

## 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 Grey Snake *Hemiaspis damelii* (Günther 1876) as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that Grey Snake *Hemiaspis damelii* (Günther 1876) has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method (DCCEEW 2022). The acceptance of this assessment is provided for by Part 4.14 of the Act.

## Summary of Conservation Assessment

The Threatened Species Scientific Committee accepts the assessment undertaken by the Commonwealth Threatened Species Scientific Committee in its Conservation Advice for *Hemiaspis damelii* (grey snake) (DCCEEW 2022).

The Grey Snake *Hemiaspis damelii* (Günther 1876) was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3 (b) (d) (e i, ii, iii, iv) because: i) the geographic distribution of the species is highly restricted; ii) the population or habitat of the species is severely fragmented; iii) there is a projected continuing decline in the number of mature individuals, the geographic distribution of the species, habitat area, extent and quality, and iv) in the number of known subpopulations.

The NSW Threatened Species Scientific Committee has found that:

1. The Grey Snake is a relatively small, venomous, front-fanged (proteroglyphous) snake that can be confused with several other similar-looking elapid species, e.g., juvenile Eastern Brown Snake (*Pseudonaja textilis*), Curl Snake (*Suta suta*), Dwyer's Snake (*Suta dwyeri*) and Carpentaria snake (*Cryptophis boshmai*). The body colour is a uniform pale or dark grey to olive grey with the top of the head and a few scale rows on the nape being black in juveniles, and more of a crescent or absent in adults. Belly colour is white, cream, or pale yellow, often with darker flecks, and the skin between the scales is black. The eyes are large relative to other small snakes that share a similar habitat. The scales are smooth and in 17 rows at the mid-body, ventral scales range from 140–170, the anal scale is divided and the subcaudal scales are single and range from 35–50 (Cogger 2014, Wilson and Swan 2017). In New South Wales (NSW), the maximum total length in males is approximately 605 mm, with average male snout vent length (SVL) approximately 426 mm, and maximum total length in females is 575 mm, with average female SVL approximately 463 mm (Shine 1987). Both sexes are on average larger in NSW than those recorded in Queensland (Shine 1987).

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2. The geographic distribution of the Grey Snake is highly restricted. While the Extent of Occurrence (EOO) is calculated at 471,500 km<sup>2</sup>, the Area of Occupancy (AOO) is estimated at 164 km<sup>2</sup> (DCCEEW 2022). This AOO value may be an overestimate due to ongoing habitat clearance and impacts of Cane Toads in the Queensland subpopulations, as well as the absence of very recent records from several NSW subpopulations despite extensive surveys in these areas, though challenges in detection, identification and reporting may offset this (DCCEEW 2022). Both EOO and AOO were calculated using records from 2000–2022 only to provide a robust assessment of the species extant range (DCCEEW 2022). 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).
3. The Grey Snake has a wide overall range from inland southern NSW to central Queensland (Cogger 2014), though the distribution is not continuous across this full range and consists of several isolated subpopulations (DCCEEW 2022). Point records indicate the species occupies five geographically discrete subpopulations in NSW, predominantly associated with the lower reaches of major westerly flowing rivers, including the Gwydir, Namoi, Castlereagh, Macquarie, Lachlan, and Murrumbidgee River systems (ALA 2020; Wilson 2005).
4. Some NSW subpopulations occur in protected areas including Yanga National Park and Gayini Nimmie-Caira, a newly acquired property under the management and ownership of the Nari Nari Tribal Council in southern NSW (Michael *et al.* 2020). Subpopulations also occur in two internationally important wetlands, the Gwydir Wetlands and the Macquarie Marshes, both of which are listed on the Ramsar Convention on Wetlands, as well as in the Great Cumbung Swamp, which is included in the Directory of Nationally Important Wetlands (DAWE 2020; DCCEEW 2022).
5. While no data exist to inform accurate population estimates for the Grey Snake, population densities are likely to be low (DCCEEW 2022). The Grey Snake is considered rare, having never been recorded in large numbers, and thus the isolated subpopulations are considered small (DCCEEW 2022). The largest recorded number of snakes discovered in recent times at a single site, after optimal conditions, is five (Michael *et al.* 2020).
6. Key habitat features of the Grey Snake are floodplains and ephemeral wetlands, which provide breeding habitat for the frog species that are its main prey, the presence of the frog species themselves, and heavy clay soils, which provide cracks and crevices that the species uses in its hunting strategy and for shelter (DCCEEW 2022). In NSW, the Grey Snake's habitat includes the margins of ephemeral wetlands within River Red Gum (*Eucalyptus camaldulensis*) and Black Box (*E. largiflorens*) vegetation communities and Tangled Lignum (*Duma florulenta*) swamps. The species has only been sighted in wetlands that have received environmental water flows, with no snakes being detected in dry phase wetlands (Michael *et al.* 2020). This suggests its detectability and activity patterns may be related to wetland inundation regimes and suitable weather conditions (DCCEEW 2022). Grey Snakes have not been detected when wetlands are in a

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summer dry phase or in other vegetation types adjacent to wetlands (D. Michael pers. obs.).

7. The Grey Snake is live bearing (viviparous) and gives birth to 4–16 (average 10) young between January and March (Shine 1987). Juvenile snakes are approximately 140 mm in length, with males maturing at around seven months of age and females maturing at 12 months (Shine 1978).
8. The Grey Snake predominantly feeds on frogs (Shine 1987). Known prey include a range of ground dwelling frog species including *Cyclorana alboguttata*, *Limnodynastes fletcheri*, *Limnodynastes tasmaniensis*, *Platyplectrum ornatum* and *Uperolea* spp. (Shine 1987). Two arboreal frog species, *Litoria fallax* and *Litoria gracilentata*, and an unidentified skink, have also been identified as prey items (Shine 1987). Shine (1987) suggests the absence of lizards from the diet of the Grey Snake could indicate this species forages in places and at times when they do not encounter lizards or cannot catch them.
9. The Grey Snake is mainly active at dusk and/or at night and it may be encountered sheltering under cover or in soil cracks during the day (Rowland 2012). Shine (1987) states that in NSW, Grey Snakes are exclusively active for only one or two hours after sunset, and this is supported by Michael *et al.* (2020). In southern NSW, the Grey Snake has been recorded as active from October to February at evening temperatures above 19° C, with most sightings at evening temperatures above 30° C (Michael *et al.* 2020). In northern NSW and southern Queensland, it has been recorded in all seasons but predominantly between October and March (ALA 2020).
10. The Grey Snake forages for floodplain frogs within soil cracks, in the open or beneath vegetation, typically during warm weather, and especially after heavy rain or when soil cracks become inundated (Rowland 2012). Most frog species that occur in the Murray-Darling Basin, and within the range of the Grey Snake, breed in temporary rain-fed ponds or ephemeral wetlands, rather than in the main river channels (Anstis 2017). This may explain why the Grey Snake is associated with floodplain wetlands rather than along river channels (DCCEEW 2022). A recent survey from the Murrumbidgee catchment found that Grey Snakes forage for frogs along wetlands within 30m of the water edge and not in the adjacent woodland or shrubland vegetation (D. Michael unpublished data 2019).
11. There is no information available about the home range size or dispersal ability of the Grey Snake though they are both inferred to be limited. Other Australian elapid snakes, including much larger and fast-moving elapids like Eastern Brown Snakes (*Pseudonaja textilis*) have small home ranges and short dispersal distances (Whitaker & Shine 2003) and so the home ranges and dispersal distances of the Grey Snake are inferred to be similarly restricted (DCCEEW 2022). Flooding, environmental flows and good rainfall seasons are expected to assist with dispersal and movement of the Grey Snake downstream and within subpopulations, however, these events are unlikely to enable the species to disperse upstream (DCCEEW 2022). It is therefore considered highly unlikely that there is any

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significant gene flow among the isolated and fragmented subpopulations (DCCEEW 2022).

12. The Grey Snake population is considered severely fragmented, as it occurs in small, isolated subpopulations, and within-subpopulation fragmentation is caused by agricultural practices removing suitable habitat (DCCEEW 2022). In addition, there are no records of the species between the floodplain environments of the five main NSW subpopulations, indicating a severely fragmented and patchy distribution with no lateral connectivity between subpopulations (DCCEEW 2022) and recolonisation between subpopulations appears unlikely (Vanderduys *et al.* 2017).
13. The primary threats to the Grey Snake are hydrological changes on floodplains due to water extraction, modified land use, changed flooding regimes, poisoning through the ingestion of Cane Toads and the impacts of Feral Pigs. 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands', 'Clearing of native vegetation', 'Invasion and establishment of the Cane Toad' and 'Predation, habitat degradation, competition and disease transmission by Feral Pigs (*Sus scrofa*)' are listed in the Act as Key Threatening Processes.
14. Floodplain environments in the Murray-Darling Basin have been significantly altered by river regulation, water extraction, and the conversion of wetlands to agricultural land (Kingsford 2000). The high proportion of surface water diversions, combined with extensive river regulation and the effects of climate change, have resulted in major changes to flow and flood regimes for many rivers and wetlands in the Murray-Darling Basin inhabited by the Grey Snake (Ryan *et al.* 2021). This includes significant reductions in inundation area and frequency in the Macquarie Marshes (Thomas *et al.* 2011), Lower Gwydir Wetlands (Keyte 1994) and Lowbidgee Floodplain (Kingsford and Thomas 2002), with only 7% of the wetland area in targeted Murray-Darling Basin catchments receiving effective environmental flows annually between 2014–15 and 2018–19 (Ryan *et al.* 2021; Chen *et al.* 2020). Reductions in floodplain inundation have been linked to declines in frog diversity and abundance (Wassens and Maher 2011, McGinness *et al.* 2014, Ocock *et al.* 2016). Such declines in frog populations can impact frog-eating snakes in many ways, including by slowing growth rates through reduced feeding potential (Brown *et al.* 2013).
15. Like many elapid snakes, *Hemiaspis* have low resistance to Cane Toad (*Rhinella marina*) toxin (Phillips *et al.* 2003). The Grey Snake has a potential impact index of 95% based on the proportion of frogs in the diet and predicted percent overlap with toads under a 2030 climate scenario, ranking highly compared to 49 other elapid species (Phillips *et al.* 2003). Considering its diet almost exclusively comprises frogs, and its range overlaps very substantially with the current and predicted future range of the Cane Toad, the potential impact (both current and future) of the Cane Toad on the Grey Snake is predicted to be extremely high (Phillips *et al.* 2003).

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16. Feral Pigs (*Sus scrofa*) prey on snakes such as the Grey Snake, compete with snakes for food (frogs), and destroy habitat by turning over large areas of soil as they forage (Jolley *et al.* 2010; DCCEEW 2022). Feral pigs are abundant in floodplain environments across the range of the Grey Snake, with recorded densities of up to 6.3 per km<sup>2</sup> across the Brigalow Belt (Gentle *et al.* 2019). Control methods are required to mitigate Feral Pig impacts on threatened small snakes including the Grey Snake (Maron *et al.* 2021).
17. Given the fact that no records have been made of the Grey Snake in several previously recorded populations since 2000, including the Macquarie Marshes, Gwydir Wetlands and Castlereagh River catchments in NSW (DCCEEW 2022) and that the AOO has been assessed to have reduced from a historical maximum of 464 km<sup>2</sup> to a current estimate of 164 km<sup>2</sup> (DCCEEW 2022), continuing decline in the geographic distribution, habitat area, extent and quality and the number of known subpopulations of the Grey Snake is strongly inferred to have occurred. The action of the above threats also means that the number of mature individuals, the geographic distribution, habitat area, extent and quality and the number of known subpopulations of the Grey Snake is inferred to remain under pressure and continue to decline into the future.
18. The Grey Snake *Hemiaspis damelii* (Günther 1876) is not eligible to be listed as a Critically endangered species.
19. The Grey Snake *Hemiaspis damelii* (Günther 1876) is eligible to be listed as an Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a high risk of extinction in Australia in the near 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 i, ii, iii, iv).**

**Clause 4.2 – Reduction in population size of species**

**(Equivalent to IUCN criterion A)**

**Assessment Outcome: Data deficient.**

<b>(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:</b>			
	(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.
<b>(2) - The determination of that criteria is to be based on any of the following:</b>			
	(a)	direct observation,	

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	(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 i, ii, iii, iv).**

<b>The geographic distribution of the species is:</b>			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
<b>and at least 2 of the following 3 conditions apply:</b>			
	(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.**

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

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		(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.**

<b>The total number of mature individuals of the species is:</b>			
	(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.**

<b>The probability of extinction of the species is estimated to be:</b>			
	(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: Clause 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.
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Senior Professor Kristine French  
 Chairperson  
 NSW Threatened Species Scientific Committee

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## Supporting Documentation:

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