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ACTHA Inc. News Oct - Nov '15

*Newsletter of the
 ACT Herpetological
 Association Inc.*

Your Committee for 2014 - 2015

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Student Representatives	Vacant

** Denotes Life Members*

Annual General Meeting

Notice is hereby given of the 2015 Annual General Meeting of the **ACT Herpetological Association Inc.** to be held at the Belconnen Soccer Club, in conjunction with our meeting on Tuesday, 20 October 2015, at 7.30pm.

All members welcome!

Agenda

Present, Apologies, Minutes of the Previous Annual General Meeting, President's Report, Treasurer's Report, Election of Office Bearers, Other Business

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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 October 2015

Managing kangaroo grazing for the conservation of grassland and grassy woodland fauna: Brett Howland

In south-eastern Australia, high intensity grazing by the native eastern grey kangaroo, *Macropus giganteus*, has been linked to ecological decline of multiple taxa. While efforts to manage the impact of grazers on biota have been undertaken, the effectiveness of these interventions is limited by a lack of knowledge of what constitutes optimal grazing levels. Brett investigated the relationship between kangaroos, grass structure and fauna to address this knowledge gap.

Dragon Hunting in the Monaro Region of NSW

Our Guest Speaker at the 18 August '15 meeting was Tim McGrath, University of Canberra, who gave a presentation on the findings of his PhD thesis on the ecology of the Grassland Earless Dragon in the Monaro Region. This article is largely based on Tim's comprehensive notes and has been presented here by Mandy Conway.

Tim started his presentation by recounting how 'Tim the Yowie Man' had accompanied him on one of his many field trips to find dragons. An article subsequently appeared in the Canberra Times calling the excursion "Dragon Hunting" and Tim McGrath "The Dragon Hunter". Both labels have stuck!

Background

The setting or context of Tim's Msc research can be based on only a few pieces of reference literature which have previously assessed reptile status across the globe. Current literature makes it clear that the world is changing rapidly as global land use intensifies and the conservation of the world's biodiversity is a challenge of paramount importance. Today, nearly 20% of reptile species across the globe are threatened with extinction and the fact is we know very little about our reptiles.

The problem is most critical in expanding agricultural environments where there have been extensive declines and localised extinctions of reptiles in Australia. This is mainly the result of poorly managed agriculture and unsympathetic livestock grazing practices.

"We are data deficient because of a lack of any momentum. The Australian Government has recent action plans for mammals and birds and yet reptiles only have a very outdated plan, drafted by Hal Cogger in 1993." Tim said.

Tim's research focussed on the Grassland Earless Dragon, *Tympanocryptis pinguicolla*, which is classed as Endangered under national environmental law (EPBC Act). This tiny dragon is one of several of the most endangered reptiles in Australia. To date, most of the research and recovery focus has predominantly been in Canberra, in isolated and urbanised grasslands. Wendy Dimond identified some real concerns for this species in Canberra, as has

Lisa Doucette. With limited follow-up surveys since Will Osborne's initial re-discovery of the species in 1993, Tim chose to look for the earless dragon in previously known historical Monaro region sites. This included the Kuma Nature Reserve, a private property at Quartz Hill and Ravensworth Travelling Stock Reserve.

Tim went on to highlight Lyn Nelson's work in 2004 (ANU), which identified some important findings:

- dragons on the Monaro had significantly higher mean body condition indices than adult lizards in the ACT;
- lizards on the Monaro were hatching up to one month later than their counterparts in the ACT;
- Monaro inhabitants were more vulnerable to stochastic events such as rain storms or bushfires.

Since Lyn's surveys there have only been a few sporadic reasons for surveys, such as the Environmental Impact Assessment for the Eastern Gas Pipeline along the Monaro Highway which produced some further discoveries of earless dragons. The Kuma Nature Reserve was set aside for the species following the discovery, which is the only such reserve on the Monaro.

This suggested that there is a relatively broad and undefined distribution in the region, with scattered records and very little known about the requirements of the species.

Importance of the Monaro Region

The Monaro is predominantly an agricultural region, where grazing has occurred for some 180 years. There is a moderate to severe erosion problem due to overgrazing. There is also a history of vertebrate fauna extinction eg emus,



bandicoots, rat kangaroos, wallabies and bustards which have disappeared since European settlement. Reptiles and amphibians remain a significant component of the vertebrate fauna in this vast area of natural



temperate grasslands, full of tussocks with good structure and rocks as far as the eye can see.



Below, Tim, standing in the same area as above, shows how cold and windy it can get. The only cover for any small animal is under rocks or tussocks!



Initial approach in 2010

"I replicated early surveys undertaken in Canberra by initially setting up some grids using artificial arthropod burrows to gain an understanding of population demographics using mark and recapture techniques. I monitored 5 known sites across the Monaro in late summer for 8 weeks. I detected the lizard



on only two occasions from one site despite 4253 trap nights."

Rethink after my first year of study

"It was a labour intensive technique which took a long time and resulted in a lack of data for any statistical analysis. There were time constraints and, being a student, I only had a couple of years to develop something. I hadn't fully realised the sheer enormity of surface rocks and other refuge sites over a greater distance available for the lizard to hide compared to Canberra sites."

Tim turned to rock turning as the most cost and time efficient technique. This was spatially effective, as he could move around the landscape to many sites, often with the help of volunteers from ACTHA and students from the University of Canberra. More sites were visited which meant Tim could get a better understanding of the habitat. This methodology was also better suited for habitat assessment at both the paddock and landscape level.

Research focus

Although Tim kept his approach fairly simple, he wanted it to be effective so that his findings could hopefully be used in decision making processes in the future.

For this reason, Tim focused on three key aspects of the ecology of *T.pinguicolla*:

- the extent of its distribution and habitat;
- the effectiveness of detection techniques;
- how land management practices in the region may affect the lizard.

One of Tim's key resources during the course of his research was a book entitled '*Occupancy estimation and modelling: inferring patterns and dynamics of species occurrence*', Academic Press, Burlington, Vermont, USA. A resource particularly valuable when studying rare species, he added.

Approach and effort

Tim designed and carried out a targeted, landscape-wide, probabilistic sampling program which accounted for *T.pinguicolla*'s rarity through statistical inference. He conducted repeated presence/absence rock turning surveys in winter at 67 sites over 4 years. "For reasons based on assumptions of the modelling I used 60 sites in the analysis. 34 of those sites were surveyed on five or more occasions, the rest twice or three times, to help

with the data-building." Tim added that his efforts concentrated on presence/absence detection and not on population densities or sexing, after a question from his audience.

A total of 69,146 rocks were turned across 60 sites on the Monaro. 284 habitat assessments were taken based on the 4m² quadrat approach over all the sites the dragon was found, as well as all the sites where Tim did a survey but didn't find a dragon.

Habitat assessments within each grid

"The data I was capturing was based on variables at the over-wintering sites. If I found a dragon, I measured the size of the rock,

whether it was embedded and by how much, and whether a burrow and/or spider was present. Also, were there any other burrows in that area?"



Tim then did three random quadrats at sites where he hadn't found dragons. Information he gathered included where the plot was in the landform, how close it was to a structural change in the grasslands, what the dominant grass species were including their average height, and the number of small, medium or large rocks. "This all produced a lot of data!"

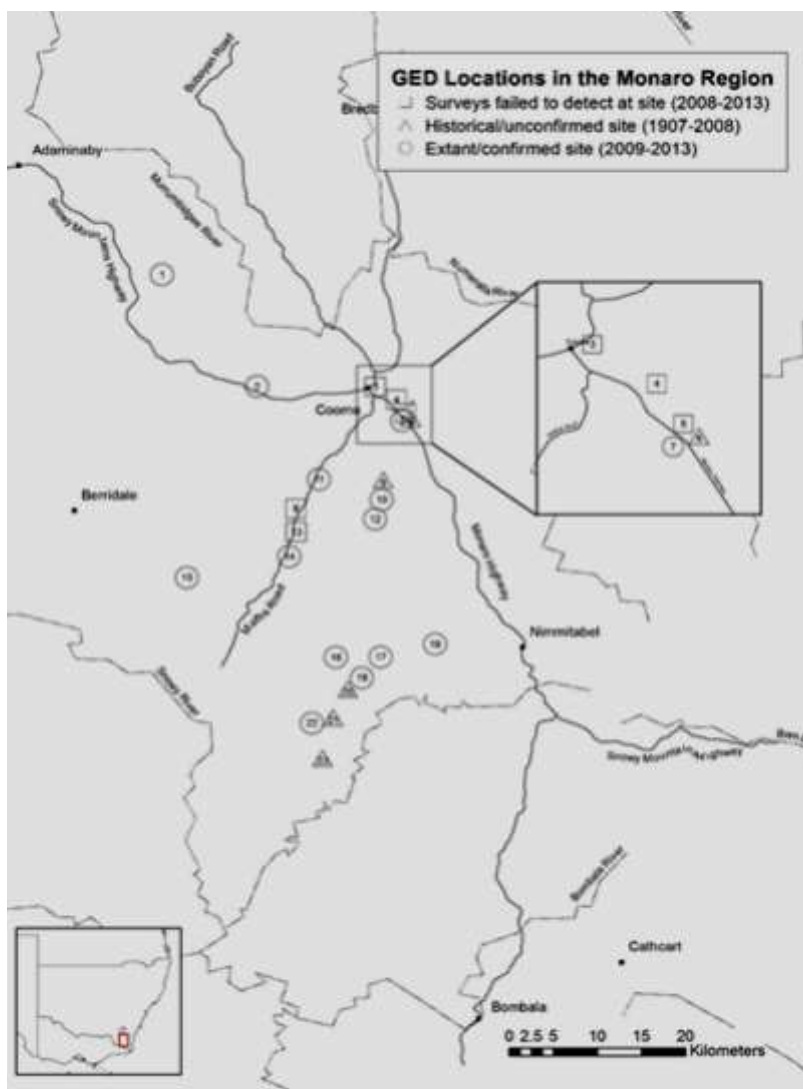
Effectiveness of techniques

Tim used a robust binomial mixture model in a software program called winBUGS, delivering a single season occupancy model which accounted for, and determined the detectability of, the species. Variations were developed to the model to allow Tim to compare his data, to be able to determine survey requirements needed to find the dragon and the probabilities of the occupancy rate. The modelling allowed Tim to pick 5 broad landscape variables for occupancy, which he built into his model.

Results - distribution

- The turning of 69,146 rocks from 237 surveys across 67 sites resulted in 36 detections of *T. pinguicolla* at 14 sites.
- Confirmed persistence at 9 historically known sites.

- Discovered populations at 5 new sites.
- Failed to detect the species at 6 historically known sites.
- The total number of individual specimens of *T. pinguicolla* recorded in the Monaro region to date was 109 from 23 known sites.
- Of the 23 known sites:
 - 12 were on privately owned agricultural land;
 - 11 were on Travelling Stock Reserves, a nature reserve or on council owned land;
 - Detected a northern range extension for *T. pinguicolla* to ~40 km north-west of Cooma but failed to extend the species southerly range despite surveys throughout what appeared suitable habitat as far south as Bombala or Cathcart;
 - Failed to record the species at numerous sites around Cooma including the Kuma Nature Reserve and at sites north of the Murrumbidgee River or south of the MacLauchlan River.



(Dragon Hunting in the Monaro Region of NSW, cont'd,...)

Results - detection

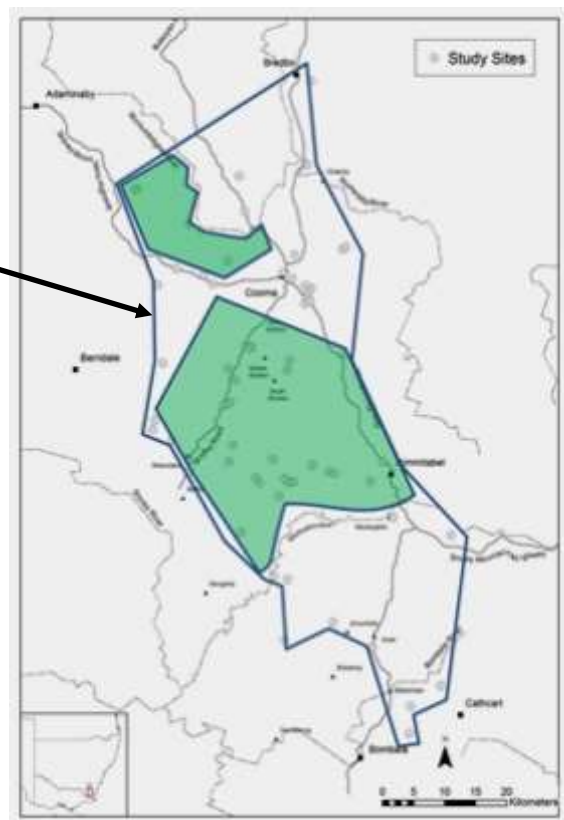
- *T. pinguicolla* has a very low detectability (0.0098).
- Tim's analysis revealed that about **2400** rocks needed to be turned at an occupied site to have a 90% chance of detecting the species.
- The number of rocks increased to **5400** to raise confidence to 99%.
- Tim's survey effort was sufficient to infer absence with high confidence at some sites, highlighting serious concern for the species at numerous sites around Cooma and in particular the Kuma Nature Reserve.

Results - occupancy

- Occupancy estimate of 0.46.
- Suggesting the species was likely to be missed at some sites during survey.
- Likely that the lizards are more widespread across the Monaro Region than previously thought.
- GED occupancy is likely to be greatest at higher elevations in native grasslands that are:
 - not dominated by kangaroo grass;
 - on private lands;
 - on both basalt and sedimentary geology;
 - between the Murrumbidgee and MacLauchlan river systems.
- Occupancy was not influenced by Travelling Stock Reserves or nature reserves, indicating private grazing lands make up most of the species area of occupancy.

Elevation prediction showed that once at 1000m above sea level the likelihood of detecting a dragon is highest. (The landscape around Cooma is of low elevation, rising higher towards Adaminaby, plateauing along the heartland before reaching the Great Dividing Range.) This suggests that elevation is a potential driver, which is interesting because the Monaro is affected by drought, sitting in a rain shadow. Tim added that a future hypothesis could very well be soil moisture in relation to egg and hatching success in those areas that receive better rainfall.

Right: This line shows the extent of Tim's survey sites, whilst the shaded landscape area indicates what an occupancy rate of 46% might look like. Quite a large area of about 120kms long by 50kms wide.



Results -

habitat

- Logistic regression modelling confirmed that wolf spider burrows associated with partially embedded surface rocks of any size are of critical importance to *T. pinguicolla*.
- Surprisingly, the number of medium or large rocks, or rock size, showed no relationship with the occurrence of the dragons.
- All spider burrows containing *T. pinguicolla* were aligned with the underside or edge of the rock, with the rock itself acting as the seal to the top or side of the burrow.
- High densities of small rocks in moderate height grasslands (200-300 mm average tussock height), particularly those dominated by snow and spear grasses, were the best predictor of *T. pinguicolla* habitat. This is interesting because this is grazed habitat.
- Where this habitat occurred in close proximity to habitat structural changes such as embedded rock outcrops this improved the likelihood of it being habitat for the dragon.
- The model predicted that kangaroo grass dominated grassland was the least preferred native habitat type. However, in sites dominated by kangaroo grass, suitability would improve with an increasing level of stoniness.

(Dragon Hunting in the Monaro Region of NSW, cont'd,...)

- Landform and aspect were not good predictors of *T. pinguicolla* habitat - the species inhabited the full spectrum of landforms and aspects available in the Monaro Region.
- Modelling demonstrated the least suitable native grasslands were those where exotics such as African lovegrass and *Phalaris* showed some dominance.



Above: a spider burrow curling underneath a rock, and left: an earless dragon curled up under a rock.

(Images: Dave Hunter).

"There were only a couple of occasions where I found a spider and a dragon in the same burrow and it was interesting to see the remains of crustaceans, slaters etc around the burrows. Diet would be another good area to study." Tim added.

- Unsympathetic grazing: particularly during times of drought where the landscape has been reduced to bare earth and rocks.
- Increasing renewable energy developments: the image below shows a windfarm recently installed on the Monaro. The federal government allowed 50x50m sites to be cleared for pads for the turbines, as well as roads. The tracks from vehicles taking shortcuts can be clearly seen, potentially spreading weeds such as African lovegrass and causing degradation.



- Rock piling/ collection by farmers for potential sale or for use in building rock walls across fields.



Despite saying that the species seemed to be more widespread than previously thought, which is good news, there are numerous and significant threatening processes in the landscape:

- Agricultural intensification: the image at right shows a site that Tim thought would be a good one to survey the next year. However when he returned it had been ploughed, which sadly has occurred more frequently with an increase in rainfall, making plough use more attractive. Below right, showing direct seeding, probably barley grass.



- There are 12 known sites where there is good quality grasslands and potential sale of some of these Travelling Stock Reserves (TSR) are creating uncertainty for the future of the species. There is a whole network of these TSR's across the Monaro which are leased by farmers during periods of drought.
- Potential or unknown threats include feral cats, foxes and rabbits, stochastic events due to climate change (during heavy rain storms many of Tim's tubes filled with mud and water), unexpected storm events during the summer when there are eggs in the soil, and erosion due to poor land management.

Conservation messages

- Managed grazing regimes in natural temperate grasslands are likely to be compatible with the conservation of *T. pinguicolla* in the Monaro Region. (This is the message we need to get across to farmers.)
- Managed grazing practices that exclude overgrazing are best placed to mimic pre-European settlement modification processes (kangaroo, wallaby and emu grazing, and fire by indigenous people). (We need regimes that mimic those early processes.)
- Wolf spider burrows associated with partially embedded surface rocks of any size are of critical importance to *T. pinguicolla*. In droughts and hard times these burrows provide shelter sites for overwintering, refuge from trampling by livestock and predation, thermoregulation and as locations where eggs can be laid.
- By contrast, the overwintering and microhabitat preferences of this dragon indicate pasture improvement through ploughing, application of fertiliser and removal of rocks are not compatible with the conservation of this species.
- The low effectiveness and likely destructive nature of rock turning as a survey technique for this dragon and other threatened reptiles. There is a need for alternative survey approaches e.g. remote wildlife cameras, sniffer dogs.
- Prompt investigation into suspected declines in parts of the species' range around Cooma and at Kuma NR. (An important message for the NSW Government.)

- Need for further surveys across the region.
- Need for a reserve network.
- Improved collaboration and relationships with private landholders in the Monaro Region. A community driven focus on the plight of endangered species has had proven success in several instances - fund raising activities including the sale of T-shirts and chocolate lizards over Easter has injected money into the management of important species sites, and landholders have also helped to conduct vulnerable species surveys. These initiatives have recently helped reptiles in agricultural environments, including for the Pygmy Blue-tongue Lizard, *Tiliqua adelaidensis* in South Australia and another earless dragon, *Tympanocryptis cf tetraporophora* on the Darling Downs of Queensland.

Tim finished his presentation by mentioning the urgent need for a national reptile action plan. The existing plan, dating back to 1993, was written by Australia's leading herpetologist Hal Cogger, where he made recommendations which have never been actioned. The federal government appears to be ignorant to reptiles, instead having a strong focus on birds and mammals.

There is also a need to revisit early Bathurst surveys for *T. pinguicolla* to see if any populations remain.

In answer to a young member in the audience, Tim did see other reptiles on his surveys including Copperhead, Brown, White-lipped and Little Whip snakes, frogs, grassland skinks and the Striped Legless Lizard.



Spot the dragon! he's there, really!!



The Australian & International Scene

Tasmanian woman fined \$350 for keeping three-legged bearded dragon

By Emilie Gramenz, ABC News, 6 August 2015

A Hobart mother has been fined \$350 for keeping a three-legged bearded dragon, an illegal species in Tasmania.



Left: The illegal lizard was handed over to the Department of Parks and Wildlife.

Roxanne Goss, 28, was given the bearded dragon as a birthday gift from her husband.

She had the animal for 18 months before police searched her Molesworth home and found it in a glass cage.

The Magistrates Court in Hobart heard bearded dragons are a

controlled animal because of the risk they pose to other native wildlife.

The court also heard the reptile was old and had only three legs. Mrs Goss was unaware owning the bearded dragon was illegal until she went to a pet store to buy food for it about a month before the raid. She had not attempted to get rid of the reptile or tried to organise a permit for it in that month.

Magistrate Sam Mollard took into account that the bearded dragon had been well cared for. "There was an element of rescue about your behaviour here, although really it was a gift situation," he said. "I accept that it was unlikely to get out and you were unlikely to release it but a very strict approach needs to be taken, especially when the wildlife is not native to Tasmania."

Mrs Goss was fined \$350 and a conviction was recorded.

The lizard was sent to Bonorong Wildlife Sanctuary before being handed over to the Department of Parks and Wildlife.

Scientists discover key clues in turtle evolution

ScienceDaily/New York Institute of Technology, 2 September 2015

Detailed digital dissections of 260-million-year-old skulls reveal new information about the origins of turtles.

A research team led by NYIT scientist Gabriel Bever has determined that a 260-million year-old fossil species found in South Africa's Karoo Basin

provides a long awaited glimpse into the murky origins of turtles.

Bever, describes the extinct reptile, named *Eunotosaurus africanus*, as the earliest known branch of the turtle tree of life.

"*Eunotosaurus* is a critical link connecting modern turtles to their evolutionary past," said Bever, an assistant professor of anatomy at the NYIT College of Osteopathic Medicine. "This is the fossil for which science has been searching for more than 150 years. You can think of it as a turtle, before turtles had a shell."

While *Eunotosaurus* lacks the iconic turtle shell, its extremely wide ribs and distinctively circular torso are the first indications that this fossil represents an important clue in a long unsolved mystery: the origin of turtles. In a new study published in *Nature*, Bever and his colleagues from the Denver Museum of Nature and Science, Yale University, and the University of Chicago focus their attention on the skull of *Eunotosaurus*. Their findings indicated that the complex anatomy of the head houses convincing evidence of the important role played by *Eunotosaurus* in the deep history of turtle evolution.

"Our previous studies showed that *Eunotosaurus* possessed structures that likely represent the first steps in the evolution of the turtle shell" added Tyler Lyson of the Denver Museum of Science and Nature and a co-author of the study, "but what those studies lacked was a detailed analysis of the skull."

Using high-resolution computed tomography, Bever digitally dissected the bones and internal structures of multiple *Eunotosaurus* skulls, all of which are housed in South African museums. He then incorporated his observations into a new analysis of the reptile tree of life. The process took the better part of four years, but according to Bever, the results were well worth the effort.

"Imaging technology gave us the opportunity to take the first look inside the skull of *Eunotosaurus*," said Bever, "and what we found not only illuminates the close relationship of *Eunotosaurus* to turtles, but also how turtles are related to other modern reptiles."

One of the study's key findings is that the skull of *Eunotosaurus* has a pair of openings set behind the eyes



(*The Australian & International Scene, cont'd...*)

that allowed the jaw muscles to lengthen and flex during chewing. Known as the diapsid condition, this pair of openings is also found in lizards, snakes, crocodilians, and birds. The skull of modern turtles is anapsid -- without openings -- with the chamber housing the jaw muscles fully enclosed by bone.

The anapsid-diapsid distinction strongly influenced the long-held notion that turtles are the remnants of an ancient reptile lineage and not closely related to modern lizards, crocodiles, and birds. The new data from *Eunotosaurus* rejects this hypothesis.

"If turtles are closely related to the other living reptiles then we would expect the fossil record to produce early turtle relatives with diapsid skulls," said Bever. "That expectation remained unfulfilled for a long time, but with some help from technology and a lot of hard work on our part, we can now draw the well-supported and satisfying conclusion that *Eunotosaurus* is the diapsid turtle that earlier studies predicted would be discovered."

In linking turtles to their diapsid ancestry, the skull of *Eunotosaurus* also reveals how the evidence of that ancestry became obscured during later stages of turtle evolution.

"The skull of *Eunotosaurus* grows in such a way that its diapsid nature is obvious in juveniles but almost completely obscured in adults. If that same growth trajectory was accelerated in subsequent generations, then the original diapsid skull of the turtle ancestor would eventually be replaced by an anapsid skull, which is what we find in modern turtles."

Although the new study represents a major step towards understanding the reptile tree of life, Bever emphasizes that it will not be the final chapter in the science of turtle origins.

"The beauty of scientific discoveries is that they tend to reveal more questions than they answer" said Bever, "and there is still much we don't know about the origin of turtles. Which of the other diapsid groups form their closest cousin? What were the ecological conditions that led to the evolution of the turtle's shell and anapsid skull? And how much of the deep history of turtle evolution can be discovered by studying the genes and developmental pathway of modern turtles?"

Other authors contributing to the study include Daniel J. Field, Ph.D. candidate in the Department of Geology & Geophysics at Yale University, and

Bhart-Anjan S. Bhullar, former postdoctoral scholar in the Department of Organismal Biology and Anatomy at University of Chicago and currently assistant professor in the Department of Geology & Geophysics at Yale University.

Yet another deadly snake species discovered in Australia

Oliver Milman, *theguardian*, 16 September 2015



Image: R. Ellis/WA Museum

Ophidiophobics should fret not, but Australia has a new species of snake. Scientists have identified a new type of death adder in the Kimberley region of Western Australia.

Named the Kimberley Death Adder, *Acanthophis cryptamydros*, the snake is about 50cm long and has a diamond-shaped head.

Scientists from Australia and the UK discovered the snake is different from the death adders found around Darwin in the Northern Territory. Previously it was thought the same species extended to the Kimberley, but an examination of 20 snakes found the WA region has its very own death adder.

The Kimberley Death Adder has a distinctive scale formation on its head. Like other death adders, it is a 'sit and wait' predator, choosing to lie in wait in order to strike its prey, most commonly birds, lizards and small animals.

Below: The Kimberley death adder's diamond-shaped head has a distinctive scale formation.

Image: R. Ellis/WA Museum



Paul Doughty, curator of herpetology at the Western Australian Museum, said 15 snakes were sent from the Northern Territory to compare with the Kimberley species in terms of genetics and physical features.

"The elusive snakes are thought to be most abundant in the north-west part of the Kimberley region. And, although numbers are thought to be low, scientists don't believe they are in immediate danger of extinction due to their isolation from key threats.

The discovery of the new death adder follows a slew of other recent discoveries in the Kimberley. A total of six new frog species have been identified since 2006, including a very large amphibian that eats other frogs.

The world's smallest species of goanna, measuring just 23cm and weighing 16g, was recently found, while several new geckos have also recently been unearthed.

"The Kimberley is an isolated corner of Australia with relic species clinging on for millions of years. There is a huge untapped diversity that we're just getting a handle on.

"I could easily point to 20 or 30 specimens we have here that haven't been described. I won't run out of things to describe from the Kimberley in my career and my successor won't run out either."

Doughty said while the Kimberley is largely inaccessible to people, especially during the wet season, its species face threats from changed fire regimes and feral animals.

The WA government has said it is addressing the conservation of the region through an \$81m plan that has removed feral cattle, handed environmental work to traditional owners and created Australia's largest national park through land handed back by Rio Tinto.

Pre-reptile may be earliest known to walk upright on all fours

ScienceDaily/Brown University, 17 September 2015

Right: About the same size as a cow, this pre-reptile also stood the same way - upright with its legs underneath. It may be the earliest known creature to do so, according to a new study. Credit: Morgan Turner.

A newly published analysis of the bones of *Bunostegos akokanensis*, a 260-million-year-old pre-reptile, finds that it likely stood upright on all-fours, like a cow or a hippo, making it the earliest known creature to do so.

To date, all of the known *pareiasaurs* who roved the supercontinent of Pangea in the Permian era a quarter of a billion years ago were sprawlers whose limbs would jut out from the side of the body and then continue out or slant down from the elbow (like some modern lizards). Morgan Turner, lead author of the study in the *Journal of Vertebrate Paleontology*, expected *Bunostegos* would be a sprawler too, but the bones of the animal's forelimbs tell a different story.

"A lot of the animals that lived around the time had a similar upright or semi-upright hind limb posture, but what's interesting and special about *Bunostegos* is the forelimb, in that it's anatomy is sprawling-precluding and seemingly directed underneath its body--unlike anything else at the time," said Turner who performed the analysis under the supervision of Professor Christian Sidor while a student at the University of Washington. Now Turner is a graduate student at Brown University. "The elements and features within the forelimb bones won't allow a sprawling posture. That is unique."

"Imagine a cow-sized, plant-eating reptile with a knobby skull and bony armor down its back," said co-author Linda Tsuji of the Royal Ontario Museum, who discovered the fossils in Niger along with Sidor and a team of palaeontologists in 2003 and 2006.

Four forelimb findings

Turner examined much of the skeleton of several individuals. The findings that matter most, however, are all in the forelimbs. In particular, four observations make the case, she said, that *Bunostegos* stood differently than all the rest, with the legs entirely beneath the body.

Starting at the shoulder joint, or the glenoid fossa, the orientation of it is facing down such that the



humerus (the bone running from shoulder to elbow) would be vertically oriented underneath. It would restrict the humerus from sticking out to the side, too.

Meanwhile, *Bunostegos*'s humerus is not twisted like those of sprawlers. In a sprawler, the twist is what could allow the humerus to jut out to the side at the shoulder but then orient the forearm downward from the elbow. But the humerus of *Bunostegos* has no twist suggesting that only if the elbow and shoulders were aligned under the body, could the foot actually reach the ground, Turner said.

The elbow joint is also telling. Unlike in sprawling pareiasaurs, which had considerable mobility at the elbow, the movement of *Bunostegos*' elbow is more limited. The way the radius and ulna (forearm bones) join with the humerus forms a hinge-like joint, and wouldn't allow for the forearm to swing out to the sides. Instead, it would only swing in a back and forth direction, like a human knee does.

Finally, the ulna is longer than the humerus in *Bunostegos*, which is a common trait among non-sprawlers, Turner said.

"Many other sprawling 4-legged animals have the reverse ratio," she said.

Going back 260 million years

The idea that *Bunostegos* would be an outlier in terms of its posture matches well with the idea that it was somewhat of an outlier in its choice of habitat.

"*Bunostegos* was an isolated pareiasaur," Turner said.

Way back when, Niger was an arid place (like some of it is today) where plants and water sources might well have been few and far between.

Scientists have associated walking upright on all fours with a more energy efficient posture than sprawling. For the long journeys between meals, Turner said, the upright posture might have been necessary for survival.

The significance of such an early example of the upright posture is that *Bunostegos* dates very far back on the evolutionary tree, pushing back the clock on when this posture shows up in evolution.

But Turner said she wouldn't be surprised if other animals of the time are eventually also found to have similarities to this posture, which evolved independently in reptiles and mammals several times over the eras.

"Posture, from sprawling to upright, is not black or white, but instead is a gradient of forms," Turner said. "There are many complexities about the evolution of posture and locomotion we are working to better understand every day. The anatomy of *Bunostegos* is unexpected, illuminating, and tells us we still have much to learn." At Brown, Turner is working in the lab of Professor Stephen Gatesy, where she is studying a continuum of postures and locomotion in ancient creatures. In addition to Turner, Tsuji and Sidor, Oumarou Ide of the University of Niamey in Niger is also an author of the study.



Please enter this date in your Diary!

***Snakes Alive!* Exhibition 2016**

Monday 18 to Sunday 24 January '16

Planning is underway and we hope to see you at the Christmas party in December with your ideas and help.

Annual General Meeting

Notice is hereby given of the 2015 Annual General Meeting
of the **ACT Herpetological Association Inc.**
to be held at the Belconnen Soccer Club,
in conjunction with our meeting on
Tuesday, 20 October 2015, at 7.30pm.

All members welcome!

Agenda

Present, Apologies, Minutes of the Previous Annual General Meeting,
President's Report, Treasurer's Report, Election of Office Bearers
Other Business



ACTHA News

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