

Australian Capital Territory

# Nature Conservation (Hoary Sunray) Conservation Advice 2024

Notifiable instrument NI2024-254

made under the

Nature Conservation Act 2014, s 90C (Conservation advice)

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## 1 Name of instrument

This instrument is the *Nature Conservation (Hoary Sunray) Conservation Advice 2024*.

## 2 Commencement

This instrument commences on the day after its notification day.

## 3 Conservation advice for Hoary Sunray

Schedule 1 sets out the conservation advice for Hoary Sunray (*Leucochrysum albicans tricolor*).

Arthur Georges  
Chair, Scientific Committee  
21 May 2024

# Schedule 1

(see s 3)

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**ACT**  
Government

Environment, Planning and  
Sustainable Development



# CONSERVATION ADVICE

## HOARY SUNRAY – *Leucochrysum albicans tricolor*

### CONSERVATION STATUS

The Hoary Sunray – *Leucochrysum albicans* subsp. *tricolor* (DC.) N.G. Walsh (2015) – is recognised as threatened in the following jurisdictions:

National	<b>Endangered</b> , <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ACT	<b>Endangered</b> , <i>Nature Conservation Act 2014</i>
NSW	<b>Endangered</b> , <i>Biodiversity Conservation Act 2016</i>
VIC	<b>Endangered</b> , <i>The Flora and Fauna Guarantee Act 1988</i>
TAS	<b>Endangered</b> , <i>Threatened Species Protection Act 1995</i>

### ELIGIBILITY

This Hoary Sunray subspecies is listed as Endangered in the ACT Threatened Native Species List under IUCN Criterion A – A2abc due to its severe population reduction at the national level from 2000–2020 (three generations), particularly in Victoria and Tasmania (DAWE 2021; Attachment 1). In south-west Victoria it is estimated to have declined (from no more than 40,000 plants in the early 2000s to 20,000–30,000 plants in 2020) due to unsecure land tenure often on roadsides. In eastern and central Tasmania, it declined, particularly on private land (from 200,000–400,000 plants in 2011 to 30,000–50,000 plants in 2020) due to clearing and poor management (DAWE 2021).

### DESCRIPTION AND ECOLOGY

The Hoary Sunray is a perennial everlasting daisy. It has a yellow flowerhead surrounded by papery white, overlapping ovate-oblong bracts which are often coloured in various shades of crimson on the outer/underside that may fade as the flowers mature.

Flowering generally occurs from October to December in the ACT. The Hoary Sunray (*L. a. tricolor* subspecies) can be distinguished from the other subspecies within *L. albicans* by its white involucral bracts and narrow, linear-oblong leaves but can, in rare instances, apparently intergrade with the yellow-flowered *L. albicans* subsp. *albicans* (NSW OEH 2023). After flowering, the plants die-back in summer but survive as a perennial rootstock (Sinclair 2010) and can likely live for 15 years (Gilfedder and Kirkpatrick 1994a) but on average the generation length is likely to be seven years.

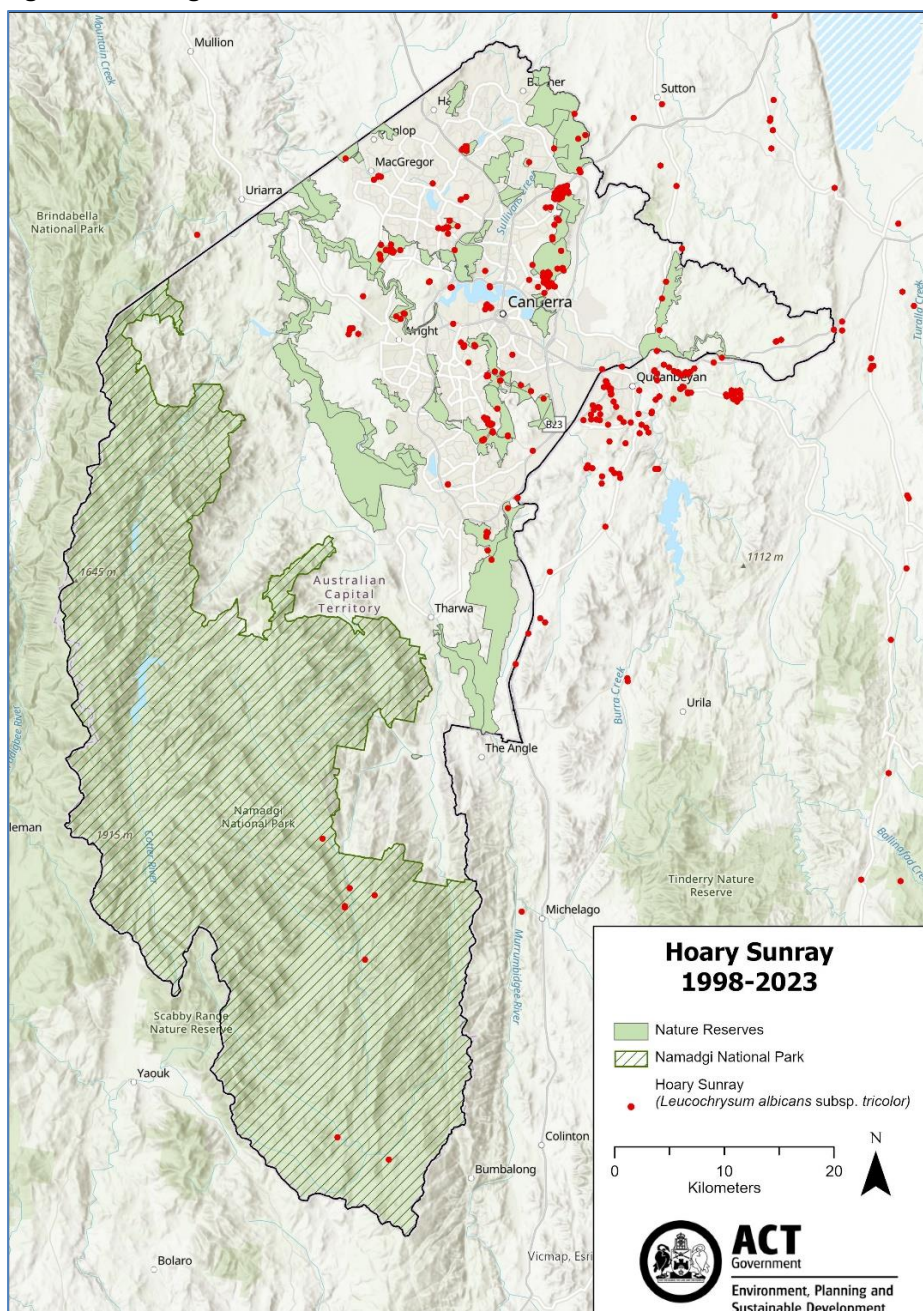


Hoary Sunray (subsp. *tricolor*) (Andrew Zelnik – Canberra Nature Map)

## DISTRIBUTION AND HABITAT

Hoary Sunray is endemic to south-eastern Australia, where it occurs in three geographically separate areas in NSW/ACT, Victoria and Tasmania (DAWE 2021). Most Hoary Sunray populations occur in NSW and the ACT where the taxon is still locally common (K McDougall pers. comm. in DAWE 2021) although some roadside subpopulations may be declining (FOG pers. comm. in DAWE 2021). Sinclair (2010) estimated the total number of plants in NSW and ACT to be greater than 200,000 plants which likely remains unchanged as most populations appear to be stable. Around 20 of the approximate 30 subpopulations in the ACT occur in nature reserves (Figure 1), with the remainder occurring on roadsides or unsecured private land (DAWE 2021).

**Figure 1: ACT region observations 1998–2023**



Mount Majura, Mount Ainslie and Percival Hill nature reserves support large populations (thousands of plants) of the Hoary Sunray and smaller populations occur in several other open forest, woodland and

grassland reserves, including, Kowen Escarpment, Farrer Ridge and Rob Roy nature reserves (ACT Government 2021). These occur in the suburbs of Watson, Majura, Hackett, Campbell, Nicholls, Farrer, Issacs, Fadden, Tuggeranong. A significant population has also been identified at Booth in Namadgi National Park (NNP) in 2022 (CNM 2023). Other medium sized populations have been recorded in Wanniasa Hills, Stromlo, Molonglo Valley, Gigerline Nature Reserve, Central Canberra, Kowen, Theodore, Latham, Pialligo, Yarralumla, Belconnen, Rendezvous Ck (NNP) and Mount Clear (NNP) (CNM 2023).

In NSW and the ACT, ‘habitat critical to the survival’ of Hoary Sunray includes the critically endangered ecological communities: Natural Temperate Grassland of the South Eastern Highlands; and White Box–Yellow Box–Blakely’s Red Gum Grassy Woodlands and Derived Native Grasslands (DAWE 2021). Hoary Sunray occurs on a variety of soil types including clays, clay loams, stony and gravelly soil and relies on bare and/or disturbed ground for germination and establishment (Sinclair 2010).

## THREATS

In the ACT (and NSW) there is no evidence of a substantial decline of Hoary Sunray (DAWE 2021). In other areas (Victoria and Tasmania), the major threats to Hoary Sunray are:

- the clearing of native grasslands
- a lack of biomass reduction in productive habitat
- weed invasion
- road maintenance works
- climate change - increasing frequency and intensity of drought
- genetic risks associated with small and fragmented populations (DAWE 2021).

## MAJOR CONSERVATION OBJECTIVE

The priority management objective should be to maintain in the long term, viable, wild populations of the species as a component of the indigenous biological resources of the ACT and as a contribution to regional and national conservation of the species. This includes the need to maintain natural evolutionary processes.

## CONSERVATION PRIORITIES

The primary way Hoary Sunray populations can be managed in the ACT is through the management of habitat and the long-term conservation of the species depends on protecting its native grassland and grassy woodland habitat.

Conservation actions are detailed in the Commonwealth Conservation Advice (DAWE 2021). Conservation and management priorities for the Hoary Sunray in the ACT should be to:

- identify and record important populations (large populations greater than 10,000 plants) and protect from damage, destruction or decline
- develop and implement a non-onerous population trend/condition monitoring program
- collect seeds from the above identified populations for *ex situ* conservation in the National Seed Bank
- climate change modelling (details in issues section below)
- identify and provide signage for roadside populations
- include specific requirements of the Hoary Sunray (e.g., appropriate biomass reduction of Hoary Sunray grassland habitat (including post-treatment weed control) in late summer to mid-autumn every 2–5 years in Kangaroo Grass-dominated grasslands (McDougall 1989)) in revisions of the

ACT Ecological Guidelines (ACT Government 2019c) and ACT Herbage Mass Guidelines (ACT Government 2019b)

- actively seek opportunities to involve members of local indigenous communities in on ground activities
- encourage and support the continuation and further development of community conservation activities.
- engage with other jurisdictions to support regional and national recovery of the species.

## CONSERVATION ISSUES

It is recommended that quantitative targets and resourcing requirements are clearly identified in any Action Plan or other related projects/programs relevant to this species. Broader conservation issues need to be considered in developing and implementing actions arising from this advice and the listing assessment (DAWE 2021).

### Critical Habitat

The Commonwealth Conservation Advice (DAWE 2021) identifies ‘habitat critical to the survival’ of the Hoary Sunray as habitats that are likely necessary for dispersal activities, the maintenance of genetic diversity and the long-term evolutionary trajectory of Hoary Sunray. These include the Yellow Box–Blakely’s Red Gum Grassy Woodland and Natural Temperate Grassland ecological communities. No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat under the EPBC Act.

### Population Viability

If other measures are not effective in restoring populations in other jurisdictions, then *ex situ* seed banking and propagation of the existing subpopulations across the species distribution and cross pollination experiments to increase genetic diversity may be necessary for this species to recover in other jurisdictions.

### Climate Change

Climate change impacts are inevitable and will affect the likelihood of persistence, within the ACT, of many species. Capacity must be developed to model the impact on the Hoary Sunray and its habitat under likely climate change scenarios if we are to anticipate and manage the impacts of climate change. This will require a combination of research and the development of in-house capacity for the collection of relevant data and its application in climate change modelling for threatened species.

### Ngunnawal Community Engagement

The ACT Government should actively facilitate, the inclusion of the Ngunnawal people in the conservation of this species and its habitat as part of Ngunnawal Country. Reference to the draft Cultural Resource Management Plan (ACT Government in prep.) would be useful to inform culturally appropriate resource management including of native species that aligns with achieving conservation outcomes for the species.

## OTHER RELEVANT ADVICE, PLANS OR PRESCRIPTIONS

- Commonwealth Conservation Advice – Hoary Sunray (DAWE 2021)
- National Recovery Plan – Hoary Sunray (Sinclair 2010)
- ACT Native Woodland Strategy (ACT Government 2019a)
- ACT Native Grassland Strategy (ACT Government 2017)
- Canberra Nature Park Reserve Management Plan (ACT Government 2021)

- Namadgi National Park Plan of Management (ACT Government 2010)

## LISTING BACKGROUND

The Hoary Sunray was eligible for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as *Leucochrysum albicans* var. *tricolor* (DC.) Paul G. Wilson on 16 July 2000. Following the elevation of rank by Walsh (2015), the name of this taxon is now conventionally accepted as *Leucochrysum albicans* subsp. *tricolor* (DC.) N.G. Walsh.

The Hoary Sunray was reassessed in 2021 and remains listed as an Endangered species under the EPBC Act. It is assessed as Endangered under Criterion 1 – A2abc of the EPBC Act. In 2023, under the *Nature Conservation Act 2014*, the ACT Scientific Committee recommended the Hoary Sunray be listed in the Endangered category in the ACT Threatened Native Species List to align with the EPBC Act listing.

## ACTION PLAN DECISION

The ACT Scientific Committee does not recommend that the Minister for the Environment should make the decision to have an action plan for the species in the ACT under the *Nature Conservation Act 2014*. The key populations of Hoary Sunray appear stable in ACT nature reserves and in Namadgi National Park where habitat is protected. The critically endangered ecologically communities in which the Hoary Sunray occurs are managed under the ACT Native Woodland Conservation Strategy (ACT Government 2019a) and ACT Native Grassland Conservation Strategy (ACT Government 2017) as well as the Canberra Nature Park Reserve Management Plan (ACT 2021) and the Namadgi National Park Plan of Management (ACT Government 2010) that is currently under review. Specific Requirements for the Hoary Sunray should be included in revisions of the ACT Ecological Guidelines (ACT Government 2019c) and ACT Herbage Mass Guidelines (ACT Government 2019b).

A National Recovery Plan is in place for the Hoary Sunray (Sinclair 2010), mostly to guide management and recovery in Victoria and Tasmania.

## REFERENCES

- ACT Government 2010. Namadgi National Park Plan of Management 2010. Land Management and Planning Division, Department of Territory and Municipal Services. ACT Government, Canberra.
- ACT Government 2017. *ACT Native Grassland Conservation Strategy and Action Plans*. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra.
- ACT Government 2019a. *ACT Native Woodland Conservation Strategy and Action Plans*. Environment Planning and Sustainable Development Directorate, Canberra.
- ACT Government 2019b. *Draft Herbage Mass Management Guidelines for Lowland Grassy Ecosystems of the ACT*. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra.
- ACT Government 2019c. *Ecological Guidelines for Fire, Fuel and Access Management Operations*. Environment Planning and Sustainable Development Directorate, ACT Government, Canberra. [https://www.environment.act.gov.au/\\_data/assets/pdf\\_file/0009/1483830/Ecological-Guidelines-2019-ver-1.3.pdf](https://www.environment.act.gov.au/_data/assets/pdf_file/0009/1483830/Ecological-Guidelines-2019-ver-1.3.pdf)
- ACT Government 2021. *Canberra Nature Park Reserve Management Plan 2021*. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra.
- ACT Government in prep. *Draft Cultural Resource Management Plan*. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra.

Canberra Nature Map 2023. *Leucochrysum albicans* subsp. *tricolor* sightings - Canberra Nature Map (naturemapr.org) Available at: <https://canberra.naturemapr.org/species/7626> Accessed 25 July 2023.

Department of Agriculture Water and the Environment (DAWE) 2021. *Conservation Advice for Leucochrysum albicans subsp. tricolor (Hoary Sunray)*. Canberra: Department of Agriculture, Water and the Environment (Commonwealth), Canberra.

Sinclair SJ 2010. *National Recovery Plan for the Hoary Sunray Leucochrysum albicans var. tricolor*. Department of Sustainability and Environment, Victorian Government, Melbourne.

Walsh NG 2015. Elevation of rank for *Leucochrysum albicans* var. *tricolor* (Asteraceae: Gnaphalieae). *Muelleria* 34: 11–13.

## FURTHER INFORMATION

Further information on the related Action Plan or other threatened species and ecological communities can be obtained from: Environment, Planning and Sustainable Development Directorate (EPSDD).

Phone: (02) 132281, EPSDD Website: <https://www.environment.act.gov.au/nature-conservation>



# ATTACHMENT A: LISTING ASSESSMENT (DAWE 2021)

## THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

The Threatened Species Scientific Committee finalised this assessment on 9 September 2021.

### Attachment A: Listing Assessment for *Leucochrysum albicans* subsp. *tricolor*

#### Reason for assessment

Hoary Sunray was listed as Endangered under the *Endangered Species Protection Act 1992* and transferred to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) when it commenced in July 2000.

#### Assessment of eligibility for listing

This assessment uses the criteria set out in the [EPBC Regulations](#). The thresholds used correspond with those in the [IUCN Red List criteria](#) except where noted in Criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing assessments through the Common Assessment Method (CAM).

#### Key assessment parameters

Table 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
<b>Table 3 Key assessment parameters</b> Number of mature individuals	250 000 – 280 000	250 000	>280 000	In NSW and ACT, the taxon is still locally common (K McDougall 2020 pers comm 23 Sept) and there is no evidence to suggest that the total NSW and ACT population estimate in Sinclair (2010) of >200 000 plants has changed substantially, although some roadside subpopulations may be declining (FOG 2021 pers comm 20 June). In Victoria, Hoary Sunray is inferred to be declining (McClaren 2013) and the estimated total population is approximately 20 000–30 000 plants (DELWP 2020b), down from the estimate of <40 000 in the early 2000s in Sinclair (2010). In Tasmania, at least one subpopulation has gone extinct (J Kirkpatrick 2020 pers comm 23 Sept) and several others have declined substantially over the past decade (Collier 2016; Tasmanian Land Conservancy 2019, Schahinger 2020 pers comm 24 Oct). The largest subpopulation in Tas, spread across several private properties at Ross with many hundreds of thousands of plants in 2011, had declined to a few hundred plants in 2020, likely due to conversion of its grassland habitat to dryland introduced pasture (R Schahinger 2020 pers comm, 24 Oct; L Gilfedder 2020 pers comm 4 Nov). In 2011, an uncertain population estimate for

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				Tas is suspected to have been between 200 000 – 400 000 plants. In 2020, a similarly uncertain estimate is between 30 000 – 50 000 plants. Therefore, there total population of Hoary Sunray is likely to be 250 000 – 280 000.
<b>Trend</b>	contracting			The total population size of Hoary Sunray is inferred to be contracting due to the decline and extinction of many subpopulations in Vic and Tas (McClellan 2013; Collier 2016; Tasmanian Land Conservancy 2019; J Morgan 2020 pers comm, 23 Sept; J Kirkpatrick 2020 pers comm, 23 Sept; R Schahinger 2020 pers comm 24 Oct).
<b>Generation time (years)</b>	7 years	5 years	10 years	Individual plants probably live for a maximum of about 15 years (Gilfedder & Kirkpatrick 1994a; DELWP 2015). The generation length of Hoary Sunray is inferred to be 5–10 years by DELWP (2020b), with J Morgan (pers comm in DELWP 2020b) suggesting five to seven years. Therefore, a generation length of around seven years appears appropriate.
<b>Extent of occurrence</b>	438 166 km <sup>2</sup> (using records from the last 20 years)	417 188 km <sup>2</sup> (using records from the last 10 years)	464 618 km <sup>2</sup> (using records from the last 40 years)	The EOO figure is based on the mapping of point records from 2000 to 2020, obtained from state governments, herbaria and CSIRO. The EOO was calculated using a minimum convex hull, based on the IUCN Red List Guidelines 2014.
<b>Trend</b>	contracting			In Vic, McClaren (2013) documented the extinction of approximately 25% of surveyed subpopulations from 2003–2012. In Tas, a subpopulation at Liawenee went extinct in the 2000s (J Kirkpatrick 2020 pers comm 23 Sept). Therefore, there is an inferred decline in EOO based on the extinction of these subpopulations and the continuing decline of other subpopulations in Vic and Tas (McClaren 2016, Tasmanian Land Conservancy 2019; J Morgan 2020. pers comm 23 Sept; J Kirkpatrick 2020 pers comm 23 Sept; R Schahinger 2020 pers comm 24 Oct).
<b>Area of Occupancy</b>	1376 km <sup>2</sup> (using records from the last 20 years)	836 km <sup>2</sup> (using records from the last 10 years)	1812 km <sup>2</sup> (using records from the last 40 years)	The AOO figure is based on the mapping of point records from 2000 to 2020, obtained from state governments, herbaria and CSIRO. The AOO was calculated using a 2 x 2 km grid cell method, based on the IUCN Red List Guidelines 2014.  Hoary Sunray is a very conspicuous plant during its flowering period. It also has a relatively high profile

				owing to its threatened status under the EPBC Act and its habitat is limited due to it being mostly confined to critically endangered ecological communities also listed under the EPBC Act. Therefore, it is not unreasonable to assume that most subpopulations of Hoary Sunray are known and recorded, and therefore the AOO figure of 1376 km <sup>2</sup> is near the actual AOO of the taxon (i.e. it is unlikely to be substantially under-reported).
<b>Trend</b>	contracting			In Vic, McClaren (2013) documented the extinction of approximately 25% of surveyed subpopulations from 2003–2012. In Tas, a subpopulation at Liawenee became extinct in the 2000s (J Kirkpatrick 2020 pers comm 23 Sept). Therefore, there is an inferred decline in AOO based on the extinction of these subpopulations and the continuing decline of other subpopulations in Vic and Tas (McClaren 2016, Tasmanian Land Conservancy 2019; J Morgan 2020 pers comm 23 Sept; R Schahinger 2020 pers comm 24 Oct).
<b>Number of subpopulations</b>	129 (using records from the last 20 years)	84 (using records from the last 10 years: 5 (Tas), 22 (Vic), 30 (ACT), 27 (NSW))	160 (using records from the last 40 years: 25 (Tas), 60 (Vic), 35 (ACT), 40 (NSW))	In NSW the Atlas of Living Australia displays records from approximately 30 subpopulations since 2000, with the ACT also recording approximately 30 subpopulations in that timeframe (ALA 2020; Canberra Nature Map 2020). Morgan et al. (2013) noted 53 subpopulations in Victoria. Tasmania has approximately 16 subpopulations recorded since 2000 (ALA 2020).
<b>Trend</b>	contracting			In Victoria the number of subpopulations is declining. In a study of approximately half of all Victorian subpopulations, McClaren (2013) documented the extinction of approximately 25% of surveyed subpopulations from 2003–2012. In Tas, the number of subpopulations also appears to be declining, with 11 subpopulations recorded since 2000 (ALA 2020) compared to an estimated 20 subpopulations in the 1990s and early 2000s (Gilfedder & Kirkpatrick 1994a; Sinclair 2010). A subpopulation at Liawenee became extinct in the 2000s (J Kirkpatrick 2020. pers comm 23 Sept) and several other subpopulations at Ross, The Nut State Reserve and Vale of Belvoir appear to be declining (Collier 2016; Tasmanian Land Conservancy 2019; R Schahinger 2020 pers comm 24 Oct).

<b>Basis of assessment of subpopulation number</b>	Morgan et al. (2013) found little genetic exchange between subpopulations in western Victoria, therefore it is inferred that most geographically distinct records of Hoary Sunray further than a few kilometres apart represent distinct subpopulations.			
<b>No. locations</b>	Unknown but certainly more than 10 (likely to be around 100)	-	-	Lack of fire, habitat loss, clearing, weeds and genetic threats from small subpopulations are the main threats facing Hoary Sunray. While these threats are widespread across the taxon's range, each threat operates at relatively small spatial scales, meaning that the majority of subpopulations could be considered separate locations.
<b>Trend</b>	decreasing			The number of locations is likely to be decreasing due to subpopulations continuing to become extinct (e.g. McClaren 2013; J Kirkpatrick 2020. pers comm, 23 Sept).
<b>Basis of assessment of location number</b>	Lack of fire, habitat loss, clearing, weeds and genetic threats from small subpopulations are the main threats facing Hoary Sunray. While these threats are widespread across the subspecies range, each threat operates at relatively small spatial scales, meaning that the majority of subpopulations could be considered separate locations.			
<b>Fragmentation</b>	Hoary Sunray is considered to be severely fragmented. Despite the presence of several large subpopulations, the majority of extant subpopulations of Hoary Sunray are probably small and likely to contain less than 1000 individuals (Sinclair 2010; McClean 2013; DPIPWE 2017; J Morgan 2020 pers comm 23 Sept). This rudimentary estimate is suggested by Frankham et al. (2014) as being a general minimum viable subpopulation size for resilience to genetic threats associated with small subpopulations. Morgan et al. (2013) studied the genetic effects of fragmentation on 19 subpopulations occurring on roadsides, cemeteries and rail lines in Victoria, concluding that subpopulations were genetically isolated from each other, and predicted further genetic erosion to occur over time and the continued loss of subpopulations. It is assumed that the pattern of genetic isolation among subpopulations observed in western Victoria by Morgan et al. (2013) is likely to be repeated elsewhere where Hoary Sunray occurs in similarly isolated subpopulations. Therefore, Hoary Sunray is considered to be severely fragmented, based on the majority of its subpopulations (and by extension AOO) being smaller in size than a rudimentary estimate of minimum viable subpopulation size of 1000 individuals (Frankham et al. 2014) and the majority of subpopulations being separated by sufficient distance to render them genetically isolated, based on the findings of Morgan et al. (2013).			
<b>Fluctuations</b>	Not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals.			

## Criterion 1 Population size reduction

Reduction in total numbers (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
A1	Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.		(a) direct observation [except A3]
A2			(b) an index of abundance appropriate to the taxon
A3			(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
A4			(d) actual or potential levels of exploitation
		Based on any of the following	(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

## Criterion 1 evidence

### Eligible under Criterion 1 2abc for listing as Endangered

The generation length of Hoary Sunray is inferred to be seven years, giving a 21 year timescale for this criterion (three generations).

In NSW and ACT, the taxon is still locally common (K McDougall 2020 pers comm 23 Sept) and there is no evidence to suggest that the total NSW and ACT population estimate in Sinclair (2010) of >200 000 plants has changed, although some roadside subpopulations may be declining (FOG 2021 pers comm 20 June). In Victoria, Hoary Sunray is inferred to be declining (McClaren 2013) and the estimated total population is approximately 20 000–30 000 plants (DELWP 2020b), down from the estimate of <40 000 in the early 2000s in Sinclair (2010). In Tasmania, at least one subpopulation has recently gone extinct (J Kirkpatrick 2020 pers comm 23 Sept) and several others have declined substantially over the past decade (Collier 2016; Tasmanian Land Conservancy 2019, Schahinger 2020 pers comm 24 Oct). The two largest subpopulations in Tasmania appear to have both declined. The largest, spread across several private properties along Tooms Lake Road near Ross, with many hundreds of thousands of plants in 2011, has declined to likely just a few hundred plants in 2020, apparently due to conversion of its grassland habitat to dryland, introduced pasture (R Schahinger 2020. pers comm, 24 Oct; L Gilfedder 2020. pers comm 4 Nov). The cover of Hoary Sunray at the second largest subpopulation at Vale of Belvoir (estimated at 30 000 plants in Sinclair 2010) declined by approximately 50 percent from 2015–2019 (Tasmanian Land Conservancy 2019), although the

reason for this decline is unknown. In 2011, an uncertain population estimate for Tasmania would have been approximately 200 000 – 400 000 plants. In 2020, a similarly uncertain estimate is probably between 30 000 – 50 000 plants.

The decline and extinction of many subpopulations in Victoria and Tasmania suggests that the total population size of Hoary Sunray is contracting. The total population size in the early 2000s is suspected to have been around 440 000 – 640 000 plants (NSW and ACT = 200 000, Vic = 40 000, Tas = 200 000 – 400 000). In 2020, the total population size is suspected to be around 250 000 – 280 000 plants (NSW/ACT = 200 000, Vic = 25 000, Tas = 40 000) indicating a decline of 56–43 percent (lower estimates – upper estimates).

Given the uncertainty around population estimates, anecdotal observations that some subpopulations in the ACT and NSW are declining (FOG 2021 pers comm 20 June), and the very large and ongoing recent declines in Tas and Vic, a precautionary approach demonstrates that the Hoary Sunray is eligible for listing as Endangered (A2bc) under this criterion, using an estimated decline of ≥50 percent.

**Criterion 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**

	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
<b>B1.</b> Extent of occurrence (EOO)	< 100 km <sup>2</sup>	< 5,000 km <sup>2</sup>	< 20,000 km <sup>2</sup>
<b>B2.</b> Area of occupancy (AOO)	< 10 km <sup>2</sup>	< 500 km <sup>2</sup>	< 2,000 km <sup>2</sup>
<b>AND at least 2 of the following 3 conditions:</b>			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(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 populations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or populations; (iv) number of mature individuals			

**Criterion 2 evidence**

**Eligible under Criterion 2 B2ab(ii,iii,iv) for listing as Vulnerable**

The area of occupancy (AOO) of Hoary Sunray is limited and estimated at 1376 km<sup>2</sup> (Department of Agriculture, Water and Environment 2020). This figure is based on the mapping of point records from 2000 to 2020, obtained from state governments, herbaria and CSIRO. The AOO was calculated using a 2 x 2 km grid cell method, based on the IUCN Red List Guidelines 2014. The AOO does not increase beyond the 2000 km<sup>2</sup> threshold for Vulnerable when records from an earlier time period are included; when records from 30 years are included AOO is 1704 km<sup>2</sup> and when records from 40 years are included AOO is 1812 km<sup>2</sup>. Hoary Sunray is a very conspicuous

plant during its flowering period. It also has a relatively high profile owing to its threatened status under the EPBC Act and its habitat is limited due to it being mostly confined to critically endangered ecological communities, which are also listed under the EPBC Act (Threatened Species Scientific Committee 2006, 2008, 2009a, 2009b, 2013, 2016). Therefore, it is not unreasonable to assume that most subpopulations of Hoary Sunray are known and recorded, and therefore the AOO figure of 1376 km<sup>2</sup> is near the actual AOO of the taxon (i.e. it is unlikely to be substantially under-reported).

Hoary Sunray is deemed to be severely fragmented. Despite the presence of several large subpopulations, the majority of extant subpopulations of Hoary Sunray are probably small and likely to contain less than 1000 individuals (Sinclair 2010; McClean 2013; DPIPWE 2017; J Morgan 2020. pers comm, 23 Sept). This rudimentary estimate is suggested by Frankham et al. (2014) as being a general minimum viable subpopulation size for resilience to genetic threats associated with small subpopulations. A large minimum viable subpopulation size is likely to be particularly applicable to taxa with short generation lengths, such as short-lived plants with transient seedbanks (Matthies et al. 2004) like Hoary Sunray and larger estimates of 5000 individuals (Flather et al. 2011) or a few thousand individuals (Traill et al. 2007) could also be applicable. Victoria contains 53 subpopulations (Morgan et al. 2013). McClaren (2013) surveyed over half of these (including most large subpopulations) and only five out of 27 subpopulations contained more than 1000 plants in 2012. Tasmania contains an estimated 16 subpopulations (ALA 2020), although only four are known to contain more than 1000 plants (Sinclair 2010). Both NSW and ACT likely contain around 30 subpopulations each and, although there appear to be many large subpopulations in these jurisdictions (K McDougall 2020 pers comm 23 Sept), half of the subpopulations with estimates in Sinclair (2010) were smaller than 1000 plants. This suggests that the majority of subpopulations of Hoary Sunray are smaller than the rudimentary estimate of minimum viable subpopulation size in Frankham et al. (2014). As large subpopulations are often concentrated in relatively small areas (Sinclair 2010; Tasmanian Land Conservancy 2019; R. Schahinger 2020 pers comm 24 Oct), it is likely that most large subpopulations occupy similar AOO (in terms of 4 km<sup>2</sup> grid square occupancy) to small subpopulations, and therefore that most (>50%) of AOO of Hoary Sunray is in habitat patches supporting small subpopulations with less than 1000 individuals. It should also be noted that most subpopulations of Hoary Sunray occur in insecure land tenure, often on roadsides in Vic and NSW and on private land in Tas, where even large subpopulations can decline to near extinction with poor management or clearing (McClean 2013; Collier 2015; J Morgan 2020 pers comm 23 Sept).

Morgan et al. (2013) studied the genetic effects of fragmentation on 19 subpopulations occurring on roadsides, cemeteries and rail lines in Victoria, concluding that subpopulations were genetically isolated from each other, and predicted further genetic erosion to occur over time and the continued loss of subpopulations. In the absence of studies investigating the genetic isolation of subpopulations in other jurisdictions, it is assumed that the pattern of genetic isolation among subpopulations observed in western Victoria by Morgan et al. (2013) is likely to be repeated elsewhere where Hoary Sunray occurs in similarly isolated subpopulations. The majority of subpopulations in these jurisdictions occur as isolated remnants on road or rail reserves (Vic and NSW) or on isolated private land and public conservation reserves (Tas), in grassland or grassy woodland habitat that has been extensively cleared for agriculture (Threatened Species Scientific Committee 2006, 2008, 2009a, 2009b, 2013, 2016). Although this

may not be the case in the ACT, where many subpopulations occur in nature reserves (Sinclair 2010) in relatively intact habitat, it is still likely that most subpopulations across its range are genetically isolated. Additionally, the species is self-incompatible (Costin et al. 2001), which increases the need for gene flow between subpopulations to maintain genetic diversity and viability.

Therefore, Hoary Sunray is considered to be severely fragmented, based on the majority of its subpopulations (and by extension AOO) being smaller in size than a rudimentary estimate of minimum viable subpopulation size of 1000 individuals (Frankham et al. 2014) and the majority of subpopulations being separated by sufficient distance to render them genetically isolated, based on the findings of Morgan et al. (2013).

There is an inferred continuing decline in area of occupancy, area, extent, and/or quality of habitat and number of subpopulations, particularly in Vic and Tas. In a study of approximately half of all Vic subpopulations, McClaren (2013) documented the extinction of approximately 25% of surveyed subpopulations from 2003–2013. In Tas, the number of subpopulations also appears to be declining, with a subpopulation at Liawenee becoming extinct in the 2000s (J Kirkpatrick 2020 pers comm 23 Sept). There is an inferred decline in AOO due to the extinction of these subpopulations. The current declines are expected to continue as all threats underlying these declines continue to operate and habitat continues to decline due to poor management and clearing. Damage to subpopulations from road maintenance activities has continued to occur since the release of the Recovery Plan, with a large subpopulation impacted at Hamilton Highway, Cressy, Vic (J Morgan 2020 pers comm 23 Sept 2020). Lack of biomass reduction continues to threaten productive grassland subpopulations in Vic and Tas and was a major factor behind the decline or extinction of 17 subpopulations in Vic (McClaren 2013) and the extinction of the subpopulation at Liawenee in Tas (J Kirkpatrick 2020 pers comm 23 Sept). The predicted frequency and severity of climate change-driven drought events is expected to increase in the region (CSIRO & Bureau of Meteorology 2015). The genetic consequences of fragmentation are expected to continue to affect isolated subpopulations of Hoary Sunray across its range (Morgan et al. 2013).

The data presented above demonstrate that the species is eligible for listing as Vulnerable (B2ab(ii,iii,iv)) under this criterion.



### Criterion 3 Population size and decline

	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each population	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one population =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

### Criterion 3 evidence

#### Not eligible

The total number of mature individuals is estimated at approximately 250 000 – 280 000 (Table 3), which is not considered limited.

The data presented above demonstrate the species is not eligible for listing under this criterion.

## Criterion 4 Number of mature individuals

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
<b>D. Number of mature individuals</b>	< 50	< 250	< 1,000
<b>D2.<sup>1</sup> Only applies to the Vulnerable category</b> Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time			D2. Typically: area of occupancy < 20 km <sup>2</sup> or number of locations ≤ 5

<sup>1</sup> The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the [common assessment method](#).

### Criterion 4 evidence

#### Not eligible

The total number of mature individuals is estimated at approximately 250 000 – 280 000 (Table 3), which is not considered low.

The data presented above demonstrate the species is not eligible for listing under this criterion.

## Criterion 5 Quantitative analysis

	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
<b>Indicating the probability of extinction in the wild to be:</b>	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

### Criterion 5 evidence

#### Insufficient data to determine eligibility

Population viability analysis has not been undertaken. There are insufficient data to demonstrate if the species is eligible for listing under this criterion.

#### Adequacy of survey

The survey effort has been considered adequate and there is sufficient scientific evidence to support the assessment.

### **Public consultation**

Notice of the proposed amendment and a consultation document was made available for public comment for 30 business days between 6 May 2021 and 24 June 2021.

### **Listing and Recovery Plan Recommendations**

The Threatened Species Scientific Committee recommends:

- (i) that *Leucochrysum albicans* subsp. *tricolor* retain its current listing status of Endangered in the list referred to in section 178 of the EPBC Act, as there is insufficient evidence to support transferring it to a different category and inclusion of the species in that category is having a beneficial impact on the continued survival of the species.