Conservation Assessment of *Zieria formosa* J.D.Briggs & J.A.Armstr. (Rutaceae)

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***Zieria formosa* J.D.Briggs & J.A.Armstr. (Rutaceae)**

Distribution: Endemic to New South Wales (NSW)
Current EPBC Act Status: Endangered
Current NSW BC Act Status: Critically Endangered
Proposed listing on NSW BC Act: Critically Endangered

Summary of Conservation Assessment

Zieria formosa was found to be eligible for listing as Critically Endangered under Criteria B1ab(iii) + B2ab(iii).

The main reasons for this species being eligible are (i) it has a very highly restricted geographic range; ii) it occurs at one location; and iii) there is inferred continuing decline in quality of habitat caused by decreasing rainfall and increasing temperature with climate change.

Description and Taxonomy

Zieria formosa is described in PlantNET as a "Rounded shrub to 1.5 m high and 1 m diam.; branches warted, stellate-pubescent; older branches less warted and glabrescent. Leaves with central leaflet lanceolate, 15–30 mm long, 3–5 mm wide, apex ± obtuse, margins ± toothed, strongly recurved; upper surface warted, stellate-pubescent, light green; lower surface sparsely warted, stellate-velvety, paler; petiole 2–4 mm long. Inflorescences slightly longer than leaves, many-flowered; bracts persistent, 1.5–6 mm long. Calyx lobes triangular, 1.5–2 mm long, hairy. Petals 3.5–4 mm long, valvate, pale pink to ± white, outer surface stellate-pubescent, inner surface ± glabrous. Cocci warted, glabrous or sparsely stellate-hairy, lacking an appendage" (Armstrong and Harden 1990).

Zieria formosa was first discovered in 1986. A systematic study by Morton (2015) showed that *Z. formosa*, *Z. buxijugum*, *Z. parrisiae*, *Z. tuberculata* and *Z. granulata* are closely related and form a clade. *Zieria formosa*, *Z. buxijugum* and *Z. parrisiae* are all only known from single populations. The three species occur in close proximity, within 15 km west of Pambula on the far South Coast of NSW. The species do not co-occur (NSW NPWS 2002). *Zieria formosa* is distinguished from *Z. buxijugum* by the presence of small terminal anther appendages and wider leaflets (3 - 5 mm wide compared to 2 - 3 mm in *Z. buxijugum*). The velvety coverage on the upper surface of its leaves distinguishes *Z. formosa* from *Z. parrisiae* (NSW TSSC 2009).

Zieria formosa has previously been referred to as *Zieria* sp. H *sensu* Armstrong (1991).

Distribution and Abundance

Zieria formosa is currently only known from a single population on private land south-west of Pambula on the NSW south coast. The population is spread over

approximately 1 ha (NSW NPWS 2002), and is found on skeletal, grey, sandy loam amid broken rocks and boulders (Briggs and Leigh 1990). Surveys of similar habitat in the region have failed to locate any additional populations (Briggs and Leigh 1990; Armstrong 2002; J. Briggs pers. comm. March 2022).

Zieria formosa has an estimated Area of Occupancy (AOO) of 4 km^2 based on 2 x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2022). *Zieria formosa* is restricted to one small site, and as a result Extent of Occurrence (EOO) is less than AOO. Where EOO is less than or equal to AOO, IUCN guidelines (2022) recommend EOO is changed to equal AOO. As such, the EOO is also 4 km^2.

Zieria formosa grows to 2.5 m high. The species is mature at 2–5 years of age, which generally corresponds to a height of more than 1 m (J. Briggs pers. comm March 2022). Therefore, plants >1 m are classed as mature individuals for this assessment. The presented total number of mature individuals is the lowest estimate, as some mature plants may fall into a smaller size class due to grazing or dieback.

During a 2021 survey the *Zieria formosa* population was found to contain 68 mature individuals, based on a count of all plants at the site and assignment to size classes. The total population size was 275, which included a large cohort of new seedlings (155 plants <20 cm). There have been seven complete population censuses since 1987, and the population has experienced several large fluctuations. In 1987, there were 125 mature plants. When the site was visited again in 1999, 59% of the mature population had been lost as a result of severe dry conditions in 1997-98 (NSW NPWS 2002). In 2001 there were only 38 mature plants, however there was also a major recruitment event and 699 plants <1 m were recorded (J. Briggs *in litt.* November 2017). By 2012, many of the young plants had grown into larger size classes, and the mature population increased to 140. After 2012, the population experienced continuing decline, reaching a low of 66 mature plants in 2020. This is likely due to senescence, wallaby browsing, and drought from 2017 onward. The current cohort of new seedlings represents the second known large recruitment event since 1987, which occurred with breaking of the drought and good seasonal conditions from mid-2020. In 2019, half of the site was fenced, to exclude wallabies, protecting ~80% of the population from the threat of wallaby browsing. This should increase the survivorship of new seedlings and young plants. Further monitoring is needed to see how many of the 155 current seedlings (plants <20cm high) mature and how this affects total population size. However, the seedlings are unlikely to survive if extended dry conditions resume (J. Briggs pers. comm March 2022). There are ex-situ *Z. formosa* collections at the Australian National Botanical Gardens and the Royal Botanic Garden (NSW NPWS 2002).

Ecology

Habitat

Zieria formosa is found on the north-east aspect of the upper slope of a hill above a small, cleared valley. It occurs mainly in full sun, and the soil is a skeletal, grey, sandy loam. The site is strewn with broken ignimbrite rocks and boulders and has a large amount of exposed surface rock (NSW NPWS 2002).

Zieria formosa occurs in Southern Montane Heathland. *Zieria formosa* is known to be associated with Far Southeast Mountain Rock Scrub (3870) and Far Southeast Mountain Skeletal Rockplate Scrub (3871) Plant Community Types (DPE 2022). Co-occurring mid-storey species include *Acacia mearnsii* (Black Wattle), *Androcalva fraseri* (Native Hemp), *Dodonaea triquetra* (Large-leaf Hop-bush), *Prostanthera nivea* (Snowy Mint-bush), *Pittosporum undulatum* (Sweet Pittosporum), *Kunzea ambigua* (White Kunzea) and *Leptospermum flavescens* (Yellow Tea-tree) (NSW NPWS 2002). Associated ground cover species include *Stypandra glauca* (Nodding Blue Lily), *Plectranthus parviflorus* (Cockspur Flower), *Dendrobium speciosum* (King Orchid), *Cheilanthes tenuifolia* (Rock Fern), *Platysace lanceolata* (Shrubby Platysace) and *Hymenanthera dentata* (Tree Violet) (NSW NPWS 2002). Most of the surrounding vegetation in the area has been cleared and sown to pasture (Armstrong, 2002).

Life history

Zieria formosa produces masses of pale pink flowers from September to October, and most seed dispersal takes place by late December (Briggs and Leigh 1990; Armstrong 2002; NSW NPWS 2002). *Zieria* species have limited seed dispersal. Initially, they have short range ballistic dispersal of seeds from mature fruits, which is followed by secondary dispersal by ants. Seeds are generally dispersed less than a few metres (Auld 2001). *Zieria formosa* is insect pollinated, and native bees, hover flies and blow flies have been observed visiting flowers (NSW Government 2021). Based on field observations, the lifespan of *Z. formosa* is thought to be approximately 10–15 years. Plants start to flower at ~2–3 years, and substantial seed set develops from ~5 years (J. Briggs *in litt.* May 2018). Using this information, generation time is estimated to be ~10 years (*sensu* IUCN 2022).

Recruitment

Zieria formosa recruitment occurs periodically (J. Briggs *in litt.* November 2017). Seeds are shed from mature plants on a yearly basis and become part of the soil seed bank (G. Phillips pers. comm. March 2022). Germination trials have shown that the seeds have a physiological dormancy mechanism, allowing seeds to remain dormant in the soil seed bank (Martyn *et al*. 2009). *Zieria formosa* appears to recruit from the seedbank following an environmental cue, which promotes germination. The species has been observed in two mass germination events. However, the germination triggers are unknown. Both observed mass germinations were associated with the breaking of drought, and in one instance, there was smoke in the air from nearby fires, although the area itself was unburned. Studies of other Rutaceae species have shown that germination triggers can involve complex interactions between cues, but commonly include specific seasonal temperature requirements and/or smoke. Maximum germination of studied Rutaceae is negatively correlated with rainfall seasonality and driest months (Collette and Ooi 2021). Following recorded large recruitment events many *Z. formosa* seedlings have died due to subsequent dry periods and those plants that reach adult stage are gradually lost to senescence. The population seems to experience a low level of recruitment until the next mass recruitment.

Fire ecology

The genus *Zieria* consists both of obligate seeders and resprouters (Auld 2001). There is no record of fire at the *Zieria formosa* site and therefore in-situ fire response of the species is unknown (J. Briggs pers. comm June 2022). However, trials indicate that a large proportion of *Z. formosa* seeds germinate after smoke and gibberellic acid treatment, suggesting that the species is an obligate seeder, and that seed dormancy may be broken by fire-related cues (Martyn *et al*. 2009). Several threatened *Zieria* species have had major recruitment events following the 2019-20 summer bushfires, even though the populations were not burnt in those fires (J. Briggs pers. comm June 2022). It is possible that the prolonged smoky conditions that affected these *Zieria* species followed by the breaking of the drought has had some influence on these significant recruitment events (J. Briggs pers. comm June 2022).

Threats

Decreasing rainfall and increasing temperature as a result of climate change

Zieria formosa is sensitive to dry conditions and high mortality occurs during extended dry conditions. Two large population declines, from 1987 to 1999, and 2012 to 2020, have been attributed to drought. *Zieria formosa* was not monitored between 2001 and 2012, so it is not possible to accurately determine what impact the severe and prolonged millennial drought (2002 - 2007) had on the species. *Zieria formosa* is thought to be particularly vulnerable to dry conditions because it occurs on skeletal soil that has low water-holding capacity (J. Briggs pers. comm March 2022). Droughts are predicted to become more frequent and intense under climate change in NSW (Hennessy et al. 2004; IPCC 2021). Climate model projections using 10 km grid cells around the *Z. formosa sites* indicate an increasing risk of below average annual (-1.6%) and spring (-7.2%) rainfall in the near future (2020-39), and higher annual temperatures (+1.85°C) and number of days >35°C (+2.5) in the far future (2060-79) (NSW Government 2022). There is a substantial projected increase in frequency of extremely hot and extremely dry years in southeast Australia (CSIRO 2021). Although substantial rainfall after drought may trigger seed germination, seedling survivorship will be lower with frequent and intense dry conditions (J. Briggs pers. comm March 2022). Additionally, decreased rainfall and increased temperatures may increase adult mortality and there will be fewer adult plants to contribute to the seed bank over time. This will reduce the number of seeds that are available to germinate following an environmental trigger, leading to population decline. 'Anthropogenic climate change' is listed as a Key Threatening Process under the Act.

Browsing by Wallabies and Rabbits

Browsing of *Zieria formosa* by Wallabies (*Wallabia bicolor*) and Rabbits (*Oryctolagus cuniculus*) has been impacting the population (NSW SOS 2021; J. Briggs *in litt.* August 2017). Wallabies are a native species, and the browsing of shrubs is considered a natural occurrence in the ecosystem. However, the very low number of mature individuals of *Z. formosa* means browsing may be having an adverse impact on the population. The cleared land in the vicinity of the *Z. formosa* population may lead to a higher level of browsing than otherwise may be occurring in a naturally vegetated environment. A site inspection in 2017 found that many of the smaller plants had been browsed by Wallabies, resulting in defoliation, and broken branches and stems. Heavy browsing, especially of smaller plants, causes stress and decreases the likelihood of

the plant surviving to maturity (NSW SOS 2017). Browsing can also impact the ability of plants to produce seed, leading to less seed being available to enter the soil seedbank and therefore reducing the recruitment potential of the population (Hendrix 1988). Browsing is likely to increase during dry periods when other foods become scarce. Interaction between these threats means that the *Z. formosa* population is even more likely to lose individuals in dry conditions.

In 2019, approximately 80% of the population was fenced to exclude Wallabies and Rabbits (NSW SOS 2019). If good weather conditions continue, the new cohort of 155 seedlings has a better chance of reaching maturity in the absence of browsing. Ameliorating the threat of browsing pressure on *Z. formosa* is dependent on the maintenance of the fence.

Uncertainty of future land management

Zieria formosa occurs on two private rural-residential properties. In 1999, an application was lodged with the aim of developing the area around the *Z. formosa* site as a rural-residential subdivision (NSW NPWS 2002). This development was never carried out (J. Briggs pers. comm June 2018). There are currently no plans to increase residential density in the area, but this may change in the future. Development is likely to directly impact population size and indirectly impact the species through increased nutrients and sediments being carried onto the site via a small creek that drains from the adjacent land. Weed infestation could subsequently become a problem. (NSW NPWS 2002).

Too frequent fire

Zieria formosa is thought to be an obligate seeding species (Fire response database 2014) and such species can be affected by high frequency fire regimes that limit the amount of seed available in the seed bank for recruitment post-fire. The small population size and restricted area intrinsically expose the whole population of the species to being burnt at the one time, and the population may depend on regeneration of seedlings from a persistent soil seed bank. The time taken for seedlings to reach maturity and produce substantial seed is five years (J. Briggs *in litt.* May 2018). There is a small risk that frequent fires may therefore interrupt the species' life cycle and result in population declines (Keith 1996). Regenerating seedlings/resprouting plants are also vulnerable to browsing post-fire. However, the site is a rocky hill which appears to be a fire refugia and would probably only burn in catastrophic fire conditions (J. Briggs pers. comm. 2017).

Assessment against IUCN Red List criteria

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

Criterion A Population Size reduction

Assessment Outcome: Not met

Justification: *Zieria formosa* appears to require disturbance or a specific environmental cue, which may be the onset of good rainfall following drought, for a substantial number of seeds to germinate. Decline in species with periodic episodes of mass recruitment is demonstrated by measuring the peak adult population following several recruitment cycles. Since the species was first surveyed in 1987, there have been two large recruitment events. The first major recruitment in 2001 resulted in a peak of the mature population in 2012 (140 individuals). A second large recruitment occurred in 2021. As of 2021, there are 68 mature and 207 immature individuals. High survivorship of seedlings may result in a future population size similar to the 2012 peak. Therefore, there is insufficient evidence for population size reduction over 30 years (three generations) under criterion A.

Criterion B Geographic range

Assessment Outcome: Critically Endangered under B1ab(iii)+2ab(iii)

Justification: *Zieria formosa* has a very highly restricted range, only occupying one small site on a rocky slope near Pambula, NSW. *Zieria formosa* has an AOO and EOO of 4 km^2, as all occurrences fall in a single 2 km x 2 km grid cell. This puts both EOO and AOO below the thresholds for Critically Endangered listing under criterion B (EOO <100 km^2, AOO <10 km^2).

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 number of locations = 1 (CR), ≤5 (EN) or ≤10 (VU).

Assessment Outcome: Sub criterion met – 1 location (CR). There is one location when considering the most serious plausible threat of decreasing rainfall and increasing temperature with climate change. The species is not considered to be severely fragmented.

Justification: *Zieria formosa* only occurs at one site, on a rocky slope above a small valley near Pambula, NSW (EPBC TSSC 2016). Decreasing rainfall and increasing temperature with climate change will affect the entire area, and the site is therefore defined as a single location.

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: Sub criterion met - continuing decline is inferred in (iii) quality of habitat.

Justification:

There is inferred continuing decline in the quality of *Zieria formosa* habitat, based on the species' known sensitivity to dry conditions combined with climate model projections of higher annual temperatures in the far future and increasing risk of

below average annual and spring rainfall in the near future, at the *Z. formosa* site (NSW Government 2022). Death of plants in previous droughts demonstrates the species vulnerability to dry conditions. *Zieria formosa* is thought to be particularly vulnerable to dry conditions because it occurs on skeletal soil that has low water-holding capacity (J. Briggs pers. comm March 2022). Decreased rainfall and higher temperatures are therefore likely to lead to poorer site conditions over time.

Extreme fluctuations

Assessment Outcome: Not met.

Justification: Changes in the mature population observed to date do not meet the subcriterion for extreme fluctuations, which are typically required to be 10-fold (IUCN 2022).

Criterion C Small population size and decline

Assessment Outcome: Data deficient.

Justification: The *Zieria formosa* population is currently observed to contain 68 mature individuals, based on a 2021 population census using height of >1 m as a proxy for maturity. Based on monitoring of the population seven times over 35 years, there has never been more than 250 mature individuals. Therefore, the species falls under the Critically Endangered threshold for number of mature individuals (<250). However, population data are currently not sufficient to determine whether there is continuing decline in numbers of mature individuals.

At least one of two additional conditions must be met. These are:

C1. An observed, estimated or projected continuing decline of at least 10% in 10 years or 3 generations (up to a max. of 100 years in future).

Assessment Outcome: Data deficient.

Justification: *Zieria formosa* appears to require a specific environmental cue for a substantial number of seeds to germinate. Decline in species with this life history is demonstrated by measuring the peak mature population following several recruitment cycles. Since the population was first surveyed in 1987, there have been two large recruitment events. The first major recruitment in 2001 resulted in a peak of the mature population in 2012. A second large recruitment occurred in 2021, however survivorship of those seedlings and impact on population size is currently unknown. Therefore, there is insufficient data to identify any change in the population over the past 30 years (three generations), or to project future change.

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

Assessment Outcome: Data deficient.

Justification: At this time, population data are not sufficient to determine whether there is continuing decline in numbers of 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: Condition met at Endangered threshold.

Justification: *Zieria formosa* occurs in a single subpopulation which contains 68 mature individuals, based on a 2021 population census using height of >1 m as a proxy for maturity. Therefore, the species falls within the Endangered threshold for this condition.

a (ii). % of mature individuals in one subpopulation = 90–100% (CR), 95–100% (EN), 100% (VU).

Assessment Outcome: Condition met at Critically Endangered threshold.

Justification: The entire population of *Zieria formosa* is found at a single site of ~0.01 km^2. *Zieria formosa* meets the criterion for listing as Critically Endangered under Criterion C2a(ii).

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data deficient.

Justification: Changes in the mature population observed to date do not meet the subcriterion for extreme fluctuations, which are typically required to be 10-fold (IUCN 2022).

Criterion D Very small or restricted population

Assessment Outcome: Endangered under D1.

Justification: The *Z. formosa* population is observed to contain 68 mature individuals, based on a 2021 population census using height of >1 m as a proxy for maturity. Therefore, the species falls within the Endangered threshold for number of mature individuals under D1 (<250). The species has a 4 km^2 Area of Occupancy, however there is no clear future threat to *Z. formosa* that would contribute to the extinction of the species in a very short time. As a result, *Z. formosa* does not meet the threshold for listing under Criterion D2.

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: Endangered under D1.

Justification: The *Z. formosa* population is observed to contain 68 mature individuals, based on a 2021 population census using height of >1 m as a proxy for maturity. Therefore, the species falls within the Endangered threshold for number of mature individuals (<250).

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: Not met.

Justification: The Area of Occupancy is estimated to be 4 km^2, however and there is no clear future threat that would contribute to the extinction of the species in a very short time.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient.

Justification: Sufficient data are not available to conduct a quantitative analysis.

Conservation and management actions

This species is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation project has been developed by the NSW Department of Planning and Environment under the Saving our Species program. The conservation project identifies priority locations, critical threats and required management actions to ensure the species is extant in the wild in 100 years. *Zieria formosa* sits within the site-managed species management stream of the SoS program and the conservation project can be viewed here (https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10855).

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Expert communications

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APPENDIX 1

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

Overall Assessment Outcome:
Zieria formosa was found to be Critically Endangered under Clause 4.3 (a)(d)(e, i, iii) and Clause 4.4a,e(i, ii(B)).

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, i, iii)

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: Endangered under Clause 4.5(b).

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.