

Australian Capital Territory

Nature Conservation (Ginninderra Peppercress) Conservation Advice 2024

Notifiable instrument NI2024-253

made under the

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

1 Name of instrument

This instrument is the *Nature Conservation (Ginninderra Peppercress) Conservation Advice 2024*.

2 Commencement

This instrument commences on the day after its notification day.

3 Conservation advice for Ginninderra Peppercress

Schedule 1 sets out the conservation advice for Ginninderra Peppercress (*Lepidium ginninderrense*).

Arthur Georges
Chair, Scientific Committee
21 May 2024

Schedule 1

(see s 3)



ACT
Government

Environment, Planning and
Sustainable Development



CONSERVATION ADVICE

GINNINDERRA PEPPERCRESS – *Lepidium ginninderrense*

CONSERVATION STATUS

The Ginninderra Peppercress *Lepidium ginninderrense* Scarlett, is recognised as threatened in the following jurisdictions:

National **Critically Endangered**, *Environment Protection and Biodiversity Conservation Act 1999*.
ACT **Critically Endangered**, *Nature Conservation Act 2014*

ELIGIBILITY

Ginninderra Peppercress is listed as Critically Endangered in the ACT Threatened Native Species List under IUCN Criterion B – B1ab(i,ii,iii,iv,v)c(iv). The main factors that make it eligible are a very restricted geographic distribution (extent of occurrence (EOO) estimated to be 58 km²), a continuing decline and extreme fluctuations in the number of mature individuals (Attachment A (DCCEEW 2023)).

DESCRIPTION AND ECOLOGY

The Ginninderra Peppercress was first described in 2001, previously being confused with the Formbe and Winged Peppercress (*Lepidium pseudopapillosum* and *Lepidium monoplocoides*, respectively) (Scarlett 2001). The Ginninderra Peppercress is a perennial herb that grows to a maximum height of 20 cm, with one to six main branches stemming from a rootstock.

Stems are striated and moderately covered with small protuberances on the surface. The leaves of the plant are thick and fleshy, glabrous (hairless) and shiny on the upper epidermis. Leaves are widely spaced out in formations of rosettes, 1.5 to 2.0 mm wide and 15–55 mm long.

The Ginninderra Peppercress blooms in late spring bearing inflorescence pedicellate flowers (that is, flowers occurring along the axis of an elongated raceme that can reach a maximum length of 15 cm). The flowers are small, 2 mm wide and 1.5 mm long. Sepals are green and there are no petals.

The species produce seeds in early summer with most seeds dispersed before August and the end of winter (Avis 2000). Germinability was tested on 4-year-old seeds stored under controlled conditions finding 100% viability and germination (Taylor et al. 2014).

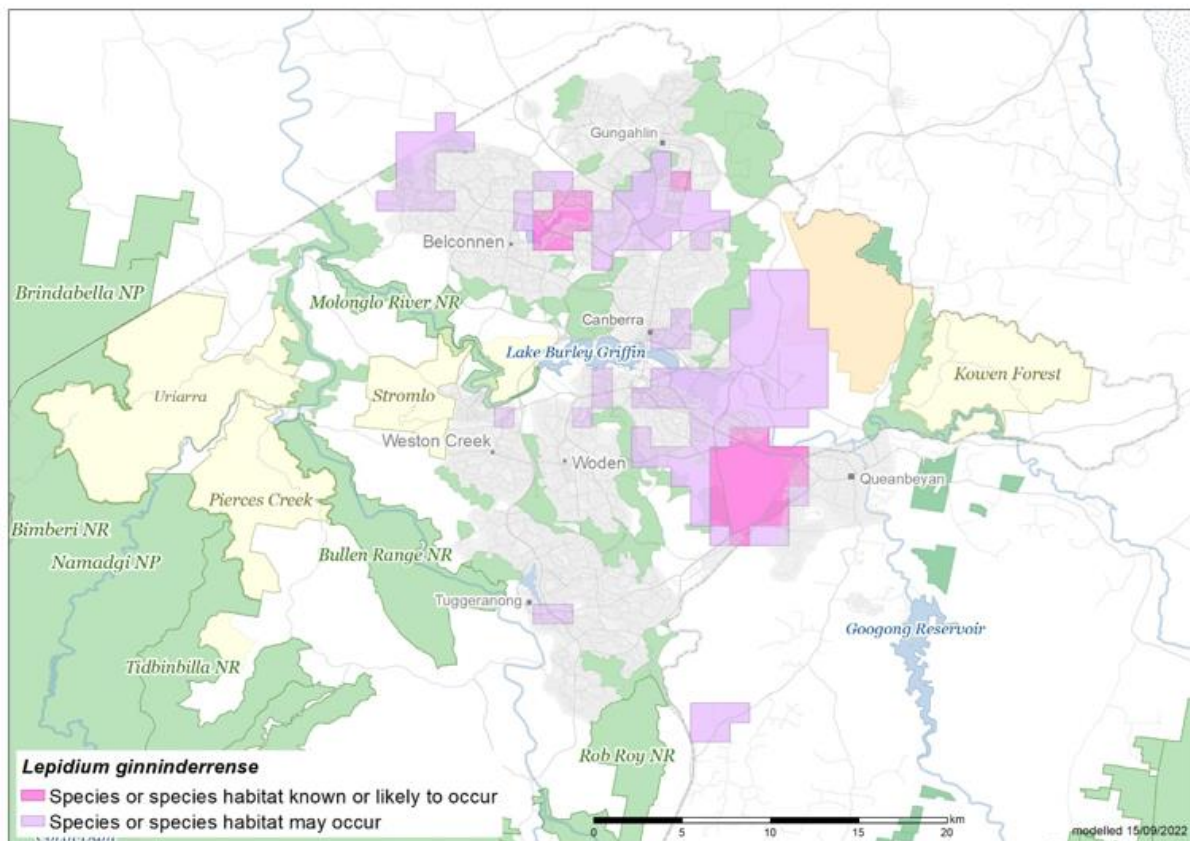


Ginninderra Peppercress (Greg Baines – Canberra Nature Map)

DISTRIBUTION AND HABITAT

The species is only known to occur in the Australian Capital Territory (ACT) as shown in Map 1 and Table 1 for a list of known subpopulations, which all occur on land that is currently managed or proposed to be set aside for conservation purposes.

Map 1 Modelled distribution of *Ginninderra pepperpress*



Source: DCCEEW (2023) – Base map Geoscience Australia; species distribution data [Species of National Environmental Significance](#) database.

Historical records from 1952 indicate the species was initially recorded in the suburb of Reid but has since been lost to development (Scarlett 2001). The only population known for many years occurs in the Natural Temperate Grassland of the north-west corner of the former Belconnen Naval Transmission Station (now known as Lawson Grasslands). In 2012, a second population was discovered approximately 6 km northeast of Lawson in the suburb of Franklin (altitude 610m) in an 18-ha paddock of disturbed grassland and remnant Box-Gum Woodland (Taws 2013; Taylor et al. 2014) and is now protected within the Budjan Galindji Grasslands Nature Reserve that was declared in 2020. In 2014, three patches were found at this site. A third population was discovered in the north-east corner of Jerrabomberra East Grasslands on 1 February 2018 in a former paddock of mixed native and exotic species and part of one of the largest connected grasslands in south-east Australia. A fourth population was identified nearby at the former Defence Bonshaw Receiving Station in December 2018. These populations are managed by the ACT Government Environmental Offsets team along with other threatened grassland species in these areas ensuring their conservation.

The species is likely to be naturally confined to the Natural Temperate Grassland in the ACT and nearby parts of NSW. Suitable habitat for the Ginninderra Pepperpress has been observed in NSW at Collector and Tarago (A Rowell pers. comm. in DCCEEW 2023) but the species has never been recorded outside the

ACT. The species is found in areas with relatively low perennial ground cover with indicators of past soil disturbance (Avis 2000) in or edging shallow depressions with seasonally waterlogged sodic soils (SMEC 2018).

Table 1: Survey results of numbers of Ginninderra Peppercress recorded at all known sites

Site name (tenure)	Survey year	No. of individuals	Source
Lawson Grasslands (Commonwealth Defence Housing Australia)	1997	<50*	Avis (2000)
	1999	80*	Avis (2000)
	2000	2243	Avis (2000)
	2005	875	HLA (2005)
	2006	3523	HLA (2006)
	2007	1181	HLA (2007)
	2008	1328	ENSR-AECOM (2008)
	2009	1137	ENSR-AECOM (2008)
	2011	406	Taylor et al. (2014)
	2018	0*	WSP (2021)
	2019	0*	WSP (2021)
	2020	0*	WSP (2021)
	2023	1508	ACT Government (2023)
Budjan Galindji Grasslands Nature Reserve (ACT Government)	2012	30*	ACT Government (2023)
	2014	103	
	2015	377	
	2017	157	
	2021	205	
	2022	228	
	2023	250	
Jerrabomberra East Grasslands (ACT Government)	2018	>45*	SMEC (2018)
	2021	212	ACT Government (2023)
	2022	75	
	2023	0	
Bonshaw (ACT Government)	2018-19	60*	SMEC (2019)
	2021	998	ACT Government (2023)
	2022	1212	
	2023	460	

*Population size estimates during some surveys were less rigorous than subsequent, more detailed monitoring efforts and these early estimates may understate the total number of individuals present.

In 2013, translocations were attempted in the grassland nature reserves of the northern suburbs of Crace and Dunlop (ACT Government 2013), however, searches in 2014 and 2015 failed to locate any plants (ACT Government 2017b). Further research is required to identify optimal habitat conditions for the species and how to establish new populations, building on the learnings from these previous translocation attempts.

THREATS

The main threats to the Ginninderra Peppercross include (ACT Government 2017):

- loss and fragmentation of habitat through clearing and development
- habitat degradation from intended or unintended actions associated with visitors and/or land management activities in the local area
- competition with grass tussocks and other plant growth for space and light – Ginninderra Peppercross requires relatively low perennial grass cover (Avis 2000; Scarlett 2001; HLA 2006; ENSR (AECOM) 2008)
- disturbance of existing drainage patterns and other changes to habitat structures caused by inappropriate management regimes
- overgrazing (e.g. by Kangaroos) – Ginninderra Peppercross is not thought to be directly grazed by Kangaroos at moderate densities when other feed is available. However, trampling, the effects of overgrazing of the surrounding grasses and any risk of direct grazing are still of concern (ENSR 2008).

MAJOR CONSERVATION OBJECTIVE

The overall objective of the Action Plan (ACT Government 2017b) is to preserve the species in perpetuity in the wild across its natural geographic range in the ACT, maintaining natural evolutionary processes. Specific objectives are further stated in the action plan for the species.

CONSERVATION PRIORITIES

Due to the small size and fragmented distribution of the populations, management actions should be directed towards maintaining existing conditions and ensuring that activities occurring nearby do not adversely affect the sites. Management actions at all sites need to consider the presence of the Critically Endangered Natural Temperate Grassland ecological community, the Golden Sun Moth (*Synemon plana*), Perunga Grasshopper (*Perunga ochracea*), Key's Matchstick Grasshopper (*Keyacris scurra*) and other threatened grassland species.

The Scientific Committee supports prioritising the conservation management actions for the Ginninderra Peppercross identified in the Action Plan (ACT Government 2017b) for the species to:

- manage vegetation biomass to maintain open habitat structure
- control weeds if they pose a threat to the species' populations of the site
- manage grazing pressure
- avoid incompatible activities, such as development of facilities, recreational use or access tracks in or near sites, especially where they may alter drainage or introduce weeds
- maintain a low profile for the sites where the species is located – the appropriateness of signage and fencing will need careful consideration
- incorporate appropriate statements of management actions in relevant plans and strategies.
- seek expert advice on best practice management of the species
- continue field collection of seed from populations for storage in the National Seed Collection, with seed replaced at appropriate intervals determined by seed longevity testing
- maintain an ex-situ 'insurance' population
- actively seek opportunities to involve members of local indigenous communities in on ground activities.

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 species listing assessment (DEECCW 2023).

Critical Habitat

The ACT contains the only known populations of the Ginninderra Peppercreep and its conservation is critical to the survival of the species. The Lawson and Bonshaw sites occur on Commonwealth Department of Defence land that is listed as Critical Habitat under the EPBC Act. A Memorandum of Understanding is in place between the Department of Defence and the Environment Planning and Sustainable Development Directorate and Environment Australia for the conservation and management of the Belconnen Naval Transmission Station. The Lawson population is behind by a man-proof fence with the Department of Defence restricting access to authorised persons, however this has presented its own set of threats to the species through lack of natural control of weeds and herbage mass by kangaroos. The Scientific Committee supports the need to remove this fence to allow more natural herbage mass reduction to occur.

Given the perilous state of this species it is critical that all available habitat, suitable for this species is protected in the ACT as critical habitat, both in the interests of existing resident populations and in the interests of maintaining opportunities for the re-establishment of the species in areas subject to local extirpation. Particular attention needs to be paid to incremental change (the tyranny of a thousand cuts) and emphasis on the avoidance of impacts on this species and its habitat is critical, with mitigation of impacts, and offsets not being appropriate mechanisms for proponents.

Climate Change

Climate change impacts are inevitable and will affect the likelihood of persistence, within the ACT, of many species. Most vulnerable in this regard are those species that occupy highly fragmented habitat with highly restricted distributions, such as the Ginninderra Peppercreep. Capacity must be developed to model the impact on the species 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.

Seed Banking

The establishment of seed banking of the Ginninderra Peppercreep is beneficial to provide insurance against stochastic losses in the wild, to manage any progressive loss of genetic diversity in the wild, and to provide a source of individuals for the re-establishment of the Ginninderra Peppercreep in local patches where it has been lost or that have been rehabilitated to be suitable for the establishment of the species.

Population Viability

Population viability analysis is important to determine if the population has declined in abundance and become fragmented resulting in a decline in genetic diversity of the species to such an extent that the species no longer has the capacity to rebound should conditions improve or to respond to management intervention. Such an assessment may need to be made in the case of the Ginninderra Peppercreep, and if it is determined that the populations are not viable, prioritising more far-reaching options for bringing the species to a position where it has the potential to recover.

Jurisdictional Collaboration

The ACT is subject to complex jurisdictional arrangements as considerable areas of grassland are managed by the Commonwealth including important habitat for the species at Lawson grasslands. Developing and implementing policies and action/recovery plans in this context therefore requires ongoing discussion/negotiations with the Commonwealth.

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

- National Recovery Plan for Ginninderra Peppercreese
- ACT Ginninderra Peppercreese Action Plan (ACT Government 2017b)
- ACT Native Grassland Conservation Strategy and Action Plans (ACT Government 2017a)
- Commonwealth Conservation Advice- Ginninderra Peppercreese (TSSC 2015 and DCCEEW 2023)
- Ex Situ Conservation Proposal for Ginninderra Peppercreese (ANBG 2008)
- Application to collect Ginninderra Peppercreese seed, Belconnen Naval Transmission Station, ACT (ANBG 2010)
- Ecological Values of the CSIRO Ginninderra Field Station Report (CSIRO 2016)
- Conservator Translocation Guidelines (ACT Government 2018)

LISTING BACKGROUND

The Ginninderra Peppercreese was listed in the ACT as an Endangered species on 26 October 2001 in accordance with section 21 of the *Nature Conservation Act 1980*. The ACT Flora and Fauna Committee (now Scientific Committee) made the listing recommendation, concluding that the Ginninderra Peppercreese satisfied the following criteria:

1.2 The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the medium-term future, as demonstrated by:

1.2.4 Severely fragmented distribution for a species currently occurring over a small range or having a small area of occupancy within its range.

The Ginninderra Peppercreese was initially listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) according to the following criteria: low population size (2000 mature individuals), restricted area of occupancy (2.7 km²) and no evidence of continuing decline. A National Recovery Plan was prepared in 2005 (Environment ACT), with 20 ha in Lawson added to the Register of Critical Habitat (Department of Environment and Heritage 2005). At the time, the Lawson Grasslands (former Belconnen Naval Transmission Station) was the only known site for the Ginninderra Peppercreese and thus the species had very restricted distribution. As the only known site at that time, it was assessed as key habitat for breeding, dispersal and the ongoing survival of the Ginninderra Peppercreese; and as 100% of the plants occur on the site, the habitat is critical to maintain genetic stock and potential long-term evolutionary development Criterion (e).

The species was reassessed and listed as Critically Endangered under the EPBC Act in 2024. In response, the ACT Scientific Committee recommended the Ginninderra Peppercross be transferred to the Critically Endangered category in the ACT Threatened Native Species List under the *Nature Conservation Act 2014*, to align with the EPBC Act listing.

ACTION PLAN DECISION

The ACT Scientific Committee recommends that the Minister for the Environment should make the decision to continue the current action plan (ACT Government 2017a) for the species in the ACT under the *Nature Conservation Act 2014*.

All known habitat on ACT-owned land is within either nature reserves or on land actively managed for conservation. However, it has an uncertain and some-what perilous future on Commonwealth-owned land in the ACT, and a national recovery plan should be developed and implemented if this would prove advantageous to managing this species well on Commonwealth land.

REFERENCES

- ACT Government 2017a. *ACT Native Grassland Conservation Strategy and Action Plans*. Environment, Planning and Sustainable Development Directorate, ACT Government Canberra.
- ACT Government 2017b. *Ginninderra Peppercross Lepidium ginninderrense Action Plan 2017*. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra
- ACT Government 2005. *A vision splendid of the grassy plains extended: ACT Lowland Native Grassland Conservation Strategy. Action Plan No. 28*. Arts, Heritage and Environment, ACT Government, Canberra.
- ACT Government 2013. *Media Release: First translocation of endangered Ginninderra Peppercross*. Accessed 24 April 2020 from: https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/corbell/2013/first-translocation-of-endangered-ginninderra-peppercross
- ACT Government 2023. ACT Protected Plants Database: *Lepidium ginninderrense* records. Environment, Planning and Sustainable Development, ACT Government, Canberra.
- ACT Government in prep. *Ginninderra Peppercross Lepidium ginninderrense Action Plan – Draft Implementation Progress Report 2022*. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra.
- ACT Government in prep. *Draft Cultural Resource Management Plan*. Environment Planning and Sustainable Development. ACT Government, Canberra.
- AECOM 2009. *Threatened Species Monitoring: Five Defence Properties in the ACT. Prepared for Spotless Services*. AECOM Australia Pty Ltd, Canberra.
- Avis K 2000. *Monitoring of Lepidium ginninderrense at the Belconnen Naval Transmission Station Lawson ACT*. Canberra Institute of Technology, Canberra.
- DCCEEW 2023. *Conservation Advice for Lepidium ginninderrense (Ginninderra Peppercross)*. Department of Climate Change, Energy, the Environment and Water (Commonwealth), Canberra.
- ENSR (AECOM) 2008. *Flora Monitoring in ACT/SNSW 2007/08. SN01944*. Prepared for Spotless Services Pty Ltd. ENSR Australia Pty Ltd, Canberra.
- HLA 2006. *Threatened Species Monitoring at Belconnen Naval Transmitting Station*. Prepared for Resolve FM. HLA-Envirosciences Pty Ltd, Canberra.
- Scarlett N 2001. *Lepidium ginninderrense* (Brassicaceae), a new species from the Australian Capital Territory. *Muelleria* 15: 69–74.

- SMEC 2018. *Jerrabomberra East Nature Reserve Golden Sun Moth Habitat Mapping 2017 30002620*. Prepared for: ACT Government- Environment and Planning, Canberra.
- SMEC 2019. *Golden Sun Moth Abundance Monitoring and Habitat Mapping 2018. Bonshaw, Jerrabomberra East and Franklin Grasslands*. Prepared for ACT Parks and Conservation Service. Canberra.
- Taws N 2013. Check Those Dead Bits! Or Finding The Ginninderra Peppercross. *News of Friends of Grasslands*, January-February 2013: 10.
- Taylor D, McAuliffe J, North T, Gibson-Roy P, Vanzella B, Taws N, Baines G, Cooke E, Lepschi B and Broadhurst L 2014. Seed production project produces translocation spin off for a highly threatened species. *Australasian Plant Conservation*, 22(3): 11–12.
- WSP (2021) Draft Biodiversity Management Plan: Former Belconnen Naval Transmitting Station (BNTS), Lawson North. Report prepared for Defence Housing Australia by WSP, Canberra.
- Personal Communication
Alison Rowell, Biologist and Environmental Consultant, Canberra.

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: NATIONAL LISTING ASSESSMENT ([DCCEEW 2024](#))

Reason for assessment

This assessment follows prioritisation of a nomination from the Commonwealth TSSC.

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 4 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria. The definition of each of the parameters follows the [Guidelines for Using the IUCN Red List Categories and Criteria](#). Table 1 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	2218	185	6681	<p>In this assessment the number of mature individuals is assumed to be the total number of individuals recorded from monitoring. Ginninderra peppergrass has a short primary juvenile period and the current monitoring protocol involves subpopulation counts in late summer (February) at a time when plants are usually reproductive and clearly visible (ACTG 2023; ACTG 2022, pers comm 15 September) (see Phenology and reproductive ecology section).</p> <p>The estimate of number of mature individuals used in this assessment is the number of plants counted in 2023 surveys (2218 plants, see Table 1).</p> <p>However, the population size fluctuates considerably from year to year. The minimum plausible value is the sum of the subpopulation minima since monitoring began (i.e. low fluctuation cycles across all years of monitoring): Lawson (50), Budjan Galindji (30), Jerrabomberra (105) (Table 1). The maximum plausible value is the sum of the subpopulation maxima: Lawson (3523), Budjan Galindji (377), Jerrabomberra (1287) (Table 1).</p>
Trend	Declining			<p>The fluctuations in population size from year to year make it difficult to determine long term trends in the number of mature individuals. In species that undergo population fluctuations, a downward phase will not normally count as a reduction without good evidence (IUCN 2022, IUCN 2001). The Budjan Galindji subpopulation is assumed to be stable. At the Lawson subpopulation, multi-year surveys showed a consistent trend of 0 plants over 3 years until 2023 when more reliable surveys revealed that plants have established in a new area of the site on a vehicle track (Table 1, ACTG 2023). The Lawson subpopulation is unstable and at risk of</p>

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
				<p>further decline if more optimal habitat conditions are not present.</p> <p>Recent (2023) surveys of the Jerrabomberra subpopulation revealed a large downward phase in population size fluctuation including no individuals at Jerrabomberra East Grasslands (Table 1 ACTG 2023). Despite these declines in mature individuals the species is likely to persist in the soil-stored seedbank at each site, but may be at risk of local extirpation if habitat conditions do not improve and the population fails to recover.</p>
Generation time (years)	1.5	0.6	2.4	<p>The species' generation length is estimated to be between 0.6 and 2.4 years based on calculations given under Criterion 1 below.</p> <p>The midpoint (1.5 years) is used in this assessment.</p>
Extent of occurrence	58 km ²	58 km ²	Unknown	<p>The Extent of Occurrence (EEO) has been calculated using vetted (reliable) point records from 2001–2021 obtained from governments, museums and CSIRO, and applying the shortest continuous imaginary boundary which can be drawn to encompass these records, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2022).</p> <p>The species is well surveyed across its known range and potential habitats within ACT, however it's possible that its range is larger than currently understood and could plausibly include parts of NSW. The species is difficult to detect, which suggests that additional subpopulations may occur that would increase the EEO. However, given that the known distribution of Ginninderra peppercress is restricted to known areas of remnant grasslands within ACT (Map 1), it is unlikely that additional subpopulations exist that would increase the EEO to >100 km².</p>
Trend	Stable but at risk of future contraction			<p>The trend in EEO is stable. However, the Lawson and Jerrabomberra subpopulations are considered at risk of future decline if suitable habitat is not maintained. If the species fails to persist at any subpopulation then the EEO will decline.</p> <p>Past agricultural disturbances and urban development in the ACT has probably destroyed historic subpopulations (Table 2), suggesting that past contraction to the EEO is likely.</p> <p>The Ginninderra peppercress has a very restricted distribution and is sensitive to a range of ongoing threats (Table 2), so the future EEO contraction is likely to follow the loss of any subpopulations.</p>
Area of Occupancy	20 km ²	20 km ²	Unknown	<p>The Area of Occupancy (AEO) has been calculated using vetted (reliable) point records from 2001–2021 obtained from governments, museums and CSIRO, and applying 2 x 2 km grid cells, as outlined in the Guidelines for Using the</p>

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
				<p>IUCN Red List Categories and Criteria (IUCN 2022).</p> <p>The species is well surveyed across its known range and potential habitats but is difficult to detect. Additional subpopulations may be discovered in the future that would increase the AOO. However, given the wide AOO threshold for the Endangered category under Criterion 2, it is unlikely that an increase in AOO will result in a change in listing category.</p> <p>The loss of the Reid subpopulation is evidence of an historic contraction to AOO (see Distribution). It is plausible that other losses have occurred but there are no herbarium records to confirm this.</p>
<p>AOO is a standardised spatial measure of the risk of extinction, that represents the area of suitable habitat known, inferred or projected to be currently occupied by the taxon. It is estimated using a 2 x 2 km grid to enable comparison with the criteria thresholds. The resolution (grid size) that maximizes the correlation between AOO and extinction risk is determined more by the spatial scale of threats than by the spatial scale at which AOO is estimated or shape of the taxon's distribution. It is not a fine-scale estimate of the actual area occupied. In some cases, AOO is the smallest area essential at any stage to the survival of existing subpopulations of a taxon (e.g. breeding sites for migratory species).</p>				
Trend	Stable but may contract in the future			<p>Ginninderra peppercress undergoes population size fluctuations that make it difficult to estimate trends in the population and AOO. No discernible trend is apparent from the available data, although the recent fluctuations at the Lawson and Jerrabomberra Valley subpopulations suggests that AOO will decline if these subpopulations fail to persist (Table 1).</p>
Number of subpopulations	3	3	Unknown	<p>The estimate used in the assessment includes subpopulations at Lawson, Budjan Galindji and Jerrabomberra. The maximum plausible value is unknown, because additional subpopulations could be discovered in the future and estimating the plausible upper limit is very difficult (but suspected to be very low).</p>
Trend	Stable but at risk of declining in the future			<p>Given the small AOO and small size of extant subpopulations, and the sensitivity of Ginninderra peppercress to a range of threats that can rapidly cause population decline, further declines in subpopulation number are likely to occur if the species is inappropriately managed.</p>
Basis of assessment of subpopulation number	<p>Colonies of Ginninderra peppercress at Bonshaw and Jerrabomberra East Grasslands are approximately ~300 m apart but are considered a single subpopulation for the purpose of this assessment. These sites are quantified as separate units during monitoring completed by the ACT Government (see Table 1), but it is likely that some genetic exchange between the two sites is possible through occasional seed dispersal and possibly through insect pollination (noting this later mechanism is not yet proven) (see Phenology and reproductive ecology).</p>			
No. locations	1-4	1	4	<p>The number of locations is estimated at four, with a plausible range of 1-4. Competitive exclusion, weed invasion, changes to site hydrology and inappropriate vegetation and soil disturbance are the most serious plausible threats to the Ginninderra peppercress because it is sensitive to disturbances that damage or kill mature plants and deplete the seed-bank, including competitive exclusion when the</p>

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
				<p>habitat becomes overgrown (see Disturbance ecology and Table 2).</p> <p>Ginninderra peppercress is found at three subpopulations that are managed for biodiversity conservation but with unique land management regimes in place at each subpopulation, which could thus be interpreted as independent locations. The Jerrabomberra subpopulation includes two discrete patches separated by 300 m and on separate land titles that are managed independently of each other (Bonshaw and Jerrabomberra East Grassland), making the number of locations 4. If climate change is interpreted as the most serious plausible threat and each subpopulation is affected synchronously by this threat through its influence on biomass, droughts and grazer populations, then there would be one location.</p>
Trend	Stable but at risk of declining in the future			<p>The number of locations is estimated at 4, which would increase if more subpopulations are discovered and will decline if any subpopulations become extirpated or if a more serious plausible threat emerges that impacts the entire subpopulation uniformly (e.g. climate change induced effects, which are currently poorly understood).</p>
Basis of assessment of location number	<p>The number of locations is based on the most plausible serious threats of competitive exclusion, weed invasion, changes to site hydrology and inappropriate vegetation and soil disturbance impacting each subpopulation independently (including two locations represented by the Jerrabomberra subpopulation).</p>			
Fragmentation	<p>Severely fragmented. The distribution and AOO of Ginninderra peppercress are thought to be well understood (see Distribution, Table 1, Map 1) and the species occupies spatially restricted habitat within a landscape where natural temperate grassland has become fragmented (ACTG 2022c; TSSC 2016). It is unlikely that much suitable habitat exists in the surrounding landscape given the dependency of the species on narrowly defined vegetation, soil and hydrological characteristics (See Relevant biology and ecology).</p> <p>Ginninderra peppercress appears to produce high quantities of viable seed during favourable conditions. Most diaspores are assumed to disperse immediately around the parent plants, resulting in a very narrow home range at each subpopulation (<1 ha). Given the large distances between Lawson, Franklin and Jerrabomberra (5–18 km) and the restricted extent of suitable habitat, seed dispersals by fauna (epizoochory and endozoochory) are unlikely to efficiently transport seeds between subpopulations or into new areas of habitat.</p> <p>Subpopulations of Ginninderra peppercress are therefore considered to be small and isolated, and in the event of a subpopulation loss, such as historically occurred at Reid, natural recolonisation of each subpopulation is unlikely.</p>			
Fluctuations	<p>Extreme fluctuations are observed in the number of mature individuals but not in EOO, AOO, number of subpopulations or locations. Fluctuations are most clear from the Lawson subpopulation in the period 1997 to 2011 (Table 1). The magnitude of fluctuations varies between subpopulations and has had the greatest minima and maxima at Lawson (50 to 3523 individuals, respectively, excluding null values from 2018-21). Fluctuations at the remaining subpopulations range from 30–377 (Budjan Galindji) and 105–1287 (Jerrabomberra) (across all years of survey data) (Table 1). These ranges indicate that the fluctuations are likely to be greater than the 10-fold threshold required to qualify as Extreme Fluctuations under IUCN guidelines (IUCN 2022).</p> <p>Recent observations from 2021-23 at Budjan Galindji and the two discrete patches of plants at the Jerrabomberra subpopulation show that asynchronous fluctuations occur (i.e. fluctuations between these subpopulations and colonies vary independently of one another and are therefore at least partly contingent on local conditions present at each site) (Table 1).</p>			

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
	Between each population fluctuation, recruitment success will vary depending on changes to site conditions in response to changes in climate and disturbance (see Population size fluctuations, and Disturbance ecology). Dispersal between all or nearly all subpopulations is unlikely to occur regularly or occasionally, so the degree of fluctuations does not need to be measured over the entire population (IUCN 2022).			

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	Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.			(b) an index of abundance appropriate to the taxon
A3	Population reduction, projected, inferred or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]			(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
A4	An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.			(d) actual or potential levels of exploitation
				(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites
			based on any of the following	

Criterion 1 evidence

Insufficient data to determine eligibility

Generation length

One method for estimating generation time given in IUCN (2022) is: Generation time = age of first reproduction + $[z * (\text{length of reproductive period})]$ where z is usually <0.5 , depending on survivorship and the relative fecundity of young vs. old individuals in the population.

The primary juvenile period of Ginninderra peppergrass in the wild is not documented, but plants grown from seed ex situ have reached reproductive maturity within approximately six months from germination (Taylor et al. 2013). The longevity of the Ginninderra peppergrass is also not documented, but perennial herbaceous *Lepidium* species from temperate south-east Australia are estimated to live up to 10 years (White et al. 2020 in Falster et al. 2021) and Ginninderra peppergrass is assumed to have similar traits. Lastly, the value of z is also not documented, and it is possible that old individuals are equally fecund as young. However, based on population size

fluctuations, it is inferred that high densities of young plants contribute disproportionately to the reproductive output of the population, and a z value of 0.2 is used in this assessment.

Based on the information above, the plausible maximum and minimum generation times are likely to be:

Maximum (longer lifespan plants that live for ten years):

Generation time = $0.5 + [0.2 * (10-0.5)] = 2.4$, assuming a juvenile period of six months and longevity of 10 years.

Minimum (shorter lifespan plants that live for one year):

Generation time = $0.5 + [0.2 * (1-0.5)] = 0.6$, assuming a juvenile period of six months and longevity of 1 year.

Therefore, the species' generation length is between 0.6 and 2.4 years (noting that there is a degree of uncertainty with this estimate). This gives an estimated three-generation period of approximately 2–7 years. IUCN guidelines require population reduction measurements are based on the longer of 10 years or 3 generations (IUCN 2022), making 10 years the period used in this assessment.

Past population reduction

The number of mature individuals of Ginninderra peppercress is inferred from the number of total individuals and is estimated to be 2218 (Table 4). One of the three extant subpopulations was discovered within the last six years, which is shorter than the minimum ten-year period required for estimating population size reductions (IUCN 2022). Ginninderra peppercress undergoes natural fluctuations in population size (Table 1) and monitoring shows both upward and downward phases of fluctuation but are limited to few monitoring events. Current available data cannot be used to conclusively demonstrate a reduction in the whole population and as such, the species does not meet the requirements for listing under A1 or A2.

Future population reduction

Recent (2023) surveys of the Jerrabomberra subpopulation show a downward trend, including no individuals seen at Jerrabomberra East Grasslands. Due to natural fluctuations in population size, it is difficult to determine if this is a genuine population reduction or a downward phase of population fluctuation. If the subpopulation does not recover then permanent decline may occur, but this cannot be forecast with confidence.

At the Lawson subpopulation, 2023 surveys revealed a subpopulation size increase, but most plants are concentrated in a new area on a vehicle track (see Disturbance ecology), which may be exposed to high risk of future decline if plants fail to persist and suitable habitat is not available elsewhere. The Budjan Galindji subpopulation appears to be stable and future subpopulation declines also cannot be forecast with confidence. As such, there is insufficient information to assess the requirements for listing under A3 or A4.

Conclusion

The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

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

	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions:			
(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 subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Criterion 2 evidence

Eligible under Criterion 2 B1ab(i,ii,iii,iv,v)c(iv) for listing as Critically Endangered

Extent of occurrence (EOO) and area of occupancy (AOO)

The EOO and AOO of Ginninderra peppercress are estimated at 58 km² (very restricted) and 20 km² (restricted) respectively (Table 4). These figures are based on the mapping of known accurate point records collected from 2001–2021 obtained from state governments, museums and CSIRO. The EOO was calculated using a minimum convex hull. The AOO was calculated using the 2 x 2 km grid cell method, as outlined in the IUCN Red List Guidelines (IUCN 2022).

The species' EOO and AOO appear to meet the thresholds for listing as Critically Endangered under B1 (EOO <100 km²) and Endangered under B2 (AOO <500 km²).

Severely fragmented

The species is severely fragmented. It only occurs in specific microhabitats within the highly fragmented Natural Temperate Grasslands of the South Eastern Highlands ecological community, and this habitat fragmentation is inferred to be resulting in population fragmentation. Subpopulations may not be viable due to the small subpopulation sizes and the threats facing the species, as evidenced by the likely extinction of the Reid subpopulation and apparent declines at the Lawson subpopulation. Subpopulations that go extinct are unlikely to be recolonised due to the distances between subpopulations, habitat fragmentation and inefficient long-distance dispersal of diaspores (Table 4).

Number of locations

Ginninderra peppercreep is estimated to occur at four locations, with a plausible range of 1–4. The location risk exposure to the species is related to the drivers of population size fluctuations and the most serious plausible threats of competitive exclusion, weed invasion, changes to site hydrology, drought, and inappropriate vegetation and soil disturbance, most of which have impacted one subpopulation (Lawson) and could feasibly impact all other subpopulations (Table 1 & 2).

Population size fluctuations in Ginninderra peppercreep appear to be driven by factors operating at the landscape and the site scale. Regional climate influences biomass levels, droughts, and grazer (macropod) populations and are likely to affect the population uniformly (driving synchronous population change across all subpopulations), suggesting one location. However Ginninderra peppercreep appears to undergo asynchronous population size fluctuations at the subpopulation and individual site scale (recognising Jerrabomberra East Grasslands and Bonshaw as separate sites) because land management, weed populations and grazing controls have been shown to independently affect subpopulation sizes (Table 1). Therefore, the most plausible number of locations is four.

Continuing decline

The number of mature individuals at Lawson is likely to have declined in recent years, with three targeted surveys from 2018 to 2020 failing to locate any individuals. In 2023 more comprehensive surveys recorded a large number of individuals in a new area of the site where most plants have colonised a vehicle track (Table 1, Disturbance ecology). Habitat quality at Lawson has severely declined as a result of significant biomass accumulation, which is likely to be driven by interactions between regional climate, growth of exotic grass and broadleaf weeds, and low grazing pressure (Table 2) (ACTG 2023. pers comm 7 March). Recent surveys also detected fewer mature individuals at the Jerrabomberra subpopulation including no individuals at Jerrabomberra East, which poses a risk of decline if the subpopulation fails to recover. A decline in mature individuals at Budjan Galindji Grasslands Nature Reserve is inferred as two of the twelve colonies of Ginninderra peppercreep, recorded during the 2015 survey, were never re-discovered (see Distribution), although the impact of this decline on the total population size is unclear based on the available monitoring data.

The soil-stored seed bank of Ginninderra peppercreep provides the species with some resilience to year-to-year variation in site conditions. However, most subpopulation surveys always recorded mature individuals at each subpopulation, and subpopulation size fluctuations have never dropped to zero until this was observed in the recent surveys at Lawson and at Jerrabomberra East Grasslands (Table 1). At Lawson, plants have colonised new areas of the site due to low habitat quality at previously occupied sites and these new plants may only partially compensate for declines in formerly occupied areas.

Therefore, it is likely that the Lawson subpopulation and possibly the Jerrabomberra subpopulation are at risk of genuine declines in the number of mature individuals. If habitat conditions do not improve and the species does not recover (i.e. from a seed bank), then the loss of plants at Lawson will drive projected decline in the extent of occurrence, area of occupancy, area of habitat, and the number of locations and subpopulations.

Across all extant subpopulations of *Ginninderra* peppercress, the historic distribution may have been much greater than the current distribution. The historic extent of suitable habitat likely declined as native grasslands were destroyed for agricultural and urban developments (Table 2), however specific losses are unable to be confirmed due to a lack of historic records in herbaria or other sources. The species is currently known from subpopulations in secure tenure or proposed to be transferred to secure tenure, and on current knowledge there are unlikely to be ongoing declines associated with development. However, there may be indirect impacts to the species arising from urban developments and construction works, for example through increased public use pressure or weed spread in urban landscapes.

Declines in habitat quality have been observed at Lawson, Budjan Galindji and Jerrabomberra in recent years (Table 2) and inferred at Budjan Galindji in 2015 (see Distribution). The species has complex habitat requirements, and inappropriate soil and vegetation disturbance, including lack of biomass disturbance, is reducing habitat suitability which will limit recruitment, survivorship of seedlings and mature individuals, and deplete the seedbank over time if mature individuals fail to recover. This ongoing threat is therefore driving continuing decline in habitat quality. While the seedbank may offer some resilience to short-term disturbances, if habitat quality is not restored then the seedbank will be depleted and the species' capacity for population recovery will decline.

Therefore, the species meets the requirement for estimated continuing decline for the number of mature individuals, projected continuing decline in extent of occurrence, area of occupancy, and number of locations or subpopulations, and inferred continuing decline in area, extent and/or quality of habitat.

Extreme fluctuations

Under IUCN guidelines, extreme fluctuations occur when population size undergo a tenfold increase or decrease, which can be diagnosed based on population trajectories or inferred based on the life history of the species (IUCN 2022). At Lawson, past fluctuations in subpopulation size range from fewer than 100 up to several thousand mature individuals, while at the remaining subpopulations, which are smaller overall, fluctuations range up to 1000 or more individuals (Table 1). The factors that contribute to these fluctuations are not all documented but likely to be strongly related to interactions between site productivity and disturbance. Habitat suitability for *Ginninderra* peppercress declines as vegetation cover increases, which correlates with population decline due to competitive exclusion (see Disturbance ecology).

Patterns of fluctuation across all three subpopulations appear to be largely asynchronous (Table 1), and there is currently no evidence that fluctuations are triggered by specific disturbance events (noting positive germination responses to smoke suggests the seed may have fire-related germination cues) (see Relevant biology and ecology).

Therefore, *Ginninderra* peppercress meets the requirement for extreme fluctuations of mature individuals under IUCN Guidelines (IUCN 2022). The species is not subject to extreme fluctuations in EOO, AOO, number of subpopulations or locations.

Conclusion

The Committee considers that the Ginninderra peppercress' EOO is very restricted (<100 km²), its AOO is restricted (<500 km²), the geographic distribution is severely fragmented and the number of locations is restricted. There are also extreme fluctuations in the number of mature individuals, and continuing decline is estimated for the number of mature individuals, projected for extent of occurrence, area of occupancy, and number of locations or subpopulations, and inferred for the area, extent or quality of habitat. Therefore, the species has met the relevant elements of Criterion 2 to make it eligible for listing as Critically Endangered.

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 subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 - 100%	95 - 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

Criterion 3 evidence

Eligible under Criterion 3 C2b for listing as Endangered

Number of mature individuals

The total median number of mature individuals is estimated to be 2218 (see Criterion 1 above and Table 4). This suggests the species meets the threshold for listing as Endangered under this criterion as applicable subcriteria are also met.

Continuing decline

As discussed in Criterion 2 (see above), the species appears to be undergoing continuing decline in the number of mature individuals. However, there are insufficient data to determine the rate of decline. Accordingly, the species appears to only meet the C2 continuing decline requirement for listing under this criterion and not the C1 continuing decline requirement.

Number of mature individuals in each subpopulation

Based on the 2023 population survey the number of mature individuals in the Budjan Galindji subpopulation is 250 and the Jerrabomberra subpopulation is 460 (Table 4). The Lawson subpopulation comprises 1508 mature individuals (Table 4). Therefore, the species does not meet the requirement for listing under this subcriterion.

Percentage of mature individuals in one subpopulation

Given that mature individuals are present across all three known subpopulations (Table 1), it is not possible for 100% of mature individuals to occur in one subpopulation. None of the subpopulations support $\geq 90\%$ of the total number of mature individuals, so the species does not meet this requirement for listing under this subcriterion.

Extreme fluctuations in the number of mature individuals

The species appears to show extreme fluctuations in the number of mature individuals (Table 4), so the species meets the requirement for listing under this subcriterion.

Conclusion

The Committee considers that the estimated total number of mature individuals of Ginninderra pepperpress is low (<2500). There is an estimated continuing decline and the species undergoes extreme fluctuations in the number of mature individuals. Therefore, the species has met the relevant elements of Criterion 3 to make it eligible for listing as Endangered.

Criterion 4 Number of mature individuals

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2. ¹ Only applies to the Vulnerable category 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 ² or number of locations ≤ 5

¹ 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

Number of mature individuals

The total median number of mature individuals is estimated to be 2218 (see Criterion 1 above and Table 4), which is above the threshold for Vulnerable (<1000) under Criterion 4.

The species has a restricted area of occupancy at 20 km², but not <20 km² and number of locations (≤5), and there is a plausible future threat that could drive the species to Critically Endangered or Extinct in a very short time. Therefore, the species may meet the relevant elements of Criterion 4 to make it eligible for listing as D2 Vulnerable.

However, EPBC regulations do not currently include provisions for listing species under subcriterion D2 (see ¹).

Conclusion

The total number of mature individuals is 2218 which is not low. Therefore, the species has not met this required element of this criterion.

Criterion 5 Quantitative analysis

	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 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.

Conclusion

There is currently insufficient information to determine the eligibility of the species for listing in any category 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 31 business days between 17 April to 31 May 2023. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process and provided to the Minister for the Environment with the Committee's advice.

Listing and Recovery Plan Recommendations

The Threatened Species Scientific Committee recommends:

- i) That the list referred to in section 178 of the EPBC Act be amended by transferring *Lepidium ginninderrense* from the Vulnerable category to the Critically Endangered category.
- ii) That there be a Recovery Plan for this species in accordance with the provisions of the EPBC Act and the Committee's conservation planning principles as follows:
 - A recovery plan will provide a clear, concise guiding framework to improve knowledge of the ecology and conservation requirements of the species and to better understand the multiple, significant threats.
 - The species is under high development pressure that can be regulated under the EPBC Act.
 - A recovery plan will help to ensure the recovery of the Lawson subpopulation, which is on Commonwealth land managed by Defence Housing Australia and includes a site on the Register of Critical Habitat.
 - Having regard to the aforementioned factors, a recovery plan is required as it would provide a significant conservation planning benefit above existing mechanisms.
 - The Committee's conservation planning principles can be found [here](#).