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Notice and reasons for the Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list Murray Mallee striated grasswren *Amytornis striatus howei* Mathews, 1911 as an ENDANGERED SPECIES under Part 2 of Schedule 1 of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Murray Mallee striated grasswren *Amytornis striatus howei* was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation* 2017: Clause 4.2 (b) 2 (b, c, e) because the sub-species has undergone a large reduction in population size in the last three generations.

The NSW Threatened Species Scientific Committee has found that:

1. The striated grasswren, of which the Murray Mallee striated grasswren is a sub-species, is a medium sized grasswren, similar in appearance to the related fairy-wrens (*Malurus* spp.), though significantly larger in size (14.5–19 cm; 15–23 g) (Rowley *et al.* 2020; DPIE 2021a). It has a relatively slender bill, long tail, which is held cocked and is blackish-brown in colour (Rowley *et al.* 2020). The upperparts are a soft reddish-brown, with white streaks while the underparts are buff with heavy white streaking on the breast. The eyebrow is rufous-brown and a heavy black whisker-streak is present. The throat is white, the bill blackish or grey and legs grey. The sexes differ slightly in plumage with the female having pale chestnut flanks. Murray Mallee striated grasswrens are similar in appearance to the Yellabinna rufous grasswren *Amytornis whitei aenigma* and to the mukarrthippi grasswren *Amytornis striatus striatus*. Murray Mallee striated grasswren has white dorsal feather striations which are wider than the mukarrthippi grasswren and the sub-species are allopatric (geographically distinct) (Black *et al.* 2020b).

2. A recent taxonomic revision has distinguished seven sub-species of the striated grasswren *Amytornis striatus* complex, within which the Murray Mallee striated grasswren is contained (Black *et al*. 2020a). The Murray Mallee striated grasswren *A. striatus howei* (Mathews 1911) was recently recognised by Black *et al*. (2020a) who separated allopatric populations of striated grasswren *A. striatus striatus sensu lato* sub-specifically, resulting in Murray Mallee striated grasswren *A. striatus howei* and mukarrthippi grasswren *A. striatus striatus sensu stricto* (Gould 1840). The mukarrthippi grasswren is under concurrent review (Hope *et al*. 2021, which follows Todd *et al*. 2021) and, based on its decline and small population, is considered to be Critically Endangered.

3. The Murray Mallee striated grasswren occurs in New South Wales, South Australia and Victoria. In NSW recent records are restricted to Scotia and Tarawi. In Scotia Sanctuary (a feral-free fenced area) they have been recorded at 27% of sites in suitable habitat during six surveys conducted between 2010 and 2018 (Verdon *et*

al. 2021, in Garnett and Baker 2021). Verdon *et al.* (2021) describe the distribution as follows: "Murray Mallee striated grasswrens occur in the Murray Mallee region where they now occur patchily through the Riverland Biosphere Reserve in South Australia, as well as in the adjacent Scotia in western New South Wales. South of the Murray, they occur from Billiatt Conservation Park in South Australia, and from the western half of Murray-Sunset National Park through Hattah-Kulkyne National Park to Annuello Flora and Fauna Reserve in Victoria as well as in the Big Desert and Wyperfeld National Park (BirdLife Australia 2020; Cornell Lab 2020; C Hedger unpublished). Fire extirpated populations in Bronzewing Flora and Fauna Reserve in Victoria and probably populations in Ngarkat and Cooltong Conservation Parks (C Hedger, P Waanders unpublished)."

4. Verdon *et al.* (2021) estimate that globally there are 17,000 (10,000-32,000) mature individuals (low reliability indicated for this estimate) and the abundance is declining (high reliability indicated for decline; Black and Gower 2017; Dooley 2019). The NSW population is estimated to be a few hundred, and NSW forms the extreme boundary of the distribution (Verdon *et al.* 2021). Globally there are an estimated five sub-populations (range 3-10) and the reliability of this estimate is stated as medium (Verdon *et al.* 2021). The number of individuals in each sub-population, is estimated, with a low reliability, as 5,000 (4,000-10,000) (Verdon *et al.* 2021).

5. The habitat of Murray Mallee striated grasswrens is sandplains dominated by mature spinifex *Triodia* spp., typically with an overstorey of mallee eucalypts (Verdon *et al.* 2021). They forage mostly on the ground, eating seeds, fruits, insects and other invertebrates (Higgins *et al.* 2001; Karubian 2001). Fire kills resident birds and recolonisation after fire usually occurs within ten years (depending on rainfall) although some birds will forage in regenerating habitat three years after fire (Carpenter and Matthew 1986; Verdon *et al.* 2021). Habitat quality declines in long unburnt sites after several decades and senescent spinifex is unsuitable habitat for this species (Verdon *et al.* 2021). Lower altitude locations provide higher protection against post-fire and drought impacts than higher sites (Connell *et al.* 2017; Verdon *et al.* 2021). Striated grasswrens are typically found in pairs, are strongly territorial and nest in cryptic nests on the ground (Karubian 2001). Nests are built by the female and are a substantial dome (with a side entrance) of interwoven grasses, bark and spinifex, well-hidden towards the top or edge of a spinifex clump (Rowley *et al.* 2020; DPIE 2021a). Breeding has been recorded Aug–Jan, and also following rainfall (Rowley *et al.* 2020). The breeding territory of striated grasswrens is approximately three hectares and there is some evidence of cooperative breeding (Rowley *et al.* 2020). Clutch size is 2–3 eggs with an incubation of 14 days; chicks are fed by both parents, independent at four weeks, but probably stay with the family for a longer period (Karubian 2001; Rowley *et al.* 2020). Generation length is estimated at 3 (2.3-3.8) years (Bird *et al.* 2020; Verdon *et al*. 2021).

6. The distribution of the Murray Mallee striated grasswren is not restricted. Verdon *et al.* (2021) provide a maximum, minimum and best estimate of extent of occurrence (EOO) and area of occupancy (AOO) as well as an indication of reliability. The EOO was estimated to be 41,200 (40,000-43,000) km^2 with a high reliability. The EOO in NSW is 975 km^2. The EOO based on a minimum convex polygon enclosing all known mapped occurrences of the sub-species, the method of assessment

recommended by IUCN (2019). AOO was estimated to be 2,800 (1,400-5,600) km^2 with a low reliability. The AOO in NSW is 312 km^2. The area of occupancy (AOO) is estimated based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2019). Both AOO and EOO are declining, the reliability of this estimate is high (Verdon *et al.* 2021). Verdon *et al.* 2021 state that "Given the rate of decline, the AOO is based on the 2x2 km encompassing all records since the major fires of 2014 (BirdLife Australia 2020; Cornell Lab 2020), but is assumed to be at least double that, as much of the suitable habitat in Victoria, particularly the Big Desert Wilderness, has not been surveyed."

7. The Murray Mallee striated grasswren is in decline. Verdon *et al.* (2021) found the rate of decline in the last ten years was between 50 and 80% (based on a generation length of 3 years), stating "The reporting rate declined at regular monitoring sites in Murray-Sunset National Park and Riverland by 86% from 2002 to 2018, and by 56% at less systematically monitored sites, with the most rapid decline coinciding with the onset of severe drought conditions around 2006 from which there has been no recovery (Dooley 2019). At Scotia (NSW) reporting rates have been steady if variable inside a feral predator-free fenced area of 80 km^2 but only two birds recorded during surveys outside the fenced area since 2013 (F L'Hotellier, T Moyle unpublished)." Concurrent with declines in total abundance the geographic extent is in decline with both AOO and EOO contracting and recent local extirpations evident (Verdon *et al.* 2021).

8. Verdon *et al.* (2021) identified the highest current risks to this species as: increase in frequency, scale or intensity of fire, increased frequency or length of droughts and rising temperatures and heat waves. Fires kill resident birds and large fires occurred in the last two decades in the Murray Mallee (Avitabile *et al*. 2013; Verdon *et al*. 2021). A lack of fire is also a threat to this species with long-unburnt spinifex unsuitable habitat (Pedler 1991; Verdon *et al.* 2021). Drought and heat waves increase fire risk and also impact this sub-species even in the absence of fire and all of these phenomena are predicted to increase in severity in the future across all tenures (Evans *et al.* 2017; Herold *et al.* 2018; Eldridge and Beecham 2018; Di Virgilio *et al.* 2019; Dooley 2019; Dowdy *et al.* 2019; Verdon *et al.* 2021). Predicted decreased rainfall and reduced ground-storey plant cover (Eldridge and Beecham 2018) are expected to negatively impact this sub-species. Habitat degradation and loss is likely to occur from grazing by rabbits *Oryctolagus cuniculus,* sheep *Ovis aries*, feral goats *Capra hircus* and overgrazing by kangaroos *Macropus* / *Osphranter* spp., given the sensitivity of the vegetation this sub-species prefers (Giljohann *et al.* 2017; Verdon *et al.* 2021; Mills *et al.* 2020). Introduced predators, feral cats *Felis catus* (Woinarski *et al.* 2018) and foxes *Vulpes vulpes* may also limit population size (Verdon *et al.* 2021). In the arid and semi-arid parts of Australia densities of these feral predators peak (boom) after large rainfall and breeding events of prey species (e.g. rabbits) (Catling 1988; Pavey *et al.* 2008), indicating possible temporal variability in this threat. Based on the spatial nature of threats and the distribution of this taxa there are more than ten locations, where a single threatening event could impact all individuals present in a location (Verdon *et al.* 2021). Clearing and land degradation has led to fragmentation, however this has not led to severe fragmentation (Verdon *et al.* 2021).

9. Historical land degradation, impacted much of this species' habitat which was initially modified for pastoralism (Fahey 2017). Later clearing for cereal crops fragmented habitat and impeded movement between populations (Hobbs 1993; Verdon *et al.* 2021). Clearing is ongoing in the region (DPIE 2021b). Abundance is negatively impacted by low-rainfall, and in drought periods population densities are lower (Connell *et al.* 2017; Dooley 2019; Verdon *et al.* 2021). 'Clearing of native vegetation', 'Competition and grazing by the feral European rabbit', 'Competition and habitat degradation by feral goats, *Capra hircus* Linnaeus 1758', 'Ecological consequences of high frequency fires', 'Human-caused climate change', 'Predation by feral cats' and 'Predation by the European red fox' are listed as Key Threatening Processes under the Act.

10. The Murray Mallee striated grasswren *Amytornis striatus howei* Mathews, 1911 is eligible to be listed as an Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a very high risk of extinction in the near future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

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

Overall Assessment Outcome: Endangered under Clause 4.2 (b) 2 (b,c,e).

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

(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: Not met

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: Not met

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: Not met

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 Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Hope B, Pennay M (2021) NSW Threatened Species Scientific Committee (2021) Conservation Assessment of Murray Mallee striated grasswren *Amytornis striatus howei* Mathews, 1911 (Maluridae). NSW Threatened Species Scientific Committee.

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