

NSW Threatened Species Scientific Committee

Conservation Assessment of *Helichrysum calvertianum* (F.Muell.) F.Muell. (Asteraceae)

J Scott May 2019

NSW Threatened Species Scientific Committee

Helichrysum calvertianum (F.Muell.) F.Muell. (Asteraceae)

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Not listed

Summary of Conservation Assessment

Helichrysum calvertianum is found to be eligible for listing as Vulnerable under Criteria B1ab(iii, v) + B2ab(iii, v); and Vulnerable under C2a(i).

The main reasons for the species being eligible for listing as Vulnerable are that: i) the species has a highly restricted geographic range with extent of occurrence (EOO) = 673 km² and the area of occupancy (AOO) = 40 km²; ii) the species has an estimated population size of between 2,500 and 3,500 mature individuals; iii) its habitat and some populations continue to be threatened by ongoing habitat disturbance; (iv) there are estimated to be <10 locations; and (v) the lower bound for the number of mature individuals in each population is <1,000.

Description and Taxonomy

Helichrysum calvertianum (F.Muell.) F.Muell. (Asteraceae) is described in PlantNet (2019) as a “twiggy subshrub to 30 cm high, much-branched; stems glabrescent with sparse woolly and minute glandular hairs, the lower leaves caducous leaving prominent scars. Leaves crowded, linear, 3–8 mm long, 0.5–0.8 mm wide, margins revolute and concealing the lower surface, surfaces green and glabrous, viscid. Heads terminal and solitary on branches, hemispherical, 0.7–1 cm long, 1–1.5 cm diam.; involucre bracts with margins woolly-ciliate towards base, laminae reflexed at maturity; intermediate bracts longest with white papery laminae often tinged pink towards the apex, outermost bracts golden and hyaline, innermost with long claws and with small white papery laminae. Florets numerous, all bisexual. Achenes oblong, terete, minutely glandular; pappus of many barbellate bristles, subplumose at the tip.”

Distribution and Abundance

Helichrysum calvertianum is endemic to New South Wales (NSW) where it is currently only known from the Wingecarribee Shire on the Central Tablelands. Seven populations of *H. calvertianum* are currently known. The south-eastern extent of the distribution is at Fitzroy Falls; the south-western extent is Penrose State Forest, the northernmost population is in the Joadja – Wanganderry area, and there are other populations between Welby, near Mittagong, and Belanglo State Forest. An old herbarium collection made in 1898 by Maiden from Barbers Creek may be from near Tallong, however there have been no other records from this area since then. A population from Mt Gibraltar near Mittagong found in 2004 could not be relocated by searches in 2010 or 2016 and may have become extinct (S. Douglas *in litt.* June 2016).

Helichrysum calvertianum has a highly restricted geographic distribution. The extent of occurrence (EOO) was estimated to be 673 km², based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2017). The area of occupancy (AOO) was estimated to be 40 km². This calculation was based on the species occupying 10 (2 x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2017).

There are currently incomplete data on the number of mature individuals of *Helichrysum calvertianum*. For the few collections that have population details, descriptions of abundance range from “occasional” to “locally frequent”. Population estimates, where available, range from 100 plants or less (Penrose and Belanglo State Forests), to approximately 1,300 plants at Welby (NSW Bionet database; NSW Herbarium records). No formal survey of population abundance for the species across its distribution has been undertaken. Douglas (*in litt.* June 2016) states “total number of individuals is estimated from database records and recent field observations to be > 2,500 and <3,500 mature plants.”

NSW Threatened Species Scientific Committee

Ecology

Helichrysum calvertianum is a perennial paper daisy flowering from winter to summer (PlantNet 2019). It occurs in dry sclerophyll forest (PlantNet 2019) and heathland with rock outcrops, predominantly on Hawkesbury sandstone (S. Douglas *in litt.* June 2016).

The known sites are at an approximate altitude of between 650 and 855 m (estimated from relevant topographic 1:25 000 map series). The highest altitude corresponds to the Mt Gibraltar site where the species has not been sighted since 2004 despite searches in 2010 and 2016 (S. Douglas *in litt.* June 2016). Rainfall across sites ranges from 850 mm pa at the westernmost sites, to over 1,500 mm at the easternmost site (S. Douglas *in litt.* June 2016).

Benson and McDougall (1994) suggested the species is found in dry eucalypt woodland on sandy soil in areas with over 900 mm of annual rainfall. They also suggested that the seeds are wind dispersed. The fire response of *Helichrysum calvertianum* is unknown (Benson and McDougall 1994).

Threats

Past Threats:

The habitat of *Helichrysum calvertianum* would appear to be naturally fragmented (S. Douglas *in litt.* June 2016) as the species generally occurs on Hawkesbury Sandstone rock outcrops. Past land clearing in the central tablelands area of NSW has reduced the extent and connectivity of this habitat.

Current Threats:

Recreational vehicles. Many of the sites (in particular the sites at Welby and in Belanglo State Forest) are near to tracks and prone to ongoing disturbance from vehicle usage and from track maintenance activities. Douglas (*in litt.* October 2017) summarised recreational threats as “Damage to and death of plants through crushing by vehicles (trail bikes, 4WDs and potentially mountain bikes); erosion of habitat by vehicle use in highly erodible and skeletal soils; siltation of downstream [*sic*] habitats affected by upstream [*sic*] erosion; increased weed invasion through weed propagules introduced on vehicles (tyres etc.)” (S. Douglas *in litt.* June 2016).

Other Disturbance. The proximity to tracks for most of the known populations means there is disturbance from track usage and maintenance activities in addition to the disturbance from recreational vehicles above. The plants at Welby are also threatened by dumped soil and rubble, and clearing for maintenance under power lines. Upslope of the Penrose SF population, woodland has been partially cleared to provide a fire buffer to the adjoining pine plantation, and this upslope area is subject to ongoing vehicle and rubbish impacts (Bionet Atlas sighting accessed June 2018). The habitat of the Canyonleigh population has been disturbed by road construction (S. Douglas *in litt.* October 2017).

Feral animals. Feral animals are likely to adversely impact on mature plants and limit ongoing recruitment. “Browsing, grazing, and digging (followed by erosion) due to feral animals including rabbits, hares, goats and deer species. Rabbits appear to be the main concern at this stage.” (S. Douglas *in litt.* June 2016).

Weed invasion. The Fitzroy Falls population is adversely impacted by weeds (*Erigeron karvinskianus* (Bonytip Fleabane) and *Rubus anglocandicans* (Blackberry)). There has also been encroachment from *Pittosporum undulatum* which now dominates the nearby forest and may be an indicator of a lack of fire in the habitat. The riparian habitat where this population occurs is more prone to weed invasion than sites in dry habitats (S. Douglas *in litt.* June 2016). Weeds at the Welby site include *Briza* sp. and *Conyza* sp. (NSW Herbarium records). The Penrose SF site is very small and has been affected by shading (and possible allelopathic impacts from pine needles) from *Pinus radiata* adjacent to the site (S. Douglas *in litt.* October 2017, December 2018)). However, some of these affects in Penrose SF have been recently mitigated by conservation actions (S. Douglas *in litt.* December 2018), though ongoing control is required.

Loss of a population:

The Mount Gibraltar population could not be detected in targeted searches in 2010 and 2016 and has not been seen since 2004 (S. Douglas *in litt.* June 2016). The loss of the species from this site may be due to

NSW Threatened Species Scientific Committee

a combination of high intensity fire, erosion of skeletal soil habitat on rock outcrops, rabbit impacts and recreational pressures (S. Douglas *in litt.* June 2016).

Potential Future threats:

Underground coal mining is proposed beneath a part of Belanglo State Forest (HumeCoal 2018). It is currently unknown if any infrastructure or activities associated with mining will adversely impact *Helichrysum calvertianum* or its habitat.

Inappropriate fire regime. Although the impacts of fire on the species are not known, changes to fire frequency (including an absence of fire) may affect the recruitment of new plants.

Adverse climate change impacts: In the region where *Helichrysum calvertianum* occurs, the number of days over 35°C is expected to increase by 2030, particularly in summer (Adapt NSW 2018), exacerbating drought impacts on sites with shallow soils. In addition, the frequency of severe fire weather events is expected to increase by 2070 (Adapt NSW 2018), increasing the risk of frequent fire in habitats where the species occurs.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Helichrysum calvertianum* 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 $\geq 30\%$ (VU threshold) over three generations or 10 years (whichever is longer). There are insufficient data to assess *Helichrysum calvertianum* against this criterion.

Criterion B Geographic range

Assessment Outcome: Vulnerable under B1ab(iii, v)+B2ab(iii, v).

Justification: *Helichrysum calvertianum* has a highly restricted geographic range.

Extent of Occurrence (EOO): The EOO was estimated to be 673 km², based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2017). To be listed as Endangered under Criterion B1 a species must have an EOO of <5000 km². *Helichrysum calvertianum* meets the EOO threshold for Endangered under Criterion B1.

Area of Occupancy (AOO): The AOO was estimated to be 40 km². This calculation was based on the species occupying 10 (2 x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2017). To be listed as Endangered under Criterion B2 a species must have an AOO of <500 km². *Helichrysum calvertianum* meets the AOO threshold for Endangered under Criterion B2.

Although *Helichrysum calvertianum* meets the thresholds of EOO and AOO for an Endangered species, the relevant subcriteria (see below) are only met at the Vulnerable threshold.

In addition, 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: Subcriterion met at Vulnerable threshold.

Justification: *Helichrysum calvertianum* is estimated to be found at seven locations. To determine the number of locations (as per definition IUCN 2017) the most plausible threats at the different sites over the entire range of the distribution of *H. calvertianum* were considered. Adverse disturbance to the habitat is a threat at most of the sites however it was judged that disturbance impacts on each site independently rather than collectively. There is insufficient information to ascertain if there are separate locations within each population, so it is assumed each population constitutes a separate location.

NSW Threatened Species Scientific Committee

Helichrysum calvertianum is unlikely to be severely fragmented, but this remains uncertain. A species is considered to be severely fragmented if most of its individuals are found in small and relatively isolated subpopulations, and the subpopulations may go extinct with a reduced probability of recolonization (IUCN 2017). "If >50% of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a viable population, or (2) separated from other habitat patches by a large distance" (IUCN 2017). Whilst the dispersal mechanism of *H. calvertianum* is unknown, species in the family Asteraceae are largely wind dispersed. It is likely that there are habitat patches between many of the populations that are not too distant to limit dispersal of seeds.

- 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: Subcriterion met for (iii) and (v). Continuing decline is inferred for quality of habitat and the number of mature individuals.

Justification: "Continuing declines at any rate can be used to qualify taxa under Criteria B or C2. This is because taxa under consideration for Criteria B or C are already characterized by restricted ranges or small population size." (IUCN 2017). There is ongoing disturbance to the habitat at most of the sites where *Helichrysum calvertianum* occurs. Predominately this is from vehicle use and track/power line maintenance and associated erosion effects, but there is also localised rubbish dumping and clearing. Rabbits and weeds are also impacting the species and its habitat at several sites. These adverse effects are expected to continue.

At one site, the population has not been relocated since 2004, despite searches in 2010 and 2016. This possible loss of the Mt Gibraltar population is likely due to "a combination of fire and erosion of skeletal soil habitat on rock outcrops, possibly worsened by rabbit diggings and recreational pressures" (S. Douglas *in litt.* June 2016).

- c) Extreme fluctuations.

Assessment Outcome: Data Deficient.

Justification: Currently there are no available data to assess the likelihood of extreme fluctuations in *Helichrysum calvertianum*.

Criterion C Small population size and decline

Assessment Outcome: Near threatened to Vulnerable via C2a(i).

Justification: The population size of *Helichrysum calvertianum* is estimated to be between 2,500 and 3,500 mature individuals (S. Douglas *in litt.* June 2016). To be listed as Vulnerable under Criterion C, a species must have between 2,500 and 10,000 mature individuals. Whilst data on abundance of *Helichrysum calvertianum* are lacking for many of the sites, expert opinion indicates there are likely to be <10,000 mature individuals in total, hence a precautionary approach is that *Helichrysum calvertianum* meets the total population threshold for listing as Vulnerable 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 10% in 10 years or 3 generation (up to a max. of 100 years in future).

Assessment Outcome: Data Deficient.

Justification: There are insufficient data to assess *Helichrysum calvertianum* against this criterion.

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

Assessment Outcome: Subcriterion met.

Justification: "Continuing declines at any rate can be used to qualify taxa under Criteria B or C2. This is because taxa under consideration for Criteria B or C are already characterized by restricted ranges or small population size." (IUCN 2017). Continuing decline is inferred by the disturbance to the habitat at most sites where *Helichrysum calvertianum* occurs. Predominately this is from vehicle use and track/power line maintenance and associated erosion effects, but there is also localised rubbish dumping and clearing. Rabbits and weeds are also impacting on several sites. At one site, the population has not been relocated since 2004, despite searches in 2010 and 2016.

NSW Threatened Species Scientific Committee

This possible loss of the Mt Gibraltar population is likely due to “a combination of fire and erosion of skeletal soil habitat on rock outcrops, possibly worsened by rabbit diggings and recreational pressures” (S. Douglas *in litt.* June 2016). These adverse effects are expected to continue.

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: Subcriterion likely to be met at Vulnerable threshold.
Justification: One of the populations (Welby) was estimated to contain approximately 1,300 plants in a survey conducted in December 2010 (S. Douglas NSW Bionet records). The number of mature individuals currently at this site is unknown but due to the ongoing high level of disturbance at this site, there is currently likely to be less than the previous estimate of 1,300. No other populations are currently thought to have more than 1,000 mature individuals. In summary at present, a lower bound estimate would be that no sites have more than 1,000 mature plants, but an upper bound would be that one site may have more than 1,000 mature plants.
- a (ii). percentage of mature individuals in one subpopulation = 90-100% (CR), 95-100% (EN), 100% (VU).
Assessment Outcome: Criterion not met.
Justification: No one population is known to contain >90% of mature individuals.
- b. Extreme fluctuations in the number of mature individuals
Assessment Outcome: Data Deficient.
Justification: Currently there are no available data to assess the likelihood of extreme fluctuations in *Helichrysum calvertianum*.

Criterion D Very small or restricted population

Assessment Outcome: Criterion not met.

Justification: The population size of *Helichrysum calvertianum* is estimated to be between 2,500 and 3,500 mature individuals (S. Douglas *in litt.* June 2016). *Helichrysum calvertianum* does not meet the threshold for listing under Criterion D.

D2. Restricted area of occupancy (typically <20 km²) 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: Criterion not met.

Justification: The area of occupancy (AOO) and number of locations exceed the indicative thresholds and it is not likely that the species could plausibly be driven to critically endangered or extinction within a very short period of time.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient.

Justification: Currently there are not enough data to undertake a quantitative analysis to determine the extinction probability of *Helichrysum calvertianum*.

Conservation and Management Actions

There is no NSW Saving Our Species site-managed program for *Helichrysum calvertianum*. The following actions are derived from available threat information.

Habitat loss, disturbance and modification

- Assess disturbance and habitat loss at each site. Assess feasibility for restricting recreational vehicle access at sites where damage to the habitat is occurring. Assess means of reducing disturbance from foot traffic at affected sites.

NSW Threatened Species Scientific Committee

Invasive species

- Undertake weed control within known habitat.
- Assess presence and effects of feral animals at each site. Establish a program for management and control.

Ex situ conservation

- Establish an ex-situ seed bank collection with collections from all known sites.

Stakeholder Management

- Reduce disturbance to the species habitat at the sites that are frequently visited by the public.
- Liaise with Forestry Corporation of NSW regarding the protection of populations of *Helichrysum calvertianum* from recreational vehicles and weed encroachment at Belanglo and Penrose State Forests.
- Report new records of *Helichrysum calvertianum* to the NSW Office of Environment and Heritage.

Survey and Monitoring priorities

- Survey known sites of *Helichrysum calvertianum* and potential habitat to assess abundance and population structure (adults versus seedlings or juveniles).
- Monitoring should be conducted to determine:
 - If disturbance of the habitat is affecting *Helichrysum calvertianum* plants.
 - The response of *Helichrysum calvertianum* to disturbance (if it occurs e.g., stem death, resprouting, leaf browning, flowering or fruiting) or fire. Conduct post fire monitoring of recruitment.
 - The influence of management actions on threatening processes. Has there been any further encroachment of weeds in the habitat? Is there any damage evident from feral animals or forestry activities or other activities?

Information and Research priorities

- Understand the ecology of *Helichrysum calvertianum*.
 - Pollination ecology – determination of pollination method (e.g. wind, insect), identification of pollinators.
 - Seed biology – germination and dormancy mechanisms, seed viability and longevity, seed dispersal and predation. Is germination promoted by fire cues?
 - Recruitment and establishment – survival rates of seedlings (germination and survival of seedlings post fire), causes of mortality, population modelling (e.g., impact of seedling loss), growth and development rates.
 - Response of *Helichrysum calvertianum* to fire (are plants killed, do they resprout, post-fire recruitment from seed germination and seedling survival).
 - Response of the species (adults and juveniles/seedlings) to grazing impacts.
- Understand the habitat of *Helichrysum calvertianum*.
 - Defining commonly co-occurring species.
 - Defining environmental characteristics.
 - This would also provide a baseline against which to monitor future change.

References

Adapt NSW (2018) South East and Tablelands Climate change snapshot. (accessed 3rd June 2018) <http://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/South-East-and-Tablelands-Climate-Change-Downloads>

Benson D, McDougall L (1994) Ecology of Sydney plant species. Part 2. Dicotyledon families Asteraceae to Buddlejaceae. *Cunninghamia* **3**, 789–1004.

NSW Threatened Species Scientific Committee

HumeCoal (2018) Project map viewed online:

<https://www.humecoal.com.au/project/project-map/>

IUCN Standards and Petitions Subcommittee (2017) Guidelines for Using the IUCN Red List Categories and Criteria. Version 12. Prepared by the Standards and Petitions Subcommittee. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.

Office of Environment and Heritage (OEH). NSW Bionet Atlas (accessed May 2018)

<http://www.bionet.nsw.gov.au/>

PlantNET (The NSW Plant Information Network System) Royal Botanic Gardens and Domain Trust, Sydney. <http://plantnet.rbgsyd.nsw.gov.au> (accessed 21 March 2019).

Expert Communications

Dr Steve Douglas – Principal Ecologist, Ecological Surveys & Planning; Visiting Fellow, Hawkesbury Institute for the Environment, Western Sydney University.

Notice of and reasons for Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list the shrub *Helichrysum calvertianum* (F.Muell.) F.Muell. as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act. Listing of Vulnerable species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Helichrysum calvertianum is eligible for listing as Vulnerable, as the highest threat category met by the taxon across all categories, under Clause 4.3 (c) (d) (e i, iii) because: i) the species has a highly restricted geographic range with an extent of occurrence of 673 km² and an area of occupancy of 40 km²; ii) the species has an estimated population size of between 2500 and 3500 mature individuals; iii) its habitat and some mature individuals continue to be threatened by ongoing habitat disturbance; iv) there are estimated to be <10 locations; and v) the lower bound for the number of mature individuals in each population is <1000.

The NSW Threatened Species Scientific Committee has found that:

1. *Helichrysum calvertianum* (F.Muell.) F.Muell. (family Asteraceae) is a “twiggy subshrub to 30 cm high, much-branched; stems glabrescent with sparse woolly and minute glandular hairs, the lower leaves caducous leaving prominent scars. Leaves crowded, linear, 3–8 mm long, 0.5–0.8 mm wide, margins revolute and concealing the lower surface, surfaces green and glabrous, viscid. Heads terminal and solitary on branches, hemispherical, 0.7–1 cm long, 1–1.5 cm diam.; involucral bracts with margins woolly-ciliate towards base, laminae reflexed at maturity; intermediate bracts longest with white papery laminae often tinged pink towards the apex, outermost bracts golden and hyaline, innermost with long claws and with small white papery laminae. Florets numerous, all bisexual. Achenes oblong, terete, minutely glandular; pappus of many barbellate bristles, subplumose at the tip.” (PlantNET 2019).
2. *Helichrysum calvertianum* is endemic to New South Wales where it is currently only known from the Wingecarribee Shire. There are seven known populations. Only one population occurs within the reserve estate, in the northern part of Morton National Park.
3. *Helichrysum calvertianum* is a perennial paper daisy flowering from winter to summer (PlantNet 2019). It occurs in dry sclerophyll forest and heathland with rock outcrops, predominantly on Hawkesbury sandstone soils at altitudes between approximately 650 and 855 m (S. Douglas *in litt.* June 2016; PlantNet 2019). Rainfall ranges from 850 mm per annum at the western-most sites, to over 1500 mm at the eastern-most site (S. Douglas *in litt.* June 2016). It is likely the seeds are wind dispersed (Benson and McDougall 1994). The fire response of *H. calvertianum* is unknown (Benson and McDougall 1994).
4. *Helichrysum calvertianum* has a highly restricted geographic distribution. The extent of occurrence is estimated to be 673 km², based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2017). The area of occupancy is estimated to be 40 km², based on the species occupying 10 (2 km x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2017).

NSW Threatened Species Scientific Committee

5. There are currently incomplete data on the abundance of *Helichrysum calvertianum* as no formal survey of population size over its distribution has been undertaken. From database records and recent field observations, Douglas (*in litt.* June 2016) estimated the total number of mature individuals to be between 2,500 and 3,500.
6. Threats to *Helichrysum calvertianum* and its habitat include ongoing anthropogenic disturbance, impacts of feral animals, weed invasion and an inappropriate fire regime. Many of the populations are close to tracks and prone to disturbance from vehicle usage and from track maintenance activities. Plant death and damage as a result of crushing by vehicles (trail bikes, 4WDs and potentially mountain bikes) has been observed (S. Douglas *in litt.* June 2016). Vehicle disturbance leads to disturbance of highly erodible and skeletal soils, and increased weed invasion through weed propagules introduced from vehicles (S. Douglas *in litt.* June 2016). Other examples of disturbance to the habitat include dumped soil and rubble, and clearing associated with power line maintenance, firebreaks and road construction (S. Douglas *in litt.* June 2016). Feral animals, particularly rabbits (*Oryctolagus cuniculus*), are likely to adversely affect mature plants and recruitment by browsing, grazing, and digging (followed by erosion) (S. Douglas *in litt.* June 2016). Invasion by weeds (*Erigeron karvinskianus* and *Rubus anglocandicans*) is adversely affecting the population at Fitzroy Falls. The Penrose State Forest population is affected by invasion of *Pinus radiata* which occurs adjacent to the site (S. Douglas *in litt.* October 2017, December 2018). Although the fire response of *H. calvertianum* is not known, changes to fire frequency (including an absence of fire) may affect plant recruitment. *Helichrysum calvertianum* plants at Mount Gibraltar have not been found at the site since 2004 despite targeted searches undertaken in 2010 and 2016 (S. Douglas *in litt.* June 2016) and the species may now be extinct there. The possible loss of the species from this site may be due to a combination of high intensity fire, erosion of skeletal soil habitat on rock outcrops, rabbit impacts and recreational pressures (S. Douglas *in litt.* June 2016). 'Competition and grazing by the feral European Rabbit *Oryctolagus cuniculus* (L.)', and 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants' are listed as Key Threatening Processes under the Act.
7. *Helichrysum calvertianum* (F.Muell.) F.Muell. is not eligible to be listed as an Endangered or a Critically endangered species.
8. *Helichrysum calvertianum* (F.Muell.) F.Muell. is eligible to be listed as a Vulnerable species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a high risk of extinction in Australia in the medium-term future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

NSW Threatened Species Scientific Committee

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: Vulnerable via Clause 4.3 (c*) (d) (e: i, iii).

* Although *Helichrysum calvertianum* meets the thresholds for restricted geographic distribution (EOO and AOO) for an endangered species, only at the vulnerable threshold are two of the three other required conditions 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.

NSW Threatened Species Scientific Committee

Clause 4.4 - Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion C)

Assessment Outcome: Vulnerable via Clause 4.4 (c) (e) (i, ii, (A(III))).

The estimated total number of mature individuals of the species is:			
	(a)	for critically endangered species	very low, or
	(b)	for endangered species	low, or
	(c)	for vulnerable species	moderately low.
and either of the following 2 conditions apply:			
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):	
		(i)	for critically endangered species very large, or
		(ii)	for endangered species large, or
		(iii)	for vulnerable species moderate,
	(e)	both of the following apply:	
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and
		(ii)	at least one of the following applies:
		(A)	the number of individuals in each population of the species is:
			(I) for critically endangered species extremely low, or
			(II) for endangered species very low, or
			(III) for vulnerable species low,
		(B)	all or nearly all mature individuals of the species occur within one population,
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.

Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)

Assessment Outcome: Not met.

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)

Assessment Outcome: Data Deficient

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

NSW Threatened Species Scientific Committee

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.
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Dr Marco Duretto
Chairperson
NSW Threatened Species Scientific Committee

Supporting Document:

Scott J (2019) Conservation Assessment of *Helichrysum calvertianum* (F.Muell.) F.Muell. (Asteraceae).
Version 1.0. NSW Threatened Species Scientific Committee.

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<http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.

PlantNET (The NSW Plant Information Network System) Royal Botanic Gardens and Domain
Trust, Sydney. <http://plantnet.rbgsyd.nsw.gov.au> (accessed 21 March 2019).