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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 rainforest cool-skink *Harrisoniascincus zia* (Ingram & Ehmann, 1981) 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 rainforest cool-skink *Harrisoniascincus zia* (Ingram & Ehmann, 1981) 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 rainforest cool-skink *Harrisoniascincus zia* (Ingram & Ehmann, 1981) was found to be Vulnerable in accordance with the following provisions in the Biodiversity Conservation Regulation 2017: Vulnerable under Clause 4.3 (c)(d)(e i,ii,iii,iv) and Clause 4.6 (c) because: i) the geographic distribution of the species is highly restricted with an AOO of 44–2,272 km^2 and an EOO of 1,121–19,499 km^2; ii) it occurs in 5–10 threat-defined locations; iii) there is inferred continuing decline in the AOO, habitat area, extent and quality, and number of mature individuals due to fire and climate change, and iv) the probability of extinction is high due to the loss of the climatic niche given future projections of increased temperatures, reduced moisture availability, and increased fire frequency, severity, and extent.

The NSW Threatened Species Scientific Committee has found that:

1. *Harrisoniascincus zia* (Ingram & Ehmann, 1981) (family Scincidae) is a small reptile species that grows up to 55 mm snout-vent length. It has well-developed legs with five toes on each limb, and a long tail. The colour varies from light to dark brown, becoming more copper towards the snout. There are scattered dark and pale specks on the back. It has a dark line, beginning at the snout and breaking up after the back leg, which has a clear upper and lower edge, and fades into pale specks along the sides. The chin, throat and neck are speckled in black, and the belly is bright yellow. The end of the tail is suffused with red-brown that becomes brighter towards the tip (Ingram and Ehmann 1981; Wilson and Swan 2021).

2. *Harrisoniascincus zia* is recorded from high elevation areas of the Great Dividing Range in two disjunct regions of Queensland (QLD) and New South Wales (NSW) The Northern region comprises Southeast QLD and northeast NSW from Main Range and Yabbra National Parks in the west to Springbrook and Nightcap National Parks in the east (Commonwealth DCCEEW 2023). The Southern region comprises Northeast NSW from Guy Fawkes River and Cunnawarra National Parks in the west to Dorrigo National Park in the east (Commonwealth DCCEEW 2023). All records of *H. zia* are from >500 m elevation, with most occurrences from >700 m

elevation (Torkkola *et al*. 2022). Species distribution modelling based on climatic niche suggests this species may occur undetected between the northern and southern regions, in the vicinity of Washpool, Gibraltar Range and Nymboida National Parks (Torkkola *et al*. 2022). The recorded distribution of *H. zia* occurs entirely within the Gondwana Rainforests of Australia World Heritage Area in central eastern Australia.

3. Habitat patchiness and unpublished genetic data suggest further subpopulation structuring is likely within the two geographically disjunct regions (Torkkola *et al*. 2022). At least five discrete subpopulations are likely: on the Lamington Plateau, at Springbrook, and along Main Range in the northern region; and in the Guy Fawkes River National Park and at the Dorrigo Plateau–New England National Park area in the southern region.

4. There is significant uncertainty about the current EOO for *H. zia*, with values varying from 1,121–19,499 km^2. The lower value is likely to be a significant underestimate due to the lack of targeted survey effort since the year 2000 across a substantial portion of the species' range. Excluding records from the parts of its range where surveys for the species have occurred unsuccessfully, reduces the maximum estimated EOO to 17,514 km^2. Excluding records from Mt Hyland, where targeted surveys for this species have also occurred unsuccessfully, does not affect the EOO value. There is also significant uncertainty about the current AOO for *H. zia*, with plausible values varying from 44–2,272 km^2. However, the most plausible values range from 250–2,000 km^2 which meet the threshold for Vulnerable. Climatic niche modelling suggests the EOO and AOO is projected to decline until there is little, if any, suitable climatic niche available for this species by 2050 (Commonwealth DCCEEW 2023). The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2 x 2 km grid cell method, based on the IUCN Red List Guidelines (2022).

5. The most likely estimated number of threat-defined locations that *Harrisoniascincus zia* is thought occur in is 5 to 10, based primarily on the threat of fire, plus the compounding threat of an ongoing decline in this species' climatic niche due to climate change.

6. *Harrisoniascincus zia* occurs in cool, high elevation rainforest including (but not restricted to) areas with *Nothofagus moorei* (Antarctic beech) (Ingram and Ehmann 1981; Wilson and Swan 2021). These ecosystems are relicts within the broader landscape due to moist and cool conditions and lack of significant fire activity (Schuster 1981). *Harrisoniascincus zia* occurs in both undisturbed closed canopy areas and in small clearings within rainforests. It is a secretive species that inhabits moist areas of deep leaf-litter where it shelters under flat rocks and logs. It basks among leaf-litter and at the edges of cleared tracks (Ingram and Ehmann 1981; Environment Australia 1999; Wilson and Swan 2021).

7. *Harrisoniascincus zia* requires continuous areas of damp, high elevation rainforest cover to disperse (Environment Australia 1999) and is unable to recolonise disturbed areas that are disjunct from occupied rainforest (Hagger *et al*. 2013). It is not active during cool conditions (Ingram and Ehmann 1981).

8. *Harrisoniascincus zia* feeds on small litter and soil invertebrates including insects and oligochaete earthworms (Ingram and Ehmann 1981; Wilson and Swan 2021). It has also been recorded as feeding on 'smooth skin' caterpillars (Environment Australia 1999).

9. *Harrisoniascincus zia* lays 3–6 eggs of approximately 10 x 8.5 mm, which are deposited by early January (Commonwealth DCCEEW 2023). Three captive females laid eggs in shallow depressions under a surface structure of moss or bark. Male testes are well-developed in late spring and early summer (Ingram and Ehmann 1981).

10. The primary threats to *Harrisoniascincus zia* are loss of climatic niche and adverse fire regimes, particularly increases in fire frequency, severity, and extent. 'Anthropogenic Climate Change' and 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' are listed as a Key Threatening Processes under the Act.

11. *Harrisoniascincus zia* occurs in relict highland areas of the Gondwana Rainforests of Australia, which are projected to become continually warmer and drier due to anthropogenic climate change (Narsey *et al.* 2020). Mapping of the current climatic niche for *H. zia* and projection of its future climatic niche under multiple climate change scenarios suggests that little to no climatically suitable habitat will remain for this species by 2050 (Cabrelli and Hughes 2015; Torkkola *et al.* 2022). Severe droughts, higher temperatures and a lifting of the cloud base are anticipated to reduce the recruitment rate of rainforest canopy plants and increase the desiccation rates of rainforest habitat for *H. zia* (Environment Australia 1999; Hagger *et al.* 2013; Narsey *et al*. 2020).

12. Fire encroachment deep into highland rainforests, as occurred during the 2019–2020 fire season, has the potential to permanently degrade highland rainforests to be uninhabitable areas for *Harrisoniascincus zia* (Environment Australia 1999; Hagger *et al*. 2013). *Harrisoniascincus zia* has a strong association with cool damp conditions that are created by an extensive rainforest canopy cover and deep leaf-litter, both of which are removed by severe fire. Expert elicitation estimated >60% mortality after severe fire and approximately 20% mortality after mild fire (Legge *et al*. 2022). Due to the species' poor recolonisation and dispersal potential across non-rainforest areas (Environment Australia 1999; Hagger *et al.* 2013), the capacity for *H. zia* to recolonise areas where it may have been extirpated by severe fire is reliant on a source population in adjacent unburnt rainforest.

13. Adverse fire regimes and loss of climatic niche are inferred to have caused, and are projected to continue to cause, a continuing decline in the AOO, area, extent and quality of habitat, and number of mature individuals. A continuing decline in the EOO and number of locations is also inferred as climate change impacts progress. The number of subpopulations may both increase as upward movement of this species' climatic niche fragments subpopulations and decrease as subpopulations become extirpated.

14. Species distribution and climate modelling of the future availability of a suitable climatic niche for *Harrisoniascincus zia* within high elevation rainforest under

conservative estimates of climate change found a 99–100% loss of climatic niche from 2020–2050 (i.e., over 30 years) (Torkkola *et al*. 2022). An earlier study by Cabrelli and Hughes (2015) projected a 79% reduction in the available climatic niche for *H. zia* over the same period. As such, *H. zia* is considered to have a greater than 10% chance of extinction in 100 years. There is insufficient quantitative information available about the probability of extinction in the wild over a shorter time frame to assess eligibility for listing as Endangered or Critically Endangered.

15. *Harrisoniascincus zia* (Ingram & Ehmann, 1981) is not eligible to be listed as an Endangered or Critically Endangered species.

16. The rainforest cool-skink *Harrisoniascincus zia* (Ingram & Ehmann, 1981) 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) and Clause 4.6 (c).

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Not met.

(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: Vulnerable under Clause 4.6 (c).

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.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

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