Conservation Assessment of Murray Mallee striated grasswren *Amytornis striatus howei* Mathews, 1911 (Maluridae)

Ben Hope, Michael Pennay 19/05/2022
NSW Threatened Species Scientific Committee

Murray Mallee Striated Grasswren *Amytornis striatus howei* Mathews, 1911 (Maluridae)

Distribution: NSW, SA, Vic
Current Federal (*Environment Protection and Biodiversity Conservation Act* 1999) Status: Not listed
Current NSW (*Biodiversity Conservation* Act 2016) Status: *Amytornis striatus*, is listed as vulnerable
Current SA (*National Parks and Wildlife Act* 1972) Status: *Amytornis striatus* is listed as Rare
The Action Plan for Australian Birds 2020: Endangered (Verdon *et al.* 2021)

Proposed listing on NSW *BC Act* and *EPBC Act*: Endangered (A2bc)

Conservation Advice: Murray Mallee striated grasswren *Amytornis striatus howei*

Summary of Conservation Assessment

The Murray Mallee striated grasswren *Amytornis striatus howei* Mathews, 1911 was assessed by Verdon *et al.* (2021) as Endangered. This assessment is based on the information provided in Verdon *et al*. (2021).

The sub-species is eligible for listing as Endangered because of a highly significant decline, evidenced by detailed analysis of reporting rates (Dooley 2019; Verdon *et al.* 2021). Significant threats include inappropriate fire regimes, drought impacts, feral predators (cats and foxes), and grazing and browsing by rabbits, goats and over abundant macropods (Verdon *et al.* 2021).

The taxonomy for striated grasswren (*Amytornis striatus*) was reviewed by Black *et al.* (2020a) and found that the Murray Mallee striated grasswren, the Opalton grasswren and the mukarrthippi grasswren are geographically disjunct and form logical units for management and conservation assessment purposes.

Description and Taxonomy

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 and 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 rufous grasswrens in South Australia (Yellabinna rufous grasswren *Amytornis whitei aenigma*) and to mukarrthippi grasswrens *Amytornis striatus striatus*. Murray Mallee striated grasswrens have white dorsal feather striations which are wider than the mukarrthippi grasswren (Black *et al.* 2020a).

The taxonomy of the striated grasswren (*Amytornis striatus*) is complicated and remains unresolved, although seven sub-species are currently recognised (Black *et al.* 2020a). Black *et al.* (2020a) separated the allopatric central New South Wales populations of *A. striatus striatus* sub-specifically, resulting in the Murray Mallee striated grasswren *A. striatus howei* (Mathews 1911) (type-locality Kow Plains in the Victorian Murray Mallee) and the mukarrthippi grasswren *A. striatus striatus* (Gould 1840) in central NSW (type-locality Liverpool Plains at the eastern extremity of records in NSW). Grasswrens, similar in appearance, but slightly larger than the nominate striated grasswren have been included by Black *et al.* (2020b) in the rufous grasswren (*Amytornis whitei* complex), using the name Yellabinna rufous grasswren (*Amytornis whitei aenigma*).

Despite these complications there is strong evidence that the *Amytornis striatus* complex is monophyletic, and there is strong support for the subclade formed by the mukarrthippi grasswren (Black *et al.* 2020a). The sister relationships between the mukarrthippi grasswren, the Murray Mallee striated grasswren and the monotypic Opalton grasswren (*A. rowleyi*) are not certain (Black *et al.* 2020ab), however as the Murray Mallee striated grasswren, the Opalton grasswren and the mukarrthippi grasswren are widely geographically disjunct (Black *et al.* 2020a), these discrete populations form logical units for management and conservation assessment purposes. Additionally, a recent comprehensive review of Australian birds reviewed this sub-species (Garnett and Baker 2021; Verdon *et al.* 2021), adopting the taxonomy of Black *et al.* (2020ab). Recent taxonomic changes, particularly the understanding of the distribution of sub-species, have had significant implications for the conservation status of this species as *A. striatus howei* is more threatened than *A. striatus sensu lato* (Garnett and Baker 2021). For these reasons it is considered appropriate to assess the Murray Mallee striated grasswren as a sub-species.

The Murray Mallee striated grasswren (as *A. striatus* based on the former concept of this species, which includes what are now recognised as *A. striatus howei* and *A. whitei*) is listed as Rare on the South Australian *National Parks and Wildlife Act* 1972. In NSW *A. striatus* is listed as Vulnerable under the *Biodiversity Conservation Act 2016.* In both NSW and SA, under the revised taxonomy of Black *et al.* (2020a) where the name *A. striatus howei* applies, Verdon *et al.* (2021) has assessed this sub-species as being Endangered, indicating the need for review of the conservation status of this taxon.

Distribution and Abundance

Distribution

The Murray Mallee striated grasswren occurs in New South Wales, South Australia and Victoria. The species is known to occur on the lands of at least the following Indigenous Peoples: First Peoples of the River Murray and Mallee Region, Latje Latje,

Munutunga, Ngarrindjeri, Ngintait, Nyeri Nyeri, Tati Tati and Wadi Wadi. 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)." They were once considered common in Riverland Biosphere, Billiatt and Ngarkat. A large fire at Billiatt in 2014 greatly reduced their numbers and there have been no records in Ngarkat since 2006 (despite targeted searches) and declines have been observed in Riverland Biosphere (Carpenter and Matthew 1986, Paton *et al.* 2009; Dooley 2019; C Hedger *in litt.* September 2021).

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. AOO was estimated to be 2,800 (1,400-5,600) km^2 with low reliability. Both AOO and EOO are declining, with high reliability (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."

Based on the spatial nature of threats and the distribution of this taxon there are more than 10 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 the subspecies is not considered by Verdon *et al.* 2021 as severely fragmented according to IUCN (2019) guidelines. These guidelines define severe fragmentation as the situation where most (>50%) of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a 'viable' population, and (2) separated from other habitat patches by a large distance relative to the dispersal capabilities of the species. The high reported rates of decline for this species (summarized by Verdon *et al.* 2021) indicate that some sub-populations are at risk of being non-viable and future research should aim to quantify this.

Abundance

Verdon *et al.* (2021) state that "The estimate of the number of Murray Mallee striated grasswrens in Murray-Sunset, Hattah-Kulkyne and Nowingi, Victoria is based on surveys in 2018–2019 that found an average of 4.5 birds/km^2 (3.5–6.0) which, when modelled for habitat suitability and detectability, gives a total population of 16,400 (8,700–28,000; S Verdon, M Clarke unpublished). A few hundred are thought to occur in Wyperfeld/Big Desert (S Verdon unpublished). The population in Riverland Biosphere Reserve occurs at a much lower density (C Hedger, P Waanders unpublished), is much more patchily distributed (Dooley 2019) and may be no more

than 100 individuals (P Waanders unpublished). A few hundred may also occur in Scotia Sanctuary in New South Wales where they were recorded at 27% of sites in suitable habitat during six surveys conducted between 2010 and 2018 (F L'Hotellier, T Moyle unpublished). 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, reporting rates have been steady if variable inside a feral predator-free fenced area of 80 km^2 but only two birds were recorded during surveys outside the fenced area since 2013 (F L'Hotellier, T Moyle unpublished)."

Recent information from exhaustive searching indicates that the Murray Mallee striated grasswren appears to be extinct in Ngarkat Conservation Reserve in SA due to the impact of fire and drought, although there is a potential for Ngarkat Reserve to be repopulated from the Big Desert / Wyperfeld population in Victoria (C. Hedger unpublished). At Cooltong Conservation Park (SA) they were common in unburnt Triodia habitat have not been found recently (C. Hedger unpublished). In this area the old growth Triodia has been severely impacted by the 2019/2020 drought and plagues of geometrid moth, leaving the habitat in very poor condition (C. Hedger unpublished). Verdon *et al.* (2021) estimate 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). 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 low reliability, as 5,000 (4,000-10,000) (Verdon *et al.* 2021).

Ecology

The habitat of Murray Mallee striated grasswren 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). 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 from Aug to Jan, and also following rainfall (Rowley *et al.* 2020). The breeding territory of the striated grasswren is approximately 3 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, become 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).

Fire has been reported to lead to localised extinctions although recolonisation after fire usually occurs within 5-15 years (depending on rainfall) and some birds will forage in regenerating habitat 3 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 greater protection against post-fire and drought impacts than higher sites (Connell *et al.* 2017; Verdon *et al.* 2021).

Threats

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 negatively impact this species and large fires, which have been prevalent in the last two decades in the Murray Mallee are likely to have caused declines through direct mortality and changes in vegetation structure (Avitabile *et al*. 2013; Verdon *et al*. 2021). A lack of fire is also a threat to this species with long-unburnt spinifex unsuitable (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. All 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 is likely to occur, in drought periods, as a result of grazing by rabbits (*Oryctolagus cuniculus*)*, s*heep (*Ovis aries*), feral goats (*Capra hircus*) and overgrazing by kangaroos (*Macropus* and *Osphranter* spp.), given the sensitivity of the vegetation preferred by this sub-species (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.

Historical land degradation impacted much of the habitat. Initially, habitat was modified for pastoralism (Fahey 2017). Later clearing for cereal crops fragmented habitat and impeded movement between populations (Hobbs 1993; Verdon et al. 2021) and 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).

‘Competition and land degradation by rabbits’, ‘Competition and land degradation by unmanaged goats’, ‘Land clearance’, ‘Predation by European red fox’, ‘Predation by feral cats’, are listed as Key Threatening Processes under the Commonwealth *EPBC Act* 1999.

‘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 NSW *BC Act* 2016.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of Murray Mallee striated Grasswren *Amytornis striatus howei* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Criterion A *Population Size reduction*

Assessment Outcome: Endangered under Criterion A2bc

Justification: Population declined by >50%–80% in the last 10 years (one generation 3.0 years Bird *et al.* 2020) (Dooley 2019; Verdon *et al.* 2021). Verdon *et al.* 2021 state that "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 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)."

Criterion B *Geographic range*

Assessment Outcome: Not met: EOO >20,000 km^2, AOO >2,000 km^2, continuing decline, >10 locations

Justification:

Verdon *et al.* (2021) provide a maximum, minimum and best estimate of extent of occurrence and area of occupancy as well as an indication of reliability. The EOO was estimated to be 41,200 (40,000-43,000) km^2 with high reliability AOO was estimated to be 2,800 (1,400-5,600) km^2 with low reliability, 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 and the decline in the reliability of this estimate is high (Verdon *et al.* 2021).

For both AOO and EOO the best estimates exceed the criteria used in this clause.

In addition to these thresholds, at least two of three other conditions must be met. These conditions are:

a) The population or habitat is observed or inferred to be severely fragmented or there is 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

Assessment Outcome: Not severely fragmented habitat, >10 locations

Justification: Verdon *et al.* (2021) found that there were more than 10 locations and that severe fragmentation is not applicable to this taxon. For one of the number of locations Verdon *et al.* 2021 noted "Not calculated: the spatial nature of the threats, even though stochastic in space and time, is such that there are >10 geographically or ecologically distinct areas were a single threatening event could affect all individuals of the taxon present within a period of three years."

b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals

Assessment Outcome: Continuing decline in i,ii,iii,iv,v.

Justification: Verdon *et al.* (2021), based on Black and Gower (2017) and Dooley (2019) found the abundance of this species was in decline. Verdon *et al.* (2021) found both AOO and EOO were contracting (which by inference means the number of subpopulations is likely declining) and there are threats present likely to lead to decline and habitat degradation (e.g. inappropriate fire regimes, grazing, droughts and heatwaves).

c) Extreme fluctuations.

Assessment Outcome: Sub-criterion not met.

Justification: Not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals (Verdon *et al.* 2021)

Criterion C Small population size and decline

Assessment Outcome: Not applicable: population >10,000 mature individuals.

Justification: Verdon *et al.* (2021) estimates there are 17,000 (10,000-32,000) mature individuals (low reliability indicated by Verdon *et al.* (2021) for this estimate) and the abundance is declining (high reliability indicated for decline; Black and Gower 2017; Dooley 2019).

In addition, at least one of two additional conditions must be met. These are:

C1. An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generation (whichever is longer) (CR); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Not eligible as population >10,000 mature individuals

C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Continuing decline inferred, but not eligible as population >10,000 mature individuals

In addition, at least 1 of the following 3 conditions:

a (i) Number of mature individuals in each subpopulation ≤50 (CR); ≤250 (EN) or ≤1000 (VU).

Assessment Outcome: Clause not met

Justification: 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).

a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: Clause not met

Justification: The number of individuals in each sub-population, is estimated, with a low reliability, as 5,000 (4,000-10,000) and the total population 17,000 (10,000-32,000) mature individuals (low

reliability indicated for this estimate) (Verdon *et al.* 2021). Based on these estimates it is unlikely that >90% of individuals are in a single population.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Sub-clause not met.

Justification: Verdon *et al.* (2021) found no evidence of extreme fluctuations

Criterion D Very small or restricted population

Assessment Outcome: Not applicable: population >10,000 mature individuals, distribution not small or restricted.

Justification: Population size is estimated to >10,000 and AOO and EOO are not restricted. The number of individuals in each sub-population, is estimated, with a low reliability, as 5,000 (4,000-10,000) and the total population 17,000 (10,000-32,000) mature individuals (low reliability indicated for this estimate) (Verdon *et al.* 2021)

To be listed as Vulnerable under D, a species must meet at least one of the two following conditions:

D1. Population size estimated to number fewer than 1,000 mature individuals

Assessment Outcome: Clause not met

Justification: Not applicable: population >10,000 mature individuals (Verdon *et al.* 2021)

D2. Restricted area of occupancy (typically <20 km^2) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

Assessment Outcome: clause not met

Justification: Number of locations >5, AOO >20 km^2

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient

Justification: Not applicable: no population viability analysis has been undertaken.

Conservation and Management Actions

Conservation objectives

- All subpopulations are stable or increasing (Verdon *et al.* 2021).
- Fire and grazing in mallee habitats are being actively managed to maintain biodiversity (Verdon *et al.* 2021) and improvement in knowledge adaptively incorporated into management actions to maintain populations.
- Manage grazing pressure to reduce habitat degradation.

Conservation actions under way

- Much of the population is within protected areas (Verdon *et al.* 2021).

- Advice on threatened mallee birds is being incorporated into fire planning and response (Verdon *et al.* 2021).
- Surveys to clarify distribution, habitat condition, population densities and monitor trends.

Research required

- understanding connectivity between subpopulations and locations.
- investigating dispersal behaviour, to understand, for example, how patches are recolonised post-fire, and the situations in which translocations may be needed when pops are extirpated.
- investigating if habitat management can increase resilience to extreme heat events.
- Understand the combined impacts of drought, heat and grazing (Verdon *et al*. 2021) and identify suitable refuge areas now and into the future (including areas that currently don't support the birds).
- Undertake research into demography and ecology (Verdon *et al.* 2021).
- Determine the role of feral predators in grasswren demography (Verdon *et al.* 2021).
- Investigate feasibility and risks or genetic rescue, captive breeding, translocation or other interventions.

Management actions required

- Actively manage the fire regime (Verdon *et al.* 2021).
- Reduce pressures from grazing (both introduced and where necessary native) and feral predators as required (Verdon *et al.* 2021).
- Avoid clearance and fragmentation of habitat.
- Develop a strategy to mitigate the threat of drought and fire for threatened mallee birds under a changing climate (Verdon et al. 2021).

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Experts consulted
Stephen Garnett
Chris Hedger
Angela Duffy

APPENDIX 1
Assessment against *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: Clause 4.3 is 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: Clause 4.4 is 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: Clause 4.5 is 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: Clause 4.6 is 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: Clause 4.7 is 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.