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Notice of 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 alpine water skink *Eulamprus kosciuskoi* (Kinghorn, 1932) as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act. Listing of Vulnerable species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that the alpine water skink *Eulamprus kosciuskoi* (Kinghorn, 1932) has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method, as provided by Section 4.14 of the Act. After due consideration of Commonwealth DCCEEW (2023), the NSW Threatened Species Scientific Committee has made a decision to list the species as Vulnerable.

Summary of Conservation Assessment

The alpine water skink *Eulamprus kosciuskoi* (Kinghorn, 1932) was found to be Vulnerable in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3(c)(d)(e i,ii,iii,iv) because: 1) the species has a moderately restricted geographic distribution with an area of occurrence of 940 km^2; 2) the species is known from two threat-defined locations; and 3) continuing decline is projected in the geographic distribution, habitat extent and quality, and is inferred in the number of populations and number of mature individuals. These declines are due to climate change, adverse fire regimes, the effects of hard-hoofed invasive species (*e.g.*, feral horses, feral deer and feral pigs) and predation by feral cats and the European red fox.

The NSW Threatened Species Scientific Committee has found that:

1. The alpine water skink *Eulamprus kosciuskoi* (Kinghorn, 1932) (family Scincidae) is a medium-sized lizard up to 85 mm in snout-vent length. The dorsal surface is olive-brown in colour. A black vertebral stripe runs along the back, with another black stripe on both sides, extending the length of the body. These stripes may be weak or absent in the northern subpopulations. There is a yellow dorso-lateral stripe running below the black side stripes, under which the body is black with yellow to cream spots. The lower flanks are pale yellow to cream with irregular black spots. The underside is pale yellow to grey and may have some black spots (Cogger 2014; Robertson and Coventry 2019; Wilson and Swan 2021).

2. *Eulamprus kosciuskoi* is found at elevations above 1000 m and up to 2000 m in New South Wales (NSW), the Australian Capital Territory (ACT) and Victoria. The distribution is naturally fragmented into ‘sky islands’ (McCormack *et al.* 2009), which are isolated high elevation sites surrounded by unsuitable lowland habitat. This corresponds with substantial genetic divergences occurring over small geographic distances in this species (Pepper *et al.* 2018). There are currently two disjunct lineages, both of which are primarily found in national parks and reserves. The northern lineage occurs in a range of montane sites in the northern NSW tablelands (Meredith *et al.* 2003), including but not limited to Barrington Tops National Park (NP), Mt Royal NP, Mummel Gulf NP, Werrikimbe NP, Oxley Wild

Rivers NP, Cathedral Rock NP, New England NP, and Gibraltar Range NP. The southern lineage occurs in alpine and sub-alpine areas (Meredith *et al.* 2003) in the ACT, south-eastern NSW, and north-eastern Victoria, including but not limited to Kosciuszko NP and Alpine NP.

3. The extent of occurrence (EOO) is estimated to be 95,396 km^2 (range 40,671–118,976 km^2) and is based on a minimum convex polygon enclosing a cleaned dataset of known occurrences of the species, the method of assessment recommended by IUCN (2024). The area of occupancy (AOO) is estimated to be 940 km^2 (range 260–1,020 km^2) using 2 x 2 km grid cells, the scale recommended by IUCN (2024). The estimates for EOO and AOO are based on the mapping of all confirmed point records and are considered to represent the current distribution of the species. The minimum plausible values represent point records dating back 20 years (four generations). The maximum plausible values represent all occurrence records (both confirmed and unconfirmed).

4. No population estimates are available for *Eulamprus kosciuskoi*, and the number of mature individuals is unknown.

5. *Eulamprus kosciuskoi* has been observed basking on granite boulders, tussocks and sphagnum moss along small alpine streams, bogs, and wet heath (Robertson and Coventry 2019; Wilson and Swan 2021). It has also been observed along drainage lines (Meredith *et al*. 2003), in tussock grasses, and up to hundreds of metres upslope, or otherwise away, from typical wetter habitat (Nick Clemann pers. comm. May 2022). In the Snowy Mountains and Brindabella Ranges, the species exhibits a high degree of habitat specialisation, being confined to sphagnum bog, fen, wet heath and, less frequently, wet sod-tussock grassland (Green and Osborne 1994).

6. *Eulamprus kosciuskoi* are active during the day and feed upon aquatic and terrestrial invertebrates, tadpoles, small fish, smaller lizards, and occasionally native fruit (Australian Museum 2020). Feeding is not a daily requirement and is undertaken when conditions are favourable (Australian Museum 2020). In winter, the species retreats to burrows under rocks, logs, and sphagnum (Jenkins and Bartell 1980; Robertson and Coventry 2019). Sphagnum cover is inferred to be important for thermoregulation and shelter (Steane *et al.* 2005).

7. Female *Eulamprus kosciuskoi* reach maturity at 2–3 years of age. Mating occurs in spring, and females give birth to live young 10–12 weeks later in late summer and early autumn (Jenkins and Bartell 1980; Robertson and Coventry 2019). The number of offspring ranges from 1 to8 within this group of skinks, and in *E. kosciuskoi*, the size of the litter is positively correlated with female size (Greer 1989). Generation length is unknown. Longevity is estimated to be 6–10 years (DAWE 2020). Male alpine water skinks defend their territories from other males. They are more aggressive compared to other water skink species (Done and Heatwole 1977; Greer 1989). The dispersal distance for the species is estimated to be less than 1 km (DAWE 2020).

8. The primary threats affecting *Eulamprus kosciuskoi* are loss of and changes to habitat caused by higher temperatures resulting from climate change, adverse fire regimes, habitat degradation due to feral hard-hoofed animals and recreational

horse riding, predation by cats (*Felis catus*) and the European red fox (*Vulpes vulpes*), and development activities. These threats can also interact to compound negative effects. For example, predation levels are likely to be elevated after fire (especially by feral cats and European red foxes). 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition', 'Anthropogenic climate change', 'Habitat degradation and loss by feral horses (*Equus caballus*) Linnaeus 1758', 'Herbivory and environmental degradation caused by feral deer', 'Predation, habitat degradation, competition and disease transmission by feral pigs, *Sus scrofa* Linnaeus 1758', 'Predation by the feral cat, *Felis catus* (Linnaeus, 1758)', and 'Predation by the European red fox, *Vulpes vulpes* (Linnaeus, 1758)' are Key Threatening Processes under the Act.

9. The most serious plausible threat to *Eulamprus kosciuskoi* is fire. Given the species' susceptibility to fire and the possible extent of the distribution that could be covered in a single fire season, the estimated number of threat-defined locations is two.

10. A continuing decline in the distribution of *Eulamprus kosciuskoi* is inferred due to an observed decline in habitat quality and extent caused by widespread high severity fires, the negative effects of hard-hoofed invasive species (*e.g.*, feral horses, feral deer and feral pigs) and potential for increased vulnerability to predation after fire (McGregor *et al*. 2015; Jason Rossendell pers. comm. August 2023). During the 2019–20 bushfires, 14% of alpine water skink habitat was burnt in high to very high severity fire, with a further 25% burnt in low to moderate severity fire (Legge *et al*. 2021). Invasive herbivores, such as feral horses (as well as recreational riding), feral deer and feral pigs, and livestock, such as cattle, are known to damage sphagnum bogs which the alpine water skink inhabit, by trampling and wallowing (Driscoll *et al*. 2019). After fire, habitat degradation is often compounded by trampling and grazing by hard-hoofed animals, as it can slow down the already slow recovery of the sub alpine/montane environment.

11. The EOO, AOO, number of populations, and number of mature adults of *Eulamprus kosciuskoi* are all projected to decline in the future as climate change progresses and habitat at lower altitudes becomes unsuitable. Tree line encroachment (Wearne and Morgan 2001) and upslope migration of alpine plants (Auld *et al.* 2022) may have implications for the maintenance of structurally and thermally suitable alpine water skink habitat. Future climate models suggest that up to 65% of climatically suitable habitat for the species could be lost by 2050 (Cabrelli and Hughes 2015). Given the species occurs on 'sky islands', loss of suitable habitat may result in local extinctions of subpopulations and related decline in mature individuals as the species would be unable to repopulate these sites naturally.

12. The alpine water skink *Eulamprus kosciuskoi* (Kinghorn, 1932) is not eligible to be listed as an Endangered or Critically endangered species.

13. The alpine water skink *Eulamprus kosciuskoi* (Kinghorn, 1932) is eligible to be listed as a Vulnerable species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a high risk of extinction in Australia in the medium-

term 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: Vulnerable under Clause 4.3(c)(d)(e i,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: Vulnerable under Clause 4.3(c)(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: 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: Not met.

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.

Professor Caroline Gross
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

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