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Eleven new species of Australian gecko within the genus *Heteronotia* Wermuth, 1965.

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ABSTRACT

The Australian gecko genus *Heteronotia* Wermuth, 1965 has been subject of recent taxonomic studies including Wells and Wellington (1985), Fujita *et al* (2010) and Pepper *et al.* (2013), two of which resulted in the formal naming of taxa.

The most commonly accepted taxonomy of just five recognized species is seen in Cogger (2014), including two forms named by Pepper *et al.* (2013).

Notwithstanding the identification of further self-evidently unnamed forms by Pepper *et al.* (2013), all of which were common knowledge among herpetologists in Australia prior, it is significant that no one has sought to assign names to other sometimes common and widespread species in the genus.

To rectify this error, obviously unnamed species and subspecies within the genus are formally named according to the rules of the *International Code of Zoological Nomenclature* (Ride *et al*. 1999 as amended online since) for the first time.

These new taxa are identified on the basis of morphological divergence, known biogeographical barriers affecting similarly constrained reptiles and the genetic evidence previously published.

These include one species and a subspecies in the *H. spelea* (Kluge, 1963) complex (currently with three recognized species), *Heteronotia planiceps* Storr, 1989 is split five ways, with four new species named, as well as a new subspecies and the Bynoe's Gecko *H. binoei* (Gray, 1845) is split into nine species, with two available subjective synonyms resurrected and six new species formally named for the first time.

A further two morphologically divergent insular subspecies in that complex are also formally named.

In summary the genus is expanded from 5 widely recognized species to include 2 resurrected forms and 11 newly named species, to make it have a total of 18 species, with four recognized subspecies.

There may yet be other species or subspecies in the genus awaiting formal description.

Keywords: Taxonomy; nomenclature, Australia, geckos; *Heteronotia*; *binoei*; *planiceps*; *spelea*; *atra*; *fasciolata*; *derbianus*; *anomalus*; *australis*, *annulatus*; *horneri*; *wadei*; new species; *whybrowi*; *binghami*; *ruffellae*; *arcerii*; *hoserae*; *oxyi*; *maxinehoserae*; *nonidem*; *keilleri*; *pailsi*; *crottyi*; new subspecies; *jameswhybrowi*; *insularis*; *grooteensis*; *sundayensis*.

INTRODUCTION

The distinctive and widely distributed Australian Bynoe's Gecko, has been placed in the genus

Heteronotia Wermuth, 1965 by all publishing herpetologists since the genus was originally created.

Prior to that, the species was placed in the genus *Heteronota* Gray, 1845, which was an unavailable name.

Following Gray's original description in 1945 of "*Heteronota binoei*" with a type locality of Houtman's Abrolhos, in Western Australia, the wide-ranging and variable putative species has acquired various other synonym names, which as of the present date (2022), have been generally disregarded or synonymised by other herpetologists.

These are (in date order):

Eublapharis derbianus Gray, 1845, from Port Essington at the top end of the Northern Territory,

Phyllodactylus anomalus Peters, 1867 from Rockhampton, Queensland,

Hoplodactylus (*Pentadactylus*) *australis* Steindachner, 1867 from New South Wales,

Diplodactylus annulatus Macleay, 1877 from Palm Island, Queensland.

In 1987, Boulenger emended the name *Heteronota binoei* Gray, 1845 to *H. bynoei*, an act later reversed by Cogger *et al.* (1983).

That was the state of play as of 1983, when Cogger *et al.* (1983) published their tome including known synonymies for all Australian herpetofauna species recognized as of that date by either the majority of herpetologists or by way of an educated decision of Harold Cogger himself, being lead author.

In 1963, Kluge described the taxon *H. spelea* from Marble Bar in Western Australia, that species having been treated as a heavily banded form of *H. binoei* prior, that species being widely recognized and accepted in herpetology immediately after publication.

In 1989, a northern variant of putative *H. spelea*, was formally named by Glenn Storr, as *H. planiceps* based on material primarily from the West Kimberley district of Western Australia.

In a thorough dissection of the work of Cogger *et al.* (1983), Wells and Wellington published two papers that significantly revised the taxonomy and nomenclature of Australian herpetology, including the formal resurrection of and newly naming of hundreds of species and genera.

While there was significant outrage at the time of the publications of Wells and Wellington (1984, 1985), the historical record showed that most of what they proposed was not just correct, but in hindsight, obviously so.

The mistakes of Wells and Wellington's works, of which there were also many, this due mainly to the sheer size and scope of their project, meaning errors were inevitable, have been the subject of endless complaints by their detractors.

Some of the legitimate complaints relating to their works have also been simple scientific disagreements and need not be inflated further.

Wells and Wellington in 1985, also proposed two new species within the *H. binoei* complex, these being, *H. horneri* with a type locality of Tenterfield, New South Wales and *H. wadei* with a type locality of Lightning Ridge, New South Wales.

Like the other preceding names mentioned, all are available for zoological nomenclature if the species concepts are agreed with.

As seen in other papers published at the same time I published this paper in 2022, or close to the same date in 2022 (on southern Australian skinks) and others I have previously published, I have often been alone in Australian herpetology in accepting and using the taxonomy and nomenclature of Wells and Wellington, or in the alternative often been the first to do so.

One such example was my acceptance and use of the species nomen "*roomi*" for the Mount Kaputar Skink in 2018 (Hoser, 2018a), followed 18 months later by Sadlier *et al.* (2019).

Another is my use of *Nyctophilopython* Wells and Wellington, 1985, in Hoser (2000), being the first other person to use this genus name for the species originally described as "*Python oenpelliensis*" by Gow in 1977.

It took two more decades for any other herpetologists to start using the name (Kaiser *et al.* 2020), with it now being in general acceptance and usage in 2022.

However, I do not blindly follow anything Wells and Wellington have written or the taxonomy they propose and I mention this because this is contrary to assertions of critics of both Wells and Wellington and also myself.

I scrutinize their works in the same way I do for any other authors.

In terms of this genus-level reclassification for the genus *Heteronotia*, I can flag here that not only did I not agree with the taxonomy of Wells and Wellington (1985), I furthermore have chosen to formally synonymise the two putative species they named with another they formally resurrected, that being *H. anomalus* Peters, 1867, based primarily on the molecular results published by Fujita *et al.* (2010), showing all to be conspecific.

In terms of the taxonomy of the genus *Heteronotia*, Pepper *et al.* (2013) formally split the putative species *H. spelea* three ways, naming the new species *Heteronotia atra* Pepper, Doughty, Fujita, Moritz and Keogh, 2013 and *Heteronotia fasciolata* Pepper, Doughty, Fujita, Moritz and Keogh, 2013.

That paper followed on from another by Fujita *et al.* (2010) that also published similar molecular data on the species within the genus.

Since the publication of the latter paper in 2013, there has been no further taxonomic work on the genus, even though Fujita *et al.* (2010) and Pepper *et al.* (2013) flagged unnamed species within putative *H. binoei*, *H. spelea and H. planiceps.*

Of course, with species not being formally identified, it is difficult to assess their conservation status, or manage them.

This is particularly relevant in Australia, where the human population is doubling every 50 years or less and the risk to all native vertebrates survival is also increasing in line with this.

To rectify the problem of there being potentially a large number of unnamed species within *Heteronotia*, an audit of the literature and specimens from across the known ranges of each putative species was conducted in order to identify and formally name those obviously unnamed taxa.

MATERIALS AND METHODS

All relevant literature on the classification, taxonomy and nomenclature of the genus *Heteronotia* as cited below was reviewed to form a baseline of recognized species and potentially available synonyms for any presently generally unrecognized forms.

This did of course involve checking each putative species to see if they were in fact valid according to accepted species concepts, these generally being breeding as a unit population and divergence from others of sufficient antiquity to imply they are evolving separately.

Most molecular biologists seem to regard in excess of 1 MYA divergence to be species level divergence, but I generally only recognize taxa with a likely divergence well in excess of that, usually being double that or more.

Specimens were examined from across the ranges of each putative species to see if morphological variation matched the previously cited molecular studies and known biogeographical barriers affecting similarly constrained reptile species.

This included live and dead animals, including in State Museums, as well as photos of specimens with good quality location information.

Field work was conducted by myself in every mainland state of Australia over more than 5 decades inspecting many thousands of living specimens, including repeated visits to many remote locations.

At least one potential species was not formally identified and named herein on the basis of limited material available, this being a taxon from north-west of Mount Isa in Queensland and I flag this here to indicate yet more work needs to be done with respect of the taxonomy and nomenclature in this genus beyond what is published within this paper.

I note that in spite of spending considerable time in the Mount Isa area and working on fauna there over many decades, the biodiversity hotspot still has reptile taxa awaiting formal description.

Literature relevant to the taxonomy and nomenclature adopted within this paper in terms of the genus *Heteronotia* include Boulenger (1885, 1897), Chiacchio *et al.* (2020), Cogger (2014), Cogger *et al.* (1983), Dittmer *et al.* (2020), Ellis *et al.* (2018), Fritz and Wiewel (2022), Fujita and Moritz (2009), Fujita *et al.* (2007, 2010, 2020), Giller (2021), Gray (1845), Greenbaum (2000), Grimm-Seyfarth *et al.* (2013), Hallermann (2020), Hoser (1989, 2007), How *et al.* (2020), Kinghorn (1924), Kluge (1963), Macleay (1877), Moritz (1983, 1991a, 1991b), Moritz and Heideman (1993), Moritz *et al.* (1990), Pepper *et al.* (2013), Peters (1867), Pianka (1969), Pianka and Pianka (1976), Riedel *et al.* (2021), Rösler (1995), Smith and Johnstone (1981), Steindachner (1867), Sternfeld (1925), Storr (1989), Swan *et al.*

(2009, 2017), Wells and Wellington (1984, 1985), Wermuth (1965), Whittier *et al*. (1994), Wilson and Swan (2010, 2017), papers and books cited elsewhere in this paper, including those specifically relating to geckos and all relevant sources cited therein.

RESULTS

The validity of the five widely recognized species *sensu* Pepper *et al.* (2013) was confirmed.

They are:

Heteronotia atra Pepper, Doughty, Fujita, Moritz and Keogh, 2013

Heteronotia binoei (Gray, 1845)

Heteronotia fasciolata Pepper, Doughty, Fujita, Moritz and Keogh, 2013

Heteronotia planiceps Storr, 1989

Heteronotia spelea (Kluge, 1963)

Relying on the preceding cited publications, in particular those of Fujita *et al*. (2010) and Pepper *et al*. (2013) and further calibration of the molecular results within these papers as well as matching this with morphological divergence and known biogeographical barriers, the following conclusions have been made, as indicated by the taxonomy and nomenclature that follows.

Newly named taxa are formally named in accordance with the rules of the *International Code of Zoological Nomenclature* (Ride *et al.* 1999, as amended online since).

H. SPELEA

The *H. spelea* (Kluge, 1963) complex (currently with three recognized species) is expanded with the formal description of one new species and an associated subspecies, being *H. whybrowi sp. nov*. from the eastern part of the main Pilbara escarpment south of the Fortescue River and *H. whybrowi jameswhybrowi subsp. nov*. from the western part of the main Pilbara escarpment south of the Fortescue River, being found mainly west and south-west of the southern branch of the Fortescue River.

Published molecular evidence tied in with the geological history of the Fortescue River basin implies a 1.5 MYA divergence for these two populations as a pair from the others, with a potentially similar divergence from one another, probably caused by a *H. binoei* complex species (*H. maxinehoserae sp. nov.*) displacing the other taxa in relatively flat, boulder or cave-free habitat.

H. spelea is now generally confined to the Pilbara region north of the Fortescue River*, H. fasciolatus* is confined to central Australia and *H. atra* is confined to a small area of hills between Millstream and Harding Dam (Harding River) north-west of the main Hamersley Range, being generally north of the Fortescue River as well.

Those species populations are also apparently divided by competing *H. maxinehoserae sp. nov.* and *H. binoei* in intervening zones comprising (mainly) less hilly and less rocky habitat.

The division of putative species across the Fortescue River basin is not new in herpetology.

This basin is unusual in that it cuts east-west more-or-less through the centre of the Pilbara region, being the only major drainage to do so.

All the rest start in the hills of the Pilbara and flow in one or other direction out of it, with rocky mountains at their headwaters.

As a biogeographic barrier, the Fortescue River, complete with competing and predatory sand or floodplain species has been an effective barrier to rock-dwelling reptiles for millions or years.

As a result, and most of the time based on molecular evidence as a starting point, many putative species have been split across this biogeographic barrier.

Examples include:

1/ *Worrellisaurus dannybrowni* Hoser, 2018, previously treated as a south Pilbara population of *W. acanthurus* (Boulenger, 1885), first flagged as a separate species by Fitch *et al*. (2006) and later formally named by Hoser (2018b).

2/ Hoser (2017b) split putative *Wellsopus* (formerly within *Delma* Gray, 1831) *elegans* (Kluge, 1974) across the Fortescue River basin into *W. robwatsoni* Hoser, 2017 (north) and *W. elegans* Kluge, 1974 (south).

3/ *Dactyloperus* (formerly erroneously included in the genus *Gehyra* Gray, 1834) *pilbara* (Mitchell, 1965), was split two ways on either side of the Fortescue River with Hoser (2018d), naming the southern population *Dactyloperus bradmaryani* Hoser, 2018.

4/ *Acanthophis wellsei* Hoser, 1998, was split across the Fortescue River by Hoser (2014), with the formal naming of the northern population as *A. hoserae* Hoser, 2014.

5/ In 2014, Maryan *et al*. quite properly defined yet another species of monitor from the Pilbara, resulting from the division of *Odatria* (*Pilbaravaranus*) *pilbarensis* (Storr, 1980) into two on the basis

of clear morphological and molecular evidence, formally naming the species found south of the Fortescue River as *O.hamersleyensis* Maryan *et al.* (2014).

I had intended naming this taxon myself, but was scooped by Maryan *et al*. (2014).

6/ Other affected species pairs as cited by Hoser (2017b).

H. PLANICEPS

Putative *Heteronotia planiceps* Storr, 1989 is split five ways, with four new species named.

Those populations are also generally separated by another *H. binoei* complex species (*H. nonidem sp. nov.*) also in flatter less rocky habitats, which clearly displace them in these habitats.

Nominate *H. planiceps* is herein confined to the West Kimberley District west of the Carson River.

The form from the Carson Escarpment is formally named *H. binghami sp. nov.* and based on both molecular evidence and the geological history of the region, has probably been evolving separately as a species for about 1.5 MYA from the nominate form of *H. planiceps* from the Prince Regent River area in the west Kimberley.

The east Kimberley form is believed to have diverged some 2 MYA from the two more western forms, based on the results of Pepper *et al*. (2013) and the geological history of the intervening region, being grounds again to separate this taxon at the species level.

It is formally named *H. ruffellae sp. nov.*

The Keep River, NT population is in turn based on the same evidence, believed to have diverged some 1.6 MYA from the East Kimberley population and is formally described herein as *H. arceri sp. nov.*.

Each are readily diagnosable from one another.

The divergent Arnhem Land, Northern Territory population is formally named *H. hoserae sp. nov.*, while an insular population on Grootre Eylandt, Northern Territory is formally named as *H. hoserae insularis subsp. nov.*.

In terms of the wider Kimberley division of putative *H. planiceps* into four geographically divergent forms, similar splits of putative species have been made for other reptile species complexes.

Examples include the following:

1/ *Oedurella* (*Parvusdactylus*) *sonnemanni* Hoser, 2017 known only from Keep River, Northern Territory, and formally named by Hoser (2017a) had previously been regarded as *Oedurella* (*Parvusdactylus*) *robinsoni* (Smith, 1995), from the Ord River area in the East Kimberley, which in turn had been treated as a population of *Oedurella* (*Parvusdactylus*) *mcmillani* (Storr, 1978), from the Mitchell Plateau in the West Kimberley.

2/ Hoser (2018b) formally split the Kimberley and nearby distributed putative species *Varanus ocreatus* (Storr, 1980)

based on the well-known biogeographical barriers, including east/west Kimberley, and the Victoria River district NT on the basis of previously published molecular data showing species-level divergence, consistent morphological differences and an absence of gene flow between the relevant populations.

3/ Putative *Odatria glauerti*, with a type locality of Wotjulum in the West Kimberley District, but distributed east of there in rocky areas to Arnhem Land in the Northern Territory was until 2013 treated as a single species, at which time, Hoser (2013b) formally named the Arnhem Land population *O. hoserae.*

Five years later Hoser (2018c) wrote:
"*Hoser (2013) divided the taxon known at the time as* Odatria glauerti *(Mertens, 1957) into two, naming the distinctive Arnhem-land population as a new species, namely* O. hoserae *Hoser, 2013.*

The same paper referred to eastern and western Kimberley populations as being morphologically distinct, but treated both as being of the same taxon. This paper formally divides O. glauerti *into two, formally naming the population found in the East Kimberley and nearby parts of the Northern Territory (extending to near the mouth of the Victoria River, on both sides) as a new species, namely* O. davidhancocki sp. nov.*. The new taxon is morphologically divergent to* O. glauerti*, with disjunct distribution and has significant molecular divergence as published by Fitch et al. (2006).*

On that basis the decision to recognize the taxon as a full species as opposed to subspecies was made obvious."

That taxon, *Odatria davidhancocki* Hoser (2018) has a type locality of the Bungle Bungle National Park in Western Australia.

As it happens, specimens from the Victoria River region in the western Northern Territory, are morphologically divergent from type *O. davidhancocki* with what seems to be zero gene flow between the populations and are in fact a fourth species in the complex.

They are most readily separated from *O. davidhancocki* on body colouration in adults, having dark grayish, rather than light reddish bands on the dorsum, which was overlooked by myself when looking at preserved specimens and concentrating on other aspects of colouration being the most consistent diagnostic characters between species.

North Kimberley specimens, east of the Carson River are different to West Kimberley ones, most notably in colouration and pattern on the upper body and probably diverged from the nominate population group about 1.5 MYA and therefore should also be recognized as either a species or subspecies.

4/ Putative *Worrellisaurus kingorum* (Storr, 1980), with a type locality of Timber Creek, Northern Territory, also found in the East Kimberley district generally around the Ord drainage.

Hoser (2018e) estimated a divergence of 2 MYA between the populations and formally named the Ord, West Australian population as *W. bigmoreum*.

This is broadly in line with the estimated divergence of 1.6 MYA here for the putative *H. planiceps* from the lower Ord region of Western Australia, based on different and separately published molecular data, formally named as a new species in this paper.

The two species pairs are effectively constrained by the same biogeographical factors, including competing or predatory species in the intervening flat lands.

5/ There are other examples including geckos named by myself as new species in the previous decade across the same biogeographic barriers.

As aluded to above, in the top part of the Northern Territory, centered on the Arnhem Land escarpment, so-called *H. planiceps* are quite different morphologically.

On the basis of this and that the barrier between this population and those to the west has presumably been present for millions of years, I have no hesitation in naming this fifth species in the group as *H. hoserae sp. nov.*.

The island population from Groote Eylandt, is also divergent from the Kakadu form, although clearly associated with it and so it is formally named as a subspecies*, H. hoserae insularis subsp. nov.*.

H. BINOEI

Putative *H. binoei* (Gray, 1845), were inspected from across Australia and morphologically each candidate species identified by the molecular results of Fujita *et al.* (2010) and Pepper *et al.* (2013), were readily identifiable, which came as a surprise as I had viewed the complex as so morphologically variable as to likely be hard to decipher.

In summary putative *H. binoei* (Gray, 1845) is split into nine species, with two available subjective synonyms resurrected, being the first available for these populations.

Six new species are formally named for the first time.

This new arrangement broadly matches the molecular results of Fujita *et al.* (2010) with each species being readily separable from one another.

As a rule, *H. binoei* complex species are habitat generalists and so determining biogeographical barriers causative of speciation had been difficult if not impossible, within the scope of my most recent studies.

Other than the species apparently confined to the rocky hills in north-west Queensland, the other species are all found in massive areas of sometimes widely divergent habitat and/or climate, especially for the more southerly distributed forms.

They appear to be habitat generalists, or so-called weedy species, being able to survive in all kinds of habitat, including heavily disturbed or altered and are also well described as invasive species.

What did emerge as well, was that each of the various species do not appear to breed or hybridize where their ranges abut and I found that sympatry occurs at locations in Queensland, the Northern Territory, and western Australia, further supporting the species concepts adopted within this paper.

This implies that ranges contract during ice-age minima and then expand during interglacials.

In terms of available names and to which populations they apply to, I make the following points.

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al.* (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus* in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central

Australia, and arid areas immediately south, are the type form of *H. binoei.*

Synonymised with *H. anomalus* are the following:

H. australis Steindachner, 1867, with a type locality of New South Wales.

H. annulatus Macleay, 1877 with a type locality of Palm Island, Queensland (offshore from Ingham).

H. horneri Wells and Wellington, 1985, with a type locality of Tenterfield, NSW.

H. wadei Wells and Wellington, 1985, with a type locality of Lightning Ridge, NSW.

I also found no basis to accord any of the preceding four names subspecies status for their type material.

While it may be easy to join the chorus of haters and attack Wells and Wellington (1985) for proposing two names I have not accepted, this criticism if fair, should be levelled at all other herpetologists who have proposed names later found to be inappropriate for putative taxa.

That would include all the so-called “greats”, like Wilhelm Karl Hartwich Peters, Edward Drinker Cope, John Edward Gray and George Albert Boulenger, who proposed names later found not to be appropriate by later herpetologists.

Of course the Wells and Wellington haters have been notable in their hypocrisy in not criticising the so-called great herpetologists of the 1800’s who are guilty of the same “crimes” as Wells and Wellington, but typically on a far greater scale.

Significant also, is that the first and only resurrections of *H. derbianus* Gray, 1845 and *H. anomalus* (Peters, 1867) was by Wells and Wellington (1985) and I have in fact accepted their decision as entirely correct and based on the scientific evidence before me, including that cited that has been published by persons completely divorced and separate from myself and/or Wells and Wellington.

The first of six newly named species in the *H. binoei* complex, *H. oxyi sp. nov.* is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland, extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus.*
Again it is readily separated from all other similar species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, south of Mount Isa, where it is sympatric with the more widespread *H. maxinehoserae sp. nov..*

H. crottyi sp. nov..is a range restricted species from the hilly country between Gunpowder and Lawn Hill in North-west Queensland.

In addition to the preceding, two very distinctive readily identifiable island forms are also formally named as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov*., being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

INFORMATION RELEVANT TO THE FORMAL DESCRIPTIONS THAT FOLLOW

There is no conflict of interest in terms of this paper or the conclusions arrived at herein.

Several people including anonymous peer reviewers who revised the manuscript prior to publication are also thanked as are relevant staff at museums who made specimens and records available in line with international obligations.

In terms of the following formal descriptions, spellings should not be altered in any way for any purpose unless expressly and exclusively called for by the rules governing Zoological Nomenclature as administered by the International Commission of Zoological Nomenclature (ICZN).

This includes if gender assignment of suffixes seems incorrect, Latinisation is wrong, apparent spelling mistakes and so on.

In the unlikely event two or more newly named taxa are deemed to be the same by a first reviser, then the name to be used and retained is that which first appears in this paper by way of page priority and as listed in the abstract keywords.

Some material in descriptions for taxa may be repeated for other taxa in this paper and this is necessary to ensure each fully complies with the provisions of the *International Code of Zoological Nomenclature* (fourth edition) (Ride *et al.* 1999) as amended online since.

Material downloaded from the internet and cited anywhere in this paper was downloaded and checked most recently as of 19 April 2022 (including if also viewed prior), unless otherwise stated and was accurate in terms of the content cited herein as of that date.

Any online citations within this paper, including copied emails and the like, are not as a rule cited in the references part of this paper and have the same most recent viewing date as just given.

Unless otherwise stated explicitly, colour and other descriptions apply to living adult specimens of generally good health, as seen by day, and not under any form of stress by means such as excessive cool, heat, dehydration, excessive ageing, abnormal skin or reaction to chemical or other input.

SVL or SV means snout-vent length, TL means tail length, preanal pores = precloacal pores, preanal = precloacal, tail measurements refer to original tails, max. size refers to maximum known, sometimes approximated up to the nearest 10 mm if number of measured specimens is below 10.

While numerous texts and references were consulted prior to publication of this paper, the criteria used to separate the relevant genera, subgenera, species or subspecies has already been spelt out and/or is done so within each formal description and does not rely on material within publications not explicitly cited herein.

HETERONOTIA WHYBROWI SP NOV.

LSIDurn:lsid:zoobank.org:act:ED2EA752-1073-4E55-A8CD-4C2274E099E0

Holotype: A preserved specimen at the Western Australian Museum, Perth, Western Australia, Specimen number R121394 from Weeli Wolli, Western Australia, Australia, Latitude 122.86667 S., Longitude 119.43333 E.

This government-owned facility allows access to its holdings.

Paratypes: Two preserved specimens at the Western Australian Museum, Perth, Western Australia, specimen numbers R114561 and R157719 collected from Newman, Western Australia, Australia approximate Latitude -23.08333 S., Longitude 119.28333 E.

Diagnosis: All of *Heterontia spelea* (Kluge, 1963), *H. whybrowi sp. nov*. and *H. whybrowi jameswhybrowi subsp. nov*. have until now been treated as three discrete populations of *H. spelea*.

While Pepper *et al.* (2013) had trouble telling individuals of the three taxa apart, my own inspection of specimens did yield consistent differences between the three putative taxa and so they are formally named within this paper.

Both *H. spelea* and *H. whybrowi sp. nov.* have a significant amount of darkening or dark brown pigment on the upper surface of the head, including towards the snout, against a beige background, versus minimal in *H. whybrowi jameswhybrowi subsp. nov*., giving that subspecies a generally light coloured upper surface of the head. See examples in Figures 8, 9 and 10 in Pepper *et al.* (2013).

In turn *H. spelea* and *H. whybrowi jameswhybrowi subsp. nov.* have an upper body with four strongly contrasting dorsal bands with more-or-less straight edges. By contrast *H. whybrowi sp. nov.* has five or six bands. The occipital band of these individuals is in contact with the temporal stripe behind the eye, similar to that seen in typical west Kimberley *H. planiceps* (Storr, 1989), as depicted by Pepper *et al.* (2013) in figure 9 (but see below).

To see an example of the type form of *H. planiceps* (Storr, 1989), showing the occipital band of these individuals in contact with the temporal stripe, see the image on page 81 (plate 11) middle left, in Storr, Smith and Johnstone (1990).

H. whybrowi sp. nov. is also separated from *H. whybrowi jameswhybrowi subsp. nov.* by having dark tail bands that are slightly wider than the narrower light ones, versus significantly wider in *H. whybrowi jameswhybrowi subsp. nov.*.

The closely related, but morphologically divergent taxon, *H. atra* Pepper *et al.*, 2013 is separated from the three preceding taxa by the following suite of characters:
A large body size (to 62.5 mm SVL), gracile habitus, elongate head (to 11.72 mm), long slender limbs and tail, greatly enlarged tympanum, typically 10 supralabials and 8 infralabials, enlarged dorsal tubercles in contact with each other at anterior and posterior edges of scale and usually to either side or separated with at most a few small granules, and a very distinctive melanistic 'charcoal' coloration (taken from Pepper *et al*., 2013).

A fifth taxon in the *H. spelea* complex, *H. fasciolatus* Pepper *et al.*, 2013 is separated from the preceding four taxa by the following suite of characters:

A medium body size (to 57.0 mm SVL), slightly robust habitus, moderately wide head (to 13.7 mm Head Width), tail stout at base, small tympanum, typically 8 or 9 supralabials and 6 or 7 infralabials, enlarged dorsal tubercles surrounded by at least one smaller granule anterior and posterior to scale, and usually two smaller granules to sides, dorsum with 6-8 strongly contrasting bands; edges of bands with dark brown border and irregular edge (some bands breaking up),top of head pale brown (modified from Pepper *et al*., 2013).

These five preceding taxa, form the entirety of the *H. spelea* complex. All are separated from their nearest congeners, being five species in the *H. planiceps* (Storr, 1989) group, by the fact that the *H. planiceps* complex have obvious dark purplish markings anterior to the eye, forming a band through the eye, and posterior to join the similarly dark purplish nuchal band; purplish speckling on the upper surface of the head posterior to the eye, all over a light grayish background and in nominate *H. planiceps* distinctive enlarged supraciliaries yellow with fine black banding, (versus not so in all members of the *H. spelea* complex).

All species in the *H. spelea* complex are confined to the Pilbara of Western Australia save for the divergent *H. fasciolatus* Pepper *et al.*, 2013, which occurs in the ranges of central Australia in the Northern Territory.

H. spelea is herein restricted to the Pilbara, in Western Australia north of the Fortescue River.

H. atra is known only from a geologically distinctive basaltic, flat-topped mesa near Karratha in thenorthwest Pilbara region and immediately adjacent to it.

Nominate *H. whybrowi sp. nov.* is found in the Pilbara region, south of the Fortescue River and generally east of the southern branch of the Fortescue River, although extending west to Mount Brockman, via a ridgeline south of the headwaters of the southern branch of the Fortescue River.

H. whybrowi jameswhybrowi subsp. nov. occurs in the far western part of the main Pilbara escarpment south of the Fortescue River, being found west of the southern branch of the Fortescue River and mainly towards the southern edge of the general Pilbara region.

The five species within the *H. planiceps* (Storr, 1989) complex occur in the Kimberley Region of Western Australian and the immediately adjacent lower Victoria River region in the Northern Territory, as well as second distinctive population in the Kakadu area and Groote Eylandt, both in the Northern Territory.

All the preceding 9 species within the *H. spelea* and *H. planiceps* complexes are separated from the eight recognized species in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens where tail bands are wide.

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

H. whybrowi sp. nov., H. whybrowi jameswhybrowi subsp. nov., *H. spelea* (from north of the Fortescue River, being the range of this taxon as defined herein), *H. atra* and *H. fasciolatus* are all depicted in Pepper *et al.* (2013).

H. spelea of the type form is depicted in life online at:

https://www.inaturalist.org/observations/35512384

and

https://www.inaturalist.org/observations/104937692

H. whybrowi sp. nov. is depicted in life in Brown (2014) on page 251, second from bottom on right (from Western Ridge, Western Australia), and online at:

https://www.inaturalist.org/observations/90248541

and

https://www.inaturalist.org/observations/37608011

and

https://www.inaturalist.org/observations/67187790

H. whybrowi jameswhybrowi subsp. nov. is also depicted in life on page 251 at bottom right of Brown (2014) and Wilson and Swan (2017) on page 149 bottom.

The phylogenies published by Pepper *et al.* (2013), support the contention that putative *H. whybrowi sp. nov.* is isolated from the other previously named species in the complex and with ancient divergence to warrant being formally named as a new species.

Distribution: Nominate *H. whybrowi sp. nov.* (of the nominate subspecies) is found in the Pilbara region, south of the Fortescue River and generally east of the southern branch of the

Fortescue River, although extending west to Mount Brockman, via a ridgeline.

The subspecies *H. whybrowi jameswhybrowi subsp. nov*. is found in the main Pilbara massif generally west and south-west of the western limit of the nominate subspecies.

Etymology: *H. whybrowi sp. nov.* is named in honour of Peter Whybrow, of Taggerty, Victoria, Australia in recognition of his contributions to herpetology spanning many decades.

HETERONOTIA JAMESWHYBROWI SUBSP NOV.

LSIDurn:lsid:zoobank.org:act:002ABC52-7150-494F-AC56-A89E3F02EE68

Holotype: A preserved specimen at the Western Australian Museum, Perth, Western Australia, Specimen number R132488 collected from Paraburdoo, Western Australia, Australia, Latitude -23.20000 S., Longitude 117.66667 E. This government-owned facility allows access to its holdings.

Paratypes: Two preserved specimens at the Western Australian Museum, Perth, Western Australia, specimen numbers R115832 and R115833 collected from The Governor (AKA Governor's Hill), Western Australia, Australia, Latitude -23.11889 S., Longitude 118.78278 E.

Diagnosis: All of *Heterontia spelea* (Kluge, 1963), *H. whybrowi sp. nov.* and *H. whybrowi jameswhybrowi subsp. nov.* have until now been treated as three discrete populations of *H. spelea.*

While Pepper *et al.* (2013) had trouble telling individuals of the three taxa apart, my own inspection of specimens did yield consistent differences between the three putative taxa and so they are formally named within this paper.

Both *H. spelea* and *H. whybrowi subsp. nov.* have a significant amount of darkening or dark brown pigment on the upper surface of the head, including towards the snout, against a beige background, versus minimal in *H. whybrowi jameswhybrowi subsp. nov*., giving that subspecies a generally light coloured upper surface of the head. See examples in Figures 8, 9 and 10 in Pepper *et al.* (2013).

In turn *H. spelea* and *H. whybrowi jameswhybrowi subsp. nov.* have an upper body with four strongly contrasting dorsal bands with more-or-less straight edges. By contrast *H. whybrowi sp. nov.* has five or six bands. The occipital band of these individuals is in contact with the temporal stripe behind the eye, similar to that seen in typical west Kimberley *H. planiceps* (Storr, 1989), as depicted by Pepper *et al.* (2013) in figure 9 (but see below).

To see an example of the type form of *H. planiceps* (Storr, 1989), showing the occipital band of these individuals in contact with the temporal stripe, see the image on page 81 (plate 11) middle left, in Storr, Smith and Johnstone (1990).

H. whybrowi sp. nov. is also separated from *H. whybrowi jameswhybrowi sp. nov.* by having dark tail bands that are slightly wider than the narrower light ones, versus significantly wider in *H. whybrowi jameswhybrowi subsp. nov.*.

The closely related, but morphologically divergent taxon, *H. atra* Pepper *et al*., 2013 is separated from the three preceding taxa by the following suite of characters:
A large body size (to 62.5 mm SVL), gracile habitus, elongate head (to 11.72 mm), long slender limbs and tail, greatly enlarged tympanum, typically 10 supralabials and 8 infralabials, enlarged dorsal tubercles in contact with each other at anterior and posterior edges of scale and usually to either side or separated with at most a few small granules, and a very distinctive melanistic 'charcoal' coloration (taken from Pepper *et al*., 2013).

A fifth taxon in the *H. spelea* complex, *H. fasciolatus* Pepper *et al*., 2013 is separated from the preceding four taxa by the following suite of characters:

A medium body size (to 57.0 mm SVL), slightly robust habitus, moderately wide head (to 13.7 mm Head Width), tail stout at base, small tympanum, typically 8 or 9 supralabials and 6 or 7 infralabials, enlarged dorsal tubercles surrounded by at least one smaller granule anterior and posterior to scale, and usually two smaller granules to sides, dorsum with 6-8 strongly contrasting bands; edges of bands with dark brown border and irregular edge (some bands breaking up),top of head pale brown (modified from Pepper *et al*., 2013).

These five preceding taxa, form the entirety of the *H. spelea* complex. All are separated from their nearest congeners, being five species in the *H. planiceps* (Storr, 1989) group, by the fact that the *H. planiceps* complex have obvious dark purplish markings anterior to the eye, forming a band through the eye, and posterior to join the similarly dark purplish nuchal band; purplish speckling on the upper surface of the head posterior to the eye, all over a light grayish or yellowish background and in nominate *H. planiceps* distinctive enlarged supraciliaries yellow with fine black banding, (versus not so in all members of the *H. spelea* complex).

All species in the *H. spelea* complex are confined to the Pilbara of Western Australia save for the divergent *H. fasciolatus* Pepper *et al*., 2013, which occurs in the ranges of central Australia in the Northern Territory.

H. spelea is herein restricted to the Pilbara, in Western Australia north of the Fortescue River.

H. atra is known only from a geologically distinctive basaltic, flat-topped mesa near Karratha in the

northwest Pilbara region and immediately adjacent to it.

Nominate *H. whybrowi sp. nov.* is found in the Pilbara region, south of the Fortescue River and generally east of the southern branch of the Fortescue River, although extending west to Mount Brockman, via a ridgeline south of the headwaters of the southern branch of the Fortescue River.

H. whybrowi jameswhybrowi subsp. nov. occurs in the far western part of the main Pilbara escarpment south of the Fortescue River, being found west of the southern branch of the Fortescue River and mainly towards the southern edge of the general Pilbara region.

The five species within the *H. planiceps* (Storr, 1989) complex occur in the Kimberley Region of Western Australian and the immediately adjacent lower Victoria River region in the Northern Territory, as well as second distinctive population in the Kakadu area and Groote Eylandt, both in the Northern Territory.

All the preceding 9 species within the *H. spelea* and *H. planiceps* complexes are separated from the eight species in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens where tail bands are wide.

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

H. whybrowi sp. nov., H. whybrowi jameswhybrowi subsp. nov., *H. spelea* (from north of the Fortescue River), *H. atra* and *H. fasciolatus* are all depicted in Pepper *et al.* (2013).

H. spelea of the type form is depicted in life online at:

https://www.inaturalist.org/observations/35512384

and

https://www.inaturalist.org/observations/104937692

H. whybrowi sp. nov. is depicted in life in Brown (2014) on page 251, second from bottom on right (from Western Ridge, Western Australia), and online at:

https://www.inaturalist.org/observations/90248541

and

https://www.inaturalist.org/observations/37608011

and

https://www.inaturalist.org/observations/67187790

H. whybrowi jameswhybrowi subsp. nov. is also depicted in life on page 251 at bottom right of Brown (2014) and Wilson and Swan (2017) on page 149 bottom.

The phylogenies published by Pepper *et al.* (2013), support the contention that putative *H. whybrowi sp. nov.* is isolated from the other previously named species in the complex and with ancient divergence to warrant being formally named as a new species.

The same paper provided evidence of divergence of the taxon *H. jameswhybrowi subp. nov.* from the nominate subspecies *H. whybrowi whybrowi subsp. nov..*

Distribution: Nominate *H. whybrowi sp. nov.* (of the nominate subspecies) is found in the Pilbara region, south of the Fortescue River and generally east of the southern branch of the Fortescue River, although extending west to Mount Brockman, via a ridgeline.

The subspecies *H. whybrowi jameswhybrowi subsp. nov.* is found in the main Pilbara massif generally west and south-west of the western limit of the nominate subspecies.

Etymology: *H. jameswhybrowi subp. nov.* is named in honour of James Whybrow, of Taggerty, Victoria, Australia, son of Peter Whybrow and Judy Fergusson, in recognition of his contributions to the Australian music industry over the past 2 decades.

HETERONOTIA BINGHAMI SP. NOV.

LSIDurn:lsid:zoobank.org:act:D8CAC097-1147-4A82-BF93-B80F9F2A10D9

Holotype: A preserved specimen at the Western Australian Museum, specimen number WAM R113996, collected from the Carson Escarpment, east of the Carson River, Kimberley District, Western Australia, Australia, Latitude -15.35000 S., Longitude 126.61667 E. This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the Western Australian Museum, specimen number WAM R173527 collected from the, Drysdale River Camp, Escarpment, Kimberley District, Western Australia, Australia, Latitude -14.608056 S., Longitude 126.935556.

Diagnosis: Until now, putative *H. planiceps* (Storr, 1989) has been treated as a single wide-ranging species extending from the West Kimberley region, across to Groote Eylandt, in the Northern Territory.

The molecular evidence of Fujita *et al.* (2010) and Pepper *et al.* (2013) confirmed the presence of multiple species under the banner of *H. planiceps*, with the split in this paper reflecting genetic divergence as known, divergence across biogeographical barriers of known antiquity and also clear and consistent morphological divergence between allopatric populations.

The five relevant species are:

H. planiceps herein confined to the West Kimberley region of Western Australia.

H. binghami sp. nov., effectively confined the Carson Escarpment area, in the north-west Kimberley region.

H. ruffellae sp. nov. found in the east Kimberley district, generally corresponding to the lower Ord River drainage.

H. arcerii sp. nov. from the Keep and Victoria River districts in the far north-west Northern Territory.

H. hoserae sp. nov. from Arnhem Land, Northern Territory.

Also formally named for the first time is *H. hoserae insularis subsp. nov*. from Groote Eylandt, in the eastern Northern Territory.

The preceding taxa are separated from one another by the following unique suites of characters:

H. planiceps is readily separated from all other species by the presence of well-defined crossbands with fairly even boundaries on top and bottom, being a rich yellow in colour alternating with purplish brown bands, that darken slightly at the upper and lower edges to give a blackish border.

The upper surfaces of limbs are a distinct combination of well defined purplish and yellow markings, of fairly even ratio, but usually slightly more purple.

The supracilliaries are large and prominent, being far more so than for any other species in the complex. They commence below the mid-line of the eye anteriorly and continue to the thin yellow temporal streak near the top of the eye on the posterior side. The supracilliaries are invariably black with yellow tips and very distinctive, or rarely all yellow. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being even in these markings.

Most of the iris is reddish brown, but with an obvious bluey-grey outer border.

H. binghami sp. nov. is similar in most respects to *H. planiceps* as described above, but the supracilliaries are not as prominent and with little if any black, instead being all yellow, the upper and lower labials are usually a dark purple grey, unique for the species complex and the yellow cross bands across the dorsum have a strong hint of purple running through them. Between the upper flanks and the belly, the lower sides are mainly a dark purple in colour, versus light in all the other species in the group. The middle of the iris has an orange streak running up/down through the middle, while the rest is speckled beige. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being more-or-less even in these markings. Purple and brown markings on the upper surfaces of the limbs are semi-distinct.

H. ruffellae sp. nov. from the East Kimberley is readily separated from the two preceding species by having a yellow-brown rinse through its colour, meaning that the dorsal cross bands alternate between light brown to beige and a chocolate brown, the darker bands darkening towards black slightly at the outer edges. Supracilliaries are generally yellow.

Other than the orange streak in the middle of the iris going up/down the rest of the iris is a dark bluish/grey.

The upper surfaces of the limbs (in adults) are beige with scattered tiny chocolate dots.

H. arcerii sp. nov. is separated from all others in the species group by having a generally faded dorsal pattern. Otherwise it is similar in most respects to *H. ruffellae sp. nov*. but further differentiated from that taxon by having a strong purplish sheen on the lower flanks. The orange streak in the centre of the eye is only semi-distinct and the iris is otherwise dark grey. Tail has an average of 8-10 lighter cross bands, alternating with dark.

The dorsal cross-bands of this species are obviously orange, alternating with dark brown (although often both are faded), but in any event beyond the hindlimbs, the bands rapidly turn to an even black and white on the original tail, also sometimes faded.

H. hoserae sp. nov. is separated from all the preceding species by having pattern of chocolate brown and light grey or light beige cross bands on the upper body.

Unlike for the Kimberley and Victoria River species, the lighter cross bands on the posterior half of the body have very irregular edges.

Upper surfaces of the limbs are mainly dark with scattered light grey patches. The orange at the centre of the eye is barely noticeable and the iris is a medium grey to brown in colour. 8-10 light cross bands on the original tail.

H. hoserae insularis subsp. nov. is similar in most respects to *H.*

hoserae sp. nov. (see above), but separated from that taxon by having a mainly light brown iris and whitish upper surfaces of the limbs with purplish markings. There is a clear lightening of the centres of the darker chocolate-brown to black crossbands at the posterior part of the body.

The morphologically similar four species and single subspecies from the *H. spelea* complex are separated from the above five species by the fact that the *H. planiceps* complex have obvious dark purplish markings anterior to the eye, forming a band through the eye, and posterior to join the similarly dark purplish nuchal band; purplish speckling on the upper surface of the head posterior to the eye, all over a light grayish or yellowish background and in nominate *H. planiceps* distinctive enlarged supraciliaries yellow with fine black banding, (versus not so in all members of the *H. spelea* complex).

All species in the *H. spelea* complex are confined to the Pilbara of Western Australia save for the divergent *H. fasciolatus* Pepper *et al*., 2013, which occurs in the ranges of central Australia in the Northern Territory.

All the preceding 9 species within the *H. spelea* and *H. planiceps* complexes are separated from the eight species in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded to an obvious degree. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens where tail bands are wide.

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Photos of the type form of *H. planiceps* in life can be found in Cogger (2014) at page 370, bottom, and online at:

https://www.flickr.com/photos/euprepiosaur/22267079729/

and

https://www.flickr.com/photos/smacdonald/5221029774/

and

https://www.flickr.com/photos/jramos15/46059559194/

Specimens from Fitzroy Crossing, as seen in the image at:

https://www.flickr.com/photos/126237772@N07/31127002498/

the depicted example of which has 12 light cross bands on the tail is otherwise morphologically most similar to the type form of *H. planiceps*, and therefore tentatively referred to that taxon.

A specimen of *H. binghami sp. nov*. in life can be found online at:

https://www.flickr.com/photos/zimny_anders/28915729912/

Photos of specimens of *H. ruffellae sp. nov*. in life can be found in Brown (1994) on page 251 top left and online at:

https://www.flickr.com/photos/reptileshots/45213228932/

and

https://www.flickr.com/photos/126002448@N02/20493084120/

Photos of specimens of *H. arcerii sp. nov*. in life can be found online at:

https://www.flickr.com/photos/reptileshots/45213229122/

and

https://www.flickr.com/photos/euprepiosaur/24925711218/

and

https://www.flickr.com/photos/euprepiosaur/38490145181/

Photos of specimens of *H. hoserae sp. nov*. in life can be found online at:

https://www.flickr.com/photos/smacdonald/3221488546/

and

https://www.flickr.com/photos/euprepiosaur/7240110822/

and

https://www.flickr.com/photos/euprepiosaur/4930457953/

and

https://www.flickr.com/photos/mattsummerville/7164378868/

and

https://www.inaturalist.org/observations/80323860

and

https://www.inaturalist.org/observations/66765276

Distribution: *H. binghami sp. nov*. is effectively confined the Carson Escarpment area, in the north-west Kimberley region.

Etymology: *H. binghami sp. nov*. is named in honour of Jarrod Bingham, of Bacchus March (west of Melbourne), Victoria, Australia. As the contracted licensed snake catcher for the cities of Brimbank, Melton and Wyndham in Melbourne's west in the past 5 years, he has kept local residents safe from venomous snakes and educated them about these reptiles as well.

HETERONOTIA RUFFELLAE SP. NOV.

LSIDurn:lsid:zoobank.org:act:A7944EE3-B7E3-4DC8-8B31-9A94F0F7E80D

Holotype: A preserved specimen at the Western Australian Museum, specimen number WAM R132761 collected from Carlton Hill Station (39 KM north-west of Kunanurra), Western Australia, Australia, Latitude -15.29111 S., Longitude 128.66917 E. This government-owned facility allows access to its holdings.

Paratypes: Two preserved specimens at the Western Australian Museum, Perth, Western Australia, Australia, specimen numbers: R101355, collected from the Carr Boyd Ranges, Western Australia, Australia, Latitude -16.116667 S., Longitude 128.683333 E., and R70450, collected 10.7 km from the (new) Lissadell Homestead, Western Australia, Australia, Latitude -16.725 S., Longitude 128.466111 E.

Diagnosis: Until now, putative *H. planiceps* (Storr, 1989) has been treated as a single wide-ranging species extending from the West Kimberley region, across to Groote Eylandt, in the Northern Territory.

The molecular evidence of Fujita *et al.* (2010) and Pepper *et al.* (2013) confirmed the presence of multiple species under the banner of *H. planiceps*, with the split in this paper reflecting genetic divergence as known, divergence across biogeographical barriers of known antiquity and also clear and consistent morphological divergence between allopatric populations.

The five relevant species are:

H. planiceps herein confined to the West Kimberley region of Western Australia.

H. binghami sp. nov., effectively confined the Carson Escarpment area, in the north-west Kimberley region.

H. ruffellae sp. nov. found in the east Kimberley district, generally corresponding to the lower Ord River drainage.

H. arcerii sp. nov. from the Keep and Victoria River districts in the far north-west Northern Territory.

H. hoserae sp. nov. from Arnhem Land, Northern Territory.

Also formally named for the first time is *H. hoserae insularis subsp. nov*. from Groote Eylandt, in the eastern Northern Territory.

The preceding taxa are separated from one another by the following unique suites of characters:

H. planiceps is readily separated from all other species by the presence of well-defined crossbands with fairly even boundaries

on top and bottom, being a rich yellow in colour alternating with purplish brown bands, that darken slightly at the upper and lower edges to give a blackish border.

The upper surfaces of limbs are a distinct combination of well defined purplish and yellow markings, of fairly even ratio, but usually slightly more purple.

The supracilliaries are large and prominent, being far more so than for any other species in the complex. They commence below the mid-line of the eye anteriorly and continue to the thin yellow temporal streak near the top of the eye on the posterior side. The supracilliaries are invariably black with yellow tips and very distinctive, or rarely all yellow. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being even in these markings.

Most of the iris is reddish brown, but with an obvious bluey-grey outer border.

H. binghami sp. nov. is similar in most respects to *H. planiceps* as described above, but the supracilliaries are not as prominent and with little if any black, instead being all yellow, the upper and lower labials are usually a dark purple grey, unique for the species complex and the yellow cross bands across the dorsum have a strong hint of purple running through them. Between the upper flanks and the belly, the lower sides are mainly a dark purple in colour, versus light in all the other species in the group. The middle of the iris has an orange streak running up/down through the middle, while the rest is speckled beige. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being more-or-less even in these markings. Purple and brown markings on the upper surfaces of the limbs are semi-distinct.

H. ruffellae sp. nov. from the East Kimberley is readily separated from the two preceding species by having a yellow-brown rinse through its colour, meaning that the dorsal cross bands alternate between light brown to beige and a chocolate brown, the darker bands darkening towards black slightly at the outer edges. Supracilliaries are generally yellow.

Other than the orange streak in the middle of the iris going up/down the rest of the iris is a dark bluish/grey.

The upper surfaces of the limbs (in adults) are beige with scattered tiny chocolate dots.

H. arcerii sp. nov. is separated from all others in the species group by having a generally faded dorsal pattern. Otherwise it is similar in most respects to *H. ruffellae sp. nov*. but further differentiated from that taxon by having a strong purplish sheen on the lower flanks. The orange streak in the centre of the eye is only semi-distinct and the iris is otherwise dark grey. Tail has an average of 8-10 lighter cross bands, alternating with dark.

The dorsal cross-bands of this species are obviously orange, alternating with dark brown (although often both are faded), but in any event beyond the hindlimbs, the bands rapidly turn to an even black and white on the original tail, also sometimes faded.

H. hoserae sp. nov. is separated from all the preceding species by having pattern of chocolate brown and light grey or light beige cross bands on the upper body.

Unlike for the Kimberley and Victoria River species, the lighter cross bands on the posterior half of the body have very irregular edges.

Upper surfaces of the limbs are mainly dark with scattered light grey patches. The orange at the centre of the eye is barely noticeable and the iris is a medium grey to brown in colour. 8-10 light cross bands on the original tail.

H. hoserae insularis subsp. nov. is similar in most respects to *H. hoserae sp. nov*. (see above), but separated from that taxon by having a mainly light brown iris and whitish upper surfaces of the limbs with purplish markings. There is a clear lightening of the centres of the darker chocolate-brown to black crossbands at the posterior part of the body.

The morphologically similar four species and single subspecies from the *H. spelea* complex are separated from the above five species by the fact that the *H. planiceps* complex have obvious dark purplish markings anterior to the eye, forming a band through the eye, and posterior to join the similarly dark purplish nuchal band; purplish speckling on the upper surface of the head posterior to the eye, all over a light grayish or yellowish background and in nominate *H. planiceps* distinctive enlarged supraciliaries yellow with fine black banding, (versus not so in all members of the *H. spelea* complex).

All species in the *H. spelea* complex are confined to the Pilbara of Western Australia save for the divergent *H. fasciolatus* Pepper *et al*., 2013, which occurs in the ranges of central Australia in the Northern Territory.

All the preceding 9 species within the *H. spelea* and *H. planiceps* complexes are separated from the eight species in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens where tail bands are wide.

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Photos of the type form of *H. planiceps* in life can be found in Cogger (2014) at page 370, bottom, and online at:

https://www.flickr.com/photos/euprepiosaur/22267079729/

and

https://www.flickr.com/photos/smacdonald/5221029774/

and

https://www.flickr.com/photos/jramos15/46059559194/

Specimens from Fitzroy Crossing, as seen in the image at:

https://www.flickr.com/photos/126237772@N07/31127002498/

the depicted example of which has 12 light cross bands on the tail is otherwise morphologically most similar to the type form of *H. planiceps*, and therefore tentatively referred to that taxon.

A specimen of *H. binghami sp. nov*. in life can be found online at:

https://www.flickr.com/photos/zimny_anders/28915729912/

Photos of specimens of *H. ruffellae sp. nov*. in life can be found in Brown (1994) on page 251 top left and online at:

https://www.flickr.com/photos/reptileshots/45213228932/

and

https://www.flickr.com/photos/126002448@N02/20493084120/

Photos of specimens of *H. arcerii sp. nov*. in life can be found online at:

https://www.flickr.com/photos/reptileshots/45213229122/

and

https://www.flickr.com/photos/euprepiosaur/24925711218/

and

https://www.flickr.com/photos/euprepiosaur/38490145181/

Photos of specimens of *H. hoserae sp. nov*. in life can be found online at:

https://www.flickr.com/photos/smacdonald/3221488546/

and

https://www.flickr.com/photos/euprepiosaur/7240110822/
and
https://www.flickr.com/photos/euprepiosaur/4930457953/
and
https://www.flickr.com/photos/mattsummerville/7164378868/
and
https://www.inaturalist.org/observations/80323860
and
https://www.inaturalist.org/observations/66765276

Distribution: *H. ruffellae sp. nov*. is found in the east Kimberley district, generally corresponding to the lower Ord River drainage, extending upstream at least as far south as Halls Creek.

Etymology: *H. ruffellae sp. nov*. is named in honour of Natasha Ruffell, of Melton, (west of Melbourne), Victoria, Australia. Working with Jarrod Bingham, as the contracted licensed snake catcher for the cities of Brimbank, Melton and Wyndham in Melbourne's west in the past 5 years, she has done countless snake catcher call outs at all hours of the day or night and kept local residents safe from venomous snakes, while educating them about these reptiles as well.

HETERONOTIA ARCERII SP. NOV.

LSIDurn:lsid:zoobank.org:act:8F71A55A-2D23-4552-A22F-B18839CEEA95

Holotype: A preserved specimen at the Museum and Art Gallery of the Northern Territory, Australia, specimen number R24569, collected from Joe Creek, Gregory National Park, Northern Territory, Australia, Latitude -15.609 S., Longitude 131.075 S. This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the Museum and Art Gallery of the Northern Territory, Australia, specimen number R18642, collected from Bradshaw Station, Northern Territory, Australia, Latitude -15.338 S., Longitude 130.108 E.

Diagnosis: Until now, putative *H. planiceps* (Storr, 1989) has been treated as a single wide-ranging species extending from the West Kimberley region, across to Groote Eylandt, in the Northern Territory.

The molecular evidence of Fujita *et al.* (2010) and Pepper *et al*. (2013) confirmed the presence of multiple species under the banner of *H. planiceps*, with the split in this paper reflecting genetic divergence as known, divergence across biogeographical barriers of known antiquity and also clear and consistent morphological divergence between allopatric populations.

The five relevant species are:

H. planiceps herein confined to the West Kimberley region of Western Australia.

H. binghami sp. nov., effectively confined the Carson Escarpment area, in the north-west Kimberley region.

H. ruffellae sp. nov. found in the east Kimberley district, generally corresponding to the lower Ord River drainage.

H. arcerii sp. nov. from the Keep and Victoria River districts in the far north-west Northern Territory.

H. hoserae sp. nov. from Arnhem Land, Northern Territory.

Also formally named for the first time is *H. hoserae insularis subsp. nov*. from Groote Eylandt, in the eastern Northern Territory.

The preceding taxa are separated from one another by the following unique suites of characters:

H. planiceps is readily separated from all other species by the presence of well-defined crossbands with fairly even boundaries on top and bottom, being a rich yellow in colour alternating with purplish brown bands, that darken slightly at the upper and lower edges to give a blackish border.

The upper surfaces of limbs are a distinct combination of well defined purplish and yellow markings, of fairly even ratio, but usually slightly more purple.

The supracilliaries are large and prominent, being far more so than for any other species in the complex. They commence below the mid-line of the eye anteriorly and continue to the thin yellow temporal streak near the top of the eye on the posterior side. The supracilliaries are invariably black with yellow tips and very distinctive, or rarely all yellow. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being even in these markings.

Most of the iris is reddish brown, but with an obvious bluey-grey outer border.

H. binghami sp. nov. is similar in most respects to *H. planiceps* as described above, but the supracilliaries are not as prominent and with little if any black, instead being all yellow, the upper and lower labials are usually a dark purple grey, unique for the species complex and the yellow cross bands across the dorsum have a strong hint of purple running through them. Between the upper flanks and the belly, the lower sides are mainly a dark purple in colour, versus light in all the other species in the group. The middle of the iris has an orange streak running up/down through the middle, while the rest is speckled beige. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being more-or-less even in these markings. Purple and brown markings on the upper surfaces of the limbs are semi-distinct.

H. ruffellae sp. nov. from the East Kimberley is readily separated from the two preceding species by having a yellow-brown rinse through its colour, meaning that the dorsal cross bands alternate between light brown to beige and a chocolate brown, the darker bands darkening towards black slightly at the outer edges. Supracilliaries are generally yellow.

Other than the orange streak in the middle of the iris going up/down the rest of the iris is a dark bluish/grey.

The upper surfaces of the limbs (in adults) are beige with scattered tiny chocolate dots.

H. arcerii sp. nov. is separated from all others in the species group by having a generally faded dorsal pattern. Otherwise it is similar in most respects to *H. ruffellae sp. nov*. but further differentiated from that taxon by having a strong purplish sheen on the lower flanks. The orange streak in the centre of the eye is only semi-distinct and the iris is otherwise dark grey. Tail has an average of 8-10 lighter cross bands, alternating with dark.

The dorsal cross-bands of this species are obviously orange, alternating with dark brown (although often both are faded), but in any event beyond the hindlimbs, the bands rapidly turn to an even black and white on the original tail, also sometimes faded.

H. hoserae sp. nov. is separated from all the preceding species by having pattern of chocolate brown and light grey or light beige cross bands on the upper body.

Unlike for the Kimberley and Victoria River species, the lighter cross bands on the posterior half of the body have very irregular edges.

Upper surfaces of the limbs are mainly dark with scattered light grey patches. The orange at the centre of the eye is barely noticeable and the iris is a medium grey to brown in colour. 8-10 light cross bands on the original tail.

H. hoserae insularis subsp. nov. is similar in most respects to *H. hoserae sp. nov*. (see above), but separated from that taxon by having a mainly light brown iris and whitish upper surfaces of the limbs with purplish markings. There is a clear lightening of the centres of the darker chocolate-brown to black crossbands at the posterior part of the body.

The morphologically similar four species and single subspecies from the *H. spelea* complex are separated from the above five species by the fact that the *H. planiceps* complex have obvious dark purplish markings anterior to the eye, forming a band through the eye, and posterior to join the similarly dark purplish nuchal band; purplish speckling on the upper surface of the head posterior to the eye, all over a light grayish or yellowish background and in nominate *H. planiceps* distinctive enlarged

supraciliaries yellow with fine black banding, (versus not so in all members of the *H. spelea* complex).

All species in the *H. spelea* complex are confined to the Pilbara of Western Australia save for the divergent *H. fasciolatus* Pepper *et al.*, 2013, which occurs in the ranges of central Australia in the Northern Territory.

All the preceding 9 species within the *H. spelea* and *H. planiceps* complexes are separated from the eight species in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens where tail bands are wide.

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Photos of the type form of *H. planiceps* in life can be found in Cogger (2014) at page 370, bottom, and online at:

https://www.flickr.com/photos/euprepiosaur/22267079729/

and

https://www.flickr.com/photos/smacdonald/5221029774/

and

https://www.flickr.com/photos/jramos15/46059559194/

Specimens from Fitzroy Crossing, as seen in the image at:

https://www.flickr.com/photos/126237772@N07/31127002498/

the depicted example of which has 12 light cross bands on the tail is otherwise morphologically most similar to the type form of *H. planiceps*, and therefore tentatively referred to that taxon.

A specimen of *H. binghami sp. nov*. in life can be found online at:

https://www.flickr.com/photos/zimny_anders/28915729912/

Photos of specimens of *H. ruffellae sp. nov*. in life can be found in Brown (1994) on page 251 top left and online at:

https://www.flickr.com/photos/reptileshots/45213228932/

and

https://www.flickr.com/photos/126002448@N02/20493084120/

Photos of specimens of *H. arcerii sp. nov*. in life can be found online at:

https://www.flickr.com/photos/reptileshots/45213229122/

and

https://www.flickr.com/photos/euprepiosaur/24925711218/

and

https://www.flickr.com/photos/euprepiosaur/38490145181/

Photos of specimens of *H. hoserae sp. nov.* in life can be found online at:

https://www.flickr.com/photos/smacdonald/3221488546/

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https://www.flickr.com/photos/euprepiosaur/7240110822/

and

https://www.flickr.com/photos/euprepiosaur/4930457953/

and

https://www.flickr.com/photos/mattsummerville/7164378868/

and

https://www.inaturalist.org/observations/80323860

and

https://www.inaturalist.org/observations/66765276

Distribution: *H. arcerii sp. nov*. occurs in the Keep and Victoria River districts in the far north-west Northern Territory, Australia.

Etymology: *H. arcerii sp. nov*. is named in honour of Joel Paul Arceri, originally of Melbourne, Victoria, Australia in recognition of his various contributions to herpetology in Australia.

HETERONOTIA HOSERAE SP. NOV.

LSIDurn:lsid:zoobank.org:act:134CB540-3FF8-404A-8A4F-CB8620D1031F

Holotype: A preserved specimen at the Museum and Art Gallery of the Northern Territory, Australia, specimen number R20457, collected from the Oenpelli Reservoir Area, Kakadu, Northern Territory, Australia, Latitude -12.333 S., Longitude 133.133 E. This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the Museum and Art Gallery of the Northern Territory, Australia, specimen number R21004, collected from the Mount Howship area in west Arnhem Land, Northern territory, Australia, Latitude -12.633 S., Longitude 133.433 E.

Diagnosis: Until now, putative *H. planiceps* (Storr, 1989) has been treated as a single wide-ranging species extending from the West Kimberley region, across to Groote Eylandt, in the Northern Territory.

The molecular evidence of Fujita *et al.* (2010) and Pepper *et al.* (2013) confirmed the presence of multiple species under the banner of *H. planiceps*, with the split in this paper reflecting genetic divergence as known, divergence across biogeographical barriers of known antiquity and also clear and consistent morphological divergence between allopatric populations.

The five relevant species are:

H. planiceps herein confined to the West Kimberley region of Western Australia.

H. binghami sp. nov., effectively confined the Carson Escarpment area, in the north-west Kimberley region.

H. ruffellae sp. nov. found in the east Kimberley district, generally corresponding to the lower Ord River drainage.

H. arcerii sp. nov. from the Keep and Victoria River districts in the far north-west Northern Territory.

H. hoserae sp. nov. from Arnhem Land, Northern Territory.

Also formally named for the first time is *H. hoserae insularis subsp. nov*. from Groote Eylandt, in the eastern Northern Territory.

The preceding taxa are separated from one another by the following unique suites of characters:

H. planiceps is readily separated from all other species by the presence of well-defined crossbands with fairly even boundaries on top and bottom, being a rich yellow in colour alternating with purplish brown bands, that darken slightly at the upper and lower edges to give a blackish border.

The upper surfaces of limbs are a distinct combination of well defined purplish and yellow markings, of fairly even ratio, but usually slightly more purple.

The supracilliaries are large and prominent, being far more so than for any other species in the complex. They commence below the mid-line of the eye anteriorly and continue to the thin yellow temporal streak near the top of the eye on the posterior side. The supracilliaries are invariably black with yellow tips and very distinctive, or rarely all yellow. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being even in these markings.

Most of the iris is reddish brown, but with an obvious bluey-grey outer border.

H. binghami sp. nov. is similar in most respects to *H. planiceps* as described above, but the supracilliaries are not as prominent and with little if any black, instead being all yellow, the upper and

lower labials are usually a dark purple grey, unique for the species complex and the yellow cross bands across the dorsum have a strong hint of purple running through them. Between the upper flanks and the belly, the lower sides are mainly a dark purple in colour, versus light in all the other species in the group. The middle of the iris has an orange streak running up/down through the middle, while the rest is speckled beige. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being more-or-less even in these markings. Purple and brown markings on the upper surfaces of the limbs are semi-distinct.

H. ruffellae sp. nov. from the East Kimberley is readily separated from the two preceding species by having a yellow-brown rinse through its colour, meaning that the dorsal cross bands alternate between light brown to beige and a chocolate brown, the darker bands darkening towards black slightly at the outer edges. Supracilliaries are generally yellow.

Other than the orange streak in the middle of the iris going up/down the rest of the iris is a dark bluish/grey.

The upper surfaces of the limbs (in adults) are beige with scattered tiny chocolate dots.

H. arcerii sp. nov. is separated from all others in the species group by having a generally faded dorsal pattern. Otherwise it is similar in most respects to *H. ruffellae sp. nov.* but further differentiated from that taxon by having a strong purplish sheen on the lower flanks. The orange streak in the centre of the eye is only semi-distinct and the iris is otherwise dark grey. Tail has an average of 8-10 lighter cross bands, alternating with dark.

The dorsal cross-bands of this species are obviously orange, alternating with dark brown (although often both are faded), but in any event beyond the hindlimbs, the bands rapidly turn to an even black and white on the original tail, also sometimes faded.

H. hoserae sp. nov. is separated from all the preceding species by having pattern of chocolate brown and light grey or light beige cross bands on the upper body.

Unlike for the Kimberley and Victoria River species, the lighter cross bands on the posterior half of the body have very irregular edges.

Upper surfaces of the limbs are mainly dark with scattered light grey patches. The orange at the centre of the eye is barely noticeable and the iris is a medium grey to brown in colour. 8-10 light cross bands on the original tail.

H. hoserae insularis subsp. nov. is similar in most respects to *H. hoserae sp. nov.* (see above), but separated from that taxon by having a mainly light brown iris and whitish upper surfaces of the limbs with purplish markings. There is a clear lightening of the centres of the darker chocolate-brown to black crossbands at the posterior part of the body.

The morphologically similar four species and single subspecies from the *H. spelea* complex are separated from the above five species by the fact that the *H. planiceps* complex have obvious dark purplish markings anterior to the eye, forming a band through the eye, and posterior to join the similarly dark purplish nuchal band; purplish speckling on the upper surface of the head posterior to the eye, all over a light grayish or yellowish background and in nominate *H. planiceps* distinctive enlarged supraciliaries yellow with fine black banding, (versus not so in all members of the *H. spelea* complex).

All species in the *H. spelea* complex are confined to the Pilbara of Western Australia save for the divergent *H. fasciolatus* Pepper *et al.*, 2013, which occurs in the ranges of central Australia in the Northern Territory.

All the preceding 9 species within the *H. spelea* and *H. planiceps* complexes are separated from the eight species in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens where tail bands are wide.

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Photos of the type form of *H. planiceps* in life can be found in Cogger (2014) at page 370, bottom, and online at:

https://www.flickr.com/photos/euprepiosaur/22267079729/

and

https://www.flickr.com/photos/smacdonald/5221029774/

and

https://www.flickr.com/photos/jramos15/46059559194/

Specimens from Fitzroy Crossing, as seen in the image at:

https://www.flickr.com/photos/126237772@N07/31127002498/

the depicted example of which has 12 light cross bands on the tail is otherwise morphologically most similar to the type form of *H. planiceps*, and therefore tentatively referred to that taxon.

A specimen of *H. binghami sp. nov.* in life can be found online at:

https://www.flickr.com/photos/zimny_anders/28915729912/

Photos of specimens of *H. ruffellae sp. nov.* in life can be found in Brown (1994) on page 251 top left and online at:

https://www.flickr.com/photos/reptileshots/45213228932/

and

https://www.flickr.com/photos/126002448@N02/20493084120/

Photos of specimens of *H. arcerii sp. nov.* in life can be found online at:

https://www.flickr.com/photos/reptileshots/45213229122/

and

https://www.flickr.com/photos/euprepiosaur/24925711218/

and

https://www.flickr.com/photos/euprepiosaur/38490145181/

Photos of specimens of *H. hoserae sp. nov.* in life can be found online at:

https://www.flickr.com/photos/smacdonald/3221488546/

and

https://www.flickr.com/photos/euprepiosaur/7240110822/

and

https://www.flickr.com/photos/euprepiosaur/4930457953/

and

https://www.flickr.com/photos/mattsummerville/7164378868/

and

https://www.inaturalist.org/observations/80323860

and

https://www.inaturalist.org/observations/66765276

Distribution: *H. hoserae sp. nov.* occurs in Arnhem Land, Northern Territory, Australia. The subspecies *H. hoserae insularis subsp. nov.* is found on Groote Eylandt, in the north-eastern Northern Territory of Australia.

Etymology: *H. hoserae sp. nov.* is named in honour of my long suffering wife, Shireen Vanessa Hoser in recognition of her many contributions to herpetology over more than 2 decades, including doing hands on reptile shows when I was unable to as part of the family reptile display and education business as well as countless other important contributions to herpetology, science and public safety.

HETERONOTIA HOSERAE INSULARIS SUBSP. NOV.

LSIDurn:lsid:zoobank.org:act:6F934E32-95E6-4E9A-AF36-E76E345570BB

Holotype: A preserved specimen at the Museum and Art Gallery of the Northern Territory, Australia, specimen number R07545 collected at Ebirramurrumanja, Groote Eylandt, Northern Territory, Australia, Latitude -13.967 S., Longitude 136.683 E. This government-owned facility allows access to its holdings. The specimen was last seen by myself in a jar labelled *H. spelea*.

Diagnosis: Until now, putative *H. planiceps* (Storr, 1989) has been treated as a single wide-ranging species extending from the West Kimberley region, across to Groote Eylandt, in the Northern Territory.

The molecular evidence of Fujita *et al.* (2010) and Pepper *et al.* (2013) confirmed the presence of multiple species under the banner of *H. planiceps*, with the split in this paper reflecting genetic divergence as known, divergence across biogeographical barriers of known antiquity and also clear and consistent morphological divergence between allopatric populations.

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H. hoserae sp. nov. from Arnhem Land, Northern Territory.

Also formally named for the first time is *H. hoserae insularis subsp. nov.* from Groote Eylandt, in the eastern Northern Territory.

The preceding taxa are separated from one another by the following unique suites of characters:

H. planiceps is readily separated from all other species by the presence of well-defined crossbands with fairly even boundaries on top and bottom, being a rich yellow in colour alternating with purplish brown bands, that darken slightly at the upper and lower edges to give a blackish border.

The upper surfaces of limbs are a distinct combination of well defined purplish and yellow markings, of fairly even ratio, but usually slightly more purple.

The supracilliaries are large and prominent, being far more so than for any other species in the complex. They commence below the mid-line of the eye anteriorly and continue to the thin yellow temporal streak near the top of the eye on the posterior side. The supracilliaries are invariably black with yellow tips and very distinctive, or rarely all yellow. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being even in these markings.

Most of the iris is reddish brown, but with an obvious bluey-grey outer border.

H. binghami sp. nov. is similar in most respects to *H. planiceps* as described above, but the supracilliaries are not as prominent and with little if any black, instead being all yellow, the upper and lower labials are usually a dark purple grey, unique for the species complex and the yellow cross bands across the dorsum have a strong hint of purple running through them. Between the upper flanks and the belly, the lower sides are mainly a dark purple in colour, versus light in all the other species in the group. The middle of the iris has an orange streak running up/down through the middle, while the rest is speckled beige. There are usually 5-8 whitish bands on the original tail, alternating with dark purple, black or grey, the colour intensity being more-or-less even in these markings. Purple and brown markings on the upper surfaces of the limbs are semi-distinct.

H. ruffellae sp. nov. from the East Kimberley is readily separated from the two preceding species by having a yellow-brown rinse through its colour, meaning that the dorsal cross bands alternate between light brown to beige and a chocolate brown, the darker bands darkening towards black slightly at the outer edges. Supracilliaries are generally yellow.

Other than the orange streak in the middle of the iris going up/down the rest of the iris is a dark bluish/grey.

The upper surfaces of the limbs (in adults) are beige with scattered tiny chocolate dots.

H. arcerii sp. nov. is separated from all others in the species group by having a generally faded dorsal pattern. Otherwise it is similar in most respects to *H. ruffellae sp. nov.* but further differentiated from that taxon by having a strong purplish sheen on the lower flanks. The orange streak in the centre of the eye is only semi-distinct and the iris is otherwise dark grey. Tail has an average of 8-10 lighter cross bands, alternating with dark.

The dorsal cross-bands of this species are obviously orange, alternating with dark brown (although often both are faded), but in any event beyond the hindlimbs, the bands rapidly turn to an even black and white on the original tail, also sometimes faded.

H. hoserae sp. nov. is separated from all the preceding species by having pattern of chocolate brown and light grey or light beige cross bands on the upper body.

Unlike for the Kimberley and Victoria River species, the lighter cross bands on the posterior half of the body have very irregular edges.

Upper surfaces of the limbs are mainly dark with scattered light grey patches. The orange at the centre of the eye is barely noticeable and the iris is a medium grey to brown in colour. 8-10 light cross bands on the original tail.

H. hoserae insularis subsp. nov. is similar in most respects to *H. hoserae sp. nov.* (see above), but separated from that taxon by having a mainly light brown iris and whitish upper surfaces of the limbs with purplish markings. There is a clear lightening of the centres of the darker chocolate-brown to black crossbands at the posterior part of the body.

The morphologically similar four species and single subspecies from the *H. spelea* complex are separated from the above five species by the fact that the *H. planiceps* complex have obvious dark purplish markings anterior to the eye, forming a band through the eye, and posterior to join the similarly dark purplish nuchal band; purplish speckling on the upper surface of the head posterior to the eye, all over a light grayish or yellowish background and in nominate *H. planiceps* distinctive enlarged supraciliaries yellow with fine black banding, (versus not so in all members of the *H. spelea* complex).

All species in the *H. spelea* complex are confined to the Pilbara of Western Australia save for the divergent *H. fasciolatus* Pepper *et al.*, 2013, which occurs in the ranges of central Australia in the Northern Territory.

All the preceding 9 species within the *H. spelea* and *H. planiceps* complexes are separated from the eight species in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens where tail bands are wide.

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Photos of the type form of *H. planiceps* in life can be found in Cogger (2014) at page 370, bottom, and online at:

https://www.flickr.com/photos/euprepiosaur/22267079729/

and

https://www.flickr.com/photos/smacdonald/5221029774/

and

https://www.flickr.com/photos/jramos15/46059559194/

Specimens from Fitzroy Crossing, as seen in the image at:

https://www.flickr.com/photos/126237772@N07/31127002498/

the depicted example of which has 12 light cross bands on the tail is otherwise morphologically most similar to the type form of *H. planiceps*, and therefore tentatively referred to that taxon.

A specimen of *H. binghami sp. nov*. in life can be found online at:

https://www.flickr.com/photos/zimny_anders/28915729912/

Photos of specimens of *H. ruffellae sp. nov*. in life can be found in Brown (1994) on page 251 top left and online at:

https://www.flickr.com/photos/reptileshots/45213228932/

and

https://www.flickr.com/photos/126002448@N02/20493084120/

Photos of specimens of *H. arcerii sp. nov*. in life can be found online at:

https://www.flickr.com/photos/reptileshots/45213229122/

and

https://www.flickr.com/photos/euprepiosaur/24925711218/

and

https://www.flickr.com/photos/euprepiosaur/38490145181/

Photos of specimens of *H. hoserae sp. nov*. in life can be found online at:

https://www.flickr.com/photos/smacdonald/3221488546/

and

https://www.flickr.com/photos/euprepiosaur/7240110822/

and

https://www.flickr.com/photos/euprepiosaur/4930457953/

and

https://www.flickr.com/photos/mattsummerville/7164378868/

and

https://www.inaturalist.org/observations/80323860

and

https://www.inaturalist.org/observations/66765276

Distribution: *H. hoserae sp. nov*. occurs in Arnhem Land, Northern Territory, Australia.

The subspecies *H. hoserae insularis subsp. nov*. is found on Groote Eylandt, in the north-eastern Northern Territory and is almost certainly restricted to this island.

Etymology: *H. hoserae insularis subsp. nov*. is named in reflection of the fact that this is an insular subspecies restricted to Groote Eylandt, Northern Territory, Australia.

HETERONOTIA DERBIANUS GROOTEENSIS SUBSP. NOV.

LSIDurn:lsid:zoobank.org:act:F8EAF646-4653-4315-BB56-45F058F44B25

Holotype: A preserved specimen at the Northern Territory Art Gallery and Museum, Darwin, Northern Territory, Australia, specimen number R07552 collected from Milyelyumurrumanja, Groote Eylandt, Northern Territory, Australia, Latitude -13.95 S., Longitude 136.467 E. This government-owned facility allows access to its holdings.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species*."

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

Science involves change at times and this change is for the better.

The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al.* (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov*. in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia

(where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.*.

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov.*, being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:

Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. On close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov.* the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the

following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

https://www.inaturalist.org/observations/24713479

and

https://www.inaturalist.org/observations/68898671

and

https://www.inaturalist.org/observations/111770813

and

https://www.inaturalist.org/observations/68898871

H. derbianus Gray, 1845 in life is depicted online at:

https://www.inaturalist.org/observations/69890852
and
https://www.inaturalist.org/observations/42206077
H. derbianus grooteensis subsp. nov. is depicted in life online at:
https://www.inaturalist.org/observations/75395312
H. anomalus (Peters, 1867) in life is depicted in Hoser (1989) on page 73 bottom left, Brown (2014) on page 250, 3 top photos on left and very top image on right, Cogger (2014) on page 369, bottom, Swan, Shea and Sadlier (2009) on page 24, Wilson and Knowles (1998) on page 235 at right middle and online at:
https://www.inaturalist.org/observations/46468286
and
https://www.inaturalist.org/observations/61548756
and
https://www.inaturalist.org/observations/53298127
H. oxyi sp. nov. is depicted in life in Brown (2014) on page 250 (bottom left) (from Doomadgee, Queensland), Wilson (2015) on page 75, bottom photo and online at:
https://www.inaturalist.org/observations/62874050
and
https://www.flickr.com/photos/euprepiosaur/24476397548/
H. maxinehoserae sp. nov. is depicted in life in Hoser (1989) on page 73, middle right image, Brown (2014) page 250, second from bottom on left (from Onslow, Western Australia), and online at:
https://www.inaturalist.org/observations/101142687
and
https://www.inaturalist.org/observations/41348033
and
https://www.inaturalist.org/observations/90323654
and
https://www.inaturalist.org/observations/101141281
H. nonidem sp. nov. is depicted in life in Hoser (1989) on page 73, top right image, Brown (2014) on page 250, second from top on right (from Mount Elizabeth Station, Western Australia) and online at:
https://www.inaturalist.org/observations/26045039
and
https://www.flickr.com/photos/euprepiosaur/22428162136/
and
https://www.flickr.com/photos/54876436@N08/9244477733/
H. nonidem sundayensis subsp. nov. in life is depicted online at:
https://www.inaturalist.org/observations/102842663
H. keilleri sp. nov. in life is depicted in Wilson and Swan (2017) on page 147, right middle (from Prince of Wales Island, Queensland) and online at:
https://www.inaturalist.org/observations/107093418
and
https://www.inaturalist.org/observations/106659996
and
https://www.inaturalist.org/observations/57804906
and
https://www.inaturalist.org/observations/57804895
H. pailsi sp. nov. is depicted in life online at:
https://www.flickr.com/photos/ryanfrancis/8278986907/
and
https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies) recognized herein, with one or more others possibly not accounted for, and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight recognized species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: The subspecies *H. derbianus grooteensis subsp. nov.* is apparently restricted to Groote Eylandt, Northern Territory, Australia.

Etymology: The subspecies *H. derbianus grooteensis subsp. nov.* is named in reflection fo where it comes from, namely Groote Eylandt, Northern Territory, Australia.

HETERONOTIA OXYI SP. NOV.

LSIDurn:lsid:zoobank.org:act:619B3DD8-FE88-4751-A716-255673DF771A

Holotype: A preserved specimen at the Australian Museum, Sydney, New South Wales, Australia, specimen number R.63459 collected from Walker Creek at The Karumba-Normanton Rd, North Queensland, Australia, Latitude -17.483 S., Longitude 141.183 S. This government-owned facility allows access to its holdings.

Paratype; A preserved specimen at the Museum and Art Gallery of the Northern Territory, Darwin, Northern Territory, specimen number R25815, collected from the Karumba Rd (42 km South of Karumba), Normanton, Queensland, Australia, Latitude -17.51 S., Longitude 141.165 E.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species.*"

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

Science involves change at times and this change is for the better.

The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al*. (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov*. in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*..

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov*., being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:
Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. In close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov*. the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and

furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.* by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with

indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

https://www.inaturalist.org/observations/24713479

and

https://www.inaturalist.org/observations/68898671

and

https://www.inaturalist.org/observations/111770813

and

https://www.inaturalist.org/observations/68898871

H. derbianus Gray, 1845 in life is depicted online at:

https://www.inaturalist.org/observations/69890852

and

https://www.inaturalist.org/observations/42206077

H. derbianus grooteensis subsp. nov. is depicted in life online at: https://www.inaturalist.org/observations/75395312

H. anomalus (Peters, 1867) in life is depicted in Hoser (1989) on page 73 bottom left, Brown (2014) on page 250, 3 top photos on left and very top image on right, Cogger (2014) on page 369, bottom, Swan, Shea and Sadlier (2009) on page 24, Wilson and Knowles (1998) on page 235 at right middle and online at:

https://www.inaturalist.org/observations/46468286

and

https://www.inaturalist.org/observations/61548756

and

https://www.inaturalist.org/observations/53298127

H. oxyi sp. nov. is depicted in life in Brown (2014) on page 250 (bottom left) (from Doomadgee, Queensland), Wilson (2015) on page 75, bottom photo and online at:
https://www.inaturalist.org/observations/62874050
and
https://www.flickr.com/photos/euprepiosaur/24476397548/

H. maxinehoserae sp. nov. is depicted in life in Hoser (1989) on page 73, middle right image, Brown (2014) page 250, second from bottom on left (from Onslow, Western Australia), and online at:

https://www.inaturalist.org/observations/101142687

and

https://www.inaturalist.org/observations/41348033

and

https://www.inaturalist.org/observations/90323654

and

https://www.inaturalist.org/observations/101141281

H. nonidem sp. nov. is depicted in life in Hoser (1989) on page 73, top right image, Brown (2014) on page 250, second from top on right (from Mount Elizabeth Station, Western Australia) and online at:

https://www.inaturalist.org/observations/26045039

and

https://www.flickr.com/photos/euprepiosaur/22428162136/

and

https://www.flickr.com/photos/54876436@N08/9244477733/

H. nonidem sundayensis subsp. nov. in life is depicted online at: https://www.inaturalist.org/observations/102842663

H. keilleri sp. nov. in life is depicted in Wilson and Swan (2017) on page 147, right middle (from Prince of Wales Island, Queensland) and online at:

https://www.inaturalist.org/observations/107093418

and

https://www.inaturalist.org/observations/106659996

and

https://www.inaturalist.org/observations/57804906

and

https://www.inaturalist.org/observations/57804895

H. pailsi sp. nov. is depicted in life online at:

https://www.flickr.com/photos/ryanfrancis/8278986907/

and

https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies), and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: *Heteronotia oxyi sp. nov.* is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

Etymology: *Heteronotia oxyi sp. nov.* is named in honour of a deceased Great Dane Dog, named "*Oxyuranus*" or "*Oxy*" for short, for services to our family, business and science over his lifetime. This included guarding our wildlife research facility in Melbourne, Victoria, Australia, from thefts over his 8 years of life.

HETERONOTIA MAXINEHOSERAE SP. NOV.

LSIDurn:lsid:zoobank.org:act:69978E0F-E029-4A96-9E0B-36D9CD8A9318

Holotype: A preserved specimen at the Museum and Art Gallery of the Northern Territory, Darwin, Northern Territory, Australia, specimen number R12132 collected from 1.3 km east of Stuart Highway on the Murchison Range Road, Northern Territory, Australia, Latitude -20.0 S., Longitude 134.233 E.

This government-owned facility allows access to its holdings.

Paratypes: Two preserved specimens at the Museum and Art Gallery of the Northern Territory, Darwin, Northern Territory, Australia, specimen numbers R12133 and R12134 collected from 1.3 km east of Stuart Highway on the Murchison Ranges Road, Northern Territory, Australia, Latitude -20.0 S., Longitude 134.233 E.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species*."

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

Science involves change at times and this change is for the better.

The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al.* (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov.* in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.*.

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov.*, being from Sunday Island,

Above: *Heteronotia anomalus* (Peters, 1867) from Dalby, SE Queensland, Australia.
Below: Left: *H. maxinehoserae sp. nov.* from Broome, Western Australia, Australia.
Below: Right: *H. nonidem sp. nov*. from Kunanurra, Western Australia, Australia.
All photos: Raymond Hoser.

Hoser 2022 - Australasian Journal of Herpetology 55:3-48.

Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:

Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. In close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov.* the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

https://www.inaturalist.org/observations/24713479

and

https://www.inaturalist.org/observations/68898671

and

https://www.inaturalist.org/observations/111770813

and

https://www.inaturalist.org/observations/68898871

H. derbianus Gray, 1845 in life is depicted online at:

https://www.inaturalist.org/observations/69890852

and

https://www.inaturalist.org/observations/42206077

H. derbianus grooteensis subsp. nov. is depicted in life online at:
https://www.inaturalist.org/observations/75395312

H. anomalus (Peters, 1867) in life is depicted in Hoser (1989) on page 73 bottom left, Brown (2014) on page 250, 3 top photos on left and very top image on right, Cogger (2014) on page 369, bottom, Swan, Shea and Sadlier (2009) on page 24, Wilson and Knowles (1998) on page 235 at right middle and online at:

https://www.inaturalist.org/observations/46468286

and

https://www.inaturalist.org/observations/61548756

and

https://www.inaturalist.org/observations/53298127

H. oxyi sp. nov. is depicted in life in Brown (2014) on page 250 (bottom left) (from Doomadgee, Queensland), Wilson (2015) on page 75, bottom photo and online at:
https://www.inaturalist.org/observations/62874050
and
https://www.flickr.com/photos/euprepiosaur/24476397548/

H. maxinehoserae sp. nov. is depicted in life in Hoser (1989) on page 73, middle right image, Brown (2014) page 250, second from bottom on left (from Onslow, Western Australia), and online at:

https://www.inaturalist.org/observations/101142687

and

https://www.inaturalist.org/observations/41348033

and

https://www.inaturalist.org/observations/90323654

and

https://www.inaturalist.org/observations/101141281

H. nonidem sp. nov. is depicted in life in Hoser (1989) on page 73, top right image, Brown (2014) on page 250, second from top

on right (from Mount Elizabeth Stn, WA, Australia) and online at:
https://www.inaturalist.org/observations/26045039
and
https://www.flickr.com/photos/euprepiosaur/22428162136/
and
https://www.flickr.com/photos/54876436@N08/9244477733/
H. nonidem sundayensis subsp. nov. in life is depicted online at:
https://www.inaturalist.org/observations/102842663
H. keilleri sp. nov. in life is depicted in Wilson and Swan (2017) on page 147, right middle (from Prince of Wales Island, Queensland) and online at:
https://www.inaturalist.org/observations/107093418
and
https://www.inaturalist.org/observations/106659996
and
https://www.inaturalist.org/observations/57804906
and
https://www.inaturalist.org/observations/57804895
H. pailsi sp. nov. is depicted in life online at:
https://www.flickr.com/photos/ryanfrancis/8278986907/
and
https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies), and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: *H. maxinehoserae sp. nov.* has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone running north of the central ranges and outliers in Central Australia (where *H. binoei* takes its place) and south of the hilly tropics of the top end of the NT and WA, but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

Etymology: *Heteronotia maxinehoserae sp. nov*. is named in honour of my English cousin, Maxine Hoser of Margate, UK (in the Kingdom of Queen Elizabeth (the second) and all her servants), in recognition for her services to herpetology back in the 1960's, assisting myself in my earliest reptile research projects.

HETERONOTIA NONIDEM SP. NOV.

LSIDurn:lsid:zoobank.org:act:D576552E-BCB8-4282-9122-9FB4CEDC9C60

Holotype: A preserved specimen at the National Museum of Victoria, Melbourne, Victoria, Australia, specimen number D34188 collected from 11.2 km south of the main Ord River Dam, near Kunanurra, Western Australia, Australia, Latitude -15.97 S., Longitude 128.75 E.

This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the National Museum of Victoria, Melbourne, Victoria, Australia, specimen number D34187 collected from 11.2 km south of the main Ord River Dam, near Kunanurra, Western Australia, Australia, Latitude -15.97 S., Longitude 128.75 E.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species.*"

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

Science involves change at times and this change is for the better.

The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al.* (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov*. in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby

parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*..

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov*., being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:

Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. In close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov*. the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another

colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.* by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.* by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light

brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

https://www.inaturalist.org/observations/24713479

and

https://www.inaturalist.org/observations/68898671

and

https://www.inaturalist.org/observations/111770813

and

https://www.inaturalist.org/observations/68898871

H. derbianus Gray, 1845 in life is depicted online at:

https://www.inaturalist.org/observations/69890852

and

https://www.inaturalist.org/observations/42206077

H. derbianus grooteensis subsp. nov. is depicted in life online at:
https://www.inaturalist.org/observations/75395312

H. anomalus (Peters, 1867) in life is depicted in Hoser (1989) on page 73 bottom left, Brown (2014) on page 250, 3 top photos on left and very top image on right, Cogger (2014) on page 369, bottom, Swan, Shea and Sadlier (2009) on page 24, Wilson and Knowles (1998) on page 235 at right middle and online at:

https://www.inaturalist.org/observations/46468286

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H. oxyi sp. nov. is depicted in life in Brown (2014) on page 250 (bottom left) (from Doomadgee, Queensland), Wilson (2015) on page 75, bottom photo and online at:
https://www.inaturalist.org/observations/62874050
and
https://www.flickr.com/photos/euprepiosaur/24476397548/

H. maxinehoserae sp. nov. is depicted in life in Hoser (1989) on page 73, middle right image, Brown (2014) page 250, second from bottom on left (from Onslow, Western Australia), and online at:

https://www.inaturalist.org/observations/101142687

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and

https://www.inaturalist.org/observations/90323654

and

https://www.inaturalist.org/observations/101141281

H. nonidem sp. nov. is depicted in life in Hoser (1989) on page 73, top right image, Brown (2014) on page 250, second from top on right (from Mount Elizabeth Station, Western Australia) and online at:

https://www.inaturalist.org/observations/26045039

and

https://www.flickr.com/photos/euprepiosaur/22428162136/

and

https://www.flickr.com/photos/54876436@N08/9244477733/

H. nonidem sundayensis subsp. nov. in life is depicted online at:
https://www.inaturalist.org/observations/102842663

H. keilleri sp. nov. in life is depicted in Wilson and Swan (2017) on page 147, right middle (from Prince of Wales Island, Queensland) and online at:

https://www.inaturalist.org/observations/107093418

and

https://www.inaturalist.org/observations/106659996

and

https://www.inaturalist.org/observations/57804906

and

https://www.inaturalist.org/observations/57804895

H. pailsi sp. nov. is depicted in life online at:

https://www.flickr.com/photos/ryanfrancis/8278986907/

and

https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies), and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: *H. nonidem sp. nov.* occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

H. maxinehoserae sp. nov. occurs in drier zones south of where *H. nonidem sp. nov.* occurs.

Etymology: *Heteronotia nonidem sp. nov.* is named in reflection of the Latin word which means “not the same”, with this taxon not being the same as its nearest related congener, *H. maxinehoserae sp. nov.*.

HETERONOTIA NONIDEM SUNDAYENSIS SUBSP. NOV.

LSIDurn:lsid:zoobank.org:act:6B24C8BF-1040-4183-8FEA-11CDABB6BA6C

Holotype: A preserved specimen at the Western Australian Museum, Perth, Western Australia, Australia, specimen number R58860 collected from Sunday Island, King Sound, Kimberley District, Western Australia, Australia, Latitude -16.416667 S., Longitude 123.183333 E. This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the Western Australian Museum, Perth, Western Australia, Australia, specimen number R58861 collected from Sunday Island, King Sound, Kimberley District, Western Australia, Australia, Latitude -16.416667 S., Longitude 123.183333 E.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species*."

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

Science involves change at times and this change is for the better.

The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al.* (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov.* in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.*.

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov.*, being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:
Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. In close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the

lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov*. the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey

distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

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https://www.inaturalist.org/observations/57804895

H. pailsi sp. nov. is depicted in life online at:

https://www.flickr.com/photos/ryanfrancis/8278986907/

and

https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies), and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row

between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: The subspecies *H. nonidem sundayensis subsp. nov.* appears to be restricted to Sunday Island, in the Kimberley district of Western Australia, Australia.

There may be other endemic taxa in this genus on other islands in north-west Australia.

Etymology: The subspecies *H. nonidem sundayensis subsp. nov.* is named in reflection of where it is found, namely Sunday Island, in the Kimberley district of Western Australia, Australia.

HETERONOTIA KEILLERI SP. NOV.

LSIDurn:lsid:zoobank.org:act:3C4372B5-15F2-4085-BA27-2F5901A967B5

Holotype: A preserved specimen at the Queensland Museum, Brisbane, Queensland, Australia specimen number J38173 collected from 18 km west north-west of Coen Airport, far north Queensland, Australia, Latitude -13.633333 S., Longitude 143.05 E. This government-owned facility allows access to its holdings.

Paratypes: 1/ A preserved specimen at the Queensland Museum, Brisbane, Queensland, Australia specimen number J34535 collected from Steens Hut, about 30 km north-east of Coen, far north Queensland, Australia, Latitude -13.566667 S., Longitude 143.216667 E. 2/ A preserved specimen at the Queensland Museum, Brisbane, Queensland, Australia specimen number J38325 collected from Peach Creek, 14 km north north-west of Mount Croll, far north Queensland, Australia, Latitude -13.666667 S., Longitude 143.116667 E.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species*."

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

Science involves change at times and this change is for the better.

The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al.* (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov.* in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*..

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov*., being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:

Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. In close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov*. the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots

or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov*. by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

https://www.inaturalist.org/observations/24713479

and

https://www.inaturalist.org/observations/68898671

and

https://www.inaturalist.org/observations/111770813

and

https://www.inaturalist.org/observations/68898871

H. derbianus Gray, 1845 in life is depicted online at:

https://www.inaturalist.org/observations/69890852

and

https://www.inaturalist.org/observations/42206077

H. derbianus grooteensis subsp. nov. is depicted in life online at: https://www.inaturalist.org/observations/75395312

H. anomalus (Peters, 1867) in life is depicted in Hoser (1989) on page 73 bottom left, Brown (2014) on page 250, 3 top photos on left and very top image on right, Cogger (2014) on page 369, bottom, Swan, Shea and Sadlier (2009) on page 24, Wilson and Knowles (1998) on page 235 at right middle and online at:

https://www.inaturalist.org/observations/46468286

and

https://www.inaturalist.org/observations/61548756

and

https://www.inaturalist.org/observations/53298127

H. oxyi sp. nov. is depicted in life in Brown (2014) on page 250

(bottom left) (from Doomadgee, Queensland), Wilson (2015) on page 75, bottom photo and online at:
https://www.inaturalist.org/observations/62874050
and
https://www.flickr.com/photos/euprepiosaur/24476397548/

H. maxinehoserae sp. nov. is depicted in life in Hoser (1989) on page 73, middle right image, Brown (2014) page 250, second from bottom on left (from Onslow, Western Australia), and online at:
https://www.inaturalist.org/observations/101142687
and
https://www.inaturalist.org/observations/41348033
and
https://www.inaturalist.org/observations/90323654
and
https://www.inaturalist.org/observations/101141281

H. nonidem sp. nov. is depicted in life in Hoser (1989) on page 73, top right image, Brown (2014) on page 250, second from top on right (from Mount Elizabeth Station, Western Australia) and online at:
https://www.inaturalist.org/observations/26045039
and
https://www.flickr.com/photos/euprepiosaur/22428162136/
and
https://www.flickr.com/photos/54876436@N08/9244477733/

H. nonidem sundayensis subsp. nov. in life is depicted online at:
https://www.inaturalist.org/observations/102842663

H. keilleri sp. nov. in life is depicted in Wilson and Swan (2017) on page 147, right middle (from Prince of Wales Island, Queensland) and online at:
https://www.inaturalist.org/observations/107093418
and
https://www.inaturalist.org/observations/106659996
and
https://www.inaturalist.org/observations/57804906
and
https://www.inaturalist.org/observations/57804895

H. pailsi sp. nov. is depicted in life online at:
https://www.flickr.com/photos/ryanfrancis/8278986907/
and
https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies), and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: *H. keilleri sp. nov*. is found from the Einasleigh Uplands and north on Cape York, Queensland, including immediately offshore Islands north of Cape York (e.g. Prince of Wales Island), but not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

Etymology: The species *H. keilleri sp. nov.* is named in honour of well known snake catcher Darren Keiller of Norlane (Geelong), Victoria, Australia (AKA Snake Catcher Geeong) in recognition of his many contributions to herpetology and wildlife conservation in Australia.

HETERONOTIA PAILSI SP. NOV.

LSIDurn:lsid:zoobank.org:act:8351C455-A702-4143-8023-C2A39AA3F653

Holotype: A preserved specimen at the South Australian Museum, Adelaide, South Australia, Australia, specimen number R42692 collected from 37 km north north-east of Mount Isa, Queensland, Australia, Latitude -20.57 S., Longitude 139.73 E. This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the South Australian Museum, Adelaide, South Australia, Australia, specimen number R.72012 collected from 135 km south of Mount Isa on the Boulia Road, Queensland, Australia, Latitude -21.700 S., Longitude 139.533 E.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species.*"

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

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The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of

Pepper *et al*. (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov*. in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.*.

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov*., being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:
Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. In close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov*. the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light

background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.* by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.* by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink

colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

https://www.inaturalist.org/observations/24713479

and

https://www.inaturalist.org/observations/68898671

and

https://www.inaturalist.org/observations/111770813

and

https://www.inaturalist.org/observations/68898871

H. derbianus Gray, 1845 in life is depicted online at:

https://www.inaturalist.org/observations/69890852

and

https://www.inaturalist.org/observations/42206077

H. derbianus grooteensis subsp. nov. is depicted in life online at:
https://www.inaturalist.org/observations/75395312

H. anomalus (Peters, 1867) in life is depicted in Hoser (1989) on page 73 bottom left, Brown (2014) on page 250, 3 top photos on left and very top image on right, Cogger (2014) on page 369, bottom, Swan, Shea and Sadlier (2009) on page 24, Wilson and Knowles (1998) on page 235 at right middle and online at:

https://www.inaturalist.org/observations/46468286

and

https://www.inaturalist.org/observations/61548756

and

https://www.inaturalist.org/observations/53298127

H. oxyi sp. nov. is depicted in life in Brown (2014) on page 250 (bottom left) (from Doomadgee, Queensland), Wilson (2015) on page 75, bottom photo and online at:
https://www.inaturalist.org/observations/62874050
and

https://www.flickr.com/photos/euprepiosaur/24476397548/

H. maxinehoserae sp. nov. is depicted in life in Hoser (1989) on page 73, middle right image, Brown (2014) page 250, second from bottom on left (from Onslow, Western Australia), and online at:

https://www.inaturalist.org/observations/101142687

and

https://www.inaturalist.org/observations/41348033

and

https://www.inaturalist.org/observations/90323654

and

https://www.inaturalist.org/observations/101141281

H. nonidem sp. nov. is depicted in life in Hoser (1989) on page 73, top right image, Brown (2014) on page 250, second from top on right (from Mount Elizabeth Station, Western Australia) and online at:

https://www.inaturalist.org/observations/26045039

and

https://www.flickr.com/photos/euprepiosaur/22428162136/

and

https://www.flickr.com/photos/54876436@N08/9244477733/

H. nonidem sundayensis subsp. nov. in life is depicted online at:
https://www.inaturalist.org/observations/102842663

H. keilleri sp. nov. in life is depicted in Wilson and Swan (2017) on page 147, right middle (from Prince of Wales Island, Queensland) and online at:

https://www.inaturalist.org/observations/107093418

and

https://www.inaturalist.org/observations/106659996

and

https://www.inaturalist.org/observations/57804906

and

https://www.inaturalist.org/observations/57804895

H. pailsi sp. nov. is depicted in life online at:

https://www.flickr.com/photos/ryanfrancis/8278986907/

and

https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies), and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: *H. pailsi sp. nov*. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov*, *H. binoei* and *H. oxyi sp. nov*..

Etymology: The species *H. pailsi sp. nov.* is named in honour of well known Victorian herpetologist, Roy Pails, of Ballarat, Victoria, Australia. He is (as of 2022) the owner of "*Pails for Scales Wildlife Conservation*", an enterprise which is doing ground-breaking wildlife conservation work and public education in Australia.

In the 1970's to 2000's Pails ran a huge number of pioneering captive breeding programs for rare and little-known species of snakes and lizards, taking pressure caused by the pet trade on these species and enhancing conservation outcomes.

HETERONOTIA CROTTYI SP. NOV.

LSIDurn:lsid:zoobank.org:act:9D6BFA00-62AC-4580-9634-2D8FB4E38277

Holotype: A preserved specimen at the Queensland Museum, Brisbane, Queensland, Australia, specimen number J46962 collected from the Gregory River Crossing, at Riversleigh Station, 300 km west north-west of Mount Isa in far north-west Queensland, Australia, Latitude -19.033333 S., Longitude 138.75 E. This government-owned facility allows access to its holdings.

Paratypes: 1/ A preserved specimen at the Queensland Museum, Brisbane, Queensland, Australia, specimen number J46964 collected from the Gregory River Crossing, at Riversleigh Station, 300 km west north-west of Mount Isa in far north-west Queensland, Australia, Latitude -19.033333 S., Longitude 138.75 E. 2/ Two preserved specimens at the Queensland Museum, Brisbane, Queensland, Australia, specimen numbers J46855 and J46856 collected from Riversleigh Station, 300 km west north-west of Mount Isa in far north-west Queensland, Australia, Latitude -19.033333 S., Longitude 138.75 E.

Diagnosis: Until now, putative *Heteronotia binoei* (Gray, 1845) has been treated as a single wide-ranging species, found in almost all of Australia except for the coldest and wettest parts of the south-west and south-east (*sensu* Cogger 2014).

However Wilson and Swan (2017) accepted the reality that more than one species was being kept within putative *H. binoei* when they stated:

"*as currently recognized, a large and problematic complex of species*."

Brown (2014) stated:

"*the Bynoe's Gecko* H. binoei *is considered to comprise numerous undescribed subspecies or species*".

Wells and Wellington (1985) were over 30 years ahead of their time in recognizing *H. binoei* as a species complex and attempting to break it up in a way they thought was sensible at the time.

As noted earlier in this paper, the specific status of the complex has been largely resolved with the morphological study by myself combined with published molecular data of Pepper *et al.* (2013) and the taxonomy within this paper is different to all previously published taxonomies.

I make no apologies for this.

Science involves change at times and this change is for the better.

The putative species *H. binoei* is herein split 9 ways, with an extra two insular subspecies formally named.

Two names are resurrected from synonymy and the rest are new and proposed in accordance with the *International Code of Zoological Nomenclature* (Ride *et al.* 1999 as amended online since).

The type form of *Heteronotia binoei* (Gray, 1845), as in all specimens referred to that species, with a type locality of Houtman's Abrolhos, Western Australia occurs in a wide area of south-central Australia, including western Queensland, across central Australia to the West Australian coast, south of the Pilbara.

H. derbianus Gray, 1845 with a type locality of Port Essington, Northern Territory was restricted to that immediate area on the Northern Territory coast and the nearby Tiwi Islands (Melville and Bathurst Islands) based on the molecular sampling of Pepper *et al.* (2013). However inspection of specimens by myself when doing fieldwork in the top end has shown the taxon to be present along the coast of the top end to at least as far as Nhulunbuy and Yirrkala further east.

The taxon in type form does not appear to be present on Groote Eylandt to the south-east, although a morphologically similar one does and so it is referred to *H. derbianus* and formally named as a new subspecies of *H. derbianus*, being *H. derbianus grooteensis subsp. nov.* in line with molecular data for other insular forms on Groote Eylandt as cited by Hoser (2018b).

H. anomalus (Peters, 1867), with a type locality of Rockhampton, Queensland, is extremely widespread occupying most of Queensland of except for the far north and north-west, being found generally south of Cape York, and south of nearby parts of the Gulf of Carpentaria and the Selwyn Ranges (where it does not occur), but then also occurring as well in almost all drier parts southern Queensland, likewise for most of New South Wales, north-west Victoria, most of South Australia and into south-east Western Australia. In the central ranges of central Australia, and arid areas immediately south, are the type form of *H. binoei.*

The newly named taxa are distributed as follows:

H. oxyi sp. nov. is found around the southern shores of the Gulf of Carpentaria and nearby parts of north-west Queensland, generally north of the Selwyn Range in the generally flatter country of far north-west Queensland (but including hills as well), extending from the Great Dividing Range in the east, west to the NT border.

H. maxinehoserae sp. nov. has a wide distribution across the north of Australia extending from the Selwyn Ranges in the east, generally west to south-west to encompass the dry zone between the central ranges and outliers in Central Australia (where *H. binoei* takes its place), but then occupying most of Western Australia outside of the tropics and much of the south-east, but including all the Pilbara and arid zones to the south and west of there, north of line running west to east from Shark Bay, including the Great Sandy Desert, Gibson Desert and Great Victoria Desert.

H. nonidem sp. nov. occupies the hilly and mountainous tropics of the top end of the Northern Territory and Kimberley District of Western Australia including intervening flat lands, other than the

very northerly locations occupied by *H. derbianus* Gray, 1845 as outlined already.

The molecular data already cited indicated a close relationship between both *H. maxinehoserae sp. nov.* and *H. nonidem sp. nov.* but they are so morphologically divergent from one another and with a divergence estimated at about 2 MYA, I had no hesitation in treating each as separate species.

Where ranges of the two abut in Western Australia no hybridization was detected in my fieldwork.

H. keilleri sp. nov. is found from the Einasleigh Uplands and north on Cape York, Queensland, not including the wet tropics, which appears to be occupied by *H. anomalus* in a north-east extension of the range of that species.

H. pailsi sp. nov. is a range-restricted species confined to a small area of rocky hills in north-west Queensland, mainly south of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.*.

H. crottyi sp. nov. is a range-restricted taxon from the hilly country between Lawn Hill and Gunpowder in north-west Queensland, north-west of Mount Isa and South of the flatter lands near the Gulf of Carpentaria, being confined on the west side by habitat that is also flatter and relatively rock free, all these boundary zones of which are inhabited by competing species in the same complex.

In addition to the preceding six newly named species, two very distinctive readily identifiable island forms are also formally named (conservatively) as new subspecies.

These are *H. nonidem sundayensis subsp. nov.* and *H. derbianus grooteensis subsp. nov.*, being from Sunday Island, Western Australia and Groote Eylandt, NT, respectively.

The nine species and two newly described subspecies are readily separated from one another with the following unique suites of characters:

H. binoei sensu stricto has the following unique suite of characters:

Iris that is either bright orange or at least orange in the centre on an otherwise yellow-brown outer edge, a dorsum that is mainly orangeish in colour, with well-defined cross bands that are either broken, or of irregular shape at the boundaries, the bands being beige in colour, sometimes but not always etched darker at the edges; the lighter beige bands or markings are always about half as wide as the darker orangeish interspaces on the dorsum; upper limbs are light orange with indistinct white dots or spots; original tail with distinctive beige bands, wide on the mid-dorsal line and rapidly narrowing on the sides of the tail, still narrower than the orangeish interspaces, which may turn blackish posteriorly in many specimens. Behind the skull and slightly anterior to the forelimbs are two well-defined and complete beige bands across the dorsum (occipital and nuchal bands), being the most well defined banding on the head or body dorsal surface. Upper surface of head is orangeish with slight amounts of grey mottling or peppering. It is not heavily spotted or marked. Upper labial markings are variable.

H. derbianus Gray, 1845 has the following unique suite of characters:

Chocolate brown iris. A generally dark chocolate-brown lizard with no obvious dorsal markings. In close inspection the dorsum has a combination of ill-defined dark and light chocolate brown markings tending to form irregularly shaped cross-bands or reticulations. There is no obvious white or light speckling on the lizard.

On the tail, the colouration and contrast rapidly sharpens to become a combination of narrow and alternating whitish and blackish rings with even boundaries and generally encircling the tail, numbering 12-14 of each on original tails. These rings usually start about 15 per cent of the way down the tail, with markings anterior to this being either ill-defined or not in the form of rings. Upper surfaces of limbs are also chocolate brown, with indistinct lighter brown spots. Banding on toes is either absent or not distinct.

H. derbianus grooteensis subsp. nov. is similar in most respects to the type form of *H. derbianus derbianus*, but differs in the following ways:

Dorsum with numerous (over 50) well-defined and tiny white spots between anterior and hind limbs, as well as similar spotting on the head (top and sides) and first fifteen percent of the anterior end of the upper surface of the tail. Banding of the tail does become black and white banded, but the bands are not relatively even and well defined as seen in the distal end of the tail in the nominate form of *H. derbianus derbianus*. In *H. derbianus grooteensis subsp. nov*. the lighter bands are peppered and indistinct anteriorly. Posteriorly, they are very narrow, making the distal end of the tail mainly black and furthermore the white bands narrow on the sides of the tail at the distal end. Fingers and toes are with distinct white bands.

H. anomalus (Peters, 1867) is identified by the following unique suite of characters:

Iris orange or orangeish. Dorsum is yellow-brown with greyish to beige markings on the dorsum, this being reduced to spots in some specimens. As a rule these lighter markings form irregular spots or may be configured to form irregular and partially joined cross-bands, which will always have irregularly shaped edges and edges marked on the sides, making any cross-banding punctuated in the form of joined spots or markings and not in the form where a light centre actually crosses the dorsum, even if irregularly (as is seen in a lot of *H. binoei*). Upper labials are invariably spotted, barred or peppered on an otherwise light background. Top of head and most of the sides is pale, but distinctively and heavily spotted or marked with dark brownish-grey spots or similar (in contrast to *H. binoei*). Upper surfaces of limbs are light in colour and marked with obvious brown spots. Markings or barring on fingers and toes is not obvious.

H. oxyi sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Iris beige, except for a tiny amount of orange in the centre. The dorsum is obviously banded dark purplish brown and greyish-beige, with 4-5 light bands on the body between front and rear limbs, this being distinctive of this species. The patterning is distinct, boundaries while not completely clean in the form of an even line, are not as irregular as seen in all other species in the *H. binoei* complex, and usually not bounded dark or with another colour.

In other words, as a rule, well formed bands do encircle the upper surface of the dorsum or alternatively similar but broken in line across the dorsum, but with wide light interspaces within the wider dark ones.

Overall, the bold patterning is also somewhat faded, as opposed to deep and bold. Limbs are a mixture of purplish brown and yellow brown, but any markings are not obvious. Fingers and toes are light in colour with a miniscule amount of peppering. The 12-14 (of each) light and dark bands on the original tail are dark yellow or grey and medium brown to purplish in colour, which may or may not have well-defined boundaries, especially with regards to the darker ones. The upper surface of the head is light with darker marbling but lacks any obvious spots, markings or peppering.

H. maxinehoserae sp. nov. is a species that is remarkably consistent in appearance across its extensive range and is separated from all other species in the *H. binoei* complex by the following characters:

All of iris is orange. A reddish orange to orange brown coloured lizard, without any distinctive markings, blotches or bands on the dorsum.

The dorsum is medium orange-brown with scattered scales which are darker in colour, sometimes tending towards black, but which do not have well defined borders with the lighter scales, meaning the lizard has no obvious pattern, spots or markings. Upper surfaces of the limbs are not distinctly marked

in the same manner as the body, although they do have darker spotting, lighter spotting or both, which is invariably wholly indistinct or at best semi-distinct. Banding on the tail is not distinct anteriorly, but becomes distinct on the second half, where it alternates between reddish brown (wider bands) and yellow-grey. Including indistinct or semi-distinct bands anteriorly (including those where dark and light bands are effectively merged), the tail has 9-14 darker and 9-14 lighter cross-bands. The upper surface of the head has no obvious markings, spots or blotches, other than indistinct peppering or rarely indistinct marbling in some eastern (Qld and nearby NT) populations.

H. nonidem sp. nov. is similar in most respects to *H. maxinehoserae sp. nov.* but is separated from that species and from all other species in the *H. binoei* complex by the following characters:

Iris yellowish to orangeish-brown, but not orange. Dorsum invariably has a semi-distinct or faded pattern incorporating irregularly-shaped and irregularly bounded cross-bands formed by a light anterior edge, grading darker towards blackish and then starting over again, with about 4-5 such bands on the body between the two sets of limbs and excluding the two being on the back of the head and just anterior to the front limbs (occipital and nuchal bands).

Banding on the tail is in contrast to the body in that it is much more distinct , alternating between dark brownish, to reddish brown (wider bands) separated by yellowish-grey narrower bands, which also either reduce or vanish on the sides of the tail.

The tail has 9-14 darker and 9-14 lighter cross-bands.

The upper surface of the head may be spotted, flecked, or marbled, either distinctively or indistinctly.

The markings on the lizard are somewhat more distinct in West Australian (Kimberley) specimens, than those from the top end of the Northern Territory, but otherwise they are much the same.

The subspecies *H. nonidem sundayensis subsp. nov.* is readily separated from all other species and subspecies in the *H. binoei* complex by the following characters:

Iris is dark brown, tending slightly orangeish in the centre. A distinctive chocolate brown dorsum of fairly even intensity, with irregularly shaped dorsal cross-bands, each formed by a row of spotted yellow scales, the bands being well formed on the anterior upper dorsum and tending to be of scattered spots posteriorly. The tail is a unique combination of chocolate brown with scattered yellow bars on the upper surface anteriorly, tending to form narrow cross-bands posteriorly, but invariably much narrower than the chocolate brown interspaces. Upper surfaces of limbs are chocolate brown with scattered tiny yellow spots. Upper surface of head is chocolate brown with numerous semi-distinct scattered yellow spots, including on the snout region.

H. keilleri sp. nov. is readily separated from all other species in the *H. binoei* complex by the following characters:

Brown iris. A dark greyish-brown colour on the dorsum punctuated by light grey tending to form cross bands, that are formed by light grey anteriorly grading rearward to near black and then starting again, this occurring about 5 times between the fore and hind limbs. On the sides of the flanks, the cross-bands tend to be spots instead, on an otherwise dark grey background. The upper surface of the head is mainly dark grey, semi-distinctly spotted with light grey. Limbs are dark grey distinctly spotted light grey.

Banding on the tail is alternate dark grey and light grey bands, of variable intensity in each, the lighter bands tend towards spots on the tail and are about as wide as the darker interspaces or bands. Toes are dark purplish-grey and prominently spotted or barred light grey.

Upper labials are mainly dark, with tiny white spots or bars.

All the preceding described markings for this species are generally bold in young specimens and become faded and indistinct in adults.

H. pailsi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.* by the following suite of characters:

Greyish-brown iris with a prominent bright orange centre. Dorsum generally dark brown with no obvious markings, bands or spots. On close inspection there are scattered darker and lighter scales with indistinct boundaries, save for some semi-distinct yellow spots or tubercles on the mid flanks. Tail is also brownish, without any obvious bands, save for a slight tendency to have yellow bars on a black background posteriorly. Anteriorly, there are barely discernible yellow bands with indistinct boundaries. Because all these are faded, the tail remains without any obvious signs of banding.

Upper surfaces of the limbs are dull reddish-brown without obvious markings, although on close inspection they are a combination of darker and lighter areas with indistinct boundaries, which is the same situation for the upper surfaces of the head and snout.

Upper labials are dark and with semi-distinct light barring.

H. crottyi sp. nov. is readily separated from all other species in the *H. binoei* complex including the potentially sympatric species *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.* by the following suite of characters:

Iris is yellow-brown with a small but distinct bit of orange along the median line vertically. Dorsum has a generally salmon-pink colour overlain on the body with 5-6 thin greyish-yellow cross bands of irregular shape and 1-2 scales wide, tending to be heavily broken on the latter third of the body. These bands are not on the flanks anteriorly, but are posteriorly. Head is light brown with semi-distinct spots, flecks or mottling of whitish colour. Upper surfaces of limbs are not distinctly marked in any way, but are of similar colour to the body, albiet slightly lighter and with scattered darker purplish-grey flecks or markings that are also faded. Feet are gereally light and barring or spots is barely noticeable. Upper labials immaculate white as is the underside of the jaw and throat.

Anterior tail is composed of bands, formed with a yellowish anterior edge grading to dark brown with blackish tips on the lower edge, each band being 4-6 scales wide, while on the lower tail these form into definite dark and light bands (beige and light brown) with well defined but not dead straight boundaries.

Ear opening is tiny in this species as in is barely noticeable, being far smaller than the small but distinct ear opening seen in the other species from North-west Queensland.

The type form of *Heteronotia binoei* (Gray, 1845) *sensu stricto* (as defined in this paper) in life is depicted in Storr, Smith and Johnstone (1990) on page 81 in top two images, both specimens being from Western Australia, Wilson and Knowles (1998) on page 235 top left and online at:

https://www.inaturalist.org/observations/24713479

and

https://www.inaturalist.org/observations/68898671

and

https://www.inaturalist.org/observations/111770813

and

https://www.inaturalist.org/observations/68898871

H. derbianus Gray, 1845 in life is depicted online at:

https://www.inaturalist.org/observations/69890852

and

https://www.inaturalist.org/observations/42206077

H. derbianus grooteensis subsp. nov. is depicted in life online at: https://www.inaturalist.org/observations/75395312

H. anomalus (Peters, 1867) in life is depicted in Hoser (1989) on page 73 bottom left, Brown (2014) on page 250, 3 top photos on left and very top image on right, Cogger (2014) on page 369,

bottom, Swan, Shea and Sadlier (2009) on page 24, Wilson and Knowles (1998) on page 235 at right middle and online at:
https://www.inaturalist.org/observations/46468286
and
https://www.inaturalist.org/observations/61548756
and
https://www.inaturalist.org/observations/53298127
H. oxyi sp. nov. is depicted in life in Brown (2014) on page 250 (bottom left) (from Doomadgee, Queensland), Wilson (2015) on page 75, bottom photo and online at:
https://www.inaturalist.org/observations/62874050
and
https://www.flickr.com/photos/euprepiosaur/24476397548/
H. maxinehoserae sp. nov. is depicted in life in Hoser (1989) on page 73, middle right image, Brown (2014) page 250, second from bottom on left (from Onslow, Western Australia), and online at:
https://www.inaturalist.org/observations/101142687
and
https://www.inaturalist.org/observations/41348033
and
https://www.inaturalist.org/observations/90323654
and
https://www.inaturalist.org/observations/101141281
H. nonidem sp. nov. is depicted in life in Hoser (1989) on page 73, top right image, Brown (2014) on page 250, second from top on right (from Mount Elizabeth Station, Western Australia) and online at:
https://www.inaturalist.org/observations/26045039
and
https://www.flickr.com/photos/euprepiosaur/22428162136/
and
https://www.flickr.com/photos/54876436@N08/9244477733/
H. nonidem sundayensis subsp. nov. in life is depicted online at:
https://www.inaturalist.org/observations/102842663
H. keilleri sp. nov. in life is depicted in Wilson and Swan (2017) on page 147, right middle (from Prince of Wales Island, Queensland) and online at:
https://www.inaturalist.org/observations/107093418
and
https://www.inaturalist.org/observations/106659996
and
https://www.inaturalist.org/observations/57804906
and
https://www.inaturalist.org/observations/57804895
H. pailsi sp. nov. is depicted in life online at:
https://www.flickr.com/photos/ryanfrancis/8278986907/
and
https://www.flickr.com/photos/ryanfrancis/8748562557/

The genus *Heteronotia* is split into three main groups, being the *H. binoei sensu lato* group (9 species and 2 subspecies), and the *H. spelea* and *H. planiceps* complexes. The nine species within the combined *H. spelea* and *H. planiceps* complexes (as defined in this paper) are separated from the eight species and two subspecies in the *H. binoei* complex by having small (not large) dorsal tubercles (more than 25 in a paravertebral row between axilla and groin, versus less than 25 in the other species), which also lie in regular longitudinal rows; body pattern is strongly banded versus either not so, or if banded they are usually of irregular shape and size and and/or usually faded. The tail is strongly banded dark and light, the bands themselves being even in colour (or mainly so in *H. fasciolatus* where the light bands are even in colour, but not the darker ones), versus not so in all species within the *H. binoei* complex, in those specimens and/or species where tail bands are relatively wide (as in less than 10 light and 10 dark tail bands on an original tail).

Species within the *H. binoei* complex are found in most parts of continental Australia, excluding the coldest and wettest parts of the far south-west and south-east.

All species within the genus *Heteronotia* Wermuth, 1965 are separated from all other Australian gekkonidae by the following suite of characters:

Digits are angular when viewed laterally, feet are bird-like; with conspicuous free terminal claws; claw is between three scales; there are two rows of lateral scales on the digits (taken from Cogger, 2014).

Distribution: *H. crottyi sp. nov.* is a range-restricted species confined to a small area of rocky hills in north-west Queensland, between Lawn Hill in the north and Gunpowder in the south, all north-west of Mount Isa, where it is potentially sympatric with the more widespread *H. maxinehoserae sp. nov.* and *H. oxyi sp. nov.*.

Etymology: The species *H. crottyi sp. nov.* is named in honour of a Great Dane Rottweiller cross dog that we owned from 1989 to 2002, called "*Crotalus*" or "Crotty" for short, who guarded our wildlife research facility for his lifetime, in recognition of his services to herpetology.

CONCLUSIONS

This and other recent papers including some cited herein, have underscored previously underestimated species diversity in well-known and common Australian reptile species. While the species formally named within this paper are not believed to be under any existential threats at present, things can change rapidly if and when new pathogens or pests enter the ecosystem, as seen for example with frogs as detailed in Hoser (1991).

Aspects of conservation of Australasian reptiles discussed by Hoser (1989, 1991, 1993 and 1996) apply to these species, as does the comments of Hoser (2019a, 2019b).

The latter two papers Hoser (2019a, 2019b) deal specifically with extinction of species arising from non-recognition of valid taxa by small minded ego-driven pseudo-scientists, not wanting to recognize the works or scientific names of persons they see as rivals.

Formal recognition of unnamed species is an important first step to their conservation and management.

It is critically important that valid species should only be named once and not subjected to unwarranted taxonomic vandalism as being practiced by the Wolfgang Wüster gang as detailed by Hoser (2007, 2009, 2012a-b, 2013a-b, 2015a-f, 2019a-b), Hawkeswood (2021) and ICZN (2021).

The ICZN formally rejected the Wolfgang Wüster gang's many applications to overwrite names of myself (Hoser) and others (ICZN 2021).

The ICZN stated that all names of Hoser were valid and available, without need to formally make a plenary ruling to effect what was already in effect and obvious.

Separately Hawkeswood (2021) said exactly the same thing.

The Plenary power is to be used to rectify things outside the *International Code of Zoological Nomenclature* and not to affect what is self-evidently compliant with it.

This is not the first time the ICZN have had to deal with the Wolfgang Wüster gang's immoral and anti-conservation actions.

In 1991, the same gang of thieves were ruled against by the ICZN in the matter of names proposed by Wells and Wellington in 1984 and 1985.

Notwithstanding the ruling of the ICZN in 1991 (ICZN 1991), in favour of Wells and Wellington's works and a second ruling in their favour in 2001 (ICZN 2001) arising from Sprackland *et al.* (1997) and the ongoing availability of the Wells and Wellington names to the biological sciences, the group known as the Wolfgang Wüster gang of thieves have pressured publishing

authors not to use or adopt the Wells and Wellington names (see Hoser 2007, 2009, 2012a, 2012b, 2013a, 2015 a-f, 2019a-b) and more recently those I have formally proposed.

This attack has been at numerous levels, ranging from control of editors of journals, lies, defamation and a number of other anti-science tactics (see also Shine 1987, Sprackland *et al.* 1997).

Central in all this has been an evidence free general proposition put by them that the taxonomy of Wells and Wellington or myself is simply wrong and that therefore the names need not be used.

A clear example of this is seen in the online database they effectively control and censor, called "*The Reptile database*", now marketed as the "go to" reference for herpetological taxonomy and nomenclature.

Online at:
https://reptile-database.reptarium.cz

and optimized for Google (Search engine optimisation), this website comes up for searches for most species of reptile globally when searched for by scientific name.

Once at this website, the internet user is fed the warped and twisted world view of reptile taxonomy as promulgated by Wolfgang Wüster and his gang of thieves.

Contrary to the position of the Wolfgang Wüster gang of thieves, the science does support the use of the names proposed in this and other works of myself and also Wells and Wellington (in the vast majority of cases as mentioned earlier) (Hawkeswood 2021), and the sooner they come into general usage, the sooner the relevant species can be properly conserved and managed.

Following on from the ICZN ruling of 2021, the scourge of the Wolfgang Wüster's gang of thieves actions should now be removed from the biological sciences.

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CONFLICTS OF INTEREST

None.

Left:
Heteronotia anomalus
(Peters, 1867)
from Boggabri. NSW.
Photo: Raymond Hoser.

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Two more new species within the *Odatria glauerti* (Squamata: Varanidae) species complex.

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ABSTRACT

Hoser (2013) divided the taxon known at the time as *Odatria glauerti* (Mertens, 1957) into two, naming the distinctive Arnhem Land population as a new species, namely *O. hoserae* Hoser, 2013.

In 2018, Hoser split the east and West Kimberley populations into two species, the type form for *O. glauerti* being from the south-west Kimberley and the Ord River form was formally named *O. davidhancocki* Hoser, 2018.

In 2018, Hoser also flagged other potentially unnamed taxa within this species group from the Kimberley region.

Following further ongoing investigations, including a re-examination of relevant specimens and a re-assessment of the timelines for the creation of extant biogeographical barriers, being somewhere between 1.5-2 MYA, this paper formally names the lower Victoria River, Northern Territory population of putative *O. davidhancocki* as a new species *O. bennymcnamarai sp. nov.* and the Carson Escarpment population of putative *O. glauerti* as a new species *O. darrenkeilleri* in accordance with the rules of the *International Code of Zoological Nomenclature* (Ride *et al.* 1999) as amended online since.

Keywords: Taxonomy; nomenclature; Varanidae; *Odatria*; *Varanus*; *glauerti*; *hoserae*; *davidhancocki*; Northern Territory, Western Australia; Australia; new species; *bennymcnamarai*; *darrenkeilleri.*

INTRODUCTION

As part of an ongoing global audit of the Varanidae, Hoser (2013) reclassified the mainly western Australian taxon known as *Varanus glauerti* Mertens, 1957 by transferring it into the genus *Odatria* Gray, 1838.

The same act had been performed by Wells and Wellington (1984 and 1985), but unfortunately their eminently sensible (and in hindsight obvious) decision had been effectively boycotted by publishing herpetologists in the intervening two decades. In other words the taxon remained known to most as *Varanus glauerti.*

This boycott had absolutely nothing to do with science, but instead was an unscientific manifestation of ego politics among other so-called herpetologists and their intent to rob Wells and Wellington of any credit for their contributions to herpetology as outlined by Hoser (2007), Hoser (2015a-f) and also as detailed in a more recent context by ICZN (2021) and Hawkeswood (2021).

As I have always put science before politics, it was for that reason that in 2013 I accepted the Wells and Wellington placement of *Varanus glauerti* Mertens, 1957 within the genus *Odatria* Gray, 1838, making it known as *Odatria glauerti* (Mertens, 1957) (Hoser 2013).

For some years it was known that a morphologically and biologically different population from Arnhem-land referred to *O. glauerti* existed and so it was inevitable that in Hoser (2013) it was afforded formal recognition as a species.

O. hoserae Hoser, 2013 was named in honour of Katrina Joan Hoser in recognition of her monumental contributions to Australian varanid conservation as outlined in Hoser (2013).

The same description in the same paper referred to eastern and western Kimberley populations as being morphologically distinct, but treated both as being of the same species-level taxon.

Further inspection of specimens from across the Kimberley showed that the East and West Kimberley populations were sufficiently divergent to warrant taxonomic recognition and in fact at the species-level.

Therefore the purpose of the paper of Hoser (2018b) was to formally divide *O. glauerti* as recognized as of that date into two, by formally naming the population found in the East Kimberley and nearby parts of the Northern Territory (extending to near the mouth of the Victoria River, on both sides) as a new species, namely *O. davidhancocki sp. nov.*.

The new taxon was obviously morphologically divergent to *O.*

glauerti, of allopatric and disjunct range and also showed significant divergence by way of molecular data as published by Fitch *et al*. (2006).

On that basis the decision to recognize the taxon as a full species as opposed to subspecies was made obvious.

While there was a significant body of material published in relation to *O. glauerti* as recognized prior to the publication of Hoser (2013), most of this is not relevant in this later paper, in as much as the sole purpose of this paper is to formally identify and name two more related species in accordance with the rules set out in the *International Code of Zoological Nomenclature* (Ride *et al*. 1999 as amended online since).

However I do make mention of relevant materials and methods leading to the obvious results published herein and conclusions, the finality being the two published descriptions herein.

Hoser (2013) flagged that there were two distinct populations being referred to as *O. glauerti*. The molecular data of Fitch *et al*. (2006) *et al*. confirmed that the two populations had species-level divergence.

As the holotype for *O. glauerti* (Mertens, 1957) is from Wotjulum, (south-west) West Kimberley, Western Australia, Australia, specimen number WAM R12337, at the Western Australian Museum in Perth, Western Australia, Australia it is self evident that it is the population from the East Kimberley that needed to be formally named.

Since the publication of Hoser (2018b), live specimens from both sides of the mouth of the Victoria River in the Northern Territory have since been inspected and while morphologically in major respects seem to conform with the specimens from the Lake Argyle and Bungle Bungles areas, they are in fact sufficiently divergent in various ways, in particular with regards to colouration in live specimens on a consistent basis to be flagged as a different taxon.

On a complete re-assessment of the evidence and any division to be made, it was determined that it should also be made at the species level.

Other putative species that have been split across the same biogeographic barrier and constrained by it, including for example *Worrellisaurus bigmoreum* Hoser, 2018 split from *W. kingorum* (Storr, 1980), was split with the new entity formally named at the species level (Hoser 2018a).

Likewise *Oedurella* (*Parvusdactylus*) *sonnemanni* Hoser (2017), from the Keep River area of the Northern Territory was split at the species level from *Oedurella* (*Parvusdactylus*) *mcmillani* (Storr, 1978), type locality Mitchell Plateau, Western Australia, a species it had been confused with and *Oedurella* (*Parvusdactylus*) *robinsoni* (Smith, 1995), type locality being the Ord River Drainage in the east Kimberley in Western Australia, with which it also been confused with, as a newly named species, based both on morphological and species-level genetic divergence as cited by Hoser (2017).

Hoser (2018b) also wrote of putative *O. glauerti*:

"*While I have formally recognized the taxon from the East Kimberley, I should note that I am not entirely satisfied that all other Kimberley specimens are in fact of a single species, or of one single subspecies-level taxon.*
This view is based on different morphotypes from the north and north-west Kimberley, versus those from the south-west, including the type locality for O. glauerti and of course including the type specimen for O. glauerti itself, which I have viewed."

To that end, I continued to scrutinize specimens of putative *O. glauerti* from the West Kimberley, including from the Mitchell Plateau area and the Carson Escarpment.

While not entirely convinced that the Mitchell Plateau specimens are conspecific with the type form of the species, *O. glauerti*, I have for the time being provisionally placed them with that species.

In terms of the specimens from the Carson Escarpment, I have formed the view that they are sufficiently divergent to warrant being treated as a new species and so are formally named as such within this paper.

With respect of that decision I refer for example to *Oedurella* (*Parvusdactylus*) *alba* Hoser (2017), type locality Theda Station, North Kimberley, Western Australia, which was split from *Oedurella* (*Parvusdactylus*) *mcmillani* (Storr, 1978), type locality Mitchell Plateau, Western Australia, a species it had been confused with and *Oedurella* (*Parvusdactylus*) *robinsoni* (Smith, 1995), type locality being the Ord River Drainage in the east Kimberley in Western Australia, with which it also been confused with, as a newly named species, based both on morphological and species-level genetic divergence as cited by Hoser (2017)

MATERIALS AND METHODS

Prior to the final taxonomic decisions being made as executed in this paper, I inspected about 100 specimens assigned to *O. glauerti*, including specimens of *O. hoserae* and *O. davidhancocki* from across the range of all the relevant putative taxa. These have included specimens in government-owned State Museums, for which acknowledgement is not normally explicitly given here or in my other taxonomic papers as it is should be assumed by any vaguely sensible reader. I have also seen numerous relevant specimens in life and by way of quality photos of specimens with known locality data.

I also consulted relevant literature with a view to finding and/or reading original descriptions of potentially relevant taxa, this being Cogger *et al*. (1983), Mertens (1957), Storr (1980), Weigel (1985), Wells and Wellington, 1984, 1985), and checking for available synonyms of which there were none.

RESULTS

These are already outlined in the abstract and introduction and I note that the two species formally named below in accordance with the rules of the *International Code of Zoological Nomenclature* (Ride *et al*. 1999 as amended online since) did not have any available synonym names that I could use or resurrect from synonymy.

In terms of the scientific names formally assigned to the two new species, they should not be amended in any way unless absolutely mandatory under the rules of the *International Code of Zoological Nomenclature* (Ride *et al*. 1999 as amended online since).

Descriptions do unless otherwise stated, refer to adult specimens in good health and in the absence of factors such as ill health, excessive stress, injury, aging or similar.
Considerable material in the two following descriptions is duplicated as the relevant species need to be formally separated from one another and share other closely related taxa.

Online material cited either in text or in the references was last checked as being online as cited on 10 March 2022.

ODATRIA BENNYMCNAMARAI SP. NOV.

LSIDurn:lsid:zoobank.org:act:683A29AF-7495-4F00-8672-38372AED844E

Holotype: A preserved specimen in the Museum and Art Gallery of the Northern Territory, Darwin, Northern Territory, Australia, specimen number R24867 collected from Lobby Creek, Bradshaw Station, Northern Territory, Australia, Latitude -15.35 S., Longitude 130.1 E. This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the Australian Museum, Sydney, New South Wales, Australia, specimen number R.190862.001 collected from the Bradshaw Training Area (Timber Creek), Northern Territory, Australia, Latitude -15.03196 S., Longitude 129.86069 E.

Diagnosis: *Odatria davidhancocki* Hoser, 2018 and *O. bennymcnamarai sp. nov.* are keyed out as *O. glauerti* (Mertens, 1957), better known as *Varanus glauerti* Mertens, 1957 in most contemporary texts such as Cogger (2014).

O. davidhancocki and *O. bennymcnamarai sp. nov.* are readily separated from *O. glauerti* and the newly named species *O. darrenkeilleri sp. nov*. by the following: On the second half of the

length of original unbroken tails there are 20-26 white cross bands, versus 14-19 in *O. glauerti* and *O. darrenkeilleri sp. nov.*, while in *O. hoserae* Hoser, 2013, there are just 10-12 white cross bands, this being perhaps the most easy way to distinguish the three species groups from one another at a glance and in the absence of locality data.

O. davidhancocki is characterised by a dorsal body pattern that is more-or-less reddish-orange with yellow bands, versus a grey to tan colour, generally being obviously grey on the forebody and head in *O. glauerti* and *O. darrenkeilleri sp. nov*. versus reddish at the forebody of *O. davidhancocki*.

In contrast to the above, *O. bennymcnamarai sp. nov.* is separated from all the preceding species by having a combination of on the second half of the length of original unbroken tails there are 20-26 white cross bands (in common with *O. davidhancocki* only); and (in contrast to *O. davidhancocki*) on the body, the darker cross-bands are greyish as opposed to reddish-orange, or if reddish, then dark reddish and with a greyish overlay, and these darker bands are significantly wider than the yellowish interspaces, versus about the same width or less, in *O. davidhancocki*. The upper surfaces of the forelimbs are blackish in *O. bennymcnamarai sp. nov.* versus greyish brown in *O. davidhancocki.*

O. hoserae is separated from all of *O. davidhancocki*, *O. bennymcnamarai sp. nov.*, *O. glauerti* and *O. darrenkeilleri sp. nov*. by having well developed and prominent ocelli on both the back of the neck and all four legs, this not being seen in the other four species, which instead have either spots on the legs or spots tending to form incomplete or indistinct ocelli, and no well defined occelli on the neck.

O. hoserae is of similar body colouration to *O. davidhancocki* (as defined above) but differs in having much stronger contrast between the dark and light bands, as well as dark reddish bands being twice as wide as the yellowish ones, versus lighter bands being slightly wider than the dark bands or of the same width in *O. davidhancocki.*

O. glauerti is readily separated from all of *O. hoserae*, *O. davidhancocki, O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov*. by the fact that the base and anterior of the upper surface of the tail does not have well-defined bands, whereas the banding on this part of the tail in the other four species is prominent.

O. glauerti is further separated from all of *O. hoserae*, *O. davidhancocki, O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov*. by the colouration on the throat, which is a thick dark yellow colour (slight orange), versus light yellow in *O. hoserae*, *O. davidhancocki, O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov*..

Specimens of *O. glauerti* from Mitchell Plateau, in line with the holotype form from further south on the south-west Kimberley coast, have reduced in size yellow markings on the back, giving a well defined ocellated pattern on the body not seen in other *O. glauerti* from other parts of the north Kimberley or south-west Kimberley, or the other two east Kimberley species *O. davidhancocki* and *O. bennymcnamarai sp. nov.*. However on the neck, these ocelli are not prominent as seen in *O. hoserae* a species from the Top end of the Northern Territory

O. darrenkeilleri sp. nov. is separated from its closest relative *O. glauerti* which based on the above it would be identified as, by having a dorsum consisting of well-defined darker and lighter cross bands, being about 8 between the fore and hind limbs, these bands consisting of large and merged square-shaped occeli with the upper and lower boundaries of these bands being irregular and in line with the outlines of the occeil that join one another, as in the lines bulge out towards the centres of the sides of the ocelli. The bands on the lower back diverge along the midline to become broken, with the end point of the rows of ocelli on the midline being different on either side of the dorsum.

In *O. glauerti* from the nearby Mitchell Plateau and further south along the west Kimberley coast, the light occeli on the back either do not merge, or do so only just and then only in some parts of the dorsum, as opposed to on all or most of the back in *O. darrenkeilleri sp. nov.*.

There is also no significant divergence of the rows of (smaller sized in this species) ocelli on the lower back in *O. glauerti* on either side of the midline. Rows of light occelli are less than 10 on the back of *O. darrenkeilleri sp. nov*. between fore and hind limbs, (measured going down the body of the lizard in an anterior to posterior direction, as opposed to across the back), versus more than 10 in *O. glauerti*.

O. glauerti, *O. hoserae*, *O. davidhancocki O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov*. are separated from all other Australasian monitors by the following suite of characteristics: Medium adult size up to 80 cm in total length; gracile build, with a long neck and the tail that may exceed 1.8 times the body length; a black tail with brilliant white or bluish-white rings to the tip; neck and shoulders being grey to tan or yellowish to rusty in colour, a prominent black temporal stripe; an unmarked yellow or white throat.

Brown (2014), at page 853 bottom left has a photo of *O. davidhancocki* in life.

Images of *O. davidhancocki* in life can be found online at:
https://www.inaturalist.org/observations/5414382
and
https://www.inaturalist.org/observations/112036433
and
https://www.inaturalist.org/observations/3691859

Brown (2014), at page 853 top has a photo of *O. glauerti* in life.

Brown (2014), at page 852 bottom has a pair of images of *O. glauerti* from the Mitchell Plateau area of Western Australia.

Brown (2014), at page 853 middle left has a photograph of *O. hoserae* in life.

An image of a live *O. hoserae* can be seen online at:
https://www.inaturalist.org/observations/99163837

A photo of *O. bennymcnamarai sp. nov*. in life can be found online at:
https://www.inaturalist.org/observations/106919730

Storr (1980), at page 259 has a photo of *O. darrenkeilleri sp. nov.* in life.

All conform to the diagnosis just given.

Distribution: *O. bennymcnamarai sp. nov*. is only known from the lower Victoria River region of the north-west Northern Territory, Australia, including the Keep River drainage.

Etymology: *O. bennymcnamarai sp. nov*. is named in honour of Benny McNamara a snake catcher based at Colac, Victoria, Australia (AKA Snake Catcher Colac), in recognition of his services to herpetology and public safety in his region of western Victoria, Australia.

ODATRIA DARRENKEILLERI SP. NOV.

LSIDurn:lsid:zoobank.org:act:6F30FF31-7C86-46D4-AF70-13231E365546

Holotype: A preserved specimen in the Western Australian Museum, Perth, Western Australia, Australia, specimen number WAM R.152796 collected from the Drysdale River National Park, Western Australia, Australia, Latitude 15.033 S., Longitude 126.816 E. This government-owned facility allows access to its holdings.

Diagnosis: Until now, *Odatria darrenkeilleri sp. nov.* has been treated as a northern population of *O. glauerti* (Mertens, 1957), better known as *Varanus glauerti* Mertens, 1957, *sensu* Hoser (2018), or Cogger (2014), who has a different concept of the species *O. glauerti* to Hoser (2018).

Odatria davidhancocki Hoser, 2018 and *O. bennymcnamarai sp. nov.* are keyed out as *O. glauerti* (Mertens, 1957), better known as *Varanus glauerti* Mertens, 1957 in most contemporary texts such as Cogger (2014).

O. davidhancocki and *O. bennymcnamarai sp. nov.* are readily

separated from *O. glauerti* and the newly named species *O. darrenkeilleri sp. nov.* by the following: On the second half of the length of original unbroken tails there are 20-26 white cross bands, versus 14-19 in *O. glauerti* and *O. darrenkeilleri sp. nov.*, while in *O. hoserae* Hoser, 2013, there are just 10-12 white cross bands, this being perhaps the most easy way to distinguish the three species groups from one another at a glance and in the absence of locality data.

O. davidhancocki is characterised by a dorsal body pattern that is more-or-less reddish-orange with yellow bands, versus a grey to tan colour, generally being obviously grey on the forebody and head in *O. glauerti* and *O. darrenkeilleri sp. nov.* versus reddish at the forebody of *O. davidhancocki*.

In contrast to the above, *O. bennymcnamarai sp. nov.* is separated from all the preceding species by having a combination of on the second half of the length of original unbroken tails there are 20-26 white cross bands (in common with *O. davidhancocki* only); and (in contrast to *O. davidhancocki*) on the body, the darker cross-bands are greyish as opposed to reddish-orange, or if reddish, then dark reddish and with a greyish overlay, and these darker bands are significantly wider than the yellowish interspaces, versus about the same width or less, in *O. davidhancocki*. The upper surfaces of the forelimbs are blackish in *O. bennymcnamarai sp. nov.* versus greyish brown in *O. davidhancocki.*

O. hoserae is separated from all of *O. davidhancocki*, *O. bennymcnamarai sp. nov.*, *O. glauerti* and *O. darrenkeilleri sp. nov.* by having well developed and prominent ocelli on both the back of the neck and all four legs, this not being seen in the other four species, which instead have either spots on the legs or spots tending to form incomplete or indistinct ocelli, and no well defined occelli on the neck.

O. hoserae is of similar body colouration to *O. davidhancocki* (as defined above) but differs in having much stronger contrast between the dark and light bands, as well as dark reddish bands being twice as wide as the yellowish ones, versus lighter bands being slightly wider than the dark bands or of the same width in *O. davidhancocki.*

O. glauerti is readily separated from all of *O. hoserae*, *O. davidhancocki, O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov.* by the fact that the base and anterior of the upper surface of the tail does not have well-defined bands, whereas the banding on this part of the tail in the other four species is prominent.

O. glauerti is further separated from all of *O. hoserae*, *O. davidhancocki, O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov.* by the colouration on the throat, which is a thick dark yellow colour (slight orange), versus light yellow in *O. hoserae*, *O. davidhancocki, O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov.*.

Specimens of *O. glauerti* from Mitchell Plateau, in line with the holotype form from further south on the south-west Kimberley coast, have reduced in size yellow markings on the back, giving a well defined ocellated pattern on the body not seen in other *O. glauerti* from other parts of the north Kimberley or south-west Kimberley, or the other two east Kimberley species *O. davidhancocki* and *O. bennymcnamarai sp. nov.*. However on the neck, these ocelli are not prominent as seen in *O. hoserae* a species from the Top end of the Northern Territory

O. darrenkeilleri sp. nov. is separated from its closest relative *O. glauerti* which based on the above it would be identified as, by having a dorsum consisting of well-defined darker and lighter cross bands, being about 8 between the fore and hind limbs, these bands consisting of large and merged square-shaped occeli with the upper and lower boundaries of these bands being irregular and in line with the outlines of the occeil that join one another, as in the lines bulge out towards the centres of the sides of the ocelli. The bands on the lower back diverge along the midline to become broken, with the end point of the rows of ocelli on the midline being different on either side of the dorsum.

In *O. glauerti* from the nearby Mitchell Plateau and further south along the west Kimberley coast, the light occeli on the back either do not merge, or do so only just and then only in some parts of the dorsum, as opposed to on all or most of the back in *O. darrenkeilleri sp. nov.*.

There is also no significant divergence of the rows of (smaller sized in this species) ocelli on the lower back in *O. glauerti* on either side of the midline. Rows of light occelli are less than 10 on the back of *O. darrenkeilleri sp. nov.* between fore and hind limbs, (measured going down the body of the lizard in an anterior to posterior direction, as opposed to across the back), versus more than 10 in *O. glauerti.*

O. glauerti, *O. hoserae*, *O. davidhancocki O. bennymcnamarai sp. nov.* and *O. darrenkeilleri sp. nov.* are separated from all other Australasian monitors by the following suite of characteristics: Medium adult size up to 80 cm in total length; gracile build, with a long neck and the tail that may exceed 1.8 times the body length; a black tail with brilliant white or bluish-white rings to the tip; neck and shoulders being grey to tan or yellowish to rusty in colour, a prominent black temporal stripe; an unmarked yellow or white throat.

Brown (2014), at page 853 bottom left has a photo of *O. davidhancocki* in life.

Images of *O. davidhancocki* in life can be found online at:
https://www.inaturalist.org/observations/5414382
and
https://www.inaturalist.org/observations/112036433
and
https://www.inaturalist.org/observations/3691859

Brown (2014), at page 853 top has a photo of *O. glauerti* in life.

Brown (2014), at page 852 bottom has a pair of images of *O. glauerti* from the Mitchell Plateau area of Western Australia.

Brown (2014), at page 853 middle left has a photograph of *O. hoserae* in life.

An image of a live *O. hoserae* can be seen online at:
https://www.inaturalist.org/observations/99163837

A photo of *O. bennymcnamarai sp. nov.* in life can be found online at:
https://www.inaturalist.org/observations/106919730

Storr (1980), at page 259 has a photo of *O. darrenkeilleri sp. nov.* in life.

All conform to the diagnosis just given.

Distribution: *O. darrenkeilleri sp. nov.* is only known from Carson Escarpment in the north-east Kimberley district of Western Australia, Australia.

Etymology: *O. darrenkeilleri sp. nov.* is named in honour of Darren Keiller of Norlane (Geelong), Victoria, Australia, (AKA Snake Catcher Geelong), a snake catcher of many decades in recognition of his services to herpetology and public safety in the Barwon region of Victoria, Australia.

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CONFLICT OF INTEREST

There are no conflicts of interest in terms of this paper and the author.

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A new species within the *Odatria timorensis* (Squamata: Varanidae) species complex.

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ABSTRACT

As part of an ongoing audit of the Varanidae, an unnamed taxon related to *Odatria timorensis* (Gray, 1831) from Sawu Island, Indonesia was identified.

It is formally named *Odatria sawuensis sp. nov*. in accordance with the rules of the *International Code of Zoological Nomenclature* (Ride *et al*. 1999) as amended online since.

Keywords: Taxonomy; nomenclature; Varanidae; *Odatria*; *Varanus*; *timorensis*; *auffenbergi*; Indonesia; Timor; Roti, Semau; Sawu; Savu; new species; *sawuensis.*

INTRODUCTION

As part of an ongoing global audit of the Varanidae, specimens of putative "*Varanus timorensis*" from Sawu island were located in private reptile collections.

Morphologically these were most similar to either *Monitor timorensis* Gray, 1831 with a type locality of Timor, or *Varanus auffenbergi* Sprackland, 1999, with a type locality of Roti Island.

Roti Island lies offshore from Timor and is connected by shallow seas. It sits between Timor and Sawu. However those two islands (Roti and Timor) are separated from Sawu by a deep sea channel, that was not a land bridge during ice-age maxima, giving rise to a belief that the Sawu island population has been isolated for an extended geological period.

As a result, I decided to audit specimens of putative "*Varanus timorensis*" from the three islands to ascertain their taxonomic status and whether or not species level recognition for each was warranted. I also note that Wells and Wellington (1984 and 1985) transferred the relevant species group to the pre-existing genus name *Odatria* Gray, 1838.

Hoser (2013) found this designation as logical and based on good science and so adopted it. More recently Bucklitsch *et al*. (2016) effectively copied the Hoser (2013) taxonomy and also used the generic name *Odatria*.

MATERIALS AND METHODS

Prior to the final taxonomic decisions being made as executed in this paper, I inspected numerous specimens assigned to *O. timorensis* (Gray, 1831) and *O. auffenbergi* (Sprackland, 1999) from across the range of all the relevant putative taxa. These have included specimens in government-owned State Museums, for which acknowledgement is not normally explicitly given here or in my other taxonomic papers as it is should be assumed by any vaguely sensible reader. I have also seen numerous relevant specimens in life and by way of quality photos of specimens with known locality data.

I also consulted relevant literature with a view to reading original descriptions of potentially relevant taxa, synonym forms previously named and molecular studies that may give clues as to the number of taxa actually involved in the relevant area (the *O. timorensis* group) in terms of the putative species.

This included Ast (2001), Brennan *et al.* (2021), Cogger *et al.* (1983), Cogger (2014), de Lisle (1996), de Rooij (1915), Duméril and Bibron (1836), Fitch *et al.* (2006), Gray (1831), Mertens (1941, 1942, 1958), Sprackland (1999), Storr (1980), Weigel (1985), Wells and Wellington (1984, 1985) and sources cited therein. I also checked for available synonyms of which there were none for the Sawu Island population at least.

RESULTS

Ast (2001) wrote:

"auffenbergi *may be a synonym for* timorensis."

But gave no information or evidence to support the claim.

However my inspection of specimens from the relevant islands did raise an interesting situation.

Most *O. timorensis* from Timor did seem to be morphologically distinct from the type form of *O. auffenbergi* in that adult specimens have a greyish brown dorsum covered in small yellow-white spots.

However specimens from about the last fifth of the island, being on the south-west end, that being nearest to Roti Island, were morphologically similar to type *O. auffenbergi* in that the dorsal spots were expanded to form distinctive large occeli, as were numerous individuals elsewhere on the island, in particular the far north-east corner.

In the absence of many apparently intermediate specimens (there were some) or molecular data for all these lizards I was unable to ascertain whether these forms were of the same species or not, or for that matter whether or not there were in fact more than two taxa involved.

However, based on the geographical proximity of the two islands, being that Pulau Roti, is only about 10 miles (16 km)

southwest of Timor across the shallow and narrow Roti Strait, I formed the tentative view that the morphologically similar lizards from south-west Timor were in fact conspecific.

I note that the two land masses were well and truly connected during times of recent glacial maxima.

The only serious question in my mind was whether those from further east on the same Island (Timor), were the same, or of a different species or subspecies.

Brennan *et al.* (2021) appears to have answered this conundrum with molecular results indicating no significant divergence between the lizards from Timor and Roti, with both *O. timorensis a*nd *O. auffenbergi* best treated as conspecific being the only logical conclusion based on the Brennan *et al.* (2021) results.

The putative *O. timorensis* from Sawu are however morphologically divergent from the populations of putative *O. timorensis* from Timor, Roti and the immediately adjacent Semau Island.

Sawu and the other three islands are also separated by more than 50 km in a straight line of open ocean, most of which was still open ocean during ice age maxima, based on current sea-level depth of below 200 metres.

That was not the case for the three islands of Timor, Roti and Semau, all of which were well connected by solid land bridges.

Because of the relative isolation of the Sawu population and consistent morphological differences, the Sawu population is formally named herein as a new species, *O. sawuensis sp. nov.*.

I also note that the Water Pythons from Sawu Island are generally regarded as taxonomically separated from those of Timor (Hoser, 2000, Carmichael, 2007, De Lang 2011) and have been presumably isolated by the same or similar biogeographical factors as the *O. timorensis* related species.

In terms of the scientific name formally assigned to the new species, it should not be amended in any way unless absolutely mandatory under the rules of the *International Code of Zoological Nomenclature* (Ride *et al.* 1999) as amended online since.

The description does, unless otherwise stated, refer to adult specimens in good health and in the absence of factors such as ill health, excessive stress, injury, aging or similar.
Online material cited either in text or in the references was last checked as being online as cited on 14 March 2022.

ODATRIA SAWUENSIS SP. NOV.

LSIDurn:lsid:zoobank.org:act:D9531D4E-53AB-4738-BA77-6758BABB4180

Holotype: A preserved specimen in the Western Australian Museum, Perth, Western Australia, Australia, specimen number WAM REPT R105488, collected from Menia, Savu Island (AKA Savu), East Nusa Tenggara, Indonesia, Latitude -10.483333 S., Longitude 121.916667 E.

This government-owned facility allows access to its holdings.

Diagnosis: Until now *O. sawuensis sp. nov.* has been treated as a population of putative *O. timorensis* (Gray, 1831).

However it is readily separated from that taxon, both the type form and type *O. auffenbergi* (Sprackland, 1999), herein treated as one and the same species, by the following suite of characters: The yellow-white line running from the eye through the ear, situated below the black temporal streak is not relatively straight and is also broken, versus relatively straight, at least along the midline and not broken in *O. timorensis* (and similar Australian forms such as *O. scalaris*); the gular region is heavily mottled and marked with dark brown, versus not so in *O. timorensis*; adults are generally dark brown in colour on the dorsum, versus grey or light brown with considerable grey in *O. timorensis*. For *O. sawuensis sp. nov.*, at the anterior end of the lower jaw, the brown markings tend to form reticulations, which is not the case in *O. timorensis* which is mainly white on the scales of the anterior lower jaw.

Australian putative *O. scalaris* (Mertens, 1941), including the type form from Western Australia, *O. similis* (Mertens, 1958) from Groote Eylandt, Northern Territory, *O. kuranda* Wells and Wellington, 1985, from Kuranda in the Queensland wet-tropics and *O. pengilleyi* Wells and Wellington, 1985, from near Iron Range on upper Cape York, Queensland are all separated from the preceding two species (*O. timorensis* and *O. sawuensis sp. nov.*) by having a mainly white lower jaw and gular region that is punctuated with an arrangement of large distinctive dark spots.

For the Australian species just listed, molecular evidence published supports all of them as valid at the species level, save for *O. pengilleyi* for which no evidence is available to me.

My own inspection of specimens confirms that those from the tip of Cape York do appear to be significantly different from those further south in the wet tropics as identified by Wells and Wellington (1985). However specimens I have seen from the Iron Range area and dry areas to the west of there, seem to conform more to those further south, as opposed to those from the tip of Cape York, the offshore islands to the north and nearby southern New Guinea. So in the absence of inspection of the holotype and an absence molecular data, I cannot confirm or deny the status of the putative taxon *O. pengilleyi.*

All the preceding species are separated from all other Australian varanid lizards by the following suite of characters:

Colouration is dark above and whitish flecks, spots or ocelli on the dorsum. The arrangement of the spots, flecks or occeli does vary between individuals and also generally by locations as well. The black temporal stripe, somewhat ill defined is bounded below in some form by a yellow line from the mid eye, through the ear. Limbs are dark and spotted white, cream or yellow. Tail is dark and with regular or irregular whitish rings, transversely arranged distally, but not spinose. Head scales are small and smooth with the smaller subequal supraoculars more-or-less merging with the somewhat larger interoculars. Nostrils are lateral, only slightly nearer the tip of the snout than to the eye. 95-135 rows of scales around the midbody. Tail is roundish in cross-section, without any indication of a median dorsal keel. There are several ventro-lateral rows of enlarged keeled scales on each side behind the vent. Tail is about 1.5 times the length of the head and body. Total length is about 60 cm.

O. sawuensis sp. nov. is depicted online in images at:
https://www.flickr.com/photos/162809684@N05/49633446913
and
https://www.flickr.com/photos/162809684@N05/49549380376/

Distribution: *O. sawuensis sp. nov.* almost certainly only occurs in Sawu Island, Indonesia.

Etymology: *O. sawuensis sp. nov.* is named in reflection of where it occurs.

Conservation: The island of Sawu has an area of just 459.6 km and a population of 89,327 (in the 2020 Census), which is 194.36 people per square kilometre (compared to 3.3 people per square km in Australia in 2021), meaning all wildlife on the island of Sawu is under extreme pressure.

Forced non-recognition of this taxon through the illegal actions of the Wolfgang Wüster gang of thieves as outlined by Hawkeswood (2021), Hoser (2007, 2009, 2012a, 2012b, 2013a, 2013b, 2015a-f, 2019a-b), (ICZN 2021) and sources cited therein can only put this species at greater risk of extinction as seen for example in taxa identified as extinct in Hoser (2019b).

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CONFLICT OF INTEREST

There are no conflicts of interest.

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A new subspecies of Lace Monitor *Varanus varius* (White, 1790).

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ABSTRACT

The large and well-known eastern Australian Lace Monitor *Varanus varius*, has long been recognized as comprising more than one form and/or taxonomic entities.

Confusion has arisen with the so-called Bell's form, being the broad banded form, often being treated as separate from the narrow-banded "normal" form, although it is well-known that both forms regularly breed with one another and that both forms can hatch from a single clutch of eggs.

In the face of the preceding, Smissen *et al.* (2013) identified three main lineages within the species relying on DNA.

Inspection of live and dead specimens from across the known ranges of each lineage, showed consistent morphological differences between the lineages and so each are formally recognized herein as subspecies.

The so-called Bells form, described as a species being *Varanus belli* Duméril and Bibron, 1836, based on a broad-banded specimen, is in fact a mutant found in one of the three herein recognized subspecies, not of the nominate form and so is nominate for the subspecies.

The third subspecies, *Varanus varius gedyei subsp. nov.* from far north Queensland is formally named for the first time.

Keywords: Taxonomy; nomenclature; Australia; Lace Monitor; *Varanus*; *varius*; *belli*; North Queensland; Australia; new subspecies; *gedyei.*

INTRODUCTION

The Lace Monitor *Varanus varius* (White, 1790) is one of Australia's largest lizards and well-known to many Australians.

Images of both type form *Varanus varius* from the type locality (Sydney district, New South Wales) and the broad-banded "Bell's form" are depicted on page 121 of Hoser (1989).

A specimen of the morphologically distinct latter form was formally named as *Varanus belli* by Duméril and Bibron in 1836.

However because it has been known for many years that "normal looking" Lace Monitors and Bells form specimens will readily mate and breed, producing offspring of one, other or both forms, all authors in the last fifty years have treated all *Varanus varius* as a single species.

Exceptional to that was Wells and Wellington (1985) who wrote: "We consider that *V. varius* is a species complex, but in their paper, they gave no evidence or information to justify this view.

Smissen *et al.* (2013) identified three main lineages within the species relying on DNA.

They found three clades (1, 2 and 3), being as follows:

Clade 1 confined to the wet tropics of far north Queensland;

Clade 2 found in Queensland south of the Burdekin gap and including the Murray Darling basin of New South Wales, including relevant parts of far north Victoria and South Australia;

Clade 3 being generally along the New South Wales coast and south into nearby parts of far north-east Victoria.

They also found the following divergences, being:

"*the age of the split between clade 3 and clades 1 and 2 is estimated to date to the Plio-Pleistocene - 2.7 Ma (95% CI: 1.6-3.3 Ma); the age of the split between clade 1 and clade 2 is estimated to date to the Pleistocene, 0.85 Ma (95% CI: 0.06-1.7 Ma).*"

While the age of the split between the third clade and the others would normally be species-level divergence, Smissen *et al.* (2013) found some genetic admixture in specimens from the Hunter Valley corridor, indicating subspecies level differentiation would be more appropriate for the clades.

Smissen *et al.* (2013) did not look at the morphology of the lizards in each clade to see if there were consistent differences between the lineages.

They did not see which available names could be applied to each lineage or if any were potentially unnamed.

The purpose of my study was to answer the two preceding questions better put as:

1/ Are the lineages morphology divergent enabling classification as subspecies? and;

2/ If there are consistent diagnosable differences between the relevant lizards, then are there available names for these lineages? and if not, one or more should be assigned according to the rules of the *International Code of Zoological Nomenclature* (Ride *et al.* 1999, as amended online since).

MATERIALS AND METHODS

Specimens of the putative species *Varanus varius* from all parts of the known range were examined, both live, dead and from quality photos of specimens with known provenance, with a view to identifying consistent differences between regions, so-called forms or the genetic lineages identified by Smissen *et al.* (2013).

Groups identified as morphologically distinct were then matched with available names (when available).

Relevant literature was inspected, including a general sweep of all the popular Australian field guides and the like with photos of specimens with known provenance as well as online photos of the same.

The taxonomic literature was inspected, including the publications of White (1790), Daudin (1802), Duméril and Bibron (1836), Borre (1870) and Berney (1936) as well as Boulenger (1885), Cogger *et al.* (1983), Denzer *et al.* (2020), Smissen *et al.* (2013) and Wells and Wellington (1985).

RESULTS

Specimens assigned to the three main lineages of Smissen *et al.* (2013), were all found to be readily diagnosable and separable from one another, allowing for confident taxonomic assignment of each.

No such analysis has ever been done in the past and I was surprised how obvious the differences between the three lineages were.

These differences are detailed below in the relevant description of a new subspecies from north Queensland, with the diagnostic differences being usable for descriptions of the two previously named subspecies, which until now have not previously been diagnosed.

The depth of divergence and possible ongoing mixture of genes between two of the three lineages as documented by Smissen *et al.* (2013), is why all are treated as subspecies and not full species.

In terms of available names and to which subspecies they should be assigned to, I note the following facts.

There is no type locality known for the original taxon name "*Lacerta varia* White, 1790".

However the image produced with the publication is of a typical specimen of the coastal New South Wales lineage, most readily identified by the obvious thick white cross-bands (unbroken) across the forelimbs, which is diagnostic for that subspecies. That is clade 3, as identified by Smissen *et al.* (2013).

"*Tupinambis variegatus* Daudin, 1802" with a type locality of Port Jackson (Sydney), New South Wales, is clearly a junior (subjective) synonym of the preceding species and subspecies.

"*Varanus belli* Duméril and Bibron, 1836", conforms to the broad-banded form found mainly in the Murray Darling basin and less commonly in coastal Queensland and so must be within that lineage, or the so-called clade 2 of Smissen *et al.* (2013).

It is the first available name for that lineage.

Varanus (*Hydrosaurus*) *mustelinus* Borre (1870) also appears to be of the coastal New South Wales form and is therefore a junior (subjective) synonym of the species and subspecies *Varanus varius*.

"*Varanus various* Berney, 1936", appears to be an erroneous use of *Varanus varius* White, 1790.

The genus *Varanus* Merrem, 1820 has a type species of "*Lacerta varia* White, 1790" by subsequent designation of Gray (1827).

The readily separable lineage from north of the Burdekin Gap in far north Queensland (wet tropics), has no available name and so is formally named herein according to the rules of *the International Code of Zoological Nomenclature* (Ride et al. 1999 as amended online since).

VARANUS VARIUS GEDYEI SUBSP. NOV.

LSIDURN:LSID:ZOOBANK.ORG:ACT:CF2863BA-2C86-42BC-82D1-3B62FEF82553

Holotype: A preserved specimen at the Queensland Museum, Brisbane, Queensland, Australia, specimen number J76106 collected from near Ravenshoe, far north Queensland, Australia, Latitude -17.598889 S., Longitude 145.476944 E. This government-owned facility allows access to its holdings.

Paratype: A preserved specimen at the Queensland Museum, Brisbane, Queensland, Australia, specimen number J87081 collected from Hopevale Road, 30 km from Cooktown, far north Queensland, Australia, Latitude -15.35 S., Longitude 145.05 E.

Diagnosis: *Varanus varius gedyei subsp. nov*. occurs in far north Queensland, in a coastal region generally north from Mt Elliot south-west of Townsville to Munburra (just north of Cooktown) in the north.

It is one of three subspecies of *V. varius* separated from one another by the following three suites of characters:

1/ *Varanus varius gedyei subsp. nov.* is readily separated from the other two subspecies by the unique combination of having a bluish pink tongue with white tips, distinct large ocelli on the upper body in adults (surrounded by black), especially on top of the lower back, no dorsal bands in adults, upper legs with white/yellow spots, not bands or spots fused to bands, or configured as such or similar as in all other subspecies.

The large size and clarity of the yellow to white ocelli on the dorsum in adults of this subspecies readily separate it from the other two.

2/ The type form of *Varanus varius varius* (White, 1790), from coastal New South Wales and nearby parts of north-east Victoria is identified by the possession of thick white or yellow cross bands across the upper and lower forelimbs, usually unbroken or if so, the dots are elongated and tending towards bands and a relatively thick white tongue.

3/ *Varanus varius belli* (Duméril and Bibron, 1836) from inland New South Wales, Queensland south of the Burdekin River and immediately adjacent parts of Victoria and South Australia of the "normal Lace Monitor colouration" is identified by the possession of a relatively thin blue tongue and with banding on the forelimbs broken to form elongated spots or peppering.

The broad-banded Bells form, found throughout most or all of the range of this same subspecies and which is included in it as a mutant form of it (also being of the holotype specimen's form), often has a white tongue as part of that mutation, and is readily separated from all other *V. varius* within this subspecies and the other subspecies by the possession of 1, 2 or 3, broad yellow bands across the dorsum and similar on the upper tail, versus numerous narrow bands, spots, peppering or ocelli in all the other forms and subspecies.

Colour images of *Varanus varius gedyei subsp. nov.* in life can be found online at:
https://www.inaturalist.org/observations/110275358
and
https://www.inaturalist.org/observations/98354913
and
https://www.inaturalist.org/observations/100970845
and
https://www.inaturalist.org/observations/90004993
and
https://www.inaturalist.org/observations/46346161

Colour images of the type form of *Varanus varius varius* (White, 1790), can be found in Hoser (1989), on page 121 (centre), and Cogger (2014) on page 787 at left, as well as online at:
https://www.inaturalist.org/observations/106384561
and
https://www.inaturalist.org/observations/16148566
and
https://www.inaturalist.org/observations/107257217
and
https://www.inaturalist.org/observations/82514944

Colour images of both the distinctive broad banded and "normal pattern" *Varanus varius belli* (Duméril and Bibron, 1836) in life can be found in Cogger (2014) on page 787 (right images), Wilson and Knowles (1988) page 321, top right ("normal pattern") and bottom left (Broad banded form) and Hoser (1989) on page 121 bottom for the broad-banded form and on page 201 top is a photo of a "normal pattern" male and "intermediate pattern" female.

Colour images of "normal pattern" *Varanus varius belli* (Duméril and Bibron, 1836) in life can be found online at:
https://www.inaturalist.org/observations/65455100
and
https://www.inaturalist.org/observations/103225102
and
https://www.inaturalist.org/observations/70723653
and
https://www.inaturalist.org/observations/107805779

Colour images of the distinctive broad banded *Varanus varius belli* (Duméril and Bibron, 1836) in life can be found online at:
https://www.inaturalist.org/observations/100755020
and
https://www.inaturalist.org/observations/107991529
and
https://www.inaturalist.org/observations/71840436

All the previously cited images were downloaded and checked most recently on 16 April 2022.

All three subspecies of *Varanus varius* can be readily separated from all other species of Varanid lizard by the following unique suite of characters:

Tail is strongly laterally (vertically) compressed, except for at the base; a distinct and obvious moderate to low median double keel dorsally along the posterior half of the tail; caudal scales are not arranged in regular rings as the ventral caudal scales are larger than the dorsal ones; nostrils are directed laterally (not upwards); all supraoculars are small and irregularly distributed; there is a row of enlarged scales forming a ridge on the inner edge of the basal part of the fourth toe (derived and modified from Cogger 2014).

Distribution: *Varanus varius gedyei subsp. nov*. occurs in far north Queensland, in a coastal region generally north from Mt Elliot south-west of Townsville to Munburra (just north of Cooktown) in the north, including hilly and wooded country to the nearby west.

Conservation: This and the other two subspecies do not appear to be under any obvious extinction threat. Populations in national parks and reserves appear to be secure.

Etymology: Named in honour of well-known snake breeder Andrew Gedye of the Cairns district in far north Queensland, Australia, (formerly of Cheltenham, Victoria, Australia), in recognition of his services to herpetology spanning some decades, including with respect of breeding in captivity rare and little-known forms.

SUMMARY

The formal taxonomic recognition of a genetically isolated lineage of Lace Monitors that diverged from all others some 850,000 years prior is long overdue.

Noting this divergence, an apparent lack of any gene flow between this and the other two subspecies of *V. varius* and that the relevant lizards are morphologically divergent, it is important that this evolving lineage be allowed to continue its evolutionary trajectory without risk of human transmigration of specimens from elsewhere.

The decision to classify the new taxon as a subspecies was made primarily on the basis of a divergence time being less than a million years, but in excess of 800K years.

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CONFLICT OF INTEREST

None.

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Two new subspecies of Thorny Devil, *Moloch horridus* Gray, 1841.

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ABSTRACT

The iconic Thorny Devil lizards of Australia, genus *Moloch* Gray, 1841 have always been treated as a monotypic genus. The species *Moloch horridus* Gray, 1841 has never been subdivided even at the subspecies level.

An audit of specimens from across Australia revealed three main populations, all readily distinguishable on the basis of differences in morphology and colour.

Although the genus itself has been shown to be significantly divergent from all other Australian agamids in numerous published molecular studies, there is no published data demonstrating timelines of divergences between regional populations.

Due to the consistent differences between the three main populations of *Moloch horridus* Gray, 1841, and no evidence of intermingling due to allopatry, each warrants taxonomic recognition at the species level.

Conservatively, the two unnamed forms are formally named herein.

The type form *Moloch horridus horridus* Gray, 1841 is herein restricted to coastal Western Australia and adjacent parts of south-west Australia.

Moloch horridus browni subsp. nov. is the taxon which occupies most of Central Australia, extending from western Queensland in the east, through the southern Northern Territory and including most of the eastern half of Western Australia.

Moloch horridus granti subsp. nov. is the taxon found on the Eyre Peninsula of South Australia and adjacent parts of southern South Australia.

Keywords:Taxonomy; nomenclature; Australia; Thorny Devil; Agamidae; *Moloch*; *horridus*; South Australia; Western Australia; Queensland; Northern Territory; new subspecies; *browni*; *granti*.

INTRODUCTION

The iconic Thorny Devil lizards of Australia, genus *Moloch* Gray, 1841 have always been treated as a monotypic genus. The species *Moloch horridus* Gray, 1841 has never been subdivided even at the subspecies level.

The closest to subdivision of the species as recognized to date was perhaps the paper of Wells and Wellington (1985), where for the entire genus they wrote:

"MOLOCH *Gray, 1841.*

Moloch horridus *Gray, 1841. We regard this species as composite and recommend the urgent examination of specimens across its entire range*."

Browne-Cooper *et al.* (2007) speculated that there may be a second species, but gave no indication as to where this idea came from or even on what basis. Their view was cited by Brown (2014).

This paper presents an answer to the question posed as to whether or not there are more than one taxonomically recognisable entities within the genus *Moloch*.

MATERIALS, METHODS AND RESULTS

An audit of several hundred specimens from across Australia, including the entire known range of *Moloch* in the wild state revealed three main populations, all readily distinguishable on the basis of differences in morphology and colour.

Although the genus itself has been shown to be significantly divergent from all other Australian agamids in numerous published molecular studies, including for example Hugall *et al.*

(2008) and Pyron *et al.* (2013) there is no published data demonstrating timelines of divergences between regional populations.

Due to the consistent differences between the three main populations of *Moloch horridus* Gray, 1841 and no evidence of intermingling due to allopatry, each warrants taxonomic recognition at the species level.

Cogger *et al.* (1983), at page 122 cites no known synonyms for the species *Moloch horridus* Gray, 1841, however an audit of the literature found one.

This was *Acanthosaurus gibbosus* Berthold, 1846.

Both the nominate specimen, depicted in Gray (1845) and the lizard of Berthold conform to the form from the west coast of Western Australia as described later in this paper in the descriptions of each new subspecies.

Conservatively, the two unnamed forms are formally named herein as subspecies.

Molecular studies in future are likely to warrant elevation of each and perhaps other populations to full species level. This is particularly the case for the most divergent population, herein named as *Moloch horridus browni subsp. nov.*.

The type form *Moloch horridus horridus* Gray, 1841 is herein restricted to coastal Western Australia and adjacent parts of south-west Australia.

Moloch horridus browni subsp. nov. is the taxon which occupies most of Central Australia, extending from western Queensland in the east, through the southern Northern Territory and including most of the eastern half of Western Australia.

Moloch horridus granti subsp. nov. is the taxon found on the Eyre Peninsula of South Australia and adjacent parts of southern South Australia.

While all relevant literature was consulted in terms of this taxonomic revision, none assisted in any way in terms of differentiating or diagnosing regional populations.

It was quite a surprise to find that not one single herpetologist in history had prior to now engaged in the fairly simple exercise of auditing specimens from across the known range of *Moloch* to see if there were taxonomically significant differences between populations.

As this exercise was done by myself for the first time ever, the differences between populations were obvious and within a short time enabled me to accurately tell location provenance of specimens put to me on a blind test, using characters diagnostic for each.

Each species is named according to the rules set out in the *International Code of Zoological Nomenclature* (Ride *et al.* 1999) and the following points relevant to each description are as follows.

Names or spelling should not be altered in any way unless mandated by the *International Code of Zoological Nomenclature* or publication that supersedes it.

In the event that a later author (first reviser) seeks to merge the two named taxa with one another, the first name to be used is that dictated by page priority and in the abstract keywords.

Colour descriptions relevant to each species do, unless otherwise stated, reflect colour in life of adult specimens.

There are no conflicts of interest in terms of this paper and the taxonomic and nomenclatural decisions taken herein.

Relevant literature in terms of this paper includes the following:

Browne-Cooper *et al.* (2007), Berthold (1846), Bohme and Bischoff (1984), Boulenger (1885), Brown (2014), Bush (1981), Cogger (2014), Cogger *et al.* (1983), Gray (1841), Hugall *et al.* (2008), Hutchinson and Hutchinson (2011), Macey *et al.* (2000), Manthey and Schuster (1999), Pianka (1969, 1997), Pianka and Pianka (1970), Pianka *et al.* (1998), Pyron *et al.* (2013), Siebenrock (1892), Switak (2017), Wells and Wellington (1985), Wilson (2015), Wilson and Knowles (1988), Wilson and Swan (2017) and sources cited therein.

MOLOCH HORRIDUS BROWNI SUBSP. NOV.

LSIDURN:LSID:ZOOBANK.ORG:ACT:2CCBB7D2-3019-4F7D-BCE5-8B8EC4066B2B

Holotype: A preserved specimen at the Australian Museum in Sydney, New South Wales, Australia, specimen number: R.113242, collected at 20 km north of Ethabuka Station Headquarters, north west of Bedourie, Queensland, Australia, Latitude 23.73 S., Longitude 138.45 E. The Australian Museum in Sydney, New South Wales, Australia is a government-owned facility that allows access to its holdings.

Paratype: A preserved specimen at the Queensland Museum, Brisbane, Australia, specimen number: J85414, collected at Cravens Peak, south-west of Boulia, Queensland, Australia, Latitude 23.13 S., Longitude 138.34 E.

Diagnosis: Until now, all lizards in the genus *Moloch* have been treated as being of the species *Moloch horridus* Gray, 1841. The genus and species as defined and diagnosed herein are readily separated from all other Australian agamids by the large conical spines that cover the fat depressed body and the presence of a large spinal nuchal hump or appendage, a large curved spine above each eye and a spinose tail that is shorter than the head and body (adapted from Cogger 2014).

All have a colour pattern including a dorsal surface with alternating dark and light cross bands of irregular shape and confused further by the conical scales and spines.

The nominate form *Moloch horridus horridus* from the west coast of Western Australia and nearby parts of the south-west of the State, away from the south coast, are separated from the other two subspecies by a dorsal pattern including chocolate brown cross-bands with lots of white and other colours on them; the dark sections of the flanks are heavily marked with white and the yellow cross-bands on the dorsal surface are faded or light yellow in colour.

The subspecies *Moloch horridus browni subsp. nov.* from central Australia, including the eastern half of Western Australia and far western Queensland is readily separated from the other two subspecies by a dorsal colouration incorporating yellow and brick-red cross-bands, both being clean as in lacking any significant intrusions of white pigment, flecks or the like.

The subspecies *Moloch horridus granti subsp. nov.* from the Eyre Peninsula in South Australia and immediately adjacent areas of the state are readily separated from the other two subspecies by a dorsal colouration including strong deep yellow cross-bands and chocolate brown cross-bands between these, the latter being clean on the upper surface (minimal white speckling or similar) and with only limited amounts of white intrusions or specking on the flanks. Unlike the other two subspecies, *Moloch horridus granti subsp. nov.* is characterised by a dominance of deep yellow on the head and large spines above the eyes.

Moloch horridus browni subsp. nov. is depicted in life in Wilson (2015) at page 167, Brown (2014) at page 765 at top, 765 at bottom, 776 at top and bottom left, 777 top right and Cogger (2014) at page 747.

Moloch horridus granti subsp. nov. is depicted in life in Brown (2014) at page 777 bottom left.

Moloch horridus horridus is depicted in life in Wilson and Knowles on page 218, lower right and Brown (2014) on page 777 at top left.

Distribution: *Moloch horridus browni subsp. nov.* occurs in central Australia, including the eastern half of Western Australia and far western Queensland

Etymology: Named in honour of Dr. Danny Brown of South-east Queensland in recognition of his amazing books on keeping and breeding Australian reptiles, generally regarded as “best in class”, including for example Brown (2014) as cited herein.

He also publicly blew the whistle on improper practices involving well known and now deceased animal abuser Steve Irwin, who was famous for corruptly making millions of dollars in cash and kind from government hand-outs and animal crulety on TV.

MOLOCH HORRIDUS GRANTI SUBSP. NOV.

LSIDURN:LSID:ZOOBANK.ORG:ACT:6C1BE5B9-27E0-4EE0-A820-ACEB24EA12B2

Holotype: A preserved specimen in the South Australian Museum, Adelaide, South Australia, Australia, specimen number: R37796, collected at Sinclair's Gap / Secret Rocks, South Australia, Australia, Latitude 33.18 S., Longitude 137.00 E. The South Australian Museum, Adelaide, South Australia, Australia is a government-owned facility that allows access to its holdings.

Paratype: A preserved specimen in the South Australian Museum, Adelaide, South Australia, Australia, specimen number: R25326, collected at Myola Station, 5 km west of Iron Baron, South Australia, Australia, Latitude 33.02 S., Longitude 137.22 E.

Diagnosis: Until now, all lizards in the genus *Moloch* have been treated as being of the species *Moloch horridus* Gray, 1841. The genus and species as defined and diagnosed herein are readily separated from all other Australian agamids by the large conical spines that cover the fat depressed body and the presence of a large spinal nuchal hump or appendage, a large curved spine above each eye and a spinose tail that is shorter than the head and body (adapted from Cogger 2014).

All have a colour pattern including a dorsal surface with alternating dark and light cross bands of irregular shape and confused further by the conical scales and spines.

The nominate form *Moloch horridus horridus* from the west coast of Western Australia and nearby parts of the south-west of the State, away from the south coast, are separated from the other two subspecies by a dorsal pattern including chocolate brown cross-bands with lots of white and other colours on them; the dark sections of the flanks are heavily marked with white and the yellow cross-bands on the dorsal surface are faded or light yellow in colour.

The subspecies *Moloch horridus granti subsp. nov.* from the Eyre Peninsula in South Australia and immediately adjacent areas of the state are readily separated from the other two subspecies by a dorsal colouration including strong deep yellow cross-bands and chocolate brown cross-bands between these, the latter being clean on the upper surface (minimal white speckling or similar) and with only limited amounts of white intrusions or specking on the flanks. Unlike the other two subspecies, *Moloch horridus granti subsp. nov.* is characterised by a dominance of deep yellow on the head and large spines above the eyes.

The subspecies *Moloch horridus browni subsp. nov.* from central Australia, including the eastern half of Western Australia and far western Queensland is readily separated from the other two subspecies by a dorsal colouration incorporating yellow and brick-red cross-bands, both being clean as in lacking any significant intrusions of white pigment, flecks or the like.

Moloch horridus browni subsp. nov. is depicted in life in Wilson (2015) at page 167, Brown (2014) at page 765 at top, 765 at bottom, 776 at top and bottom left, 777 top right and Cogger (2014) at page 747.

Moloch horridus granti subsp. nov. is depicted in life in Brown (2014) at page 777 bottom left.

Moloch horridus horridus is depicted in life in Wilson and Knowles on page 218, lower right and Brown (2014) on page 777 at top left.

Distribution: *Moloch horridus granti subsp. nov.* occurs on the Eyre Peninsula in South Australia and adjacent areas.

Etymology: Named in honour of Scott Grant, who as of 2019 was owner and manager of the Whyalla Fauna Park in Whyalla, South Australia, Australia in recognition for his contributions to wildlife conservation in Australia.

That park was shut down by government directive in November 2021 because it was viewed as competition for their own dysfunctional Adelaide Zoo business.

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CONFLICTS OF INTEREST

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