

## *Botrychium lunaria* Grassy Moonwort

### Taxonomy

*Botrychium lunaria* (L.) Sw.

### Current conservation status

Categorised as Vulnerable in the 2014 Advisory list of rare or threatened flora (DEPI 2014).

### Proposed conservation status

Endangered in Victoria

Criteria B1ab(iii,v)+2ab(iii,v)

### Species Information

#### Description and Life History

Plants are 7–15 cm tall. Sterile lamina oblong, 3–7 cm long, pinnate with 3–6 pairs of broadly fan-shaped pinnae. Spike with relatively long stalk arising from near base of sterile lamina, pinnate with short lateral branches bearing numerous, close-set, sessile sporangia (VicFlora, no date).

The taxon is a perennial fern that produces leaves each year, and then dies back to an underground rhizome.

#### Generation Length

The generation length of *Botrychium lunaria* is suspected to be 20 to 40 years. *Botrychium* taxa closely related to *B. lunaria* have been determined to produce 6 years worth of above ground leaves, and up to 4 years of dormancy in the period of their life when they produce leaves (Lesica and Ahlenslager 1996). In addition to this, gametophytes are known to live for up to 5 years in *Botrychium* (Anderson and Cariveau 2003) and between 1 to 9 years underground before producing leaves (Kelly 1994). Longevity may be in the 20-80 year range.

#### Distribution

The taxon occurs in high altitude sites above 1,000 metres in the Snowy Range, near the source of the Buchan River, and around Mt Cobberas.

#### Habitat

In Victoria, *B. lunaria* occurs in moist, well-drained, and humus-rich grassy areas among subalpine woodland.

#### Threats

Climatic drying and increased temperature may threaten the taxon, which is restricted to moist sites in cooler subalpine areas. Most records of *B. lunaria* in Victoria are from around Mount Cobberas where there is an abundance of feral horses. Introduced herbivores such as feral horses, Sambar Deer (*Rusa unicolor*), and hares can be threats through herbivory of plants and introduction of weeds.

### IUCN Criteria

Criterion A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%

  

<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>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.</p> <p>A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</p> <p>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.</p>	<p>based on any of the following:</p>	<p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>
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### Evidence:

#### Ineligible under Criterion A

There is insufficient evidence to determine whether there has been or will be a reduction in population sufficient to meet any threshold for Criterion A.

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Criterion B. Geographic range in the form of either B1 (extent of occurrence) and/or B2 (area of occupancy)			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km <sup>2</sup>	< 5,000 km <sup>2</sup>	< 20,000 km <sup>2</sup>
B2. Area of occupancy (AOO)	< 10 km <sup>2</sup>	< 500 km <sup>2</sup>	< 2,000 km <sup>2</sup>
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			

### Evidence:

#### Eligible under Criterion B1 as Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 2,392 km<sup>2</sup>, based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA).

The taxon is estimated to have 1 location as all sites of known occurrence are exposed to the same set of key threats identified.

It has a continuing decline in (iii) and (v) above, based on the identified threats of climatic drying, increased temperature, herbivory, and weed invasion.

#### Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 72 km<sup>2</sup>, based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA.

As above, the taxon has 1 location, and a continuing decline in (iii) and (v) above.

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Criterion C. Small Population size and decline		Critically Endangered	Endangered	Vulnerable
Number of mature individuals		< 250	< 2,500	< 10,000
AND at least one of C1 or C2				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2	An observed, estimated, projected or inferred continuing decline AND least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
	(ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b)	Extreme fluctuations in the number of mature individuals			

### Evidence:

#### Ineligible under Criterion C as Data Deficient

Previous records of *B. lunaria* lack any indication of abundance or the number of individuals at sites visited. The small size and rarity of the taxon, coupled with the possibility that not all plants are producing above ground leaves when visited, makes it difficult to estimate number of individuals at sites and observe change in numbers over time. As a result it is uncertain how many mature individuals there are currently.

Criterion D. Very small or restricted populations		Critically Endangered	Endangered	Vulnerable
Number of mature individuals (observed or estimated)		< 50	< 250	< 1,000
D2. Only applies to the VU 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: AoO < 20 km <sup>2</sup> or number of locations ≤ 5

### Evidence:

#### Ineligible under Criterion D

There is insufficient evidence to determine the number of mature individuals.

Criterion E (Quantitative Analysis) was not addressed as the taxon does not have a detailed Population Viability Analysis.

### References

Anderson, D.G. and Cariveau, D. (2003). *Botrychium campestre* W.H. Wagner and Farrar (Iowa moonwort): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available: <http://www.fs.fed.us/r2/projects/scp/assessments/botrychiumcampestre.pdf>



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Kelly, D. (1994). Demography and conservation of *Botrychium australe*, a peculiar, sparse mycorrhizal fern. *New Zealand Journal of Botany* 32: 393-400.

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