Conservation Assessment of Bathurst Grassland Earless Dragon *Tympanocryptis mccartneyi* Melville, Chaplin, Hutchinson, Sumner, Gruber, MacDonald & Sarre 2019 (Agamidae)

C. Bray and J. Rowley 21/01/2022
NSW Threatened Species Scientific Committee

Bathurst Grassland Earless Dragon *Tympanocryptis mccartneyi* Melville, Chaplin, Hutchinson, Sumner, Gruber, MacDonald & Sarre 2019 (Agamidae)
Distribution: Endemic to NSW
Current EPBC Act Status: Endangered as *Tympanocryptis pinguicolla*
Current NSW BC Act Status: Endangered as *Tympanocryptis pinguicolla*

Proposed listing on NSW BC Act and EPBC Act: Critically Endangered

Conservation Advice: *Tympanocryptis mccartneyi*

Summary of Conservation Assessment

Tympanocryptis pinguicolla, the South-eastern Lined Earless Dragon was listed as an Endangered Species on Part 1 of Schedule 1 of the Threatened Species Act 1995 in 15/11/1996. Individuals of *Tympanocryptis pinguicolla* in NSW were recently recognised as two separate species, *Tympanocryptis mccartneyi* and *Tympanocryptis osbornei* (Melville *et al.* 2019). Both these species have been reassessed under the IUCN Red List criteria and the BC Act criteria. Assessment of *Tympanocryptis osbornei* can be found in a separate report.

Tympanocryptis mccartneyi was found to be eligible for listing as Critically Endangered under Criterion B1ab (i,ii,iii,iv,v) and B2ab (i,ii,iii,iv,v).

The main reasons for this species being eligible are; a very restricted geographical range, fragmentation of habitat, and ongoing threats, including the loss, fragmentation and degradation of habitat through urban, industrial and agricultural development, adverse fire regimes, weed invasion, predation by native and introduced species and climate change.

Description and Taxonomy

Taxonomy: *Tympanocryptis mccartneyi* is part of the *T. lineata* species complex (which includes *T. lineata, T. osbornei*, *T. mccartneyi*, and *T. pinguicolla*) and are referred to as the "grassland earless dragons", being the only members of the family Agamidae to be restricted to natural temperate grasslands. *T. mccartneyi* was previously considered a population of *T. pinguicolla,* but a recent taxonomic revision has described this as a separate species, based on genomics and morphology (Melville *et al.* 2019).

Description: Melville *et al.* (2019) describes *Tympanocryptis mccartneyi*: “Lateral neck fold well developed, from angle of jaw to gular fold; spines along extent of fold. Head and snout with strongly keeled dorsal scales; keels irregular, those on the lateral scales aligned more obliquely than those on the more medial scales. Snout

shape smoothly tapering in profile, the canthal scales continuous with the rostral scale. Nasal scale dorsal margin does not cross onto the dorsal side of the canthus rostralis. No row of enlarged scales along the ventral margin of the nasal scale between the nasal and small snout scales. Dorsal body scales weakly to moderately keeled and imbricate. Numerous scattered strongly enlarged spinous dorsal scales, at least twice the width of adjacent body scales, each with a strong median keel ending in prominent spine directed posterodorsally; posterior edge weakly raised, not convex. Ventral body scales weakly keeled, throat scales keeled. Thigh scalation heterogeneous, with scattered enlarged tubercular scales similar to those on body. Lateral fold between axilla and groin present. Snout–vent length of the two known specimens, 53 mm (holotype) and 51 mm (paratype); femoral pores = 0; preanal pores = 2.

Dorsal colour pattern (in preservative) brownish grey with six dark brown transverse bands and with 5- lined pattern well defined and continuous. Dorsolateral lines as wide as or wider than the vertebral line, well defined, straight edged, not expanding around the vertebral blotches. Vertebral and dorsolateral stripes continue weakly onto the tail outlining 12–14 dark caudal blotches. Pale supra-ocular bar usually strongly contrasting. Venter whitish, with dark speckled pigmentation on throat and sides of the belly."

Tympanocryptis mccartneyi differs from both *T. lineata* and *T. osbornei* in having enlarged tubercular scales scattered on the thighs and keeled rather than smooth throat scales. This species differs from *T. pinguicolla* from Victoria in having more acutely pointed dorsal tubercles directed more posteriorly than vertically and keeled rather than smooth gular scales (Melville *et al.* 2019).

Common Name: Bathurst Grassland Earless Dragon

Distribution and Abundance

Tympanocryptis mccartneyi is endemic to New South Wales (NSW) where it is restricted to the grasslands and open country on the alluvial plains around Bathurst in the Central Tablelands of NSW (Melville *et al.* 2019). The grasslands occur at altitudes up to approximately 1200 m and are naturally treeless or sparsely treed, with native tussock grasses being the dominant vegetation (Melville *et al.* 2019).

The population size of *Tympanocryptis mccartneyi* is unknown. The species is known from only three records (two in 1966 and one from the early 1990s). The species has not been encountered for more than 30 years, although there have been few surveys targeting this species. In September 2019, a week- long search was conducted in the Bathurst region focussed on finding appropriate habitat for the species and searching potential burrows but the species was not located. Of the six sites visited only two of them had some possible but unlikely habitat for the species and even those sites contained no more than 50 x 50 m patches of potential but unlikely habitat (S. Mahony *in litt.* January 2021). Areas of other private and public land still need to be assessed as potential habitats for *T. mccartneyi*, including Travelling Stock Reserves and roadside and rail verges (Melville *et al.* 2019).

Ecology

Key habitat requirements: *Tympanocryptis mccartneyi* is a grassland specialist, inhabiting treeless plains and open grasslands. The species has been found along railway tracks, with weedy *Paspalum* grass thickets, and in vacant paddocks with tall pasture grass (Melville *et al.* 2019).

Other species of grassland earless dragons have been discovered beneath rocks in either burrows, rock crevices or depressions (Osborne *et al.* 1993). Burrows excavated by wolf spider (*Lycosidae* sp.) associated with partially embedded surface rocks are of critical importance to these dragons. The burrows provide shelter sites for overwintering, refuge from trampling by livestock and predation and as locations where eggs can be laid (McGrath 2015). Fidelity to these burrows is known to increase with the onset of winter (Stevens *et al.* 2010) and the related *T. osbornei* is reported to be torpid in winter between May and September (McGrath *et al.* 2015).

Like the other grassland earless dragons, *T. mccartneyi* is likely to be a sit-and-wait predator, feeding mainly on small invertebrates including ants, beetles, spiders and moths (McGrath 2015).

Habitat fragmentation: Since European settlement, 99.5% of Natural Temperate Grassland of the South Eastern Highlands (a nationally critically endangered ecological community, EPBC Act 1999) in Australia has been destroyed or drastically altered, due mostly to urban and agricultural development in the region, and now only occurs in small (<10 ha) highly fragmented patches (Kirkpatrick *et al.* 1995, Environment ACT 2005; Threatened Species Scientific Committee 2016). Remnant grassland habitat occurs now only in outlying areas that are generally restricted to the lower slopes of broad open valleys (Keith 2004). The effects of fragmentation include the restriction or prevention of the movement of native fauna species and dispersal between sites and may lead to in-breeding and local extinctions (Hoehn *et al.* 2013). Although little is known about dispersal distances in *T. mccartneyi*, it is likely that they are small. The related *T. lineata* has been recorded to have restricted movement (usually less than 100 metres in six weeks of monitoring) and occupy home ranges of between 925 m^2 and 4768 m^2, focussed around one or two burrows (Stevens *et al.* 2010).

Genetic studies of populations of the related species *T. lineata* identified substantial population structure in the highly urbanised Canberra region where this species occurs, despite relatively short distances between sites. Populations were found to only likely have migration between them where there is some integrity and connectedness of the natural temperate grasslands (Hoehn *et al.* 2013). These results suggest that significant development can cause rapid isolation and population fragmentation and it is likely that any extant populations of *T. mccartneyi* would also be severely fragmented due to urbanisation of its habitat around Bathurst.

Life History: There are no detailed studies of the life history of *T. mccartneyi* and most information is based on the better understood related species of grassland earless dragons (Smith 1994, Langston 1996, Nelson 2004, Stevens *et al*. 2010, Dimond *et al*. 2012).

Grassland earless dragons are oviparous, laying clutches of 3-6 eggs in late spring or early summer, in shallow nests which develop over 9-12 weeks before hatching in late summer or early autumn (Smith 1994, Langston 1996, Nelson 2004). The young disperse probably soon after hatching (Smith 1994, Dawson 2003). No information is available concerning either hatching success or juvenile mortality. They quickly grow to adult size (by late autumn-early winter), with males maturing earlier than females and mating occurs the following spring (Langston 1996, Nelson 2004; Robertson and Evans 2009).

Based on information of other species of grassland earless dragons, this species is likely to be short-lived. The closely related *T. osbornei* lives for one to three years in the wild, though they can reach the age of four to six years, sometimes up to nine years within captivity (Nelson 2004, Robertson and Evans 2009; S. Sarre *in litt*. Jan 2021). Females *T. osbornei* can breed in their first year and in the wild most seem to only survive long enough to produce one clutch of eggs. In captivity they have occasionally been recorded to produce a second clutch (Langston 1996; Nelson 2004; S. Sarre *in litt*. Jan 2021). The generation length of *Tympanocryptis mccartneyi* in the wild is estimated to be one to two years.

Adult grassland earless dragons have been shown to move as much as 40 to 110 m per day (Langston 1996, Nelson 2004), with some movements in excess of 230 m over longer periods. Nothing is known about movements of juveniles, although this stage may be when dispersal occurs (Robertson and Evans 2009). Population density may be influenced by social interactions, as aggressive encounters between individual lizards, involving vocalisations and displays, have been observed in captive animals and in the field and (Smith 1994, Robertson and Evans 2009).

Threats

The threats to *Tympanocryptis mccartneyi* are unknown, however it is assumed that threats for this species would be similar to those of the related grassland earless dragons, which include: removal and degradation of native tussock grasslands, for urban, rural and infrastructure development, changes to the pattern of burning, weed invasion, predation by native and introduced species and climate change.

Agricultural and urban development:

Since European settlement much of the natural grassland habitat of south-eastern Australia has been cleared (Benson and Redpath 1997; Threatened Species Scientific Committee 2016). The Bathurst area may have contained 20 000 hectares of native grasslands at the time of European discovery, which has now been mostly replaced by weeds, horticultural crops and/or trees (Semple 1997). Only five surveyed sites in the Bathurst-Orange range have been identified as potential tussock grassland sites suitable for this species (Department of Environment 2016; Melville *et al.* 2019).

The areas of remaining grassland habitat are subject to ongoing degradation processes including, crash grazing practices or overstocking, ploughing or sowing of exotic pastures, rock removal, pasture improvements through use of agricultural chemicals and invasion by weeds (Robertson and Evans 2009, McGrath 2015). The

related *T. lineata* has never been captured in grassland that is highly modified such as through ploughing and conversion to exotic grassland (Stevens *et al.* 2010).

A change in grazing regime by domestic stock and feral animals significantly impacts grassland community structure and composition (Costin 1954; Clarke 2003; Keith 2004; Environment ACT 2005; Threatened Species Scientific Committee 2016). Over-grazing is known to affect grassland species composition by reducing those plant species that have higher palatability to stock and lower capacity to regenerate (McIntyre and Lavorel 1994; McIntyre *et al*, 2003) and too little grazing may result in increased biomass and a reduction of inter-tussock spaces, altering the structure of the grassland community (Threatened Species Scientific Committee 2016).

Changes in grazing intensity and has been shown to adversely affect reptile abundance, richness and diversity (Kay *et al*. 2017; Howland *et al.* 2014) and livestock grazing has been implicated in historical changes to several Australian reptile assemblages (Sadlier and Pressey 1994; Smith *et al*. 1996; Landsberg *et al*. 1997). Ground-dwelling reptiles are vulnerable to changes in the intensity of grazing due to their use of a particular vegetation structure and microhabitat features that are important for foraging, shelter, reproduction and thermoregulation (McElhinny *et al.* 2006). In addition, their limited dispersal ability prevents them from migrating into higher quality areas when habitat is degraded (Brown *et al.* 2011). Heavy grazing by kangaroos, rabbits, stock, or close mowing leads to loss of tussock structure and excessive bare ground. A study of ground-dwelling reptiles in grassy habitats showed that no species was more likely to occur at high grazing intensities (Howland *et al.* 2014). Trampling by stock is also likely to damage grassland structure (McGrath 2015).

Ploughing and overgrazing is likely to reduce the number of arthropods that Grassland earless dragons rely on to form burrows, reducing availability for shelter and over wintering sites (Nelson 2004).

The removal of bushrock from grassland habitats either for use in farming activities or for home landscaping use removes important habitat elements for grassland earless dragons (Threatened Species Scientific Committee 2016). “Bushrock removal” is listed as a key threatening process under the NSW Biodiversity Conservation Act.

<u>Changed and inappropriate fire regimes</u>:
Fire can be regenerate native grasslands and to maintain diversity in grassland structure, but too frequent burning and wildfire may also kill individuals, alter vegetation composition and structure and reduce the abundance of prey (Environment ACT 2005; ACT Government 2017). The related *T. lineata* has been recorded both escaping from and being killed by an unplanned fire (Osborne *et al.* 2009). Too-frequent burning or fires that are too hot or at inappropriate times are identified as a threat to native grasslands, and particularly to the small, relatively immobile fauna species that occur in small, fragmented sites (Environment ACT 2005; Dunlop *et al.* 2012; Threatened Species Scientific Committee 2016). “High frequency fire resulting in the disruption of life cycle processes in plants and animals

and loss of vegetation structure and composition is declared a key threatening process under the NSW Biodiversity Conservation Act.

Invasive flora and fauna:
Introduced plant species have had a major impact upon grassland habitats. Species such as *Hypericum perforatum* (St John's Wort), *Nassella trichotoma* (Serrated Tussock) and *Nassella neesiana* (Chilean Needlegrass) can outcompete native grassland species for water, light and nutrients and can form a monoculture. The young plants can grow into inter-tussock spaces, potentially restricting movement and obscuring sheltering burrows (ACT Government 2017).

The burrowing and grazing activities of the European rabbit (*Oryctolagus cuniculus*) and the wallowing and rooting behaviour of the feral pig (*Sus scrofa*) are sources of disturbance to grasslands habitats (Costin 1954; Environment ACT 2005; Threatened Species Scientific Committee 2016). Impacts by these animals include soil disturbance and erosion which can promote the invasion of weeds and prevent the recruitment and survival of native plants, which can adversely affect the microhabitat requirements of *T. osbornei* (Costin 1954; Environment ACT 2005; DEWHA 2008). "Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus*" and "Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)" are listed as key threatening processes under the NSW Biodiversity Conservation Act and the Environment Protection and Biodiversity Conservation Act.

Predation by introduced and native animals:
Reduction of vegetation cover as a result of grazing is likely to increase the impact of predators such as feral cats, dogs and foxes. Foxes are likely to be more numerous on the rural sites and predation by domestic pets and feral cats might increase where *T. osbornei* sites are closer to urban developments (Robertson and Evans 2009). The impact of native predators like ravens, raptors, magpies and snakes may also increase with lack of vegetation and increased exposure (Robertson and Evans 2009). "Predation by the European Red Fox *Vulpes vulpes*" and "Predation by the Feral Cat *Felis catus*" are listed as key threatening process under the NSW Biodiversity Conservation Act and the Environment Protection and Biodiversity Conservation Act.

Climate Change:
Modelling of the effect of climate change predicts warmer year-round temperatures for south eastern Australia by the end of the century, with an increase in the intensity and frequency of hot days and heatwaves, intensifying drought conditions and changing rainfall patterns (OEH 2014). These changed conditions have the potential to impact the habitat quality, population resilience and recruitment of all grassland earless dragons (J. Melville *in litt.* Sept 2020). Monitoring data of the related *T. lineata* from 2002-2010, showed that successive years of drought led to population declines and local extinctions, suggesting this species may be sensitive to the predicted effects of climate change (Dimond *et al.* 2012). As a result of drought, sparser ground cover will lead to higher ground temperatures, which may increase mortality of eggs and hatchlings through desiccation (Dimond *et al.* 2012), thermal refuges may also

be less effective, and at high temperatures the daily activity period may reduce foraging time (Sinervo *et al*. 2010).

Associated impacts correlated with, or exacerbated by, anthropogenic climate change also include an increase in the severity and frequency of fire (Flannigan *et al.* 2009) and any effects on populations from habitat fragmentation and degradation (Hoehn *et al.* 2013). The relatively low fecundity and short life span of *T. osbornei* makes local populations vulnerable to the effects of wildfire, drought and other environmental changes on their habitat. “Anthropogenic Climate Change” is listed a key threatening process under the NSW Biodiversity Conservation Act.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Tympanocryptis mccartneyi* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Criterion A Population Size reduction

Assessment Outcome: Data Deficient
Justification: To be listed as threatened under Criterion A, the species must have experienced a population reduction of ≥30% (VU threshold) over three generations or 10 years (whichever is longer). Although the species may have undergone a reduction in population size as a result of habitat loss due to severe fire, there are no quantitative data available on the population size or dynamics of this species and there are no data on population declines over any relevant time frames (10 years or 3 generations). Therefore, there are insufficient data to assess *Tympanocryptis mccartneyi* against this criterion.

Criterion B Geographic range

Assessment Outcome: Critically Endangered under Criterion B1ab (i, ii, iii, iv, v) and B2ab (i, ii, iii, iv, v)
Justification: *Tympanocryptis mccartneyi* is known only from three records all within 1 km of each other.

Extent of occurrence (EOO) for all known records for the species, was estimated to be <1 km^2, based on a minimum convex polygon enclosing all known mapped occurrences of the species, the method of assessment recommended by IUCN (2019). A species with an EOO of less than 100 km^2 qualifies under the Critically Endangered threshold.

The area of occupancy (AOO) for all records was estimated to be 4 km^2, based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2019). A species with an AOO of less than 10 km^2 qualifies under the Critically Endangered threshold.

Note: ‘If the EOO is less than AOO, EOO should be changed to make it equal AOO to ensure consistency with the definition of AOO as an area within EOO’ (IUCN 2019). Therefore, the EOO is 4 km^2. A species with an EOO of less than 100 km^2 qualifies under the Critically Endangered threshold.

Tympanocryptis mccartneyi meets the Critically Endangered category for Criterion B1 and B2.

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: Severely fragmented habitat and one location.

Justification: As a result of habitat loss due to urban and agricultural development very little of the species preferred tussock grassland habitat remains. Any remaining habitat patches are separated by distances beyond the dispersal ability of the species inhibiting migration between patches.

There is one location with threat from urban and agricultural development causing loss, degradation and fragmentation of habitat.

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) and (v)

Justification: There is a continuing decline as a result of current ongoing threats including loss and degradation of habitat as a result of urban and rural development, changed fire regimes, invasion by weeds and climate change.

c) Extreme fluctuations.

Assessment Outcome: Data Deficient

Justification: There are no available data to suggest that extreme fluctuations occur in population size or geographic distribution of *Tympanocryptis mccartneyi.*

Criterion C Small population size and decline

Assessment Outcome: Data Deficient

Justification: Currently there are no available census data to assess the population size or trends in *Tympanocryptis mccartneyi*. Therefore, there is insufficient information to assess this species under Criterion C.

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) (CE); 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: Data Deficient

Justification: There are no data on population declines over any relevant time frames to determine whether or not there is a continuing decline in population size.

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

Assessment Outcome: Data Deficient

Justification: There is no information for this species for which to determine whether or not there is a continuing decline in population size.

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: Data Deficient

Justification: There are no available census data to assess number of mature adults per subpopulation of the species.

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

Assessment Outcome: Data Deficient

Justification: The percentage of mature adults per subpopulation is unknown. There are insufficient data to assess the species against this subcriterion.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient

Justification: There are no available data to suggest that extreme fluctuations occur in population size or geographic distribution of *Tympanocryptis mccartneyi.*

Criterion D Very small or restricted population

Assessment Outcome: Vulnerable under Criterion D2
Justification: Although currently there are no available census data to assess the population size of *Tympanocryptis mccartneyi*, the species has a restricted area of occupancy of 4km^2.
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: Data Deficient

Justification: Currently there are no available census data to assess the population size or trends in *Tympanocryptis mccartneyi.* Therefore, there is insufficient information to assess this species under this subcriterion.

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: Vulnerable

Justification: The area of occupancy (AOO) for all known records was estimated to be 4 km^2, based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2019). A species with an AOO of less than 20 km^2 qualifies under the Vulnerable threshold for this subcriterion. In addition, there is estimated to be only one location, with threat from urban and agricultural development causing loss, degradation and fragmentation of habitat. A species with five or less locations qualifies for the Vulnerable threshold for this subcriterion.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient
Justification: There are insufficient data available to undertake a quantitative analysis to determine the extinction probability of *Tympanocryptis mccartneyi.*

Conservation and Management Actions

Survey and Monitoring priorities

- A priority for this species is targeted surveys of suitable habitats. Surveys across the higher altitude remnant native grasslands of the region, including Bathurst, Orange, Blayney and even south towards Cowra. Private and public lands need to be assessed as potential habitats, including roadside and rail verges, Travelling Stock Routes and Reserves. Such survey work will be critical in assessing the distribution, habitat requirements and population health of this species.

Information and Research priorities:

- Where the species is detected, aim to undertake research to identify key aspects of the species biology with respect to habitat, including the attributes of preferred sheltering sites, diet and population structure.
- At known sites for the species, undertake threat assessment, including of any predators.

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Expert Communications

- Stephen Mahony, Research Associate Herpetology and Mammalogy, Australian Museum,
- Jane Melville, Senior Curator, Terrestrial Vertebrate, Museums Victoria, jmelv@museum.vic.gov.au
- Tim McGrath, Threatened Species Officer, Department of Agriculture, Water and the Environment, Tim.McGrath@awe.gov.au
- Stephen Sarre, University of Canberra, Stephen.Sarre@canberra.edu.au>

Appendix 1
Assessment against Biodiversity Conservation Act criteria
The Clauses used for assessment are listed below for reference.

Assessment of *Tympanocryptis mccartneyi* against BC Act criteria

Overall Assessment Outcome: Critically Endangered under Clause 4.3 (a) (d) (e 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: Critically Endangered under Clause 4.3 (a) (d) (e ii, iii, iv).
[Equivalent to IUCN Criterion B via B1ab (i, ii, iii, iv, v) and B2ab (i, ii, iii, iv. v)]

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: 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: Vulnerable

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.