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ACTHA Inc. News

Aug - Sept '19

*Newsletter of the
ACT Herpetological
Association Inc.*

In this issue

ACTHA Reptile Keepers Club, read all about what happened in May and July, pages 2 and 3.

Sex determination in dragons: the unusual effects of temperature on sex in two Australian dragon lizards, Dr Sarah Whiteley, Institute for Applied Ecology, CSIRO was our guest speaker in June, from page 3.

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Chevron's gas plant construction sees native animals moved to safety, page 12.

Tiny turtle embryo's temperature shifts could help buffer it against climate change, page 14.

Diary date

The *bi-monthly* meetings of the Association are usually held on the **third Tuesday of the month at 7.30pm**. Our usual venue is:

**Belconnen Soccer Club, Hawker
(cnr Belconnen Way & Springvale Drive)**

Upcoming meeting:

Tuesday, 20 August 2019

Our Guest Speaker:

Anke Maria Hoefer, ACT Frogwatch Coordinator is pleased to announce that Frogwatch has secured funding for the current financial year! Come and join our next ACTHA get-together to celebrate and also hear Anke Maria give a presentation entitled **'Eavesdropping on our local frogs in the name of science - what has been unearthed so far?'**

Find out about unexpected shifts in frog breeding activities due to a warming climate, species specific habitat preferences of frogs in the ACT, the overall prevalence and persistence of local frogs since 2002 and how the world's first FrogPhone could revolutionise auditory surveys in the future.

Your Committee for 2018 - 2019

President	Jason Spurr
Vice President	Ric Longmore*
Secretary	Dennis Dyer
Treasurer	Margaret Ning
Newsletter Editor	Mandy Conway
Webmaster	Angus Kennedy
Public Officer	John Wombey*
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Conservation Officer	Joe McAuliffe
Committee Members	Scott Keogh Iris Carter Greg Flowers Roy Chamberlain Peter Child
Youth Representative	Liam Thornton
* Denotes Life Members	

**ACTHA 2019 - 2020 Membership Renewal
Now Due**

\$20 family/individual m'ship, **\$10** university student m'ship
[**\$15** 'Herpetofauna']

Membership year runs from 1 July 2019 to 30 June 2020. Payment can be made at our next meeting,

OR, preferably, a direct debit to:
ACTHA BSB 112-908, A/c 486822880

OR by cheque to ACTHA, **PO BOX 440**, Jamison Centre, ACT 2614.

Most importantly, please don't forget to note your name so we can identify you on the bank statement.

ACTHA Reptile Keepers Club

Just in case you are wondering what the Reptile Keepers' Club is all about, these relaxed get-to-togethers are more hands on, husbandry focussed evenings than our main Association meeting nights and are held every second 'off' month, ie **March, May, July, Sept and Nov.**

Reptile Keepers Club meetings are held at the **Canberra Reptile Zoo** (thanks to the Zoo's generosity) and start at 6pm.

Why not rug up, rug the kids up, and come along!

Save the date for the next meeting: 17 September 2019.

Cheers, Margaret Mob. 0427 788 304

ACTHA Reptile Keepers Club - 21 May 2019 meeting

At this, the group's second get-together, Peter Child took the opportunity to speak about the ACT's Reptile Licensing Policy, which did not see any changes in a recent review.

Liam Thornton then spoke to approx. 20 ACTHA members in attendance about his keeping techniques for his large number of pet reptiles: including his disinfectant regime, feeding and feed enrichment routine and his detailed documentation charts that were also a must.

Liam brought out several diamond pythons and a Children's python for people to hold and admire towards the end of the evening.

ACTHA Reptile Keepers Club - 16 July 2019 meeting

Keeping small skinks in captivity

Summary by Margaret Ning

Around 20 Reptile Keepers Club members gathered once again at the Canberra Reptile Zoo to listen to ACTHA members Angus and Brian tell them everything they ever needed to know about keeping small skinks.



[Above: The Yakka Skink (*Egernia rugosa*) is an extremely secretive species, hiding under rocks, in hollow logs or ground vegetation, or in burrow systems. Its presence is often indicated by a pile of droppings near shelter sites. It is found in the Brigalow Belt bioregion, Qld, and is listed as a vulnerable species. Image: Jake Meney]

These are the main groups of skinks able to be kept in captivity:

- bluetongues and shinglebacks - *Tiliqua*, *Bellatorias* and *Cyclodomorphus*;
- rock-dwelling species - *Egernia* and some *Liopholis*;
- water and forest skinks - *Eulamprus/Concinnia/Karma/Saproscincus*;
- diurnal terrestrial skinks - *Ctenotus*, *Lampropholis*, *Carlia*, *Morethia*, *Carinascincus*, *Cryptoblepharus*;
- nocturnal skinks - *Liopholis*, *Eremiascincus*, *Cyclodomorphus* (slender bluetongues).

Angus and Brian discussed the availability and approximate prices of skink species, ranging from around \$50 for some of the larger skinks to thousands of dollars for a Yakka Skink.

Why keep small skinks?

Skinks are entertaining, although one

needs to be careful they don't fight. Brian owns three copper-tailed skinks, which he enjoys watching interact, and their pecking order.

Brian and Angus' presentation contained excellent pics of each group of skinks and their habitat requirements, including enclosure size and equipment. Some of the enclosure set ups were extremely

creative, including underground areas for burrowing species, and included live plants as habitat in one proposed set up. There wasn't a happy ending however, as when the lizard woke up from winter sleepiness it quickly ate all the plants. There was some discussion on the use of live plants, indoor vs other.

That aside, our presenters obviously derived a lot of fun and satisfaction setting up their own enclosures. Other requirements like food, UV were also covered.

Angus and Brian shared the presentation, taking turns to impart their knowledge. From time to time, they passed some skinks around the room to illustrate something in particular, either their own animals or a couple from the Reptile Zoo.

Some interesting points that they made were:

- It is a good idea to add slaters to the enclosures of water skinks, as the slaters break down poo/shed/other stuff like dead crickets in the enclosure - making the enclosure bioactive and therefore it doesn't require cleaning;
- Nocturnal desert skinks, especially sand swimmers, are even easier to keep than blue tongues;
- Different skink species can be mixed in their enclosures even;
- Tiliqua species - Blue Tongue Skinks are straight forward to keep, and are OK to be handled regularly. The smaller skinks should not be handled very much as they can always be close to dropping their tails;
- It is good to keep Cunningham skinks in threes;
- One downside of owning skinks in general is that it is hard to monitor them for health issues.

Q&A at the end of the evening covered a few things including:

- the sharing of info on sourcing legal acquisition, and some discussion of licensing requirements, and
- that Brian puts some reptile pics up on Canberra Nature Map, which Geoff encouraged everyone at the meeting to do.

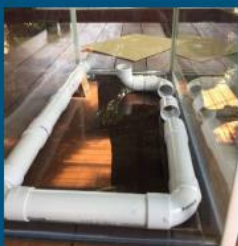
The evening's presentation came from two confident, extremely knowledgeable young lads who took us through five groups of skinks and their main requirements. I have to say that it was pretty amazing to listen to them strut their stuff and share their knowledge. It was obvious their passion for reptiles keeps their geography skills enhanced, as the discussion was not confined to within Australia either.

Thanks once again to Peter Child for welcoming ACTHA members to the Reptile Zoo and making such a comfortable area available for these meetings.

And then there was the Barking Owl in the background.....



Brian's enclosure for Copper Tails, using elevated and low basking sites as well as warm and cool hides for refuge and thermoregulation. Source: B. La Rance



A false burrow system for semi fossorial and burrowing species. Source: A. Cleary



A fully planted & bio active bar sided skink setup. This is a relatively cheap and easy to establish tank, using only low light plants and immerse fish tank plants. No special lighting is used, only basic, bright downlights. Source: B. La Rance

Heres an example of a water skink setup



Sex determination in dragons: the unusual effects of temperature on sex in two Australian dragon lizards

Our monthly meeting on 18 June 2019 saw **Dr Sarah Whiteley**, Institute for Applied Ecology, CSIRO, talk about her ongoing research project.

Sarah studied at the University of Queensland, graduating with a Bachelor of Science (Zoology and Ecology) before embarking on an Honours Research Project 'Embryonic development of the Central Bearded Dragon'. She is currently a 2nd year PhD student at the University of Canberra/CSIRO.

Temperatures experienced during embryonic development can influence the sex of many reptile species. Amongst these are two well known Australian natives; the Central Bearded Dragon, *Pogona vitticeps*, and our local Jacky Dragon, *Amphibolurus muricatus*. These were the two species Sarah chose to study to try and understand how temperature influences sex, and to identify the genetic mechanisms by which this occurs.

Back to basics

Genetic sex determination, as in humans, sex chromosomes inherited from the parents determines males or females. In a lot of reptiles, it is the actual incubation temperature of the eggs which determines sex, which is called temperature-dependent sex determination.

"We know that embryonic development in egg-laying species starts with fertilisation and ends when an animal hatches. Sex is not determined early on: it occurs at a later point during embryonic development as temperature determines whether the hatchling will be male or female." Sarah said.

Why study sex determination?

"We know that climate change is having an impact on many of our animals who are sensitive to environmental factors like temperature. One recent example is the sex imbalance of green sea turtles nesting on the Great Barrier Reef; nests are being increasingly subjected to hotter temperatures which can result in a biased sex ratio and be detrimental to a population, particularly if it is already vulnerable. Not only is the sex ratio of hatchlings a cause for concern; behaviour or fitness of an animal to survive in the wild can also be at risk."

Using model organisms

Model organisms, or animal species, are commonly used in research.

If a male *P. vitticeps* embryo is incubated at higher temperatures it can result in a sex reversed female; genetically the hatchling is male but physically presents as a female. Essentially this means temperature during incubation can create a third sex. (see 2 slides below)

Using Model Organisms

Central Bearded Dragon
Pogona vitticeps



Transitional system
GSD with sex reversal

Sex determination in *Pogona vitticeps*



Temperature creates a "third sex" – genetic males that are physically females

How is sex determined?

Genetic Sex Determination

Inherited sex chromosomes determine sex

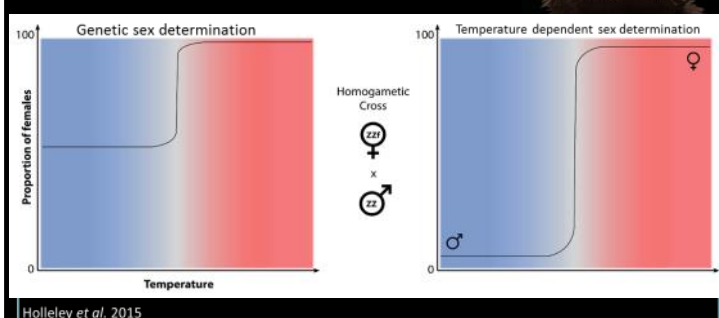


Temperature Dependent Sex Determination

Incubation temperature determines sex

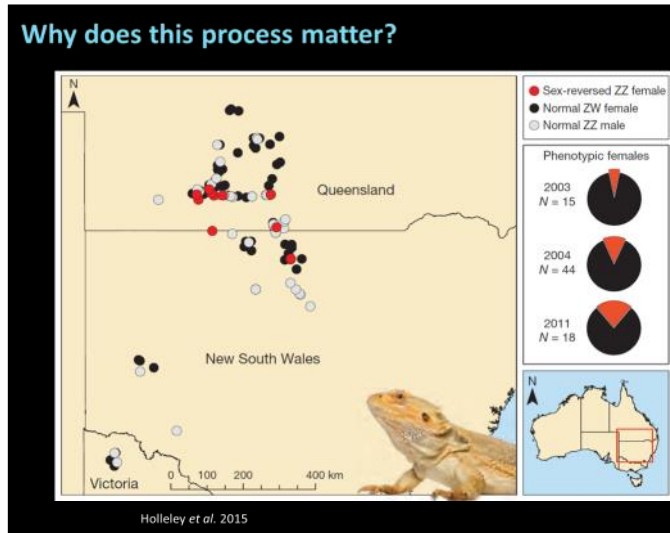


Sex determination in *Pogona vitticeps*



Holley et al. 2015

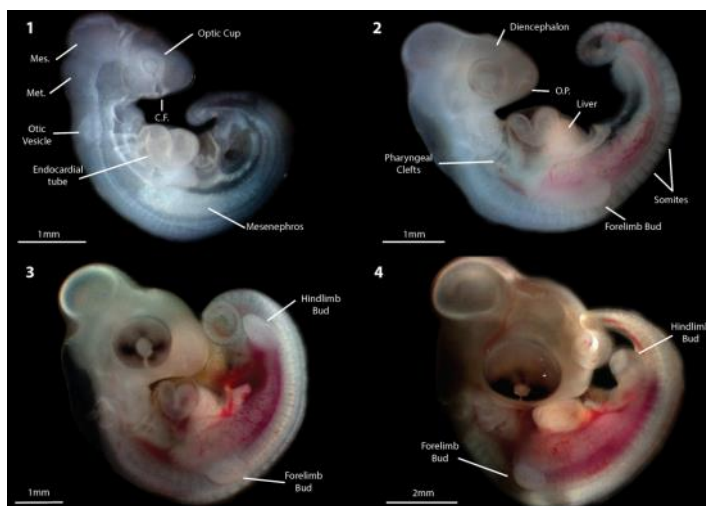
"As the temperature increases so does the proportion of females that come out of a nest. These sex reversed females have two Z chromosomes just like a male however they are a completely functionally female and are even more fertile than 'normal' females. This has also been found in wild populations."



So what happens during sex reversal?

Sarah's Honours work focusses on this conundrum. "It wasn't really obvious how adults had become physically female whilst at the same time remaining genetically male. The mechanism responsible for sex reversal during embryonic development was a mystery."

In the laboratory, eggs from both normal and sex reversed females were incubated at different temperatures. 28°C produces males whilst 36°C produces females. Embryo samples were meticulously examined throughout incubation, with particular emphasis on aspects of developmental biology.



Above: These are images of *P.vitticeps* embryos. Each embryo image was numbered which enabled further analysis at any developmental stage. Data was also recorded based on morphological traits. No. 18 is almost at point of hatch.

Gonad development

"We get into more detail here to try and understand what is involved with sex reversal, which means looking more closely at gonad development. Gonad development is unique as when it first forms, it is considered to be "bipotential" as sex hasn't been determined, so it has the potential to develop either as an ovary or testes. I used histology to examine the cellular composition of the gonad through development, looking at cells at microscopic levels." Sarah shared her slides of intricate histology samples with her ACTHA audience, pointing out 'ovotestes' (a sex organ which is half male and half female), which occurs during sex reversal. This 'ovotestes' result was unexpected as it is very rarely observed.

Left: Image no.1 is an embryo at date of lay, only a couple of mm's in length and already organs have formed.

Jacky Dragon
Amphibolurus muricatus



Temperature-dependent
sex determination

Have ovotestes been observed in other species?

The Jacky Dragon, *A. muricatus*, the subject of Sarah's PhD, has temperature dependent sex determination.

Sarah explained that intermediate temperatures result in a similar proportion of males and females while

extreme temperatures, either hot or cold, result in increasing numbers of females. "How are two different temperature cues only producing females?" Sarah asks.

"I incubated *A. muricatus* at three different temperatures to get a mixture of the different sexes that could be produced and then sampled embryos throughout their development.

A. muricatus developed in much the same way as the bearded dragon, albeit smaller in size. However, ovotestes were seen at all three incubation temperatures, which was a very unexpected result."

A new term: Temporary Pseudohermaphroditism (TPH)

"During embryonic development, the female embryos possess differentiated ovaries and hemipenes (male genitalia) at the same time for a period during development. The embryo looks male, but internally it is female. This is an anomaly; if you have a differentiated ovary it is supposed to pump out female hormones that makes everything else female.

"There have only been four studies with enough information where we know whether TPH is occurring or not, and of the four, three of them do it. A Mexican lizard is particularly interesting because they do not become completely female until 13 months post-hatch. The other interesting aspect is that these lizards all have some sort of thermal influence on their sex determination (the one species lacking TPH was strictly genetic)."

"We think that this TPH state may be a hallmark of thermally sensitive species, but more research is needed.

"The work on sequencing genomes and more genetic analyses continues."

A change of pace... a look at epigenetics

Sarah received an ACTHA Grant to assist her collaboration efforts with researchers at The University of Canberra, coming to grips with the laboratory techniques being used to study cancer in humans which could potentially be used as a methodology in her research with a reptile species. A first!

What is epigenetics?

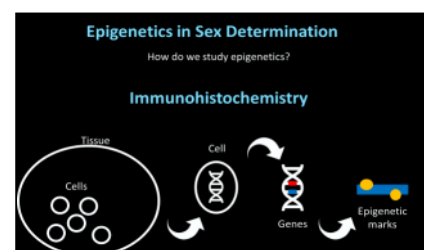
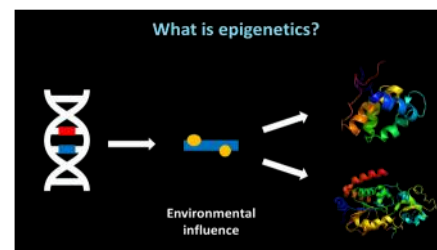
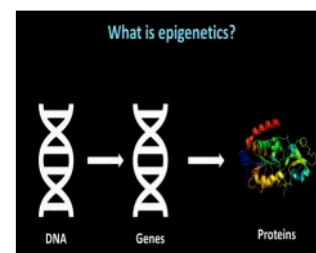
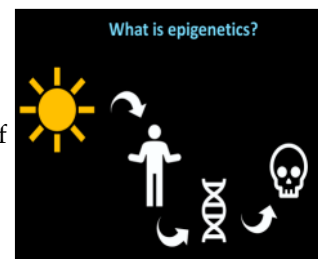
There are many factors that influence our genetics: DNA is present in every cell of our bodies, within that DNA are genes, a code which our bodies understand and from which proteins are created. Epigenetics is the study of environmental influences which can alter those genes, which in turn results in different proteins being produced.

In the 1950's there was much discussion around genetic codes being in a static, unchanging and un-influence-able code. Forward to today, we now understand that the environment has in fact a huge influence.

Epigenetics in the context of sex determination

An environmental factor such as temperature can influence the genetic code. The study of 'codes' through Immunohistochemistry, which involves taking a sample of tissue, or a biopsy, from a living thing, enables us to see how the genetic code is being controlled.

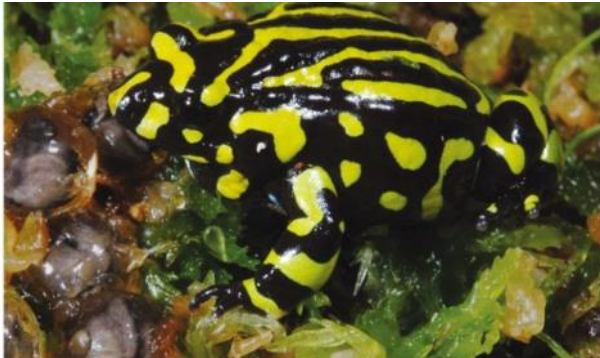
Development of cutting edge techniques to understand how temperature influences sex at a cellular level is another step towards finally understanding how temperature determines sex. Once this is understood it opens up unforeseen avenues for conservation of many species threatened by climate change. Novel conservation applications for species threatened by climate change.



The Australian and International Scene

Endangered frog eggs released into wild

By Samantha Dick, The New Daily, 5 July 2019



Above: The Northern Corroboree Frog is under serious threat. Image: Zoos Victoria.

A critically endangered frog could return to a national park near Canberra after conservationists released hundreds of their eggs into parkland.

Known for their distinctive yellow and black stripes, the Northern Corroboree Frog is under threat due to a poisonous fungus, damage to its breeding sites and climate change.

Last month, a team from Healesville Sanctuary in Victoria handed over 710 little eggs to a team at Tidbinbilla Nature Reserve in the Australian Capital Territory.

The eggs were released into snow-covered bogland and when the snow starts to melt, the eggs will hatch.

Healesville Sanctuary keeper Meg Whittard said that while mature frogs have been released in the past, this release was especially significant.

"For the first time ever we will be releasing Healesville Sanctuary bred Northern Corroboree frogs as eggs," Ms Whittard said.

"This is important as we're not only adding large numbers to the wild population, but also allowing for that development process in their natural habitat."

Mature, male Northern Corroboree frogs have been heard calling at release sites in the wild, showing that the work of the conservationists is boosting population numbers.

"Since the breeding program started in 2010, we have bred a total of 5276 eggs," Ms Whittard said.

Pythons and freshwater crocodile stolen from Canberra Reptile Zoo

By Andrew Brown, The Canberra Times, 19 July

Two snakes and a crocodile have been stolen by an intruder to the Canberra Reptile Zoo in the early hours of Friday.

The thief broke into the Gold Creek-based zoo around 6am, stealing one Stimson's python named Tim Tam, a hatchling jungle python named Zebra and Jaws Junior, a freshwater crocodile.

Snake supplies, a register computer and a stereo were also taken from the zoo in the early-morning incident.

The zoo's founder and managing director, Peter Child, said staff at the zoo were devastated.

"We're horrified by the loss of the animals," Mr Child said.

"These animals meant a lot to us and we're feeling shattered."

Security footage of the incident has been posted on social media by the zoo in an attempt to identify the offender.

ACT police are investigating.

Mr Child said the intruder broke in through a back entrance to the zoo and targeted the snakes.

"They broke in and went for the snakes on display and smashed the enclosures as well, and removed a lot of products from the shop so they would be able to keep the snakes alive," he said.

"Unfortunately, one of the crocodiles was out the back of the display in a container and they took that too."

Below: Freshwater crocodile Jaws Junior, who was stolen from the zoo. Image: Facebook.



"The croc being stolen might have been opportunistic."

Zebra had only been at the zoo since last December, while Tim Tam was a popular attraction for the past three years, and Jaws Junior had been there for four years.

"I saw our alarm go off, but we've had many false alarms over the years because of all the animals moving, so I was probably a bit slower than I should have been," Mr Child said.

"By the time I had got there, they had broke in and taken the items."

The zoo had been saving for a new enclosure for one of its crocodiles, Charlie, who had grown so large he had outgrown his habitat.

However, most of that money will now have to go towards the clean up and security upgrade following the animal theft.

Despite the loss of their three reptiles, Mr Child said he had been touched by the outpouring of community support.

"We've received a big response, and there's been a lot of people who have contacted us," he said.

"Someone must know who this person is, a croc isn't a small thing to hide."

Anyone with information has been urged to contact CrimeStoppers on 1800 333 000.

Bruny Island cracks down on feral cat numbers through strict new by-laws

By Georgie Burgess, ABC News, 12 June 2019



Above: Cat owners who continue to let their cats stray could face large fines.

Image: supplied, Kingborough Council.

Cat owners on Bruny Island who continue to let their felines stray could be slapped with a \$600 fine under tough new laws to crack down on wildlife killings and feral populations.

Every year in the Kingborough Council region in southern Tasmania, 180,000 native animals are killed by domestic cats alone.

The new laws will be exclusive to Bruny Island, which contains an estimated 2,000 feral cats, and be the toughest in Tasmania.

They include compulsory registration, de-sexing of domestic cats before six months of age, and a limit of two cats per household in the absence of a permit.

Council's cat management officer, Kaylene Allan, said while most owners on the island were doing the right thing, action was needed.

"It's the first comprehensive by-law in Tasmania and we're hoping it might be a model for other councils," she told Leon Compton on ABC Radio Hobart.

Globally, cats are listed as one of four species that threaten the greatest number of endangered native animals.

Feral cats kill 466 million reptiles and 272 million birds in Australia annually.

Most cat owners surveyed on Bruny Island already de-sex and microchip their cats, but almost 60 per cent were letting them roam.

"They need to keep their cats on their property," Ms Allan said.

She said it would be up to owners to decide how they restrict their cats; whether it was by keeping them inside, using better fences or constructing outside enclosures.

Below: Bruny Island is home to many species of endangered birds and animals. Image: ABC News.



"All cats that either reside permanently on the island or regularly visit the island will need to be registered with council."

"They have to be kept within their owner's property boundaries at all times, unless they are on a lead or restrained in a car."

"If there is a complaint against your cat and your cat roams regularly on your property boundary then we will be taking action," she said.



*Above: This cat was spotted with a shearwater in its mouth at The Neck Game Reserve.
Image: Kingborough Council.*

Ms Allan said the impact of domestic and stray cats on native mammals and birds was greater where cats lived adjacent to bushland areas and reserves.

Under the laws, the feeding of stray cats will also be prohibited.

"We're trying to make it as consistent as possible with the control and management of dogs so it's fair and reasonable," she said. "We believe we've got the balance right."

Laws are 'strict'

Mayor Dean Winter said he didn't personally agree with the by-law.

"It is quite strict — cat owners have been tasked with an onerous set of responsibilities," he said.

"I think we'll see how that plays out in terms of whether council is able to educate the community about these new by-laws."

The laws on Bruny Island will come into effect later this year.



Above: A critically endangered blue-tailed skink, now not found in the wild, suns itself. Image: Parks Australia.

Gone from the wild for a decade, there's now a plan to revive the blue-tailed skink on Christmas Island

By Tom Joyner and Will Ockenden, ABC News, 3 May 2019

Not much is known about how or why, but the simple fact is that at some point a decade ago an entire species of tiny lizard vanished almost overnight from Christmas Island.

The blue-tailed skink, measuring only centimetres in length and featuring a bright blue streak down its back to its tail, is native to the remote island.

Only months before the mass die-off, Christmas Island National Park staff managed to scoop up 86 specimens from the rainforest floor in an effort to preserve rapidly declining numbers.

For reasons mysterious to them — although there are certainly theories — the skink was wiped out soon afterwards.

"We were like a second before extinction," said Kent Retallick, a senior reptile keeper at the park.

"The decline in the animal's population in the wild was so drastic and so dramatic that if nothing had been done when we did it we would have lost the species."

In the ten years since the skinks vanished in the wild, Mr Retallick and his team have pulled off something of a small miracle.

Hidden deep in the dense rainforest of Christmas Island is a sunlit shed containing row after row of clear enclosures, known as the Pink House.

It is there that they have managed to breed more than 1,600 healthy blue-tailed skinks from the original group of 86.

Through a process of trial and error, park staff have devised a diet of crickets and other insects

gathered with a net from a lush area around the island's airport.

From an initial five enclosures, the facility has now grown to 40 to house the skinks alongside another endangered lizard known as Lister's gecko.



Above: Kent Retallick has worked on the project to protect the skinks for the last decade. (ABC News: Tom Joyner)

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From an initial five enclosures, the facility has now grown to 40 to house the skinks alongside another endangered lizard known as Lister's gecko.

"I always remember the first two eggs that we ever found. It was one of the most amazing periods of time for me," Mr Retallick said.

The plan, a decade in the making, is to one day reintroduce the skinks into the wild on Christmas Island.

Mr Retallick admits it is a wildly ambitious project, but said he is confident it has so far worked according to plan.

In January, he led a team to prepare the nearby Cocos Islands for the introduction of 150 skinks as part of a controlled experiment.

The implications of that trial, which followed extensive preparations and approvals before it could go ahead, will not be apparent for some time. 'It could take ten years'

Many endemic species have been threatened or even made extinct by invasive species on Christmas Island since human settlement more than a century ago.

The yellow crazy ant, for example, and first believed to have arrived on phosphate mining ships, has wiped out tens of millions of red crabs on the island since the 1990s.

But it was the decline of the pipistrelle bat in the 2000s that set in motion a review of endangered reptiles on the island, Mr Retallick said.

The father-of-two has dedicated a decade of his career so far to the preservation of the blue-tailed skink, and said he is in it for the long haul.

"It could take ten years [or more]. So what I don't want to do is get all excited about it," he said.

Should something happen to the captive bred population of skinks on Christmas Island — disease or fire, for example — the park staff have a backup.

A conservation team at Taronga Zoo in Sydney, more than 5,000 kilometres away, have bred their own skinks as an 'insurance' population.



Above: An 'insurance' population of blue-tailed skinks is kept at Taronga Zoo in Sydney. (ABC News: Will Ockenden)

In two rooms at the facility on the shores of Sydney's harbour, hundreds of blue-tailed skinks and Lister's geckoes are kept in glass enclosures.

Between Christmas Island and Taronga Zoo, a lot of money and work has gone into protecting the last of the two species.

But there is little doubt among any involved that the work is vital and contributing to a larger pushback against the devastation caused by invasive species nationwide.

"Every animal has a slight role in the ecosystem," said Michael McFadden, a fauna supervisor at the zoo.

"For a blue-tailed skink, that was formerly common all over the island, I have no doubt that the prey species they used to feed on have increased."

Mr McFadden said conservation authorities may not always have a solution to protect vulnerable species, but that did not preclude finding one in the future.

"Something that might not be easy to mitigate or re-establish in the wild now, in five or ten years' time we might have a silver bullet," he said.

Until that time, the blue-tailed skinks will continue to live in captivity.

Dragon Quest: Australia kicks off search for possibly extinct lizard

By John R. Platt, *Scientific American*, 15 June 2019

The Victorian grasslands earless dragon hasn't been observed for 50 years, but conservationists haven't given up hope yet

Below: Grassland Earless Dragon, photographed at Jerrabomberra, NSW in 1991.

Image: John Wombey CSIRO



Got good eyesight and some time on your hands? Australia needs you.

Zoos Victoria has issued a public appeal to help find a lizard species that hasn't been credibly observed in 50 years. The Victorian Grassland Earless Dragon (*Tympanocryptis pinguicollis*) was last seen in 1969 and could possibly be mainland Australia's first reptile extinction—if it isn't just hiding.

And hiding is something this dragon is good at. In addition to being small, elusive and camouflaged, the species also managed to hide its very existence from scientists until this year.

Its cover was blown last month when researchers announced that what had previously appeared to be one lizard species—the grassland earless dragon—was actually four different species with minor morphological differences and unique genetic makeups.

The previous taxonomic name, *T. pinguicollis*, has been assigned to the lizards once found, but now long unseen, in the Victoria region. The three new species, all found in different locations, have been named *T. lineata* in the Canberra region; *T. osbornei* in Cooma; and *T. mccartneyi* near Bathurst.

The new dragon species—including the possible extinction—were announced in a paper published May 22, 2019, in the journal *Royal Society Open Science*.

The paper's title identifies the Victorian dragon as "the first possible extinction of a reptile in mainland Australia," but the write-up takes a much more cautious approach. The researchers note that the species is difficult to detect and surveys may not have covered all the dragons' remaining habitat. Therefore, they wrote, "we suggest that *T. pinguicollis* does not yet meet the criteria for being considered either Extinct or Critically Endangered (Possibly Extinct)."

Its extinction risk, however, still needs to be assessed, as does that of the other three species.

"Now that they are four separate species the conservation recovery teams will be working to re-evaluate the status of the species," lead author Jane Melville told the Australian Associated Press. She also noted that the recovery plan for the previously recognized species is a decade old and in need of revision.

If the Victorian dragon still exists, now is the time to find it. The grasslands where it was previously seen have mostly been paved over or converged to agricultural fields, leaving little possible habitat. A 2017 study identified a few possible locations to search, but intensive trapping in 2018 failed to turn up any living dragons, according to Zoos Victoria. (The search did, however, improve their understanding of the local invertebrate community, showing that the areas could still potentially support the lizards.)

The Zoo is still looking, and they hope the general public can aid in the dragon quest. "We need your help," the zoo posted last month. "Nine possible sightings have been reported by the community in the past two years. Upon further investigation these were identified as other dragon species, but the more people looking, the higher the chance of finding the dragons if they are out there." Sightings can be reported to the Dragon Search website.

Does the Victorian grassland earless lizard still exist? In a recent post for *The Conversation*, Melville acknowledged that the news of the possible extinction was worrying, but quickly added "We're not leaving this lizard for dead just yet."

The quest continues—as it does for so many other lost and possibly extinct species.

Chevron's Wheatstone gas plant construction sees 30,000 native animals moved to safety

By Susan Standen, ABC Pilbara, 25 July 2019

Below: A Black-headed Python emerges from a termite mound. Image: supplied Terrestrial Ecosystems.



The remote spinifex and termite mound clustered country of Western Australia's north-west has experienced rapid industrialisation due to its proximity to the vast mineral resources and offshore oil and gas reserves.

During construction of Chevron's massive gas processing facility, 12 kilometres from the tiny town of Onslow, just over 30,000 animals were salvaged from the 1,000 hectare site at the top of Exmouth Gulf.

Many native species of frogs, lizards, snakes, mice, and geckos, among others, were collected by a team of zoologists ahead of the termite mound 'deconstructions'.

Graham Thompson, partner and principal zoologist at Terrestrial Ecosystems said it was the largest number of animals he had ever removed from an industrial development site.

One hundred and fifty-eight termite mounds were slowly and carefully destroyed with the help of a front-end loader, enabling 5,500 fauna to be collected.

The ecology of a termite mound can reveal a huge number of animals that co-exist within its vast network of air-conditioning vents.



Above: Termite mound 'deconstruction'.
Image: supplied Terrestrial Ecosystems.

World inside the mound

Large termite mounds provide an important food resource for small vertebrates and protection from fires and flooding.

A thermal environment modifies external extreme temperatures, and the mounds also provide nesting sites for birds and reptiles.



Above: An Orange-naped Snake emerges from a termite mound (Supplied: Terrestrial Ecosystems)

"Due to their size and how hard they were, a small excavator would break up portions of the termite mounds and these would be carefully broken up by hand or hand-held hammers," zoologist Scott Thompson said. "The process could take up 3 hours per mound with four to five staff."

Graham Thompson said about 150 snakes were found in total.

"They were big termite mounds that were active, so lots of termites were in them; they were clearly capable of supporting and sustaining a substantial vertebrate community," he said.

Snakes eat the mice, and the carnivorous marsupial mice — called planigales — eat the white ants and geckos who also eat the white ants in a never ending cycle of life inside a mound, which can last hundreds or even thousands of years in some countries."

Hundreds of species recorded

One hundred and eighty-four king brown snakes, 60 death adders, 444 Stimson's pythons, and 106 black-headed pythons were caught overall on the project.

Scientists found at least one Stimson's python in each termite mound.

Above: A Stimson's python emerging from a termite mound. (Supplied: Terrestrial Ecosystems)



In all, 240 species were recorded in the mammoth effort to collect and relocate as many animals as possible from November 2011 until July 2018.

Cats and small native mammals were caught in cage traps and aluminium box traps.

All the reptiles were caught by hand.

The 10km radius outside of the plant construction site was used to relocate the animals, where similar conditions exist to original habitat.

Approximately 10,000 frogs were found in the waterways, flow sheets and dry areas where frogs hibernate between the wet periods.

Invaders

The less-than-glamorous part of the work included managing incursions of invading species such as green tree frogs, rats, foxes and a huge number of cats.

Scott Thompson said one of the lessons for companies was that they should establish a quarantine area when development begins, to prevent pest species from entering the area in vehicles.



Above: Many pests were spotted during the rescue operation. (Supplied: Terrestrial Ecosystems)

FIFO camps also presented a problem.

Dr Thompson said best-practice waste management was critical in the prevention of cat numbers exploding.

"Where humans set up a facility in a remote location, it is common for feral cats to enter the area."

Feral cats and wild dogs will scavenge at any waste dump or camp food source, so waste needs to be removed from sites completely to prevent issues such as wild animals causing injuries to either humans or native species.

"If waste management practises aren't high quality and tightly managed, then you could have a cat or fox problem and a wild dog problem," Dr Thompson said.

High survival rate

At the peak of the work, eight staff worked seven days a week.

Around 50 early-career zoologists were employed on the project, allowing them to get valuable experience on a real site.



Above: A Desert Spadefoot Frog.
Image: Supplied Terrestrial Ecosystems.

Most of the wildlife were caught by hand and although there is little research into salvage operations, he believes they have a 70 per cent success rate for animals that survived.

Dr Thompson said fauna relocation had high value.

"For large projects in remote areas where we know there are substantial fauna, then it's worth putting a zoologist onsite to collect the animals," he said.

Tiny turtle embryo's temperature shifts could help buffer it against climate change

By Genelle Weule, ABC Science, August 2019



Eggs exposed to high temperatures are more likely to be females, and cooler eggs more likely to be males, in some species.

It's a quirk of nature that has some scientists worried that these turtle populations will become skewed towards females as global temperatures rise.

Last year, it was reported that **99 per cent of Australian green turtle hatchlings** on beaches in the northern reaches of the Great Barrier Reef were female.

But it appears there is a little wriggle room for at least one species of freshwater turtle.

The embryos of the Chinese Pond Turtle (*Mauremys reevesii*) can change the temperature that influences their sexual destiny by moving around the egg, according to a new study published today in the journal **Current Biology**.

"We have always regarded embryos as passive little organisms that don't have any control over their own environments until after they hatch out of the egg," said study co-author Rick Shine of Macquarie University.

Modelling by the team suggests the ability of an embryo to find the temperature sweet spot could help some species maintain sex ratio balances and help buffer against rising temperatures.

But other scientists say this "fascinating phenomenon" is likely to have a minimal impact in the face of climate change and other threats.

Right: The Chinese pond turtle, also known as Reeves' Turtle, lays large eggs in a shallow nest.
Image: Flickr, Denise Chan.



The sex of a few turtle species, such as Australian freshwater turtles, is determined by X and Y chromosomes just like us.

But the sex of other species of freshwater turtles, all sea turtles, and many snakes, lizards and crocodiles is determined by the environment.

Left: For many species of turtles and tortoises higher temperatures mean a female is more likely to emerge from the egg. Image: Wikimedia, K. Kristina Drake/USGS

It has long been known that many species of turtle embryos move within the egg during incubation, but the idea that this could actively play a role in determining the sex of the embryo has been hotly contested.

To find out if this phenomenon was possible, the team led by Yin-Zi Ye of the Chinese Academy of Sciences incubated the eggs of the endangered Chinese pond turtle in the lab and in an outdoor pond under normal seasonal conditions.

A temperature of 27.9°C is needed to produce an equal mix of males and females in this species, which is found in Asia.



Above: A Chinese pond turtle.

Image: Ye et al/Current Biology

The researchers detected thermal gradients of up to 4.7°C between the two ends of the eggs. They then injected half the eggs with a substance that blocked the embryo's ability to sense temperature. The embryos within these eggs moved less than eggs that hadn't been manipulated.

When they hatched they skewed towards females under hotter conditions or males under cooler conditions. Meanwhile, an equal number of males and females hatched from the other eggs.

Will it provide a buffer against climate change?

The ability of turtles to use this mechanism will vary from species to species, Professor Shine said.

"It will only work for species that have large eggs in shallow nest in sun-exposed soil, but that's still a lot of species, especially in groups like turtles," Professor Shine said.

"The beauty of embryonic control over incubation temperature is that it allows immediate responses to unpredictable bouts of cool or hot weather." But, he said, the mechanism would be no match for temperature extremes.

"An embryo may be able to keep a bit hotter or colder than would otherwise be the case, but it won't be able to achieve optimum conditions."

Rory Telemeco of California State University Fresno, who studies how animals adjust to climate change, has previously argued that a vast majority of reptiles would be unable to regulate their temperature in the egg.

An embryo's ability to control its sexual destiny would be limited if the egg was too small, or the embryo too large or young to move around.

"There's this extremely finite set of conditions where it can work," Dr Telemeco said.

"[The researchers] have found a species that meets all those conditions ... which is really impressive and cool, but I don't know if it really changes the idea that the majority of species [of reptiles] aren't going to."

He said the phenomenon would not work for turtle species that lay large clutches of eggs in deep nests, such as sea turtles.

"As you go deeper in the soil, you stop having any real temperature variation either through the day or with depth that can go across the sides of the egg." More often, he said, the environment or the mother's behaviour would dictate the sex ratio of the hatchlings.

Factors that can influence nest temperature include local climate and geographic conditions, amount of vegetation and shade, nest structure and laying season.

How big a problem is feminisation?

There is growing evidence feminisation may not be the biggest threat facing turtles and other reptiles, Dr Telemeco said.

"There seems to be a lot of mechanisms in place where historically these organisms have coped with this climate variation and not had big feminisation-induced declines."

Ricky Spencer, a population ecologist at Western Sydney University who studies

freshwater turtles, said his **unpublished modelling** suggests feminisation generally provides more — not less — resilience for turtles to a point.

This is because there will be more females around to breed and they can live for 100-plus years.

"As long as there are some males being produced somewhere within the population they're actually quite resilient."

That's not to say climate change hasn't had a major impact on hatchlings.

All it takes is one sudden spike in temperature to wipe out baby turtles, Dr Telemeco said.

"A lot of nests are failing and nothing about a baby moving in the egg is going to keep them from just experiencing temperatures that cause them to flat-out die."

"The effects of global change on their ability to survive might actually be the bigger challenge for them than becoming feminised," he said.

Dr Spencer said turtles were a barometer of climate change.

Recently there have been reports of turtles **nesting earlier**.

"By nesting earlier they're nesting in the cooler period," he said. "So there will be responses to climate change, but whether they can adapt quickly enough that's a different question."

But there are even greater threats, according to Dr Spencer, one of 50 authors on a report about the **global conservation status of turtles and tortoises**.

Disease, water contamination, pests and human activity are taking their toll on the world's 360 species of turtles and tortoises.

"If you've got a turtle that can produce eggs every year for 100 years it only needs one clutch to really survive ... but if you take out one of those adults that's 100 years or 75 years of reproduction gone."

Professor Shine agreed.

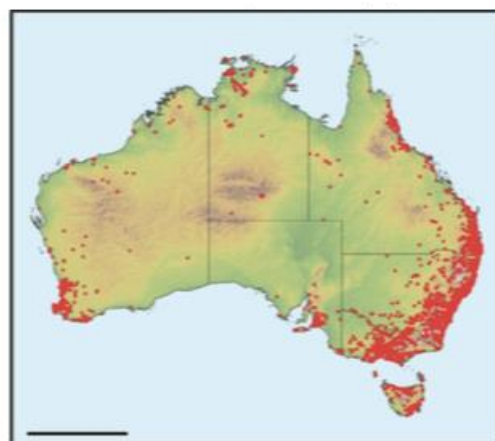


Above: Nearly half of Australia's freshwater species are in trouble, facing threats from drought, disease, pests and humans.

FROGID'S FIRST YEAR: WHAT YOUR DATA TELLS US



May 2019 update. The findings from the first 12-months of FrogID are in! In just one year, FrogID has generated the equivalent of 13% of all frog records collected in Australia over the last 240 years. The submitted recordings have resulted in over 66,000 validated calls and detected 175 of Australia's 240 known native frogs. The data has informed scientists on the impacts of climate change and pollution on Australia's frogs including the first evidence of the decline in Sydney of the Australian Green Tree Frog; the spread of the invasive Cane Toad; and information on the breeding populations of 28 globally threatened and 13 nationally threatened frog species.



Location of all frog records for the first year of FrogID.