Zoom meeting, and you've received Margaret's invitation to the session, you'll be prompted to download the Zoom App - this may take a few minutes.

Once you've downloaded the App you will automatically be directed to the session. You'll then be prompted to select your audio and video settings, you need to do this before you can hear and be heard and seen (You can leave the video turned off if you prefer.)

In this issue

The Australian & International Scene

Upcoming meeting:

Tuesday 21 April 2020

The presenter and host of the meeting will be **Phil Pearson,** a PhD candidate from the University of Canberra, who is originally from Alabama, USA.

The title of Phil's presentation is **Maternal nest site selection and consequences of sex reversal on hatchling Central Bearded Dragons.**
Sex determination and sex reversal are hot topics in the world of herpetology. However, the consequences of sex reversal on the offspring characteristics are unclear. Phil will be presenting preliminary results from his PhD thesis concerning field nest temperatures and lab based hatchling sprint performance.

ACTHA Reptile Keepers Club - 17 March 2020 meeting

held at the Canberra Reptile Zoo

Jake McAuliffe on Heat Stress in Pythons

By Margaret Ning

It was a small turnout of ten members for the March 2020 ACTHA Reptile Keepers Club meeting, where we practiced social distancing, but once again managed to thoroughly enjoy the occasion. The pizza supply in particular stood up very well!

The warm up show-and-tell included Dennis showing us his Centralian Python (*Morelia bredli*) eggs that have been incubating at the Canberra Reptile Zoo since they were laid on 1 February. One egg is into the hatching process to the extent that there is a hole in the egg, the baby python is visible and occasionally wriggles, and the red veins in the egg are also visible.

Not to be outdone, Liam brought out a baby Red-bellied Black Snake which was one of seven born five days earlier at the Zoo. It was about 20cm long, around the same size as it was at birth, and reasonably lively.

The main talk of 'Heat Stress in Pythons' by Jake McAuliffe stemmed out of his dad's sad experience with five of their own pythons, kept at Wamboin, NSW. One day in the first week of January 2019 temperatures unexpectedly drifted up from their normal level for that time of the year, and the outcome was two very large, dead coastal carpet pythons, one presumed dead central python (Morelia bredli) and two surviving diamond pythons. Given that moves had already been underway for the animals to be brought to more appropriate accommodation at Jake's place in Canberra, the death of long-time family pets left a particularly bitter taste.

It was estimated that the temp in the area the pythons were in possibly reached 50 degrees with an outside temp of 40 degrees.

The two large carpet pythons and the Bredli had been housed in a wooden enclosure with glass doors, which in turn was on top of the enclosure housing the diamond pythons. When discovered, the carpets had totally succumbed to the extreme temperature and were stiff already, the first third of the Bedli's body was also stiff, its body was still hot as a result of the weather, but no breathing was detected. According to Jake, the diamonds were actually looking for food!

Jake took the Bredli home, put it in a 100L tub of water in the coolest room in the house, in an effort to cool it down. He changed the water every couple of days, and after a week the animal curled up. Jake didn't actually see it move for three weeks, and didn't touch it for all those weeks. After three weeks, the animal was 'just' moving, and could sort of lift its head up. After three months he started following Jake's hand. Jake likened the animal's condition to Bells Palsy in humans, which sees a sudden weakness in the muscles on one half of the face. It was a long painful recovery and the animal stayed in the water for over six months. Some time between six and nine months, Jake offered him a mouse which he took and passed normally. Jake removed the water at that stage. Since the nine month stage, the animal has not knocked back a feed. Jake also rubbed him with olive oil.

Jake has kept handling to a minimum and the length of time he handled the animal at the meeting was the longest he had handled it since it all happened. The Bredli is now around two metres long, with an estimated age of 10 years to early teens. It has suffered brain damage, and when feeding he still misses nearly every time.

Jake's recovery procedure basically cooled the animal down, and hydrated him. Jake was not following any known advice as to how to treat animals in this condition, but following his own instincts as to what to try. The audience asked lots of questions and there was general discussion within the group as to the reasons for the different fates of the three species.
[Ed. Jake will let the Group know how the snakes are doing at a future meeting.]

And the final treat for the evening was when Liam fed the barking owl a couple of mice.

Once again we fitted our pizzas and our talk into an efficient time frame that saw us going home around 7.30pm.

ACTHA Reptile Survey at Stirling Park, Yarralumla, Sunday 15 Mar '20

By Margaret Ning

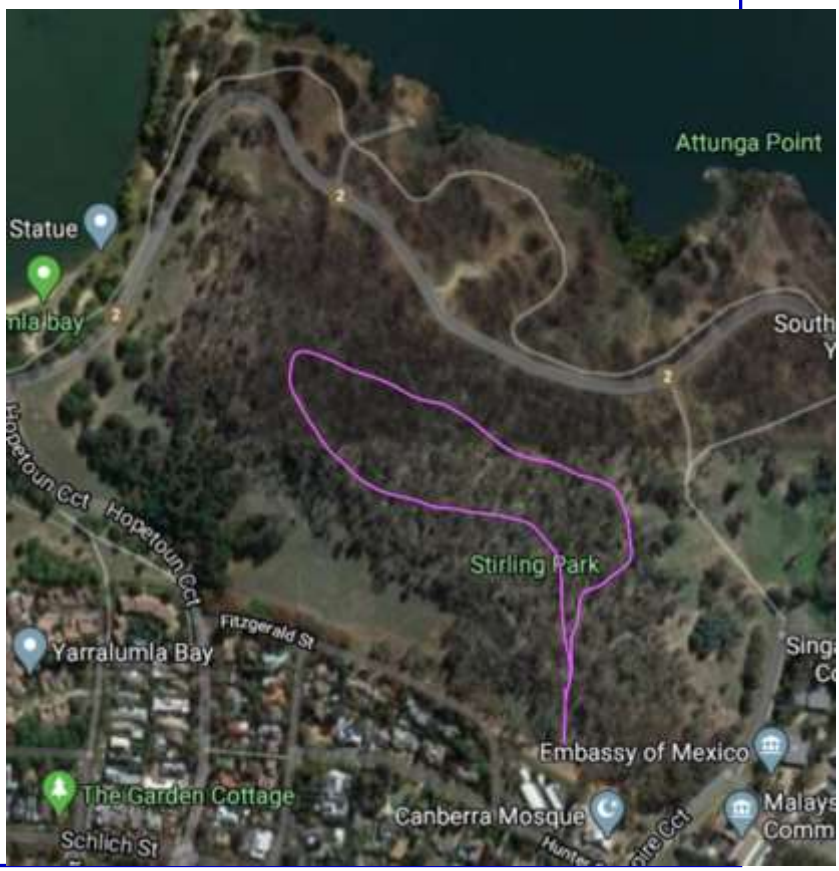
On Sunday 15 March we held a three hour reptile survey at Stirling Ridge, Yarralumla, in response to a request from Jamie Pittock of Friends of Grasslands. Jamie has been the project leader for around ten years of on-ground work at the site which has led to a transformation of the area from being infested with exotic woody weeds back to being a quality woodland site.

Jake led an ACTHA troupe of 16 members into the field. We started at 9am and within the first five minutes had located three skink species. This was no fluke however, as we started our search among some sizeable logs that had been introduced to the site a few years back as habitat enhancement. Jake and Brian explained that the lower such logs are placed in the landscape the more quickly they are inhabited by all sorts of reptile and invertebrate species.

We had come equipped with a collection sheet that was designed for the occasion (thanks Emma!), but which will hopefully get further use if we conduct future surveys. It enabled us to record the name of the species we found, the time we found it, a photograph of each animal (where possible), an approximate measurement, whether tail loss, and how the animal was detected. We also recorded the temperature, cloud cover and humidity as a basic record of the day's conditions.

We split into two teams and, between us, covered approximately the area in pink on the map. Generally we watched how it was done, learnt how to do it safely, helped with record keeping and photographing, etc.

In all, we turned up over 20 animals from 7 species, of which 6 were skink species and one was a gecko. They were: *Morethia boulengeri* (Boulenger's Skink), *Lampropholis delicata* (Delicate Skink), *Hemiergis talbingoensis* (Three-toed Skink), *Ctenotus robustus* (Robust Striped-skink), *Ctenotus taeniolatus* (Copper-tailed Skink), *Tiliqua scincoides* (Eastern Blue-tongue), *Christinus marmoratus* (Southern Marbled Gecko)



'Australian Water Dragons' by Lisa Mitchell

- book launched 13 September 2019 at ANBG

ACTHA member Rosemary Blemings recently came across this little gem of a book, and has taken delivery of a number of them for distribution around the ACT.

The book provides a readable overview of the scientific background, history, identification, communication, lifecycle, predators and conservation of these reptiles. Well illustrated with colour photographs, it is aimed at 9+ years, but suitable for young and older readers alike.

The A5 book can be purchased for $10 from Margaret at any ACTHA meeting, or $12.50 if postage required.

Please contact Margaret Ning at margaretning1@gmail.com to secure your copy.

Investigating the ecological causes and consequences of sex reversal under natural conditions

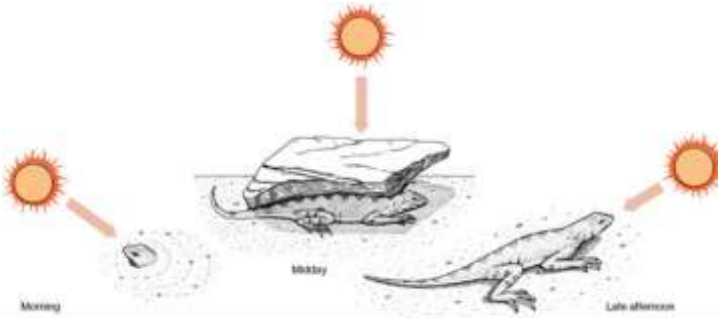
***Ed**. This summary of Kris Wild's presentation is predominantly taken from his extensive notes.*

A bad hailstorm kept many ACTHA members at home on the evening Kristoffer Wild, University of Canberra, gave his presentation at the scheduled 18 February 2020 ACTHA meeting. The subject of Kris' presentation (above) formed the basis of his talk but our little group were able to discuss many aspects of Kris' research work in greater detail throughout the evening.

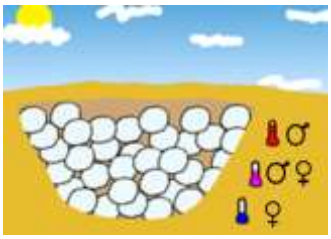
Kris' current PhD work has focussed mainly on Central Bearded Dragons and their responses to any ecological consequences of sex reversal. Very little is known about the ecology of these reptiles, and the opportunity to study other attributes, like their behaviour and physiology in their natural habitat, has led to a broader ecologically descriptive study. Kris has a background in fire ecology of reptiles, for example where he studied movement of the US Eastern Box Turtle in response to fire in the landscape, which helped some aspects of his current research.

Determining the causes and consequences of sex reversal in nature is Kris' primary goal and he highlighted that this research would not have been possible without funding sources and support from organisations like ACTHA and a great group of students and volunteers in the field.

News images on climate change have become quite the norm in Australia. In this past year Australia experienced its warmest physical year to date and its driest summer ever recorded. This provides an interesting framework to ask questions relating to a warming trend and how such rapid changes may affect native fauna.



Adapted from Pennell *et al.*, 2018



Ectotherms rely largely on external sources of heat, such as sunlight or basking rocks, to achieve body temperature for various activities. Temperatures can also influence reproductive processes.

Sex determining mechanisms are relatively diverse within reptile species. Two modes of sex determination in reptiles include:

<u>Genetic Sex Determination</u> (GSD) - sex is determined by sex chromosomes at the time of fertilization.

<u>Temperature Sex Determination</u> (TSD) - temperature of the eggs during a certain period of development is the deciding factor in determining sex.

One topic of interest is how warming temperatures can potentially influence population ratios. Under rare circumstances GSD and TSD pathways can interact with one another; this is commonly referred to as 'sex-reversal'. Lizards can provide an excellent working example of this process.

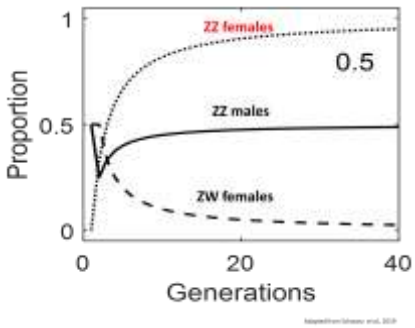
One species where this phenomenon has been documented in is the Central Bearded Dragon *Pogona vitticeps*. The chromosome system has shown to be overridden by temperature in natural populations.

Normally, with bearded dragons, sex is genetically determined, where chromosomal sequence is
ZW Females and ZZ Males. When eggs develop in temperatures above 33°C the offspring have been shown to undergo sex reversal. When this occurs, the offspring have lost the presence of the W chromosome. This is a widespread event occurring throughout their recorded range.

Sex reversal increased by 16% between the years 2003 and 2011, the results shown when a large number of specimen samples were taken in these areas. The increase in numbers can, in part, be attributed by warming temperatures associated with climate change.

"What we know about these animals is that these sex reversed females show behavioural phenotypes that are similar to males. Laboratory studies have shown that sex reversed females are more aggressive and bolder than normal females and even resemble morphologies similar to and greater than normal males. It is possible that these behavioural phenotypes can be a catalyst to a rapid transition from GSD to TSD."

A sex reversed female can produce eggs and lay them, however all offspring will lack the W chromosome, thus changing the population from genetic sex determination to everything in that clutch being temperature dependent.



Sex reversal in the Central Bearded Dragon

Our Model showed that a population could change from normal females to sex reversed populations.

The Model approach investigates sex ratios and the number of generations needed to cause a transition from GSD to TSD in a theoretical population. Once ZZ proportions near 50% in a population it can quickly shift from a GSD system to a TSD system. However, under natural conditions, differences in behaviors and field conditions may cause this curve to behave differently.

Key questions

"I'm generally interested in quantifying these sex-reversed individuals that may have a competitive edge over their normal counterparts in the wild."

Frequency: baseline data on numbers and if we increase this trend.

Movement: how are they using their surrounding habitats and how are they competing for resources.

Body Condition: health of these individuals.

Field surveys were conducted to locate lizards

"Once lizards are captured we determine their phenotypic sex and then take a blood sample. The lizards are then fitted with custom made 'jackets' with GPS/Telemetry gear so that they can be tracked and records of animal movements can be taken weekly.

"From the field data we can extrapolate fitness related traits such as home range metrics and activity and then finally we can see how these fitness related traits relate to previous laboratory findings on sex reversal. This will provide us with an understanding of conditions that could drive a rapid change from GSD system to a TSD system."

Question 1: Movement patterns

The movements of three individuals with a GPS data point was taken every day. "From this data we can gather valuable information such as daily movement patterns, habitat use, and eventually home range size. We found evidence that sex reversal occurred in approximately 20 of the individuals.

"For this presentation tonight I'm going to focus on straight line movements. Taking the distance of two GPS points recorded on consecutive days and then averaging them together, we determined 'Average' daily movement."

Question 2: Body condition

"Body condition is a common surrogate for the health of an organism and has been shown as a relationship between energetic state and reproductive potential: essentially it is similar to a Body Mass Index given to us by our doctor.

"As ecologists, we were interested in estimating extra fat storages. Body conditions for our lizards were derived by looking at the relationship between snout-vent length, body mass of each individual and then comparing the residual difference among the sexes. Data suggests there are differences in BCI among sex and they are approaching significance."

Conclusions thus far

- First study to report the frequency of sex reversal in a population;
- Differences in movement patterns for a widespread reptile;
- Differences in body condition and how this may vary across sex;
- More field data needed.

Morphometrics

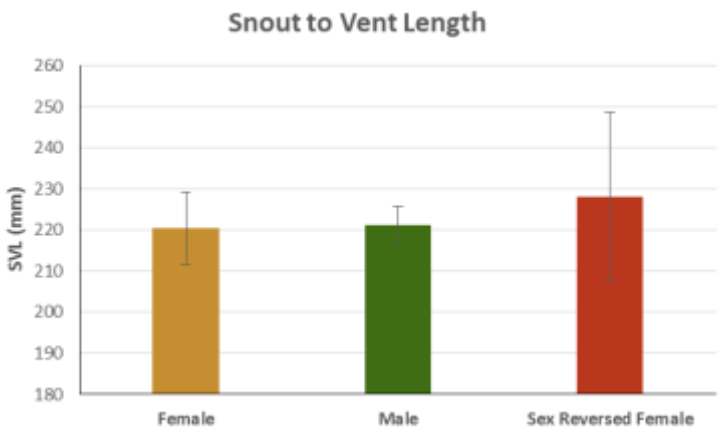


Figure 1: Sex of individuals.

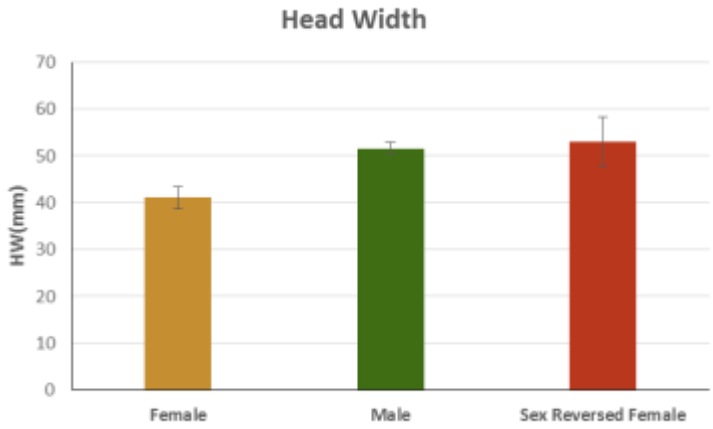


Figure 2: The females were on average smaller in size, mass, and head morphology than males.

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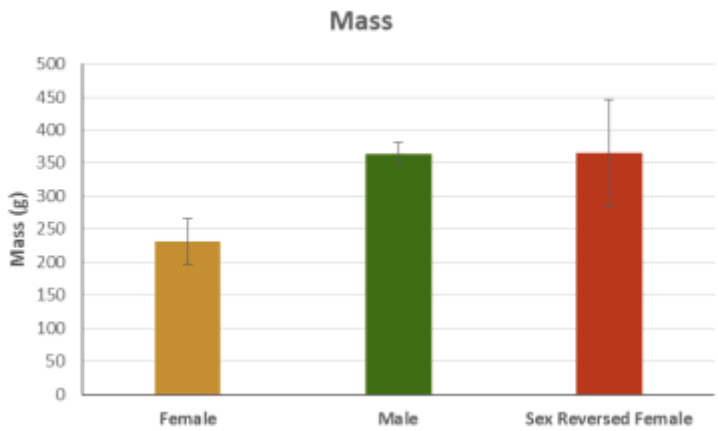

Figure 3: Note that sex reversed females, on average, show similar or even larger features than males!

The Culprits...

"We found lizards are common menu items. We have traced lizards in Wedge tailed and black-breasted Buzzard nests and also found other birds, such as the whistling kite actively predating on other species of lizards. We also have the reptilian culprits that have attempted to predate on some of our smaller individuals.

And finally cats... the room sighed in unison...

General 'all things reptile' discussion amongst us followed Kris' very insightful presentation. We look forward to further presentations from him as his research on the Central Bearded Dragon continues!

'I walked 1,200km in the outback to track huge lizards. Here's why...'

By Sophie Cross, The Conversation, 7 Feb 2020

In 2017 and 2018 I walked the equivalent of 28 marathons in the scorching Western Australian outback. Why, you ask? To assess how some of Australia's largest lizard species interact with restored mines.

As part of my PhD research, I hiked in often extreme heat on a mine site in WA's sparsely populated Mid West region. My fieldwork was both physically and mentally demanding, as I spent many hours each day walking through the bush looking for signs of monitor lizards.

Being in a remote location and mostly alone, I had plenty of time to ponder the wisdom of my career choice, particularly on days when temperatures exceeded 40◎ and not even the lizards ventured from their homes.

Pushing through these mental challenges was difficult at times, but my work has provided me with some of my most rewarding experiences. And what I discovered may be crucial for restoring habitats destroyed by mining.

Restoring abandoned mines

Habitat loss is a leading cause of biodiversity loss worldwide. Although mining typically has a smaller environmental footprint than other major industries such as agriculture or urbanisation, roughly 75% of active mines are on land with high conservation value.

Above: Sophie Cross walked more than 1,200km and tracked a young adult perentie to find out whether it utilised a restored mining area. Image: Author provided.

There are around 60,000 abandoned mines in Australia, but very few of them have been officially closed. How to restore them is a growing public policy problem.

Recovering biodiversity can be an exceptionally challenging task. Animals are vital to healthy ecosystems, yet little is understood about how animals respond to restored landscapes.

In particular, reptiles are often overlooked in assessments of restoration progress, despite playing key roles in Australian ecosystems.

Do animals return to restored habitats?

I wanted to know whether restored habitats properly support the return of animals, or whether animals are only using these areas opportunistically or, worse still, avoiding them completely.

To study how reptiles behave in restored mining areas, I hand-caught and tracked a young adult perentie. The perentie is Australia's largest lizard species, growing to around 2.5m in length, and is an apex predator in arid parts of the country.

I tracked the lizard for three weeks to determine whether it was using the restored area, before the tracker fell off during mating.

Above: The tracking device revealed how the perentie navigated a restored mine, before it fell off during mating. Image: Author provided.

Previous methods of tracking assume the animal used all locations equally. But I used a new method that measures both the frequency with which animals visit particular places, and the amount of time they spend there. This provided a valuable opportunity to assess how effective restoration efforts have been in getting animals to return.

Restoration needs more work

My research, published this week in the Australian Journal of Zoology, shows that while the perentie did visit the restored mine, it was very selective about which areas it visited, and avoided some places entirely. The lizard went on short foraging trips in the restored mine area, but regularly returned to refuge areas such as hollow logs.

Above: The method used GPS and a VHF tracking antenna to follow the perentie.
Image: Author provided.

This is because hot, open landscapes with minimal refuges present high risks for reptiles, which rely on an abundance of coverage to regulate their body temperature and to avoid predators. Such costs may make these areas unfavourable to reptiles and limit their return to restored landscapes.

In comparison, undisturbed vegetation supported longer foraging trips and slower movement, without the need to return to a refuge area. Unfortunately, areas undergoing restoration often require exceptionally long time-periods for vegetation to resemble the pre-disturbed landscape.

How can we help reptiles move back into restored areas?

Restored landscapes often lack key resources necessary for the survival of reptiles. As vegetation can require a long time to reestablish, returning fauna refuges like hollow logs and fauna refuge piles (composed of mounds of sand, logs, and branches) could be crucial to aiding in the return of animal populations.

My research team and I have called for animals to be considered to a greater extent in assessments of restoration success. In the face of increasing rates of habitat destruction, we need to understand how animals respond to habitat change and restoration.

Failing to do so risks leaving a legacy of unsustainable ecosystems and a lack of biodiversity.

Loggerhead turtle's journey tracked 37,000km from Cape Town in South Africa to Australia

By Karen Michelmore, ABC Pilbara, 7 March 2020

An 180 kilogram turtled named Yoshi has excited scientists, who tracked her remarkable journey halfway around the world after she was released from 20 years in captivity.

It's believed the loggerhead turtle may be Australian, after she made a determined 37,000-kilometre swim across the Indian Ocean to a turtle nesting site on Western Australia's Pilbara coastline.

Scientists, who began tracking her journey from Cape Town two years ago, believe Yoshi may have wanted to return to her original hatching site to breed and nest.

Sabrina Fossette, a research scientist from WA's Department of Biodiversity, Conservation and Attractions, said it was very exciting.

WA scientists will next week attempt to locate the turtle, to obtain biopsy samples to determine her origin, check her health, and to replace the satellite tracking device, which is nearing the end of its life.

Above: An aquarium in Cape Town released Yoshi after 20 years in captivity. Image: Jean Treston.

"This satellite has been working for two years but might stop at any time, particularly when the turtle is close to the shore," Dr Fossette said.

Above: Yoshi was taken to Two Oceans Aquarium in Cape Town after receiving an injury to her shell in 1997. Image: Geoff Spiby.

Yoshi arrived at Cape Town's Two Oceans Aquarium after crew on a Japanese fishing boat found her with a damaged shell.

"They contacted the aquarium to ask if we could please come and fetch this little turtle," aquarium chief executive Maryke Musson said.

"At the time, the aquarium had only been open for two years, so we did not really anticipate keeping sea turtles on display.

"We did not know all that much, but she crept into everybody's hearts, and settled down really quickly.

The aquarium staff learned a lot about caring for injured turtles from Yoshi, but soon also started getting requests to help more and more stranded and injured turtles.

Ms Musson said the aquarium had rehabilitated and released more than 600 sea turtles in the past 10 to 12 years.

Above: A team from Two Oceans Aquarium released Yoshi into the ocean near Cape Town, South Africa, two years ago. Image: Olivia Anderson.

The aquarium's rehabilitation program was so successful, attention eventually turned to whether Yoshi herself should be released back into the ocean.

By then, she had grown to 180kg with many decades of life still potentially ahead of her.

"She was coming to an age when she was probably sexually mature and we were wondering whether she would actually adjust back to life in the wild," Ms Musson said.

Other large turtles were rehabilitated and released successfully, so the aquarium decided to prepare Yoshi for release — with a strict exercise regime.

Ms Musson said aquarium staff encouraged Yoshi to swim 20m lengths as part of her training.

"Early on, we actually trained her to feed on a target, because she quickly caught on that she was getting food from divers, so she actually started harassing anybody in her big exhibit," she said.

"So by training her on a target, it allowed us to do any sort of investigation, have a quick look at her, give her a health check up, and then of course get her to move around in the exhibit, chasing a target.

"We actually called it 'Yoshi tennis'.

"We would have two divers in the exhibit, one on either side, and she would swim these lengths, which was 20m across every day for a little treat."

The training continued for 18 months, until December 2017 when, after a farewell party, aquarium staff working with South Africa's Department of Environmental Affairs fitted Yoshi with a satellite tag and released her 30 nautical miles off Cape Town.

"[We] put her back in the ocean, waved goodbye, and she swam off," Ms Musson said.

"Since then we've been following her and it's been an incredible journey.

"We had no idea where she was heading, because of course we had no idea from which loggerhead population she was from."

Yoshi's big swim

Yoshi spent her first year swimming up the west coast of Africa, to Angola, before turning around and returning to Cape Town. Then she headed across the Indian Ocean for Australia.

"We are thrilled because of course she's protected over there. There are lots of sea turtles, and it seems as though there is a lot of food for her to eat," Ms Musson said.

"And what's also incredible is the interest — by everybody."

The aquarium contacted the WA Government, and its scientists then started watching Yoshi too.

Currently, Yoshi is just off the Pilbara coast near Point Samson.

"It looks like she might actually be foraging," Dr Fossette said.

"She's been swimming around in a smallish area for two days now and she's very, very close to the coast.

"Now that she's actually stopped we think we can give it a go and try to jump on a boat and try to find her and maybe even catch her."

"We think we will give it a go but we need to be a bit lucky to find her. But who knows?"

Dr Fossette said if Yoshi was an Australian turtle, she was in the right place, close to a known turtle nesting site.

"She's a bit late for this nesting season, so she probably won't nest this year, and anyway after swimming 37,000 kilometres, you probably need to feed a little bit and eat a little bit and put on some weight before laying eggs," she said.

"Maybe next next year or the year after."

Yoshi gathers support on her journey

Ms Musson said Yoshi's journey had been followed, and celebrated, around the world.

She said it was believed to be the first recorded movement of a sea turtle between Africa and Australia.

Yoshi also navigated, and survived, hazards such as plastic pollution, fishing gear and vessels, swimming around 50km a day.

"It's a very impressive distance for a turtle her size," Ms Musson said.

"When we released her she was 180kg, which is on the bigger side for an adult loggerhead.

"I think it's helped her a lot, it's kept her safe and she's strong.

"We are incredibly proud of what she's done and what she's achieved thus far."

Above: After swimming around the west coast of Africa, Yoshi swam across the Indian Ocean to WA's Pilbara coast. Image: Two Oceans Aquarium.

Animals have an astounding response to bushfire. These are the tricks they use to survive

By Dale Nimmo, The Conversation, 8 January 2020

Above: Sleepy lizards begin pacing and rapidly flicking their tongues when they smell smoke. Image: Ann Jones

Have you ever wondered how our native wildlife manage to stay alive when an inferno is ripping through their homes, and afterwards when there is little to eat and nowhere to hide? The answer is adaptation and old-fashioned ingenuity.

Australia's bushfire season is far from over, and the cost to wildlife has been epic.

A sobering estimate has put the number of animals killed across eastern Australia at 480 million — and that's a conservative figure.

But let's look at some uplifting facts: how animals survive, and what challenges they overcome in the days and weeks after a fire.

Sensing fire

In 2018, a staff member at Audubon Zoo in the United States accidentally burned pastry, and noticed something peculiar.

In nearby enclosures 10 sleepy lizards, or *Tiliqua rugosa*, began pacing and rapidly flicking their tongues. But sleepy lizards in rooms unaffected by smoke remained burrowed and calm.

It was obvious the lizards sensed the smoke from the burnt pastry, probably through olfaction, or sense of smell (which is enhanced by tongue flicking). So the lizards were responding as they would to a bushfire.

In Australia, experiments have shown smoke also awakens Gould's long-eared bats and fat-tailed dunnarts, enabling their escape from fire.

Animals also recognise the distinct sounds of fire. Reed frogs flee towards cover and eastern-red bats wake from torpor when played the crackling sounds of fire.

Other species detect fire for different reasons. Fire beetles from the genus *Melanophila* depend on fire for reproduction, as their larvae develop in the wood of burned trees.

They can detect fire chemicals at very low concentrations, as well as infrared radiation from fires.

The beetles can detect very distant fires; one study suggests individuals of some species identify a fire from 130 kilometres away.

Stay or go?

Once an animal becomes aware of an approaching fire, it's decision time: stay or go?

It's common to see large animals fleeing a fire, such as the kangaroos filmed hopping from a fire front in Monaro in NSW a few days ago.

Kangaroos and wallabies make haste to dams and creek lines, sometimes even doubling back through a fire front to find safety in areas already burned.

Other animals prefer to stay put, seeking refuge in burrows or under rocks. Smaller animals will happily crash a wombat burrow if it means surviving a fire.

Burrows buffer animals from the heat of fires, depending on their depth and nearby fuel loads.

From here, animals can repopulate the charred landscape as it recovers. For example, evidence suggests populations of the agile antechnius (a small carnivorous marsupial) and the bush rat recovered primarily from *within* the footprint of Victoria's Black Saturday fires.

Avoiding fire is only half the battle

The hours, days, and weeks after fire bring a new set of challenges. Food resources will often be scarce, and in the barren landscape some animals, such as lizards and smaller mammals, are more visible to hungry predators.

Birds of prey arrive quickly at fires. Several species in northern Australia have been observed intentionally spreading fires by transporting burning sticks in their talons or beaks.

One US study published in 2017 recorded a seven-fold increase in raptor activity during fire. They begin hunting as the fires burn, and hang around for weeks or months to capitalise on vulnerable prey.

In Australia, introduced predators can also be drawn to fires. Feral cats have been observed travelling up to 12.5 kilometres from their home ranges towards recently burned savanna ecosystems, potentially drawn by distant smoke plumes promising new prey.

A 2016 study found a native rodent was 21 times more likely to die in areas exposed to intense fire compared to unburned areas, mostly due to predation by feral cats. Red foxes have an affinity for burned areas too.

So should a little critter hunker down, or begin the hazardous search for a new home?

Staying put

Perhaps because of the risks of moving through an exposed landscape, several Australian mammals have learnt to minimise movement following fire. This might allow some mammal populations to recover from within a fire footprint.

Native mammals have been found hiding in beds of ash after fires.

Short-beaked echidnas seek refuge and, when finding it, lower their body temperature and limit activity, so reducing the amount of food they need for energy.

Above: Despite their spiny defences, echidnas have been found more often in the stomachs of foxes following fire, so staying put is a good move. Image: Margaret Smith.

Small marsupials such as brown and yellow-footed antechinus also use torpor to suppress their energy use and therefore the need to seek food.

Running the gauntlet

Not all wildlife have adapted to stay put after a fire, and moving in search of a safe haven might be the best option.

Animals might take short, information-gathering missions from their refuges into the fireground before embarking on a risky trek.

They may, for example, spot a large, unburned tree that would make good habitat, and so move towards it.

Without such cues to orient their movement, animals spend more time travelling, wasting precious energy reserves and increasing the risk of becoming predator food.

Survival is not assured

Australia's animals have a long, impressive history of co-existing with fire. However, a recent study I led with 27 colleagues considered how relatively recent threats make things much harder for animals in fire-prone landscapes.

Some native species are not accustomed to dealing with red foxes and feral cats, and so might overlook cues that indicate their presence, and make the bad decision to move through a burned landscape when they should stay put.

When fires burn habitat in agricultural or urban landscapes, animals might encounter not just predators but vehicles, livestock and harmful chemicals.

And as this bushfire season has made brutally clear, climate change is increasing the scale and intensity of bushfires. This reduces the number of small refuges such as fallen logs, increases the distance animals must cover to find new habitat and leaves fewer cues to direct them to safer places.

We still have a lot to learn about how Australia's wildlife detect and respond to fire. Filling in the knowledge gaps might lead to new ways of helping wildlife adapt to our rapidly changing world.

Lizard evolution under microscope as scientists investigate if ticks and fleas can create new subspecies

By Gary-Jon Lysaght and Shannon Corvo, 19 February 2020

Above: The impact parasites have on shingleback lizards, otherwise known as sleepy lizards, is the focus of an international study. Image: Gary-Jon Lysaght.

South Australian researchers will lead an international study into whether fleas and ticks are creating new subspecies of sleepy lizards.

Fleas, ticks and other parasites live on sleepy lizards — also known as shinglebacks — and other lizards.

The international study, led by Flinders University in South Australia, will be conducted two hours north of Adelaide, between Burra and Morgan, where the environment consists of both Mallee scrub and grassland.

This location was chosen because it is where lizards with different parasites interact with one another.

"Parasites represent a major selective force in host evolution," said lead researcher, Associate Professor Mike Gardner.

He said parasites could alter their hosts' immune gene — which was what they use to fend off diseases.

"The parasite type in a geographic area might cause the lizards there to all have the particular form of that gene that has the ability to resist the parasite," Professor Gardner said.

The study will be looking at how parasites cause host divergence, which is when one species becomes two.

Professor Gardner said the immune gene was how sleepy lizards recognised each other and if the parasites caused a change in that gene, it would make it difficult for the lizards to recognise one another.

"If the parasites' ability to cause differences in the lizards' genes is really strong, then maybe lizards with different parasites will stop recognising them [lizards] as being the same species," he said.

One species becomes two

Sub-species can sometimes occur when a physical barrier is put up, making it difficult for one group of sleepy lizards to interact with another.

But Professor Gardner said it was also possible for that to happen without a physical barrier.

"It can occur through other measures such as parasites," he said.

"The selection pressures that are occurring in the host sleepy lizard on either side of that barrier may actually be driving some level of host divergence where individuals on either side are unable to recognise each other."

The study will investigate whether parasites can act as a similar barrier.

"It all comes back to the parasites evolving ways to attack their hosts and the lizards evolving ways to defend against those parasites," he said.

Lizard monogamy

While sleepy lizards commonly interact with one another, they are monogamous when mating, meaning they only have one partner.

"Males and females come together for three months of the year during the breeding season and then move about in the landscape and encounter other individuals," said Martin Whiting, an Associate Professor in animal behaviour at Macquarie University.

He said sleepy lizards were well suited for the type of research in SA, because they interacted with each other.

"Understanding how the social system might be driven by the types of parasites that they're dealing with is a really interesting question," he said.

The effect of climate change

Professor Gardner said the research would also look at whether or not climate change was affecting where the parasites called home.

"If parasites are going to change their ranges according to the changing climate, they're going to come into contact with different hosts than they would normally," he said.

"So, that may affect how the species reacts to the parasites; it may affect how those interactions occur."

Tropical snake decline linked to deadly frog disease

By Nick Kilvert, ABC Science, 14 February 2020

Below: The number of snake species declined from 30 to 21 after the chytridiomycosis outbreak. Image: Kevin Enge

Researchers believe a decline in tropical snakes in Panama is linked to a deadly fungal disease in frogs.

The infectious chytrid fungus, which attacks the skin of amphibians, has devastated frog populations worldwide since it was first discovered in Queensland in 1993.

Researchers knew that an outbreak of chytridomycosis was inevitable at El Cope in Panama, and so they had time to gather plenty of data before the disease struck the forest ecosystem in 2004.

It turned out they were able to amass seven years of data on amphibian and reptile biodiversity at El Cope before the disease hit, and then continued gathering more data in the six years after the outbreak.

After the disease took hold, the number of amphibian species including frogs declined by 75 per cent, they stated in a paper published in Science today.

Above: Panama's frogs have been decimated by the fungal chytridiomycosis disease.

(Getty Images: George Grall)

But the number of observed snake species also took a dive, from 30 prior to the outbreak down to 21 after.

Although snakes don't suffer directly from the disease, their decline was most probably caused by the loss of their food source, lead author Elise Zipkin of Michigan State University said.

"Given that many snakes eat frogs or frogs' eggs, we hypothesised that there would be some negative consequences on snakes," Dr Zipkin said.

"But we were surprised by the extent of the losses to snake diversity."

Research suggests the chytrid fungus originated in the Korean peninsula but Australian and Central American frogs have suffered the greatest declines from the chytridiomycosis disease.

The extinction of seven Australian frogs has been linked to chytrid fungus, and 37 more have suffered serious population reductions, including our iconic corroboree frog and the tropical Tinker frog.

Most impacts probably happened before disease detection in Australia.

Above: Many Australian species like the red-belly black snake are frog eaters. Image: Facebook: Snake Away Services

Although it was first identified in the '90s, chytrid fungus is thought to have had its biggest impacts earlier than that.

The gastric-brooding frog went extinct in Australia in 1979, the golden toad from Costa Rica in 1987, and worldwide frog declines were recorded during that period.

But because the cause of these declines were unknown at the time, there is little data to understand what broader effect that had on other animals like snakes, according to ecologist Ben Scheele of the Australian National University, who wasn't involved with this study.

"It's highly likely that similar declines [in snakes] occurred in Australia, but it's very difficult to quantify that," Dr Scheele said.

"It's a bit intuitive, that if an animal's food source declines then it would too, but we haven't actually been able to observe that before.

Frogs are an important food sources for a number of Australian snakes, including red-belly black and brown tree snakes.

Of the 37 frogs that significantly declined due to chytridiomycosis in Australia, about a third are showing some recovery, Dr Scheele said.

"Then there's about a third that have greatly declined but their populations are stable in reduced numbers, and the other third is those that are continuing to decline," he said.

Some frog species that are continuing to decline share habitats with other species that are resistant to the disease, which carry it and pass back to vulnerable frog species they come in contact with.

Numerous species of Australian snakes are also declining, but it is difficult to distinguish between the effects of habitat loss, climate change, cane toads and chytrid fungus.

The research provides a strong example of the cascading effects of biodiversity loss, according to Dr Zipkin.

But there are things we can do to combat the biodiversity crisis the world is currently facing, she said.

"One of the biggest causes of biodiversity loss is loss of habitat. Protecting habitat is a critical first step."

"Beyond that, we need to create policies that prevent the spread of non-native species and curb emissions to slow climate change."

And while these intitiatives need to be government led, there are things that individuals can do too, according to Dr Zipkin.

"People can do a lot to protect and conserve nature and native species, even in their backyards," she said.

"Plant native species in your garden for pollinators, support local protected areas."

This lizard lays eggs and gives birth. We think it's undergoing a major evolutionary transition

By Charles Foster and Camilla Whittington, The Conversation, 3 April 2020

Our earliest vertebrate (animals with backbones) ancestors laid eggs, but over millions of years of evolution, some species began to give birth to live young.

There is a traditional dichotomy in vertebrate reproduction: species either lay eggs or have live births. However, as is often the case in biology, things aren't as simple as they first appear, and there are a handful of vertebrate animals that do both.

One of these is the three-toed skink (*Saiphos equalis*). Our recent research suggests the egg-laying *S. equalis* may currently be in the process of transitioning from egg-laying to giving live birth.

Studying them gives us a unique opportunity to watch evolution in action.

Below: Saiphos equalis has a distinctive yellow belly, and a long, slender body, ideal for its underground lifestyle. Charles Foster

From eggs to babies, and back again?

There are two main reproductive strategies in vertebrates.

Animals that lay eggs are called "oviparous". For instance, many fish species spawn eggs that are fertilised externally. In other oviparous species, including birds and some lizards and snakes, eggs are fertilised inside the mother, an eggshell is added, and then eggs are laid.

Depending on the species, much or all of the nutrition needed to grow a healthy baby is supplied in the egg yolk.

In contrast, "viviparous" animals carry embryos internally until they are fully developed. The embryos can rely entirely on yolk for nutrition, or the parents can provide supplementary nutrition, sometimes via a placenta (as in humans).

There is strong evidence that egg-laying is ancestral to live birth, meaning it came first. Many physiological changes were necessary for live birth to have evolved from egg-laying. With this transition, some structures were lost, including the hard outer eggshell. Other mechanisms were gained to ensure embryonic survival within the parent, including the supply of adequate oxygen and water during development.

The evolution of live birth has occurred frequently, including at least 121 times in independent groups of reptiles.

Evolutionary "reversals" to egg-laying are much rarer, probably because regaining the physiological machinery for producing eggshells would be exceptionally difficult.

Despite the vast differences between egg-laying and live birth, some species can do both. This phenomenon called "bimodal reproduction" is exceptionally rare. There are more than 6500 species of lizards worldwide, but only three exhibit bimodal reproduction.

We're lucky enough to have two of these in Australia. Our research group at the University of Sydney studies the bimodally reproductive three-toed skink, in the hope of understanding how live birth evolved.

In northern NSW, the three-toed skink gives birth to live young, but near Sydney, they lay eggs. Even though they reproduce differently, previous research has shown these lizards are a single species.

Above: The three-toed skink displays geographic variation in reproductive mode. It has four very tiny legs, and only three toes per foot. Image: Yi-Kai Tea

Even the egg-laying members of the species are odd, as the eggs are retained within the mother for a relatively long time. After being laid, ordinary skink eggs are incubated for at least 35 days before they hatch, but some three-toed skink eggs hatch in as few as five days after being laid.

One female even laid eggs and gave birth to a live baby in the same litter.

Above: An egg-laying three-toed skink from near Sydney with its clutch of eggs.
Image: Stephanie Liang.

The genetics behind different reproductive modes

Most aspects of an animal's development are controlled by its genes, but not every gene is always active. Genes can be expressed (switched on) to different degrees, and gene expression can stop when not needed.

An egg-laying skink uterus undergoes only a couple of genetic changes between being empty and holding an egg.

A live-bearing skink uterus is different. It undergoes thousands of genetic changes to help support the developing baby, including genes that probably help provide oxygen and water, and regulate the mother's immune system to keep the baby safe from immunological attack.

Unexpected similarities between the egg-laying and the live-bearing

Our research measured changes in gene expression between egg-laying and live-birth in the three-toed skink. We investigated how the expression of all genes in the uterus differed between when the uterus was empty and when it held an egg or embryo.

As expected, live-bearing *S. equalis*, undergo thousands of genetic changes during pregnancy to produce a healthy baby.

But surprisingly, when we looked at the uterus of the egg-laying *S. equalis*, we found these also undergo thousands of genetic changes, many of which are similar to those in their live-bearing counterparts.

Above: Embryos of egg-laying Saiphos equalis are nearly completely developed at the time of laying. Image: Stephanie Liang.

Some of the most important genetic changes in gene expression in egg-laying *S. equalis* allow embryos to develop within the mother for a long time. These genes also seem to allow the uterus to remodel to accommodate a growing embryo, and drive the same kinds of functions required for the embryonic development in live-birthing three-toed skinks.

Are 'reversals' to egg-laying easier than previously thought?

Our findings are important because they demonstrate that egg-laying three-toed skinks are an evolutionary intermediate between "true" egg-laying and live birth.

We now know that uterine gene expression in egg-laying *S. equalis* mirrors live-bearing skinks much more closely than true egg-laying skinks. These results may explain why it's possible for a female three-toed skink to lay eggs and give birth to a live baby in a single pregnancy.

The similarities in gene expression between egg-laying and live-bearing three-toed skink uteri might also mean "reversals" from live birth back to egg-laying could be be easier than previously thought. However, this may be restricted to species in which live-birth has evolved recently, such as the three-toed skink.

Six species of native Australian gecko identified in long-running research project

By Kemii Maguire, ABC North West Qld, 10 March 2020

Above: Gehyra gemina is native to northern Australia. This specimen was spotted in Halls Creek in Western Australia. (Supplied: Stephen Zozaya)

Six new native gecko species have been discovered during the course of a two-decade long research program by the Queensland Museum and Griffith University.

The university's Dr Paul Oliver, who is also a senior curator at Queensland Museum, said identifying the new species required painstaking detective work.

"Part of the reason these common species have been undiscovered for so long is that they're very hard to tell apart," he said.

Tail tips from the creatures were analysed to identify the genetic differences.

"Although we can't tell them apart, [other geckos] certainly can," he said.

Above: This native Geyhra arnhemica was discovered almost four hours east of Katherine, in the Northern Territory, at the Wongalara Sanctuary. (Supplied: Stephen Zozaya)

The story in a tail

Despite being as common as the Asian house gecko, which can be found in many homes across Australia, native geckos have three distinct differences:

- Asian house geckos make the famous gecko "clicking" sound, but their Australian cousins are much quieter
- Asian house geckos have spikes on their tails, while the six native geckos share smooth tails
- Native geckos do not have a claw on their first toe, whereas Asian house geckos have claws on all their toes

Above The Gehyra lapistola can be found in bushland, like this one that was spotted in the NT's Fish River. (Supplied: Steven Richards)

Where to find the new species

The newly discovered Australian geckos, according to Dr Oliver, are fairly widespread.

"They're basically dotted across northern Australia, from Broome to as far south as Brisbane," he said.

The Northern Territory is home to the *Geyhra arnhemica* and the *Gehyra chimera,* found in rocky ranges towards the Top End.

Gehyra gemina occurs widely through the northern deserts of Western Australia and Northern Territory, with the *Geyhra chimera* and *Geyhra calcitectus* found mainly in the Kimberley region.

North-west Queensland has the *Gehyra lauta*, better known as the "ghost gecko" for its pale appearance, and it can also be seen in bushland in the north-eastern Northern Territory.

If you find a gecko a long way away from people in the bush, Dr Paul Oliver said the probability is that it's a native gecko.

Above Gehyra lauta — better known as the "ghost

gecko" — has been spotted in north-west Queensland and the Northern Territory. (Supplied: Mark Hutchinson)

New discoveries nothing new

Steve Wilson, the author of the Guide to Australian Reptiles, said new species were constantly being identified by researchers and wildlife enthusiasts each year.

"We had about 1,100 Australian reptile species, and over the past three years we've had another 80 added to that," Mr Wilson said.

Mr Wilson said there were two common ways

to identify new species of animals.

"One is to turn over a rock and say, 'That's a new lizard that no-one has ever seen before,'" he said.

"The other way is to look at a species that has a wide distribution and genetically test them [and they] turn out to be different, which is what's happened with this new discovery."

Mr Wilson says anyone who finds an unusual animal should take a photo of it and the location and send them to the Queensland Museum.

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