Publication date: 11/02/2022

Notice and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list the Monaro Grassland Earless Dragon *Tympanocryptis osbornei* Melville, Chaplin, Hutchinson, Sumner, Gruber, MacDonald & Sarre 2019 as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act, and as a consequence omitting reference to *Tympanocryptis pinguicolla* (Mitchell 1948). Listing of Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Tympanocryptis osbornei was found to be endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017:* clause 4.3 (b) (d) (e ii, iii, iv) because: i) the distribution of the species is highly restricted with an extent of occurrence and area of occupancy of 1044 km^2 and 68 km^2 respectively; ii) the species is known from a small number of locations; and iii) there is a continuing decline in the geographic distribution and the habitat area, extent and quality of the species.

The NSW Threatened Species Scientific Committee has found that:

1. *Tympanocryptis pinguicolla*, the South-eastern Lined Earless Dragon was listed as an Endangered Species on Part 1 of Schedule 1 of the Threatened Species Act 1995 in 15/11/1996. Individuals of *Tympanocryptis pinguicolla* in NSW were recently recognised as two separate species *Tympanocryptis mccartneyi* Bathurst Grassland Earless Dragon and *Tympanocryptis osbornei* Monaro Grassland Earless Dragon (Melville *et al.* 2019).

2. *Tympanocryptis osbornei* is described by Melville *et al.* (2019) as: “Lateral neck fold well developed, from angle of jaw to gular fold; spines along extent of fold. Head and snout with strongly keeled dorsal scales; keels irregular, those on the lateral scales aligned more obliquely than those on the more medial scales. Snout shape smoothly tapering in profile, the canthal scales continuous with the rostral scale. Nasal scale dorsal margin does not cross onto the dorsal side of the canthus rostralis. No row of enlarged scales along the ventral margin of the nasal scale between the nasal and small snout scales. Dorsal body scales weakly to moderately keeled and imbricate. Numerous scattered strongly enlarged spinous dorsal scales, at least twice the width of adjacent body scales, each with a strong median keel ending in a prominent spine directed posterodorsally; sharply convex trailing edge not raised into a rim. Ventral body scales and throat scales smooth. Thigh scalation homogeneous, lacking scattered enlarged tubercular scales. Lateral fold between axilla and groin present. Snout–vent length 49–58 mm; femoral pores = 0; preanal pores = 2. Dorsal colour pattern variable in degree of development and colour hue, from reddish brown to greybrown with six or seven dark brown transverse bands and with 5-lined pattern well defined, and usually continuous, or at most briefly interrupted on the paler interspaces between the dark cross bands. Dorsolateral lines as wide as or wider than the vertebral line, well

defined, straight-edged, not expanding around the vertebral blotches. Vertebral and dorsolateral stripes continue weakly onto the tail outlining 12–14 dark caudal blotches. Pale supra-ocular bar present but usually weakly contrasting. Venter whitish, often heavily patterned with blackish speckling, especially on the throat."

3. *Tympanocryptis osbornei* is part of the *T. lineata* species complex (which includes *T. lineata, T. mccartneyi*, *T. osbornei*, and *T. pinguicolla*) and are referred to as the "grassland earless dragons", being the only members of the family Agamidae to be restricted to natural temperate grasslands. *T. osbornei* was previously considered a population of *T. pinguicolla,* but a recent taxonomic revision has described this as a separate species, based on genomics and morphology (Melville *et al.* 2019).

4. *Tympanocryptis osbornei* is endemic to New South Wales (NSW), Australia, where it is restricted to native tussock grasslands of the Monaro high plains. The species is known to occur within a small region bounded by the Maclaughlin and Murrumbidgee Rivers in the south and north, the Monaro Highway in the east and Berridale in the West (Melville *et al.* 2019).

5. The species is mainly known to occur on freehold agricultural land used for grazing and limited crops but has also been recorded in a number of travelling stock reserves (TSRs) and in Kuma Nature Reserve near Cooma. Kuma Nature Reserve is the only grassland reserve on the Monaro managed for *T. osbornei* and Natural Temperate Grassland of the South Eastern Highlands (a nationally critically endangered ecological community, EPBC Act 1999; NSW NPWS 2007). The species was last recorded in Kuma NR in 1998 (NSW BioNet) and may no longer occur there.

6. *Tympanocryptis osbornei* is known to occur in rocky open grassland communities dominated by *Poa sieberiana* and *Austrostipa scabra* with sub dominant *Rytidosperma caespitosum* or *Rytidosperma racemosum,* on predominately basalt geology with heavy clay soils (Robertson and Evan 2009, Eco Logical Australia 2009, McGrath 2015, Melville *et al.* 2019). Sites in the Cooma region were noted to be on well drained north facing slopes that had not been subject to ploughing or pasture modification (Nelson 2004). The species has been recorded at elevations of 758 to 1234 m above sea level though sites at higher elevations are more likely to contain the species (McGrath *et al.* 2015, Melville *et al.* 2019).

7. The species has been discovered beneath rocks in either burrows, rock crevices or depressions (Osborne *et al.* 1993). Burrows excavated by wolf spider (*Lycosidae* sp.) associated with partially embedded surface rocks are of critical importance to *T. osbornei*. These burrows provide shelter sites for overwintering, refuge from trampling by livestock and predation and as locations where eggs can be laid (McGrath 2015). Fidelity to these burrows is known to increase with the onset of winter (Stevens *et al.* 2010) and the species is reported to be torpid in winter between May and September (McGrath *et al.* 2015).

8. *Tympanocryptis osbornei* is a sit-and-wait predator, feeding mainly on small invertebrates including ants, beetles, spiders and moths (McGrath 2015).

9. Detailed studies of the life history of *T. osbornei* are limited (other than Nelson 2004) and most information is based on the better understood related species *T. lineata* (Smith 1994, Langston 1996, Stevens *et al*. 2010, Dimond *et al*. 2012). Grassland earless dragons are oviparous, laying clutches of 3-6 eggs in late spring or early summer, in shallow nests which develop over 9-12 weeks before hatching in late summer or early autumn (Smith 1994, Langston 1996, Nelson 2004). The young disperse probably soon after hatching (Smith 1994, Dawson 2003). No information is available concerning either hatching success or juvenile mortality. They quickly grow to adult size (by late autumn-early winter), with males maturing earlier than females (Langston 1996, Nelson 2004). Mating occurs the following spring (Robertson and Evans 2009).

10. Generation length of *Tympanocryptis osbornei* in the wild is estimated to be one to two years. The species is short lived, surviving usually for only one to three years in the wild though they can reach the age of four to six years, sometimes up to nine years within captivity (Nelson 2004, Robertson and Evans 2009; S. Sarre *in litt*. January 2021). They are able to breed in their first year and most females in the wild seem to only survive long enough to produce one clutch of eggs however in captivity they have occasionally been recorded to produce a second clutch (Langston 1996; Nelson 2004; S. Sarre *in litt*. January 2021).

11. Adult grassland earless dragons have been shown to move as much as 40 to 110 m per day (Langston 1996, Nelson 2004), with some movements in excess of 230 m over longer periods. The closely related *T. lineata* has been recorded to occupy home ranges of between 925 m^2 and 4768 m^2 (Stevens *et al.* 2010). Nothing is known about movements of juveniles, although this stage may be when dispersal occurs (Robertson and Evans 2009). Population density may be influenced by social interactions, as aggressive encounters between individual lizards, involving vocalisations and displays, have been observed in captive animals and in the field (Smith 1994, Robertson and Evans 2009).

12. The distribution of *Tympanocryptis osbornei* is considered to be highly restricted. Using the recorded occurrences of the species (ALA 2020; NSW BioNet 2020), *Tympanocryptis osbornei* occupies an extent of occurrence (EOO) estimated to be 1258 km^2, based on a minimum convex polygon enclosing all known mapped occurrences of the species, the method of assessment recommended by IUCN (2019). The area of occupancy (AOO) for all records was estimated to be 124 km^2, based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2019).

13. Since European settlement, 99.5% of the Natural Temperate Grassland of the South Eastern Highlands ecological community, which *Tympanocryptis osbornei* relies upon, has been destroyed or drastically altered and now only occur in small highly fragmented patches (Kirkpatrick *et al.* 1995, Environment ACT 2005; Threatened Species Scientific Committee 2016). Studies have shown that currently *T. osbornei* has low levels of genetic structure with no indication of significant isolation by distance. Known locations of the *T. osbornei* in the Monaro are widely spaced, separated by up to 50 km (McGrath *et al*. 2015), but connectivity among extant populations may occur as potentially suitable tracts of contiguous natural

grassland have been retained (Carlson *et al*. 2016). However, low genetic structuring may be a result of historical rather than present-day connectivity as extant sites are small (no more than 650 ha) and often delineated by unsuitable habitat such as cultivated improved pastures or are separated by distances greater than 300 m (Stevens *et al*. 2010; Department of Environment 2016; T. McGrath *in litt.* Sept 2020). Further clearing for agricultural and rural residential development is planned in the Monaro region resulting in greater contraction of suitable habitat, increased fragmentation and reduction of connectivity between suitable habitat patches (NSW Government 2017; Fallding 2002).

14. The population size of *Tympanocryptis osbornei* is unknown and information regarding population trends of the species is limited (Osborne *et al.* 1993; Robertson and Evans 2009). There has been no comprehensive surveying of *Tympanocryptis osbornei* and the detection rate of this species is extremely low, making it difficult to accurately estimate population extent (McGrath *et al*. 2015, Melville *et al.* 2019).

15. Much of the natural grassland habitat of *Tympanocryptis osbornei* has either been cleared or has undergone extensive structural and compositional degradation as a result of agricultural development and related disturbances (Costin 1954; Benson and Redpath 1997; Threatened Species Scientific Committee 2016). The remaining areas of grassland habitat are subject to ongoing degradation processes including, crash grazing practices or overstocking, ploughing or sowing of exotic pastures, pasture improvements through use of agricultural chemicals and rock removal (Robertson and Evans 2009, McGrath 2015). A change in grazing regime by domestic stock and feral animals significantly impacts grassland community structure and composition (Costin 1954; Clarke 2003; Keith 2004; Environment ACT 2005; Threatened Species Scientific Committee 2016). Ground-dwelling reptiles are vulnerable to changes in the intensity of grazing and trampling by stock due to their use of a particular vegetation structure and microhabitat features that are important for foraging, shelter, reproduction and thermoregulation (McElhinny *et al.* 2006). Furthermore, their limited dispersal ability prevents them from migrating into higher quality areas when habitat is degraded (Brown *et al.* 2011). A study of ground-dwelling reptiles in grassy habitats showed species abundance and diversity were highest at low grazing intensities (Howland *et al.* 2014). The closely related *T. lineata* has never been captured in grassland that is highly modified, such as through ploughing and conversion to exotic grassland (Stevens *et al.* 2010). Ploughing and overgrazing are likely to also reduce the density of arthropods that *T. osbornei* relies on to form burrows, reducing availability for shelter, and may also reduce the abundance of prey items (Nelson 2004).

16. The removal of bushrock from grassland habitats either for facilitation of farming activities or for home landscaping use removes important habitat elements for grassland earless dragons (Threatened Species Scientific Committee 2016). ‘Bushrock removal” is listed as a Key Threatening Process under the Act.

17. Exotic flora species have had a major impact upon grassland habitats and are still considered as severe threats throughout the range of *T. osbornei* (Environment ACT, 2005; Threatened Species Scientific Committee 2016). The perennial grass

Eragrostis curvula (African Lovegrass) is regarded as one of the weeds of most concern within the Snowy Monaro region due to its invasiveness and potential for spread. As *Eragrostis curvula* has little grazing value, due to its low nutritional value and palatability, stock and other wildlife avoid it unless there is nothing else to eat and so it rapidly replaces more palatable grasses, especially during drought, forming a monoculture. It also invades native vegetation including grassland, by establishing in thin and bare patches, blocking movement and obscuring burrows essential for *T. osbornei*. Other species identified as priority weeds impacting the Monaro grasslands include *Nassella trichotoma* (Serrated Tussock), *Nassella neesiana* (Chilean Needle Grass) and *Hypericum perforatum* (St John's Wort) (Environment ACT 2005; Threatened Species Scientific Committee 2016; Snowy Monaro Regional Council 2018).

18. The burrowing and grazing activities of the European rabbit (*Oryctolagus cuniculus*) and the wallowing and rooting behaviour of the feral pig (*Sus scrofa*) are sources of disturbance to grasslands habitats (Costin 1954; Environment ACT 2005; Threatened Species Scientific Committee 2016). Impacts by these animals include soil disturbance and erosion which can promote the invasion of weeds and prevent the recruitment and survival of native plants, which can adversely affect the microhabitat requirements of *T. osbornei* (Costin 1954; Environment ACT 2005; DEWHA 2008). "Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus*" and "Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)" are listed as Key Threatening Processes under the Act.

19. The reduction of vegetation cover as a result of grazing in grassland habitats is likely to increase the impact of predators such as feral cats, dogs and foxes. Foxes are likely to be more numerous on the rural sites and predation by domestic pets and feral cats might increase where *T. osbornei* sites are closer to urban developments (Robertson and Evans 2009). The impact of native predators like ravens, raptors, magpies and snakes may also increase with lack of vegetation and increased exposure (Robertson and Evans 2009). "Predation by the European Red Fox *Vulpes vulpes"* and "Predation by the Feral Cat *Felis catus*" are listed as Key Threatening Processes under the Act.

20. Modelling of the effect of climate change predicts warmer year-round temperatures for south eastern Australia by the end of the century, with an increase in the intensity and frequency of hot days and heatwaves, intensifying drought conditions and changing rainfall patterns (OEH 2014). These changed conditions have the potential to impact the habitat quality, population resilience and recruitment of *T. osbornei* (J. Melville *in litt.* Sept 2020). Monitoring data of the related *T. lineata* from 2002-2010, showed that successive years of drought led to population declines and local extinctions, suggesting this species may be sensitive to the predicted effects of climate change (Dimond *et al.* 2012). As a result of drought, sparser ground cover will lead to higher ground temperatures, which may increase mortality of eggs and hatchlings through desiccation (Dimond *et al.* 2012), thermal refuges may also be less effective, and at high temperatures the daily activity period may reduce foraging time (Sinervo *et al*. 2010). Associated impacts correlated with, or exacerbated by, anthropogenic climate change also include an increase in the

severity and frequency of fire (Flannigan *et al.* 2009) and any effects on populations from habitat fragmentation and degradation (Hoehn *et al.* 2013). The relatively low fecundity and short life span of *T. osbornei* makes local populations vulnerable to the effects of wildfire, drought and other environmental changes on their habitat. "Anthropogenic Climate Change" is listed a Key Threatening Process under the Act.

21. Fire can regenerate native grasslands and maintain diversity in grassland structure, but too frequent burning and wildfire may also kill *T. osbornei*, alter vegetation composition and structure and reduce the abundance of prey (Environment ACT 2005; ACT Government 2017). The related *T. lineata* has been recorded both escaping from and being killed by an unplanned fire (Osborne *et al.* 2009). Too-frequent burning or fires that are too hot or at inappropriate times are identified as a threat to native grasslands, and particularly to the small, relatively immobile fauna species that occur in small, fragmented sites (Environment ACT 2005; Dunlop *et al.* 2012; Threatened Species Scientific Committee 2016). "High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition" is listed as a Key Threatening Process under the Act.

22. *Tympanocryptis osbornei* Melville, Chaplin, Hutchinson, Sumner, Gruber, MacDonald & Sarre 2019 is not eligible to be listed as a Critically endangered species.

23. The NSW Threatened Species Scientific Committee is of the opinion that an amendment to the Schedule is necessary or desirable to reflect the reclassification and reassessment of the newly described species as a result of taxonomic revision and that *Tympanocryptis osbornei* Melville, Chaplin, Hutchinson, Sumner, Gruber, MacDonald & Sarre 2019 is eligible to be listed as an Endangered species as it is facing a very high risk of extinction in Australia in the immediate future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

Assessment against *Biodiversity Conservation Regulation* 2017 criteria
The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Endangered under Clause 4.3 (b) (d) (e ii, iii, iv).

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Data Deficient

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or

	(c)	for vulnerable species	a moderate reduction in population size.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

Clause 4.3 - Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)
Assessment Outcome: Endangered under Clause 4.3 (b) (d) (e ii, iii, iv).
[Equivalent to IUCN Criterion B via B1ab (i, ii, iii, iv, v) and B2ab (i, ii, iii, iv, v)]

The geographic distribution of the species is:				
	(a)	for critically endangered species		very highly restricted, or
	(b)	for endangered species		highly restricted, or
	(c)	for vulnerable species		moderately restricted,
and at least 2 of the following 3 conditions apply:				
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,		
	(e)	there is a projected or continuing decline in any of the following:		
		(i)	an index of abundance appropriate to the taxon,	
		(ii)	the geographic distribution of the species,	
		(iii)	habitat area, extent or quality,	
		(iv)	the number of locations in which the species occurs or of populations of the species,	
	(f)	extreme fluctuations occur in any of the following:		
		(i)	an index of abundance appropriate to the taxon,	
		(ii)	the geographic distribution of the species,	
		(iii)	the number of locations in which the species occur or of populations of the species.	

Clause 4.4 - Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion C)
Assessment Outcome: Data Deficient

The estimated total number of mature individuals of the species is:			
	(a)	for critically endangered species	very low, or
	(b)	for endangered species	low, or
	(c)	for vulnerable species	moderately low,
and either of the following 2 conditions apply:			

	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):				
		(i)	for critically endangered species			very large, or
		(ii)	for endangered species			large, or
		(iii)	for vulnerable species			moderate,
	(e)	both of the following apply:				
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and			
		(ii)	at least one of the following applies:			
			(A)	the number of individuals in each population of the species is:		
				(I)	for critically endangered species	extremely low, or
				(II)	for endangered species	very low, or
				(III)	for vulnerable species	low,
			(B)	all or nearly all mature individuals of the species occur within one population,		
			(C)	extreme fluctuations occur in an index of abundance appropriate to the species.		

Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)
Assessment Outcome: Data Deficient

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data Deficient

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 - Very highly restricted geographic distribution of species– vulnerable species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Vulnerable

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.

Dr Anne Kerle
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

NSW Threatened Species Scientific Committee (2021) Conservation Assessment of *Monaro Grassland Earless Dragon Tympanocryptis osbornei Melville, Chaplin, Hutchinson, Sumner, Gruber, MacDonald & Sarre 2019* (Agamidae). NSW Threatened Species Scientific Committee.

References:

ACT Government (2017) ACT native grassland conservation strategy and action plans (Environment, Planning and Sustainable Development, Canberra).

Benson JS, Redpath PA (1997) The nature of pre-European native vegetation in south-eastern Australia: a critique of Ryan, D.G., Ryan, J.R. and Starr, B.J. (1995) The Australian Landscape – Observations of Explorers and Early Settlers. *Cunninghamia* **5**, 285–328.

Brown GW, Dorrough JW, Ramsey DSL (2011) Landscape and local influences on patterns of reptile occurrence in grazed temperate woodlands of southern Australia. *Landscape and Urban Planning* **103**, 277–288.

Carlson E, MacDonald AJ, Adamack A, McGrath T, Doucette LI, Osborne WS, Gruber B, Sarre SD (2016) How many conservation units are there for the endangered grassland earless dragons? *Conservation Genetics* **17**, 761–774.

Clarke PJ (2003) Composition of grazed and cleared temperate grassy woodlands in eastern Australia: patterns in space and inferences in time. *Journal of Vegetation Science* **14**, 5–14.

Costin AB (1954) 'A Study of the Ecosystems of the Monaro Region of New South Wales with Special Reference to Soil Erosion.' (Government Printer: Sydney) Special Reference to Soil Erosion. Government Printer, Sydney.

Dawson J (2003) Report on survey for the endangered Grassland Earless Dragon *Tympanocryptis pinguicolla* at 'The Poplars', Queanbeyan. NSW National Parks and Wildlife Service, Queanbeyan.

Department of Environment (2016) Natural Temperate Grassland of the South Eastern Highlands ecological community – map. Available at http://www.environment.gov.au/biodiversity/threatened/communities/maps/pubs/152-map.pdf (accessed 22/01/2021).

DEWHA (2008) Threat Abatement Plan for competition and land degradation by rabbits. Australian Government Department of the Environment, Water, Heritage and the Arts.

Dimond WJ, Osborne WS, Evans MC, Gruber B, Sarre SD (2012) Back to the brink: population decline of the endangered grassland earless dragon (*Tympanocryptis pinguicolla*) following its rediscovery. *Herpetological Conservation and Biology* **7**, 132–149.

Dunlop M, Hilbert DW, Ferrier S, House A, Liedloff A, Prober SM, Smyth A, Martin TG, Harwood T, Williams KJ, Fletcher C, and Murphy H (2012) The Implications of Climate Change for Biodiversity Conservation and the National Reserve System: Final Synthesis. A report prepared for the Department of Sustainability, Environment, Water, Population and Communities, and the Department of Climate Change and Energy Efficiency. CSIRO Climate Adaptation Flagship, Canberra.

Eco Logical Australia (2009) Unpublished Environmental Impact Assessment Report for the Boco Rock windfarm, Wind Prospects Pty Ltd.

Environment ACT (2005) National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT): an endangered ecological community (Environment ACT, Canberra).

Fallding M (2002) Planning framework for natural ecosystems of the ACT and NSW Southern Tablelands. Natural Heritage Trust, NSW NPWS and Land and Environment Planning.

Flannigan MD, Krawchuk MA, de Groot WJ, Wotton BM, Gowman LM (2009) Implications of changing climate for global wildland fire. *International Journal of Wildland Fire* **18**, 483–507.

Hoehn M, Dimond W, Osborne W and Sarre S (2013) Genetic analysis reveals the costs of peri-urban development for the endangered grassland earless dragon, *Conservation Genetics* **14**, 1269–1278.

Howland B, Stojanovic D, Gordon IJ, Manning AD, Fletcher D, Lindenmayer DB (2014) Eaten Out of House and Home: Impacts of Grazing on Ground- Dwelling Reptiles in Australian Grasslands and Grassy Woodlands, PLoS ONE **9**, e105966.

IUCN Standards and Petitions Subcommittee (2019) Guidelines for Using the IUCN Red List Categories and Criteria. Version 14. Prepared by the Standards and Petitions Subcommittee. http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf

Keith DA (2004) 'Ocean Shores to Desert Dunes: the native vegetation of New South Wales and the ACT.' (NSW Department of Environment and Conservation: Sydney)

Kirkpatrick JB, McDougall K, Hyde MK (1995) 'Australia's most threatened ecosystem.' (Surrey Beatty: Sydney)

Langston A (1996) The ecology and distribution of *Tympanocryptis lineata pinguicolla* (Southern Lined Earless Dragon) in the Australian Capital Territory and adjacent sub-region. Honours thesis, University of Canberra.

McElhinny C, Gibbons P, Brack C, Bauhus J (2006) Fauna-habitat relationships: a basis for identifying key stand structural attributes in temperate Australian eucalypt forests and woodlands. *Pacific Conservation Biology* **12**, 89–110.

McGrath T (2015) The conservation and ecology of a rare and declining agamid lizard, the grassland earless dragon *Tympanocryptis pinguicolla* in the Monaro region of New South Wales, Australia. Masters Thesis, University of Canberra.

McGrath T, Guillera-Arroita G, Lahoz-Monfort JJ, Hunter D, Osborne W, Sarre SD (2015) Accounting for detectability when surveying for rare or declining reptiles. *Biological Conservation* **182**, 53–62.

Melville J, Chaplin K, Hutchinson M, Sumner J, Gruber B, MacDonald AJ, Sarre SD (2019) Taxonomy and conservation of grassland earless dragon: new species and an assessment of the first possible extinction of a reptile on mainland Australia. *Australia Royal Society of Open Science* .6190233 http://doi.org/10.1098/rsos.190233

Nelson L (2004) Thermal ecology and implications for life history variation in *Tympanocryptis pinguicolla* (Grassland Earless Dragon). Ph.D. Thesis, The Australian National University, Canberra.

NSW Government (2017) South East and Tablelands Regional Plan 2036. NSW Government.

NSW NPWS (2007) Kuma Nature Reserve Plan of Management. NSW National Parks and Wildlife Service, Queanbeyan, New South Wales.

OEH (2014) South East and Tablelands Climate Change Snapshot. Office of Environment and Heritage (NSW). https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/South-East-and-Tablelands-Climate-Change-Downloads (accessed 16 December 2020)

Osborne, WS, Kukolic K, Williams KD (1993) Conservation of reptiles in the Southern Tablelands of New South Wales and the Australian Capital Territory. In 'Herpetology in Australia: A diverse discipline'. (Eds D Lunney, D Ayers) pp. 151-158. (Transactions of the Royal Society of New South Wales, Surrey Beatty & Sons Pty. Ltd. Chipping Norton, NSW)

Osborne W, Wong D, Dimond W (2009) Habitat mapping for the Grassland Earless Dragon (*Tympanocryptis pinguicolla*) at Cookanalla and Wendover, Symonston, ACT. Report and mapping for ACT Planning and Land Authority. Institute for Applied Ecology, University of Canberra, Canberra.

Robertson P Evans M (2009) National Recovery Plan for the Grassland Earless Dragon *Tympanocryptis pinguicolla*. ACT Department of Territory and Municipal Services, Canberra.

Sinervo B, Mendez-de-la-Cruz F, Miles DB, Heulin B, Bastiaans E, Villagrán-Santa Cruz M, Lara-Resendiz R, Martínez-Méndez N, Calderón-Espinosa ML, Meza-Lázaro RN, Gadsden H, Avila LJ, Morando M, De la Riva IJ, Sepulveda PV, Rocha CFD, Ibargüengoytía N, Puntriano CA, Massot M, Lepetz V, Oksanen TA, Chapple DG, Bauer AM, Branch WR, Clobert J, Sites JW Jr (2010) Erosion of lizard diversity by climate change and altered thermal niches. *Science* **328**, 894–899.

Smith WJS (1994) The ecology and taxonomy of the Southern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*). Honours thesis, Australian National University, Canberra.

Snowy Monaro Regional Council (2018) Snowy Monaro Region Local Weed Management Plan https://www.snowymonaro.nsw.gov.au/DocumentCenter/View/7780 (accessed 16 December 2020)

Stevens TA, Evans MC, Osbornes WS, Sarre SD (2010) Home ranges of, and habitat use by, the grassland earless dragon (*Tympanocryptis pinguicolla*) in remnant native grasslands near Canberra. *Australian Journal of Zoology* **58**, 76–84.

Threatened Species Scientific Committee (2016) Approved Conservation Advice (including listing advice) for Natural Temperate Grassland of the South Eastern Highlands (EC 152). Department of the Environment, Canberra. Available at http://www.environment.gov.au/biodiversity/threatened/communities/pubs/152-conservation-advice.pdf (accessed 22/01/2021).