Notice of the Determination for provisional listing of a critically endangered species on an emergency basis

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Determination for provisional listing, on an emergency basis, of the species, *Tympanocryptis lineata* Peters 1863 as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act.

What happens next?

This species will be provisionally listed as critically endangered species when the provisional listing determination is published on the New South Wales legislation website www.legislation.nsw.gov.au.

In the near future the Committee will make a preliminary determination regarding this proposal which will be placed on public exhibition. Public submissions will be invited at that time.

Dr Anne Kerle
Chairperson
NSW Threatened Species Scientific Committee

Publication date: 10/06/2022

Determination for provisional listing of an endangered species on an emergency basis

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Determination for provisional listing, on an emergency basis, of the species, *Tympanocryptis lineata* Peters 1863 as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act. Provisional Listing of Critically Endangered species on an emergency basis is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Tympanocryptis lineata Peters 1863 was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.2(1)(a),(2)(b,c); Clause 4.3(a)(d)(e, i,ii,iii,iv); Clause 4.4(a)(d,(i)), (e(i), (ii, A(I))); and Clause 4.5. The main reasons for this species being eligible are: i) it has a very highly restricted geographical range ii) the estimated total number of mature individuals is extremely low; (iii) habitat is severely fragmented (due to poor quality intervening habitat or infrastructure such as roads or urban development); (iv) there is projected continuing decline due to ongoing threats including habitat degradation through changed grazing regimes, pasture improvement and weed infestations; and increased extreme climatic events that have increased mortality and/or decreased reproduction. As a result, this species is subject to an immediate and significant threat of extinction.

The NSW Threatened Species Scientific Committee has found that:

1. *Tympanocryptis lineata* 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 44–61 mm; femoral pores = 0; preanal pores = 2. Dorsal colour pattern variable in degree of development and colour hue, from light brown to grey-brown 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 7–11 dark caudal blotches. Pale supra-ocular bar present but usually weakly contrasting. Venter whitish, often heavily patterned with blackish speckling, especially on the throat."

2. *Tympanocryptis lineata* 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. *Tympanocryptis lineata* 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).

3. *Tympanocryptis lineata* were thought to be extinct in the Australian Capital Territory (ACT) (not recorded for 30 years) until an opportunistic observation near Canberra in the early 1990s (Osborne *et al.* 1993a). They are now known to be geographically isolated and restricted to Natural Temperate Grassland (of the South-East Region - EPBC Act listed ecological community) around Canberra in the ACT and adjacent Natural Temperate Grassland in NSW.

4. Genetically, *T. lineata* is divided into three discrete units or populations that align with geography – Jerrabomberra West (ACT), north Canberra (ACT), and south Canberra (ACT and NSW) (Colley 2021). There is no evidence of recent (within approximately 15 years) gene flow between these three populations and evidence of only very small levels of gene flow among sampling sites within them (Colley 2021). It is unknown whether gene flow existed among these populations before the establishment of Canberra but they are now separated by significant infrastructure including major highways, rail lines, a prison, semi-industrial precincts, the Molongolo River, and Canberra Airport.

5. *Tympanocryptis lineata* has been found at fourteen sites, two of which occur in NSW; Queanbeyan Nature Reserve (NR) and adjacent private property 'Poplars', (half of which is currently protected under a biobanking agreement). The total area of habitat in NSW covers around 140 ha (ACT Scientific Committee 2022; R. Armstrong pers. comm. April 2022).

6. *Tympanocryptis lineata* is found in Natural Temperate Grassland and native pastures, usually on well-drained sites dominated by *Austrostipa bigeniculata* (Tall Speargrass) and shorter *Rytidosperma* spp. (Wallaby Grasses), with patches of tussocks and open spaces between them (Osborne *et al*. 1993a; Robertson and Evans 2009). The species has also been recorded in grassland derived from box gum woodland, when adjacent to natural temperate grassland (R. Armstrong pers. comm. April 2022). The sites where they have been found are frost-hollow grasslands, have usually had little or no ploughing or pasture improvement (Osborne *et al*. 1993a), are characterised by open structured tussock grasslands with few or no trees and shrubs and have a tendency towards slightly higher ground in well-drained areas (Melville *et al.* 2019).

7. The species has been discovered beneath rocks in either burrows, rock crevices or depressions (Osborne *et al.* 1993b). Burrows excavated by arthropods, such as the Common Wolf Spider (*Lycosa godeffroyi*) and the Canberra Raspy Cricket (*Cooraboorama canberrae*), associated with partially embedded surface rocks are of critical importance to the species. These burrows provide protection from extreme (low and high) temperatures, overwintering shelter sites, refuge from trampling by livestock and predation and as locations where eggs can be laid (Stevens *et al.* 2010).

8. *Tympanocryptis lineata* is a sit-and-wait predator and eats a variety of small invertebrates, especially ants, beetles, spiders and moths (including larvae) (Howe 1995; Benson 1999; Dimond 2010).

9. The generation length (IUCN 2022) of *T. lineata* in the wild is estimated to be one year (Dimond *et al.* 2012). The species is short lived, surviving usually for less than two years in the wild (Dimond 2010) although they can live to five years or even older in captivity (Doucette and Sarre, 2018). 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, occasionally two (ACT Scientific Committee 2022)

10. *Tympanocryptis lineata* are oviparous, laying clutches of three to seven eggs (typically five) (Doucette and Sarre 2018) in mid-October through to February (Doucette and Sarre 2018), in shallow nests which develop over 9-12 weeks before hatching in January to March but may well extend through to May (Langston 1996; Dimond 2010; Doucette unpublished data). The young probably disperse soon after hatching (Smith 1994, Dawson 2003). High abundance of invertebrate prey coincides with the juvenile recruitment period (Benson 1999; Nelson 2004). 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).

11. Adult *T. lineata* have been shown to move as much as 40 to 110 m per day with some movements in excess of 230 m over longer periods (Langston 1996, Nelson 2004). This species occupies mostly one or two natural burrows within a home range of 925–4768 m² with some overlap in home ranges (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). Langston 1996, Nelson 2004).

12. The distribution of *T. lineata* is considered to be very highly restricted. Using the recorded occurrences of the species (ALA 2020; NSW BioNet 2020; R. Armstrong unpubl. data, April 2022), *T. lineata* occupies an extent of occurrence (EOO) estimated to be 0.3 km^2, based on a minimum convex polygon enclosing all known mapped occurrences of the species, the method of assessment recommended by

IUCN (2022). The area of occupancy (AOO) for all records was estimated to be 8 km^2, based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2022). If the EOO is less than AOO, EOO should be changed to make it equal AOO to ensure consistency with the definition of AOO as an area within EOO' (IUCN 2022). Therefore, the EEO is also 8 km^2.

13. Since European settlement, 99.5% of the Natural Temperate Grassland of the South Eastern Highlands ecological community, which *T. lineata* relies upon, has been destroyed or drastically altered as a result of urban, industrial, or agricultural development, and now only occur in small highly fragmented and degraded patches often not suitable to support populations of the species (Kirkpatrick *et al.* 1995, Environment ACT 2005; Threatened Species Scientific Committee 2016). *Tympanocryptis lineata* has never been captured in grassland that is highly modified, such as through ploughing and conversion to exotic grassland (Stevens *et al.* 2010) and the genetic data suggest that even a distance of 100 m of sub-optimal grassland will prevent most genetic exchange in this species (Colley 2021). Roads and other hard surfaces also present a significant barrier impenetrable to the species (Hoehn *et al.* 2013; Carlson *et al*. 2016; Colley 2021).

14. The population size of *T. lineata* in NSW is considered to be extremely low. The Queanbeyan NR site has been monitored annually since 2006 and 'Poplars' site, since 2011. In the last 10 years numbers at these two sites have remained low but stable (with some fluctuations) until the last few years when they have undergone a decline. In 2021, no individuals were captured at either site. Surveys undertaken in 2022, recorded only one to two individuals at each site (R. Armstrong pers. comm., April 2022). A population size of 100 is considered to be the minimum number required to avoid rapid inbreeding (Frankham, Bradshaw & Brook 2014) and associated inbreeding depression.

15. Much of the natural grassland habitat of *T. lineata* has either been cleared or has undergone extensive structural and compositional degradation (Benson and Redpath 1997; Threatened Species Scientific Committee 2016). The remaining areas of grassland habitat are subject to ongoing degradation processes including, changed grazing regimes, ploughing or sowing of exotic pastures, pasture improvements through use of agricultural chemicals and rock removal (Robertson and Evans 2009; ACT Scientific Committee 2022). In addition, sections of grassland habitat within the Poplars site (along both sides of Tompsitt Drive) are subject to ongoing urban development pressure (R. Armstrong pers. comm., April 2022). Overgrazing by kangaroos, rabbits or stock, or close mowing leads to loss of tussock structure and excessive bare ground (ACT Government 2017). *T. lineata* populations declined dramatically during the last decade (2005–2009), possibly as a result of lack of ground cover caused by drought and exacerbated by overgrazing (Dimond 2010; Dimond *et al*. 2012). 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). Ploughing and

overgrazing is likely to also reduce the number of arthropods that *T. lineata* relies on to form burrows reducing availability for shelter and may also reduce the abundance of prey items (Nelson 2004). The application of pasture improvement enables introduced pasture species to outcompete native species for water, light and nutrients (ACT Scientific Committee 2022). Insufficient grazing leads to a reduction in inter-tussock spaces for foraging and basking, a reduction in soil surface temperatures, and may increase the risk of wildfire. (ACT Government 2017). The removal of bushrock from grassland habitats either for use in 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.

16. Exotic flora species have had a major impact upon grassland habitats and are still considered a severe threat throughout the range of *T. lineata* (Environment ACT, 2005; Threatened Species Scientific Committee 2016). The perennial grass *Eragrotis curvula* (African Lovegrass) has the potential to substantially change the herbage mass of grasslands, to become a monoculture and to destroy the Natural Temperate Grassland Ecological Community essential to the survival of *T. lineata* (ACT Scientific Committee 2022). This weed invades native vegetation including grassland, by establishing in thin and bare patches, blocking movement and obscuring burrows essential for *T. lineata* (Threatened Species Scientific Committee 2016).

17. The burrowing and grazing activities of rabbits are a source 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. lineata* (Costin 1954; Environment ACT 2005; DEWHA 2008). "Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus*" listed as Key Threatening Processes under the Act.

18. 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. lineata*. Monitoring data of *T. lineata* from 2002-2010, showed that successive years of drought led to population declines and local extinctions, suggesting the 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 and burrow 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 includes, 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. lineata* makes local populations vulnerable to the effects of wildfire, drought and other environmental changes on their habitat (ACT Scientific Committee 2022). 'Anthropogenic Climate Change' is listed a Key Threatening Process under the Act.

19. Fire can regenerate native grasslands and maintain diversity in grassland structure, but too frequent burning and wildfire may also kill *T. lineata*, alter vegetation composition and structure and reduce the abundance of prey (Environment ACT 2005; ACT Government 2017). *Tympanocryptis 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.

20. 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. lineata* sites are closer to urban developments (Robertson and Evans 2009; ACT Government 2017). 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.

21. *Tympanocryptis lineata* Peters 1863 is eligible to be provisionally listed as, in the opinion of the NSW Threatened Species Scientific Committee:
    (a) the species:
        (ii) is subject to an immediate and significant threat of extinction, and
    (b) the species is not listed in Schedule 1 as an endangered or critically endangered species.

Dr Anne Kerle
Chairperson
NSW Threatened Species Scientific Committee

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Assessment against Biodiversity Conservation Act criteria
The Clauses used for assessment are listed below for reference.

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Critically Endangered under Clause 4.2(1)(a),(2)(b,c).

(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: Critically Endangered under Clause 4.3(a)(d)(e, i,ii,iii,iv).

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 Clause C)
Assessment Outcome: Critically Endangered under Clause 4.4(a)(d,(i)), (e(i), (ii, A(I))).

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: Critically Endangered under Clause 4.5(a).

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 under Clause 4.7.

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.