

## Conservation Assessment of *Pimelea cremnophila*

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### ***Pimelea cremnophila* L.M. Copel and I. Telford (Thymelaeaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Critically Endangered

Proposed change for alignment: List on EPBC Act as Critically Endangered

### Conservation Advice: *Pimelea cremnophila*

### **Summary of Conservation Assessment**

*Pimelea cremnophila* was found to be eligible for listing as Critically Endangered under criteria B1+B2ab(iii) and C2a(ii).

The main reasons for this species being eligible are i) the species has a very restricted geographic range, both the extent of occurrence (EOO) and area of occupancy (AOO) are 4 km<sup>2</sup>; ii) there is a very small population size (fewer than 100 mature individuals) and possibly only a single population remains; and iii) a continuing decline is observed in the number of populations and the number of mature individuals due to grazing by goats, extreme droughts and inappropriate fire regime.

### **Description and Taxonomy**

The NSW Scientific Committee (2017) state that *Pimelea cremnophila* is an “erect shrub to 2.5 m high. Stems red-brown, hirsute with strigose white antrorse hairs to 3 mm long, glabrescent with age. Leaves opposite, petiolate. Petioles 1 mm long, densely hairy; lamina narrow-elliptic to narrow-ovate, acute, 10–37 mm long, 2.5–6 mm wide, abaxial surface hirsute with scattered white strigose hairs, the hairs denser and longer toward the margins. Inflorescence axillary or terminal, 1–4 flowered; peduncle c. 1 mm long, strigose; bracts leaf-like. Flowers functionally male, bisexual or functionally female, subsessile. Male flowers with hypanthium 6–8 mm long; sepals 3–4 mm long; stamens 2, rarely 3; anthers narrow-oblong. Bisexual flowers protandrous with hypanthium 4–6.5 mm long; sepals 3–4 mm long, stamens similar to male flowers; ovary c. 1.5 mm long, with erect hairs at apex; style eventually exerted; stigma brushlike. Female flowers with hypanthium 3–4.5 mm long; sepals 1.5–2.5 mm long; staminodes minute; gynoeceum similar to bisexual flowers. Fruit dry ovoid, enclosed in the persistent base of the hypanthium, pale green. Seeds ovoid 3–3.5 mm long with minute longitudinal, foveate furrows, red brown (Copeland and Telford 2006)”.

### **Distribution and Abundance**

The NSW Scientific Committee (2017) state that “*Pimelea cremnophila* is endemic to New South Wales (NSW) and is known only from Oxley Wild Rivers National Park, approximately 40 km east of Walcha in the New England Tablelands Bioregion. A single population occurs along the rim of the Macleay River gorge at 1,050–1,090 m a.s.l. (Copeland and Telford 2006). *Pimelea cremnophila* was first observed by botanists working the Oxley Wild Rivers National Park in 2002 and populations were monitored in 2003–2004 and 2008. A brief search of the two northernmost populations of *P. cremnophila* in November 2015 failed to relocate known individuals. Surveys to locate additional populations have been conducted in suitable habitat within Oxley Wild Rivers National Park since 2006, including a major survey in 2012–2013. These surveys have failed to locate new populations of *P. cremnophila* (L. Copeland *in litt.* May 2016)”.

*Pimelea cremnophila* is a rare species that is restricted to Steepdrop Falls and nearby Rowleys Creek gorge rim, in the southern part of Oxley Wild Rivers National Park. A survey in 2008 reported three small populations along a 5 km stretch of the rim (Copeland pers. comm. 2017). These populations were not censused and the population size in 2008 is not known (Copeland pers. comm. 2017). In November 2015, a visit to the area failed to find two of the three populations (Copeland pers. comm. 2017), though the species may persist as seed in the soil seed bank. Currently, there is only one known population and the number of mature individuals is estimated to be fewer than 100 plants, all within the Oxley Wild Rivers National Park (Copeland pers. comm. 2017).

The NSW Scientific Committee (2017) further state that “The geographic distribution of *Pimelea cremnophila* is very highly restricted. The area of occupancy (AOO) and extent of occurrence (EOO) were estimated to be 4 km<sup>2</sup>. The AOO is equivalent to a single 2 x 2 km grid cell, the scale recommended for assessing AOO by IUCN (2016).” Even though surveys in the last few years have failed to locate new populations, there are still areas of potentially suitable habitat that could be searched for new populations (Copeland pers. comm. 2017).

### Ecology

The NSW Scientific Committee (2017) state that “*Pimelea cremnophila* occurs on exposed cliff tops or more sheltered cliff-side sites with southwesterly to south-easterly aspects in shallow skeletal loam soils over metasediments (Copeland and Telford 2006). The habitat is open forest of *Eucalyptus campanulata*, *E. retinens* and *Allocasuarina littoralis* with a shrubby understorey including *Acacia blakei* subsp. *diphylla*, *Maytenus silvestris*, *Prostanthera rhombea*, *Dodonaea rhombifolia*, *Astrotricha longifolia*, *Ozothamnus obcordatus*, *Persoonia media*, *Callistemon* sp. nov., *Correa reflexa* var. *reflexa*, *Lepidosperma elatius* s. l., *L. laterale*, *Rhodanthe* sp. nov. and *Rytidosperma longifolium* (Copeland and Telford 2006). In addition, several species have been noted in herbarium collections to co-occur with *P. cremnophila* including *Logania albiflora*, *Leiocarpa serpens*, *Lomandra longifolia*, *Gonocarpus oreophilus*, *Persoonia linearis* and *Ozothamnus diosmifolius*. *Pimelea cremnophila* is likely to flower throughout spring as flowers, floral buds and young fruits have been observed in October (Copeland and Telford 2006)”.

“*Pimelea cremnophila* belongs to section Epallage (Endl.) Benth. and appears to be most similar to *P. umbratica*” (Copeland and Telford 2006). “Sexuality in sect. Epallage requires further study. Threlfall (1983) stated that in *P. umbratica*, male, female and bisexual flowers may occur on the same individual. However, Threlfall included *P. leptospermoides* under *P. umbratica* and did not cite which specimens had been studied for that observation. Rye (1990) claimed *P. umbratica* has bisexual and female flowers. We have observed apparently functionally male (with pistillodes) and functionally female (with staminodes) flowers on the same plant. In *P. cremnophila*, plants appear to be polygamous, with functionally male and bisexual flowers on the same plants and only functionally female on others” (Copeland and Telford 2006).

The primary juvenile period of *P. cremnophila* is unknown but is possibly about 2 years (Copeland pers. comm. 2017). Based on observations from cuttings, this species appears to be fast growing, and its lifespan is estimated to be approximately between 5-10 years (Copeland pers. comm. 2017). However, growth of wild plants from seed may be much slower.

*Pimelea cremnophila* has a dry/hard fruit and small hard seeds (Copeland pers. comm. 2017). It does not appear to have any conspicuous adaptations to assist seed dispersal. It has been suggested that this species is likely to be dispersed by ants (myrmeconchory) like other species of the Thymelaeaceae family (Westboy et al. 1990, Benson and McDougall 2001). If so, its dispersal distance is likely to be low (Copeland pers. comm. 2017). “Distances that seeds are carried by ants, limited by ant foraging distances, are typically 1-2 m and rarely exceed 5 m although the occasional

exceptional distance has been reported” (Hughes et al. 1994). Though they travel a limited distance, ants may disperse seeds quite deeply into the soil. “Dispersal by ants, unlike other dispersal modes, may result in seeds being buried down to depths of 20 cm, although the majority of seeds in ant nests are found in the upper 8 cm (Shea et al. 1979; Bond & Slingsby 1983; Bond & Stock 1989; Hughes & Westoby 1992)” (Hughes et al. 1994).

This species is likely to maintain a long-lived, persistent, soil-stored seed bank as per other species of Thymelaeaceae (Fox 1988, Benson and McDougall 2001, Willis *et al.* 2003,). “The response to fire of *P. cremnophila* is poorly understood, but the species is suspected to be an obligate seeder” (Copeland pers. comm. 2017, Benson and McDougall 2001).

### **Threats**

The NSW Scientific Committee (2017) state that “Threats to *Pimelea cremnophila* include grazing by feral goats, extreme drought conditions and inappropriate fire regimes (Copeland and Telford 2006). Evidence of grazing by feral goats has been observed (L. Copeland in litt. May 2016). Mortality of mature individuals was also observed during 2002–2003, potentially correlated with extreme drought during this period (Copeland and Telford 2006). The forecast increase in the frequency and intensity of drought associated with anthropogenic climate change may therefore be a threat to this species. The population dynamics of *P. cremnophila* are currently poorly characterised, but the species is suspected to be an obligate seeder and therefore vulnerable to high frequency fires preventing successful recruitment and replenishment of the soil-stored seed bank.”

## Assessment against IUCN Red List criteria

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

### *Criterion A Population Size reduction*

Assessment Outcome: Data Deficient.

Justification: To be listed as a threatened under Criterion A, the species must have experienced a population reduction of at least 30% over three generations or 10 years (whichever is longer). Based on direct observations, there may have been a reduction in the number of mature individuals in the decade. *Pimelea cremnophila* was first observed in 2002. The entire population (three known populations) was visited in 2003-2004 and 2008. Unfortunately, the total population size was unknown at the time but estimated to be around 100 individuals. In November 2015, a visit to the two northernmost populations failed to relocate any individuals and less than 100 individuals were found at the third site. Grazing by goats, extreme drought conditions and inappropriate fire regimes may have contributed to any decline. However, declines in above ground plants in this species may also reflect natural fluctuations and the species may persist as seed in the soil seed bank. The life history of this species has not been sufficiently well documented to calculate generation length while it is uncertain how much of the declines observed are true declines versus natural fluctuations. Hence there is insufficient data to assess this species under this criterion.

### *Criterion B Geographic range*

Assessment Outcome: Critically Endangered under Criterion B1+2ab(iii).

Justification: The geographic distribution of *Pimelea cremnophila* is very highly restricted. The species is confined to gorge rims in the southern part of the Oxley Wild Rivers National Park along a 5 km stretch growing in “shallow, skeletal loam over metasediments on exposed cliff tops” (Copeland and Telford 2006). The extent of occurrence (EOO) for *Pimelea cremnophila* was estimated to be 4 km<sup>2</sup> based on a convex hull polygon fitted around all the species occurrences as per IUCN Guidelines (2017). A species with an EOO less than 100 km<sup>2</sup> qualifies for the Critically Endangered threshold. The area of occupancy (AOO) was also estimated to be 4 km<sup>2</sup>, based on one 2 x 2 grid cell (as recommended by IUCN 2017). A species with an AOO less than 10 km<sup>2</sup> qualifies for the Critically Endangered threshold for this criterion.

In addition to these thresholds, at least two of three other conditions must be met. These conditions are:

- a) The population or habitat is observed or inferred to be severely fragmented or number of locations; one (CR), ≤5 (EN), or ≤10 (VU).

Assessment outcome: sub criterion met at Critically Endangered with one location.

Justification: *Pimelea cremnophila* occurs at one location, as defined by the most plausible threat, which is grazing by goats. There is evidence of goats browsing on *Pimelea cremnophila* (Copeland pers. comm. 2017). This species occurs on shallow skeletal loam soils, and alteration of vegetation caused by goats represents an increased risk during extreme drought events. “Wild populations have become established, by goats escaping from farms or being abandoned by farmers when they have become unprofitable” (NSW OEH 2017). The number of feral goats in the area is likely to increase, threatening the survival and any recolonization of this species. “In Oxley Wild Rivers National Park, NPWS research has shown that feral goats cause significant damage to the dry rainforest communities in the Macleay gorges and significantly increase soil erosion” (NSW OEH 2017). Extreme drought is also suspected to cause mortality of this species, and predicted to increase in frequency and intensity caused by climate change (NSW Scientific Committee 2017).

- b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals

Assessment outcome: sub criterion met for iv and v.

Justification: There is evidence of continuing decline in the following;

(iv) number of populations: several populations were located along the gorge rim in a 5 km stretch in the southern part of the Oxley Wild Rivers National Park. In November 2015, a search in the area failed to relocate the two northernmost populations. It is uncertain whether the species may persist as seed in a persistent soil seed bank. Possible recolonization or recruitment may be highly threatened by the following:

- Fragmentation: the one remaining population is approximately 1.80 – 2.80 kms from the northernmost populations, and the dispersal mode of this species is highly likely to be myrmecochory. The dispersal achieved by ants is limited by their foraging distances, typically by 1-2 m and rarely exceed 5 m (Hughes et al. 1994).
- To recolonize the two northernmost populations, the species will require the presence of a persistent soil seed bank with viable seeds, a disturbance event to promote recruitment and a lack of grazing pressure from goats to allow any new recruits to survive and persist. *Pimelea cremnophila* is suspected to be an obligate seeder (Copeland pers. comm. 2017, Benson and McDougall 2001). The last registered fire in the area was approximately 10 years ago (Copeland pers. comm. 2017). Currently, the soil seed bank and the appropriate fire regime for this species are not well documented.

(v) number of mature individuals: the number of mature individuals is estimated to be low with fewer than 100 plants occurring in the only known population (Copeland pers. comm. 2017). In the past decade, the population of *Pimelea cremnophila* has declined to less than 100 individuals. A continuing decline is inferred due to the following threats:

- *Grazing by goats*: evidence of feral goats browsing on *Pimelea cremnophila* has been observed (NSW Scientific Committee 2017).
- *Extreme droughts*: individuals appear to die as a result of extreme drought. In 2003, a loss of a number of mature individuals was potentially correlated to extreme drought. An increase in the frequency and intensity of extreme drought caused by climate change is considered to be a threat to the species (NSW Scientific Committee 2017).
- *Inappropriate fire regimes*: this species is suspected to be an obligate seeder. Therefore, fires that are very frequent or infrequent may prevent recruitment and replacement of seed in the soil seed bank (NWS Scientific Committee 2017).

- c) Extreme fluctuations.

Assessment outcome: sub criterion data deficient.

Justification: There is no evidence of extreme fluctuation in this species.

#### *Criterion C Small population size and decline*

Assessment Outcome: Critically Endangered under Criterion C2a(ii).

Justification: A species with less than 250 mature individuals in each population qualifies for the Critically Endangered threshold for this criterion. Currently, the population size of this species is fewer than 100 mature individuals, and all individuals are in a single population. The northernmost populations may persist in a soil seed bank, however, at the time of the assessment (2017), all mature individual in the entire population are in a single population.

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

- 1) An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generations (whichever is longer) (CE); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment outcome: sub criterion data deficient.

Justification: To meet this sub criterion, the species must have experienced a population decline of at least 10% in 10 years or 3 generations (whichever is longer). Based on direct observations, a potential decline of the population has occurred in the past decade and the causes of the decline (grazing by goats, extreme drought and inappropriate fire regime) may have not ceased. The population size estimate before the decline is only very approximate (100 plants), and the life history of this species has not been well enough documented to calculate generation length. In addition, there may be potential for some recovery from a persistent soil seed bank. Therefore, there is insufficient data to assess this species under this sub criterion.

- 2) An observed, estimated, projected or inferred continuing decline

Assessment outcome: sub criterion met.

Justification: A continuing decline is observed; the number of mature individuals is estimated to be low with fewer than 100 plants occurring in the only known population (Copeland pers. comm. 2017). In the last decade, the population of *Pimelea cremnophila* has declined to fewer than 100 individuals due to the following threats:

- Grazing by goats: evidence of feral goats browsing on *Pimelea cremnophila* has been observed (NSW Scientific Committee 2017).
- Extreme droughts: individuals appear to die after extreme drought. In 2003, a loss of a number of mature individuals was potentially correlated to extreme drought. An increase in the frequency and intensity of extreme drought caused by climate change is considered to be a threat to the species (NSW Scientific Committee 2017).
- Inappropriate fire regimes: this species is suspected to be an obligated seeder. Therefore, fires that are very frequent or infrequent may prevent recruitment and replacement of seeds in the soil seed bank (NSW Scientific Committee 2017).

In addition, at least 1 of the following 3 conditions:

- a (i). Number of mature individuals in each population

Assessment outcome: sub criterion met at Endangered threshold.

Justification: A species with less than 250 mature individuals in each population, qualifies for the Endangered threshold for this sub criterion. Currently, the population size of this species is fewer than 100 mature individuals, and all individuals are in a single population.

- a (ii). % of mature individuals in one population

Assessment outcome: sub criterion met at Critically Endangered threshold.

Justification: A species with 90-100% of mature individuals in a single population, qualifies for the Critically Endangered threshold for this sub criterion. Currently, 100% of all known individuals are in a single population.

- b. Extreme fluctuations in the number of mature individuals

Assessment outcome: data deficient.

Justification: There is no evidence of extreme fluctuation for *Pimelea cremnophila*.

#### *Criterion D Very small or restricted population*

Assessment Outcome: Endangered under Criterion D.

Justification: A species with less than 250 mature individuals qualifies for the Endangered threshold for Criterion D. The only known population of *Pimelea cremnophila* is estimated to have fewer than 100 individuals.

D2: To be listed as Vulnerable, a species must meet at least one of the two following conditions:

- 1) Restricted area of occupancy (typically <20 km<sup>2</sup>) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

Assessment outcome: sub criterion met.

Justification: *Pimelea cremnophila* has a highly restricted area of occupancy (AOO) of 4 km<sup>2</sup>, based on one 2 x 2 grid cell (as recommended by IUCN 2017). *Pimelea cremnophila* occurs at one location, as defined by the most plausible threat that could drive the species to extinction, which is grazing by goats. Recent declines in all above ground plants at two sites suggests that the species could become extinct within a very short timeframe.

#### *Criterion E Quantitative Analysis*

Assessment Outcome: Data Deficient

Justification: At present, there is not sufficient data available for *Pimelea cremnophila* to estimate the risk of extinction under this criterion.

### **Conservation and Management Actions**

There is no National Recovery Plan and no NSW Saving our Species program for this species. The following is derived from the threat information.

#### Habitat loss, disturbance and modification

- Control feral goats from modifying/disturbing the habitat of this species.

#### Invasive species

- Control feral goats browsing and trampling on this species.
- Fence the area where the remaining population is located to protect it from feral goats.

#### Ex situ conservation

- Develop a targeted seed collection program for ex situ seed banking.
- Re-establish former population with seed/cuttings from the extant population.

#### Stakeholder Management

- Inform farmers of the impact of abandoning goats.
- Create a plan for farmers when goats become unprofitable.

### **Survey and Monitoring priorities**

- Monitoring for increased habitat degradation
- Regular surveys to determine whether there is a decline in the population
- Survey all potential habitat
- Monitor the two northernmost populations
- Monitoring for recruitment, including at the 2 previously known sites
- Monitor the species during extreme weather, especially drought.

### **Information and Research priorities**

- Information and research about the species ecology:
  - mode of dispersal,
  - recruitment,
  - existence and lifespan of soil seed bank,
  - fire ecology and appropriate fire regime.
- Research the effect of extreme weather on this species.
- Research best protocol for translocations.

## References

- Benson, D. and McDougall, L., 2001. Ecology of Sydney Plant Species – Part 8 Dicotyledon families Rutaceae to Zygophyllaceae. *Cunninghamia*, vol. 7(2): 241-462.
- Briggs, J.D. & Leigh, J.H., 1996. Rare or Threatened Australian Plants, revised edition. CSIRO Publishing: Collingwood.
- Copeland, L.M., 1997. Rare or Threatened Plants (ROTAPs) occurring in Oxley Wild Rivers National Park. Unpublished report produced for the NSW National Parks and Wildlife Service.
- Copeland, L.M. and Telford, I.R.H., 2006. *Pimelea cremnophila* (Thymelaeaceae), a new species from the New England Tablelands escarpment of northern New South Wales. *Telopea* 11(2): 111-116.
- Fox, M.D., 1988. Understorey changes following fire at Myall Lakes, New South Wales. *Cunninghamia*, vol. 2(1): 85-95
- Harden, G.J., 1990. Thymelaeaceae. Pp. 375–387 in Harden GJ (ed.) *Flora of New South Wales*, vol. 1. New South Wales University Press: Kensington.
- Holmgren, P.K., Holmgren, N.H. & Barnett, L.C., 1990. *Index Herbariorum* 8th Edition. New York Botanical Garden: New York.
- Hughes, L., Dunlop, M., French, K., Keishman, M.R., Rice, B., Rodgers, L. and Westboy, 1994. Predicting dispersal spectra: a minimal set of hypotheses based on plant attributes. *Journal of Ecology* 82: 933-950.
- IUCN Standards and Petitions Subcommittee, 2017. Guidelines for Using the IUCN Red List Categories and Criteria, Version 13.
- IUCN, 2012. *IUCN Red List Categories and Criteria: Version 3.1*, 2nd ed. Gland, Switzerland and Cambridge, UK.
- NSW OEH, 2017. Feral Goats. URL <http://www.environment.nsw.gov.au/pestsweeds/FeralGoats.htm> (accessed 11.10.2017).
- NSW Scientific Committee, 2017. Preliminary Determination to list the shrub *Pimelea cremnophila* L. M. Copel. & I. Telford as a Critically Endangered Species. URL <http://www.environment.nsw.gov.au/resources/threatenedspecies/determinations/PDPimcremnCR.pdf> (accessed 10.10.17).
- Rye, B.L., 1990. Thymelaeaceae. Pp. 122–215 in George AS (ed.) *Flora of Australia*, vol. 18. Australian Government Publishing Service: Canberra.
- Silcock, R.G. and Mann, M.B., 2014. Germinating the seeds of three species of *Pimelea* sect. *Epallage* (Thymelaeaceae)1. *Australian Journal of Botany*, 62(1): 74-83.
- Thomson, F.J., Moles, A.T., Auld, T.D., Ramp, D., Ren, S. and Kingsford, R.T., 2010. Chasing the unknown: predicting seed dispersal mechanisms from plants traits. *Journal of Ecology* 98: 1310-1318.
- Threlfall, S., 1983. The genus *Pimelea* (Thymelaeaceae) in eastern mainland Australia. *Brunonia* 5: 113–201.
- Willis, A.J., McKay, R., Vranjuc, J.A., Kilby, M.J., and Groves, R.H., 2003. Comparative seed ecology of the endangered shrub, *Pimelea spicata* and a threatening weed, Bridal Creeper: Smoke, heat and other fire-related germination cues. *Ecological Management and Restoration*, vol. 4 No. 1 pp 55-65.

## Expert Communications

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