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## Morphological diversity and genetic structure within *Lerista kalumburu* Storr, 1976 (Squamata: Scincomorpha: Sphenomorphidae)—taxonomic implications

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### Abstract

Discovery of a population of two-toed *Lerista* allied to *L. kalumburu* prompted a morphological and genetic examination of this taxon. Molecular analysis showed limited divergence and parphyly of three-toed populations with respect to the two-toed form. We contend that these populations are best viewed as a single species exhibiting remarkable diversity in limb morphology. As this prevents successfully identifying the taxon using published keys, we provide a new diagnosis and a redescription of the species.

**Key words:** Kalumburu Kimberley Slider, taxonomy, limb morphology, limb reduction

### Introduction

The genus *Lerista* Bell, 1833 is an Australia-wide group of skinks well known for its multiplicity of species (currently 91 recognised species, Wilson & Swan 2013) and diversity of limb morphology, from five fingers and toes (presumed ancestral) to complete limb loss, with almost every combination in between. Rather than a rare event, limb reduction appears to have occurred numerous times within *Lerista* (Skinner *et al.* 2008). Selection against complex limb morphology is presumably a response to the adoption of ‘sand-swimming’, where forward motion is gained by pushing the body against objects as snakes do, and *Lerista* has often been cited as an ideal model for the study of this process (Greer 1987;1989;1990; Lee *et al.* 2013).

Another recurring trend within this genus is the high frequency of very limited distributions. Twenty-four of the 91 species have areas of occurrence less than 5,000 km<sup>2</sup>, one of the criteria used by the IUCN to place a species in the Endangered category, and ten species are known from less than ten voucher specimens (areas of occurrence estimated using minimum polygon method on records in the Atlas of Living Australia website at <http://www.ala.org.au>, accessed 8 August, 2013; see also Wilson & Swan 2013). While some show distinct habitat preferences (for example, the vine thicket specialists of northern Queensland, Amey & Couper 2009), the endemism is primarily thought to be due to their low vagility (Edwards *et al.* 2012; Lee *et al.* 2013). Consequently, a population of *Lerista* with two toes but otherwise similar to the three-toed *Lerista kalumburu* Storr, 1976, 50 km south of *L. kalumburu*’s type locality, was initially thought to represent an undescribed taxon. However, further investigation combining morphological and genetic data from several populations does not support this view. Instead, the data demonstrate these populations form a single species exhibiting surprising morphological diversity in limb structure.

### Material and method

Twenty-four specimens of *Lerista kalumburu*, including the holotype (WAMR27915) were examined and 12 associated tissue samples were sequenced. Collection localities are shown in Figure 1. All specimens collected from the vicinity of Theda Station, approximately 50 km south of the type locality of Kalumburu, had two toes on the hindlimbs, whereas all other specimens had three toes. Specimens examined are listed in the Appendix.

requirements of this species. Its situation may be similar to that of its congeners *L. lineopunctulata* and *L. praepedita* (Boulenger, 1887), where population structure is more sensitive to habitat connectivity than to previously identified geographic barriers to dispersal, especially when compared with other, more mobile, reptile taxa (Edwards *et al.* 2012). Further investigation of the factors limiting dispersal in this species is warranted.

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## References

- Amey, A.P. & Couper, P.J. (2009) A new limb-reduced skink (Scincidae: *Lerista*) from the dry rainforest of north Queensland, Australia. *Zootaxa*, 2173, 19–30.
- Arevalo, E., Davis, S.K. & Sites, J.W. (1994) Mitochondrial DNA sequence divergence and phylogenetic relationships among eight chromosome races of the *Sceloporus grammicus* complex (Phrynosomatidae) in central Mexico. *Systematic Biology*, 43, 387–418.  
<http://dx.doi.org/10.1093/sysbio/43.3.387>
- Bell, T. (1833) Characters of two new genera of reptiles. *Proceedings of the Zoological Society of London*, 1, 98–99.
- Boulenger, G.A. (1887) *Catalogue of the Lizards in the British Museum (Natural History)*. Trustees of the British Museum, London, 575 pp.
- Cogger, H.G. (2014) *Reptiles & Amphibians of Australia*. Reed New Holland, Sydney, 1033 pp.
- Duméril, A.M.C. & Bibron, G. (1839) *Erpétologie Générale, ou Histoire Naturelle Complète des Reptiles*. Roret, Paris, 854 pp.
- Edwards, D., Keogh, J.S. & Knowles, L.L. (2012) Effects of vicariant barriers, habitat stability, population isolation and environmental features on species divergence in the south-western Australian coastal reptiles community. *Molecular Ecology*, 21, 3809–3822.  
<http://dx.doi.org/10.1111/j.1365-294x.2012.05637.x>
- Fry, D.B. (1914) On a collection of reptiles and batrachians from Western Australia. *Records of the Western Australian Museum and Art Gallery*, 1, 174–210.
- Fujita, M.K., McGuire, J.A., Donnellan, S.C. & Moritz, C. (2010) Diversification and persistence at the arid-monsoonal interface: Australia-wide biogeography of the Bynoe's Gecko (*Heteronotia binoei*; Gekkonidae). *Evolution*, 64, 2293–2314.  
<http://dx.doi.org/10.1111/j.1558-5646.2010.00993.x>
- Gans, C. (1975) Tetrapod limblessness: evolution and functional correlates. *American Zoologist*, 15, 455–467.
- Gray, J.E. (1864) *Catalogue of the Specimens of Lizards in the Collection of the British Museum*. British Museum, London, 289 pp.
- Greer, A.E. (1987) Limb reduction in the lizard genus *Lerista* 1. Variation in the number of phalanges and presacral vertebrae. *Journal of Herpetology*, 21, 267–76.  
<http://dx.doi.org/10.2307/1563968>
- Greer, A.E. (1989) *The Biology and Evolution of Australian Lizards*. Surrey Beatty & Sons, Sydney, 264 pp.
- Greer, A.E. (1990) Limb reduction in the scincid lizard genus *Lerista* 2. Variation in the bone complements of the front and rear limbs and the number of postsacral vertebrae. *Journal of Herpetology*, 24, 142–150.  
<http://dx.doi.org/10.2307/1564221>
- Guindon, S. & Gascuel, O. (2003) A simple, fast and accurate algorithm to estimate large phylogenies by maximum likelihood. *Systematic Biology*, 52, 696–704.  
<http://dx.doi.org/10.1080/10635150390235520>
- Günther, A. (1867) Additions to the knowledge of Australian reptiles and fishes. *Annals and Magazine of Natural History*, 20, 45–68.
- Horner, P. (1992) *Skinks of the Northern Territory*. Northern Territory Museum of Arts and Sciences, Darwin, 174 pp.
- Kendrick, P.G. (1989) Two new species of *Lerista* (Lacertilia: Scincidae) from the Cape Range and Kennedy Range of Western Australia. *Journal of Herpetology*, 23, 350–355.  
<http://dx.doi.org/10.2307/1564045>
- Lee, M.S.Y., Skinner, A. & Camacho, A. (2013) The relationship between limb reduction, body elongation and geographical range in lizards (*Lerista*, Scincidae). *Journal of Biogeography*, 40, 1290–1297.  
<http://dx.doi.org/10.1111/jbi.12094>
- Loveridge, A. (1933) New scincid lizards of the genera *Sphenomorphus*, *Rhodona*, and *Lygosoma* from Australia. *Occasional*

*Papers of the Boston Society of Natural History*, 8, 95–100.

- Marx, H. & Hosmer, W. (1959) A new skink from Australia (*Rhodona karlschmidti*, sp. nov.). *Copeia*, 1959, 207–208.
- Mitchell, F.J. (1955) Preliminary account of the Reptilia and Amphibia collected by the National Geographic Society - Commonwealth Government - Smithsonian Institution Expedition to Arnhem Land (April to November, 1948). *Records of the South Australian Museum*, 11, 373–408.
- Posada, D. (2008) jModelTest: Phylogenetic model averaging. *Molecular Biology and Evolution*, 25, 1253–1256.  
<http://dx.doi.org/10.1093/molbev/msn083>
- Posada, D. & Crandall, K.A. (1998) Modeltest: Testing the model of DNA substitution. *Bioinformatics*, 14, 817–818.  
<http://dx.doi.org/10.1093/bioinformatics/14.9.817>
- Rambaut, A. (1996) Se-A: Sequence Alignment Editor, v2.0a10. Available from: <http://evolve.zoo.ox.ac.uk> (accessed 28 May 2014)
- Ronquist, F., Teslenko, M., Van Der Mark, P., Ayres, D.L., Darling, A., Höhna, S., Larget, B.L., Suchard, M.A. & Huelsenbeck, J.P. (2012) MRBAYES 3.2: Efficient Bayesian phylogenetic inference and model selection across a large model space. *Systematic Biology*, 61, 539–542.  
<http://dx.doi.org/10.1093/sysbio/sys029>
- Skinner, A. (2007) Phylogenetic relationships and rate of early diversification of Australian *Sphenomorphus* group scincids (Scincoidea, Squamata). *Biological Journal of the Linnean Society*, 92, 347–366.  
<http://dx.doi.org/10.1111/j.1095-8312.2007.00843.x>
- Skinner, A. (2010) Rate heterogeneity, ancestral character state reconstruction and the evolution of limb morphology in *Lerista* (Scincidae, Squamata). *Systematic Biology*, 59, 723–740.  
<http://dx.doi.org/10.1093/sysbio/syq055>
- Skinner, A., Lee, M.S.Y. & Hutchinson, M.N. (2008) Rapid and repeated limb loss in a clade of scincid lizards. *BMC Evolutionary Biology*, 8, 310.  
<http://dx.doi.org/10.1186/1471-2148-8-310>
- Storr, G.M. (1971) The genus *Lerista* (Lacertilia: Scincidae) in Western Australia. *Journal of the Royal Society of Western Australia*, 54, 59–75.
- Storr, G.M. (1976) Revisionary notes on the *Lerista* (Lacertilia: Scincidae) of Western Australia. *Records of the Western Australian Museum*, 4, 241–256.
- Storr, G.M. (1982) Four new *Lerista* (Lacertilia: Scincidae) from Western and South Australia. *Records of the Western Australian Museum*, 10, 1–9.
- Storr, G.M. (1985) Two new skinks (Lacertilia: Scincidae) from Western Australia. *Records of the Western Australian Museum*, 12, 193–196.
- Storr, G.M. (1986) Two new members of the *Lerista nichollsi* complex. *Records of the Western Australian Museum*, 13, 47–52.
- Storr, G.M. (1991a) Four new members of the *Lerista nichollsi* complex (Lacertilia: Scincidae). *Records of the Western Australian Museum*, 15, 139–147.
- Storr, G.M. (1991b) Partial revision of the *Lerista macropisthopus* group (Lacertilia: Scincidae). *Records of the Western Australian Museum*, 15, 149–61.
- Storr, G.M., Smith, L.A. & Johnstone, R.E. (1999) *Lizards of Western Australia. I Skinks*. Western Australian Museum, Perth, 291 pp.
- Swofford, D.L. (2002) PAUP\* Phylogenetic Analysis Using Parsimony (\* and other methods). Sinauer Associates, Sunderland.
- Werner, F. (1903) Neue reptilien und batrachier aus dem Naturhistorischen Museum in Brüssel. *Zoologischer Anzeiger*, 26, 246–253.
- Wilson, S. & Swan, G. (2013) *A Complete Guide to Reptiles of Australia*. New Holland Publishers, London, 592 pp.

## APPENDIX. Specimens examined.

WAMR = Western Australian Museum, QMJ = Queensland Museum. Specimens with tissue vouchers analysed in this study are highlighted in bold text.

***Lerista gascoynensis***: WAMR55971 (Gascoyne Junction, 16 km S, 25° 10' S 115° 12' E; holotype).

***Lerista kalumburu***: WAMR27915 (Kalumburu 14° 18' S 126° 38' E; holotype), WAMR99203, 99208–210, 100188–89, (Face Point, Carson Escarpment, 2.5 km N, 14° 50' 20" S 126° 49' 10" E), **WAMR113949** (Carson Escarpment 14° 51' S 126° 49' E), **WAMR113983** (Carson Escarpment 15° 21' S 126° 37' E), WAMR129938–39 (Kalumburu, 10 km N, 14° 12' S 126° 38' E), WAMR131660 (Kalumburu area, 14° 12' 37" S 126° 38' 43" E), **WAMR151647** (Mary Island, 13° 59' 00" S 126° 22' 45" E), **WAMR151860**, **151885–86**, **151998** (Sir Graham Moore Island, 13° 53' S 126° 34' E), **WAMR165945** (Truscott, 14° 05' 11" S 126° 26' 48" E), WAMR166151–52 (Doongan Station, 15° 18' 25" S 126° 09' 31" E), WAMR166153–54 (Theda Station, Cypress Valley, 14° 48' 22" S 126° 30' 27" E), **WAMR168457** (Sir Graham Moore Island, 13° 53' S 126° 34' E), WAMR171600 (Mary Island, 13° 59' 00" S 126° 22' 45" E), **WAMR172346** (Theda Station, 14° 50' S 126° 16' E), **WAMR172358** (Theda Station, 14° 47' S 126° 30' E).

***Lerista kendricki***: WAMR93887 (Hamelin HS, 15 km SW, 26° 32' S 114° 05' E; holotype).

- Lerista lineopunctulata***: WAMR121369 (City Beach, Perth 31° 56' S 115° 46' E), WAMR136105 (Peron Peninsula, Shark Bay 25° 59' S 113° 36' E), WAMR136106 (Shark Bay, 26° 34' S 114° 00' E), WAMR136109 (Edel Land, Shark Bay, 26° 28' S 113° 28' E), WAMR136132 (City Beach, 31° 56' S 115° 46' E), WAMR140905 (Cataby, 15 km WNW, 30° 43' 10" S 115° 19' 01" E), WAMR141182 (Lancelin, 15 km NNE, 30° 59' 31" S 115° 23' 43" E), WAMR152637 (Gun Island, 28° 53' 18" S 113° 51' 40" E), WAMR156890 (West Wallabi Island, 28° 27' 21" S 113° 41' 02" E).
- Lerista macropisthopus galea***: WAMR83228 (Galena, 8 km S, 27° 53' S 114° 42' E; holotype).
- Lerista macropisthopus macropisthopus***: WAMR144586 (Mount Jackson, 30° 15' 22" S 119° 16' 27" E).
- Lerista nicholli***: WAMR152989 (Walga Rock, 27° 23' 55" S 117° 28' 15" E).
- Lerista petersoni***: WAMR46197 (Yinnietharra, 24° 39' S 116° 09' E; holotype).
- Lerista punctatovittata***: QMJ64818 (Taroom, 6 km N, 25° 36' S 149° 46' E), QMJ76874 (SF161, Condamine, 26° 58' 07" S 150° 17' 42" E), QMJ77729 (Darling Downs, near Brymaroo, 27° 11' 13" S 151° 33' 53" E), QMJ78726 (Welford NP, 25° 08' 44" S 143° 16' 14" E), QMJ89479 (Bendee Downs hstd, 28° 03' 54" S 146° 33' 54" E), QMJ91082 (Hairy-nosed Hwy, Epping Forest NP, NW Clermont, 22° 21' 09" S 146° 41' 29" E), QMJ91782, 91802 (Welford NP, 25° 10' 18" S 143° 20' 05" E).
- Lerista yuna***: WAMR97214 (East Yuna Reserve, 28° 28' S 115° 13' E; holotype).