



## Consultation Document on Listing Eligibility and Conservation Actions

### *Philothea sporadica* (Kogan waxflower)

You are invited to provide your views and supporting reasons related to:

- 1) the eligibility of *Philothea sporadica* (Kogan waxflower) for inclusion on the EPBC Act threatened species list in the Endangered category; and
- 2) the necessary conservation actions for the above species.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment and Energy.

Responses are to be provided in writing either by email to:  
[species.consultation@environment.gov.au](mailto:species.consultation@environment.gov.au)

or by mail to:

The Director  
Terrestrial Threatened Species Section  
Biodiversity Conservation Division  
Department of the Environment and Energy  
PO Box 787  
Canberra ACT 2601

**Responses are required to be submitted by 18 May 2018.**

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## General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the Department's website at:

<http://www.environment.gov.au/biodiversity/threatened/index.html>.

Public nominations to list threatened species under the EPBC Act are received annually by the Department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at:

<http://www.environment.gov.au/biodiversity/threatened/pubs/guidelines-species.pdf>.

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at:

<http://www.environment.gov.au/biodiversity/threatened/nominations.html>.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the Department's website at:

<http://www.environment.gov.au/biodiversity/threatened/recovery.html>.

## Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the *Privacy Act 1988* (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the '[common assessment method](#)'. As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: <http://environment.gov.au/privacy-policy>.

## Information about this consultation process

*Philotheca sporadica* (Kogan waxflower) was being considered for delisting by the Threatened Species Scientific Committee (the Committee), following a public nomination received in 2015. A draft assessment was undertaken in 2017, including a public consultation period between 29 November 2017 and 24 January 2018. The Committee considered the information in that assessment, including a recommendation that the Kogan waxflower is eligible for listing as Endangered. The Committee has subsequently recommended a further consultation period, to ensure all interested parties are able to provide comment on the proposed uplisting.

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the Department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

# *Philotheca sporadica*

Kogan waxflower

## Taxonomy

Conventionally accepted as *Philotheca sporadica* (Bayly) Paul G. Wilson.

## Species/Sub-species Information

### Description

The Kogan waxflower (family Rutaceae) is an open to compact shrub that grows to 150 cm high and has numerous branches. Along its length, each branch has many small (1–4 mm long) hairless, club-shaped leaves. The white flowers are 6–10 mm in diameter, solitary and occur on short stalks (up to 0.7 mm long) at the end of branchlets. Flowering has been recorded from August to October. Mature fruits have been observed in late November. Seeds are almost kidney-shaped, about 3 mm long and are forcibly ejected from the mature fruit (Halford 1995, cited in DoEE 2017a).

### Distribution

The Kogan waxflower is endemic to southern Queensland, occurring in the Brigalow Belt South IBRA bioregion. It is known from an area ranging from just south-west of Chinchilla, south down to Tara, further south to just beyond the Waar Waar State Forest, east across to the Western Creek State Forest, and then north up to Warra, crossing the Warrego Highway. The distribution area covers several state forests, including Dalby State Forest, Braemar State Forest, Vickery State Forest and large parts of Kumbarrilla State Forest. Kogan, after which the species is named, is located just north of the Braemar State Forest, within the distribution area (QGC 2015, pers comm, 26 March).

The distribution of this species overlaps with the following EPBC Act-listed threatened ecological communities, but is not considered a listed component of either ecological community (DECCW 2010; TSSC 2013):

- Brigalow (*Acacia harpophylla* dominant and co-dominant); and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

### Relevant Biology/Ecology

The Kogan waxflower is more common in partial shade than full sunlight and is more frequently found in sparse to dense patches, than as isolated plants. It is a perennial shrub. The longevity of individual plants is unknown, but it is likely to be at least 20 years (Halford 1995, cited in DoEE 2017a). The species is difficult to propagate from seeds or cuttings (it is likely to be physiologically dormant), but does respond well under tissue culture (USC 2012, cited in QGC 2015, pers comm, 26 March).

The Kogan waxflower is found on residual hills which are remnants of laterised Cretaceous sandstones. Topography of these areas is undulating to flat with low dissected flat-top or rounded hills. The soils on which this species grows are of low fertility (Dawson 1972; Halford 1995, both cited in DoEE 2017a; QGC 2015, pers comm, 26 March).

The vegetation associated with the Kogan waxflower is open shrubland to closed shrubland to closed woodland (HLA-Envirosciences Pty Ltd 2005, cited in DoEE 2017a). The Kogan waxflower is often associated with *Acacia burrowii* (yarron wattle), *Eucalyptus exserta*, *Eucalyptus crebra* (narrow-leaved ironbark), *Eucalyptus fibrosa* subsp. *nubilis* (red ironbark) and *Callitris glaucophylla* (white cypress pine) (Halford 1995, cited in DoEE 2017a). The Kogan waxflower occurs in dense thickets of shrubs, such as *Thryptomene* sp. While these waxflower individuals can be either older specimens or young recruits, the general appearance is that the

*Thryptomene* sp. thickets, being taller, are gradually excluding the waxflowers from the top of the scald (QGC 2015, pers comm, 26 March).

Although fire may adversely impact on other shrub species, such as *Thryptomene* sp., *Micromyrtus* sp. or *Calytrix* sp., the Kogan waxflower's response to varying fire regimes is unknown. The species potentially has a physiological seed dormancy may be released by fire, generating emergence, but a further understanding of this response is required.

Anecdotal evidence indicates that when the Kogan waxflower is damaged by fire, such as where the fire removes all above ground foliage, the plants are capable of shooting from the base and regenerating at a rate of up to 0.5 m growth in height in the first year (QGC 2015, pers comm, 26 March). This would indicate that the plants are capable of supporting rapid growth (Brundrett 2008, cited in QGC 2015, pers comm, 26 March). However, physiological seed dormancy mechanisms in Rutaceae, disturbance responses can vary widely, leading to variable recruitment success (Keith, 2017, pers comm, 21 November). However, because of physiological seed dormancy mechanisms recorded in other Rutaceae, suggest that disturbance responses can vary widely, leading to variable recruitment success (Keith, 2017, pers comm, 21 November).

It is possible that, like many other Rutaceae, the Kogan waxflower has a close relationship with mycorrhizae (a symbiotic relationship between fungi and plants). This would enable the species, along with other, co-occurring species, to extract valuable resources from the poor, shallow, sandy soils (Brundrett 2008, cited in QGC 2015, pers comm, 26 March).

A survey of wallaby and kangaroo grazing on the Kogan waxflower indicates most grazing was targeted at foliage. There was also occasional evidence of bark chewing (TSSC 2008). Rabbits could be the most likely cause of bark-stripping in this area (Keith, 2017, pers comm, 21 November). The Kogan waxflower has a pungent aromatic scent when brushed against and it is possible that, along with other co-occurring myrtaceous species, the aromatic compounds in the foliage makes the species less palatable. Whether the development of aromatic compounds within the foliage has evolved to inhibit grazing, or as a consequence of other factors, is unknown (QGC 2015, pers comm, 26 March).

## Threats

The main identified threat to the Kogan waxflower is habitat loss and fragmentation, with other threats identified as grazing, invasive weeds and fire (TSSC 2008).

Table 1 – Threats impacting the Kogan waxflower in approximate order of severity of risk, based on available evidence

| Threat factor                  | Threat type and status | Evidence base   |
|--------------------------------|------------------------|---|
| Habitat loss and fragmentation | Known/<br>Current      | <p>Habitat is being cleared and fragmented as a result of development and recreational activities:</p> <ul style="list-style-type: none"> <li>• coal seam gas development (pipelines, associated infrastructure, maintenance tracks) (DoEE 2017b);</li> <li>• general road maintenance activities and/or associated use of roadsides, i.e. laydown areas (QGC 2015, pers comm, 26 March);</li> <li>• development of local council quarry pits (QGC 2015, pers comm, 26 March);</li> <li>• development of transmission lines and other infrastructure (Powerlink Queensland 2005, cited in DoEE 2017a);</li> <li>• forestry practices (Halford 1995, cited in DoEE 2017a); and</li> <li>• recreational use (such as cross-country motorcycle riding) (Halford 1995, cited in DoEE 2017a).</li> </ul> |

|         |                       |   |
|---------|-----------------------|---|
| Grazing | Possible/<br>Current  | The Kogan waxflower has been observed to persist in areas where sheep have grazed for many years. However, the population at one site is restricted to a road verge, with grazing by domestic animals possibly excluding the species from the adjacent paddock (Halford 1995, cited in DoEE 2017a).   |
| Fire    | Possible/<br>Current  | The effect of fire on this species is uncertain (Keith 2017, pers comm, 21 November; QGC 2015, pers comm, 26 March). However, it is noted that fire intensity and fire season may be factors impacting on the magnitude and timing of seedling emergence in other Rutaceae with physiological dormancy, with varied germination responses (McKenzie et al., 2016). Further research is needed to determine an appropriate fire management regime for the Kogan waxflower. |
| Weeds   | Suspected/<br>Current | Halford (1995, cited in DoEE 2017a) recorded mother of millions ( <i>Bryophyllum</i> sp.) at the Warra Road site and considered that this invasive species might cause environmental problems in future, due to its invasive nature, i.e. competition.  |

### **Assessment of available information in relation to the EPBC Act Criteria and Regulations**

| <b>Criterion 1. Population size reduction (reduction in total numbers)</b>                            |  |  |   |  |
|---|--|--|---|--|
| Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4 |  |  |   |  |
|   | <b>Critically Endangered<br/>Very severe reduction</b>   | <b>Endangered<br/>Severe reduction</b> | <b>Vulnerable<br/>Substantial reduction</b> |  |
| <b>A1</b>   | <b>≥ 90%</b>   | <b>≥ 70%</b>                           | <b>≥ 50%</b>                                |  |
| <b>A2, A3, A4</b>   | <b>≥ 80%</b>   | <b>≥ 50%</b>                           | <b>≥ 30%</b>                                |  |
| A1  | <div> <div>Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</div> <div>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.</div> <div>Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</div> <div>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.</div> </div> <div> <div>based on any of the following:</div> <div>(a) direct observation [except A3]</div> <div>(b) an index of abundance appropriate to the taxon</div> <div>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</div> <div>(d) actual or potential levels of exploitation</div> <div>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</div> </div> |  |   |  |
| A2  |  |  |   |  |
| A3  |  |  |   |  |
| A4  |  |  |   |  |

#### **Evidence:**

#### **Insufficient data to determine eligibility**

More information is required to determine whether the Kogan waxflower is in decline.

Halford (1995, cited in DoEE 2017a) estimated that individual Kogan waxflower shrubs can live for 20 years, which is likely to be a minimum age, given its apparent capacity for vegetative regeneration (Keith, 2017, pers comm, 21 November). There is no information concerning

generation length. It was observed that the Kogan waxflower often occurs in small discrete clusters in open areas, including road verges, and additional plants are likely to be found in unsurveyed hard soil crust areas near other known plants (Powerlink Queensland 2005, cited in DoEE 2017a).

An initial total population estimate of 64 000 (Halford 1995, cited in DoEE 2017a) has been increased, following verification of an additional 2761 records from coal seam gas surveys (Brown 2018, pers comm, 4 January; QGC 2015, pers comm, 26 March). Following analysis, the additional number of individuals represented by this new data is estimated as being between 55 000 and 71 000, with a total estimated population for the Kogan waxflower, including the new data, between 119 000 and 135 000 (ERIN 2018b).

These population estimates indicate that the increased survey effort has located more individuals and thus, that population numbers are becoming more accurate. This is consistent with records verified by the Atlas of Living Australia, which indicate an increase in records in the last three decades (ALA 2017). This data does not, however, indicate a clear trend concerning population numbers. More information, for example, surveys in the southern part of the range, is required to demonstrate if there is a trend concerning increase or decrease in population numbers.

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

| <b>Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy</b>  |  |                                  |                               |
|---|--|----------------------------------|-------------------------------|
|   | <b>Critically Endangered<br/>Very restricted</b> | <b>Endangered<br/>Restricted</b> | <b>Vulnerable<br/>Limited</b> |
| 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 indicating distribution is precarious for survival:  |  |                                  |                               |
| (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 2 B1 B2 (a),(b)(iii) for listing as Endangered**

The extent of occurrence for the Kogan waxflower is 2,976 km<sup>2</sup> and the area of occupancy is 220 km<sup>2</sup>. These figures are based on the mapping of post-1998 species observations over a 20-year timeframe, obtained from state governments and Commonwealth agencies, along with museums, herbaria, research institutions and non-government organisations (ERIN 2018c). The extent of occurrence was calculated using a minimum convex hull and the area of occupancy calculated using a 2x2 km grid cell method, based on the *IUCN Red List Categories and Criteria* (v3.1) (IUCN SSC 2012) and *Guidelines for Using the IUCN Red List Categories and Criteria* (v13) (IUCN SPC 2017; ERIN 2018c). The figures used in this assessment include the new data referred to in the nomination and provided to the Queensland WildNet database.

The calculation used in this analysis (2,976 km<sup>2</sup> for extent of occurrence and 220 km<sup>2</sup> for area of occupancy) do not include records dating back more than 20 years (ERIN 2018c), as plants are often not extant after this period of time.

The IUCN defines a location as “a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of a taxon present” (IUCN SPC 2017). The Kogan waxflower occurs in a northern and southern population area, with the southern population area further separated into two discrete areas (ERIN 2018c). In accordance with the IUCN definition for location, this analysis identified three locations in which the Kogan waxflower occurs, one northern location (the northern population area) and two southern locations (two discrete southern locations). Further, it is considered that coal seam gas development is the most plausible serious threat to the Kogan waxflower across the northern population area (IUCN SPC 2017; QGC 2017; ERIN 2017b).

The extent and quality of habitat in the northern population area is being increasingly fragmented and is in decline, owing to increasing development for the coal seam gas industry. Exploration and development licences for coal seam gas exist across almost the entire northern population area (QGC 2017). Coal seam gas development is also likely to be reducing the number of occurrences within the northern population area, as infrastructure removes individuals and increasingly fragments habitat (Williams et al., 2012).

Information concerning the level of habitat fragmentation is inferred from data concerning increasing coal seam development, particularly in the northern population area (ERIN 2017b). It is unclear whether this fragmentation may lead to an increased risk of extinction. Analysis of the impacts of linear infrastructure suggests the cumulative effect of vegetation loss and edge effects is substantially more than is often recognised (Raiter 2018). A genetic analysis of the Kogan waxflower indicates high genetic diversity within those populations that were sampled and which were found to be genetically similar (Shapcott et al., 2014). These results indicate high gene flow, and distinct and viable gene connectivity between the sampled populations. The study noted, however, that there is likely to be a loss of genetic diversity for populations affected by direct clearing for pipeline infrastructure works, with resulting alterations to inter-population gene flow (Shapcott et al., 2014). As more coal seam gas developments come on line, increasing habitat fragmentation from clearing is likely to be genetically detrimental to the species.

In summary, the available data indicate that:

- although the estimates of the area of occupancy (now 220 km<sup>2</sup>) and extent of occurrence (2,976 km<sup>2</sup>) have improved as a result of the verification of new records (2761 records), the Kogan waxflower’s restricted distribution meets the requirements for the category of Endangered;
- habitat is increasingly fragmented, particularly in the northern population area, owing to coal seam gas development;
- the species occurs in only three locations (a northern and two southern population areas), and meets the requirements for the category of Endangered;
- the prevalence of coal seam gas development licences, particularly in the northern population area, is resulting in a continuing observed decline in the extent and quality of habitat (DoEE 2017a; ERIN 2018c; ERIN 2017b; QGC 2017); and
- there is insufficient information to determine if the Kogan waxflower is subject to extreme fluctuations.

The Committee considers that the species’ extent of occurrence and area of occupancy is very restricted, and the geographic distribution is precarious for the survival of the species because its habitat is being increasingly fragmented, it occurs in only three locations (one northern and two southern population areas), and decline in area, extent and/or quality of habitat may be inferred or projected. Therefore, the species has met the relevant elements of Criterion 2 to make it eligible for listing as Endangered.



| <b>Criterion 3. Population size and decline</b>   |  |   |  |
|---|--|---|--|
|   | <b>Critically Endangered<br/>Very low</b>  | <b>Endangered<br/>Low</b>   | <b>Vulnerable<br/>Limited</b>  |
| Estimated number of mature individuals  | <b>&lt; 250</b>  | <b>&lt; 2,500</b>   | <b>&lt; 10,000</b>   |
| 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)   | <b>Very high rate<br/>25% in 3 years or 1 generation<br/>(whichever is longer)</b> | <b>High rate<br/>20% in 5 years or 2 generation<br/>(whichever is longer)</b> | <b>Substantial rate<br/>10% in 10 years or 3 generations<br/>(whichever is longer)</b> |
| 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: |  |   |  |
| (i) Number of mature individuals in each subpopulation  | <b>≤ 50</b>  | <b>≤ 250</b>  | <b>≤ 1,000</b>   |
| (a) (ii) % of mature individuals in one subpopulation =   | <b>90 – 100%</b>   | <b>95 – 100%</b>  | <b>100%</b>  |
| (b) Extreme fluctuations in the number of mature individuals  |  |   |  |

#### **Evidence:**

#### **Insufficient data to determine eligibility**

While population estimates have been made, there is no definitive information on the number of mature individuals across the species' range.

Halford (1995, cited in DoEE 2017a) estimated the total population to be 58 150 individuals, with >80 percent of the total population around Kogan, but emphasised that this figure was likely to be an underestimate of the actual population size. A survey by Powerlink Queensland reported an additional 6000 individuals southeast of Kogan and revised the total population estimate to in excess of 64 000 individuals in the wild (HLA-Envirosciences Pty Limited 2005; Powerlink Queensland 2005, both cited in DoEE 2017a).

Surveys between 2010 and 2014 by the coal seam gas industry have reported > 159 000 individuals at over 3000 locations, an estimated additional 30 populations (QGC 2018, pers comm 24 January; QGC 2015, pers comm, 26 March). Data provided to the Queensland WildNet database verified 2761 records from this survey work (Brown 2018, pers comm, 4 January), which was restricted to the northern population area..

An analysis was undertaken to determine how many individual plants this new data represents. The data provided specific individual plant counts for some records and these numbers were added to the previous total of 64 000. However, some records provided only a range for the number of plants, or an estimate. Where no specific figure was provided, the analysis included the average number of individuals for that record (ERIN 2018a, pers comm, 25 January).

In some cases, records included more than one count for the same location; essentially, a duplicate record. Where this occurred, duplicate records were not counted and the analysis included the 'best fit', that is, the most likely number of individuals for that record, given the size of the area in which the record was made. For example, a small location of approximately 10 m<sup>2</sup> was represented by multiple records (up to 12) with the same count (500 plants). In this case, only one record was used to contribute to the total population count. It was assumed that the

other (11) records are duplicate entries that are describing the count in the same location (ERIN 2018a, pers comm, 25 January).

As a result of this analysis, the total number of individual plants from the new data was an estimated range of between 55 459 and 71 258 (rounded down as 55 000 and 71 000). Added to the estimate of 64 000, this provides a total population figure of between 119 459 to 135 258 (rounded down as 119 000 and 135 000) (ERIN 2018b). This is substantially below the figure of > 159 000, the estimate provided in the nomination for the total population (QGC 2018, pers comm 24 January; QGC 2015, pers comm 26 March) and it remains unclear how this estimate was determined.

A commissioned unpublished study undertaken in June 2011 by the University of the Sunshine Coast (USC 2012, cited in QGC 2015, pers comm, 26 March) concluded that, across 18 surveyed populations within the extent of occurrence, the average population density of the Kogan waxflower was 4200 individuals per hectare. Based on a per hectare calculation, it was estimated that the total population size across the 18 sites surveyed was approximately 74 410 individuals, noting that surveys were carried out only in the northern population area (USC 2012, cited in QGC 2015, pers comm, 26 March). The study reported the average reproductive proportion to be > 80 percent (USC 2012, cited in QGC 2015, pers comm, 26 March), an estimate that remains to be published.

Analysis of the survey data from between 2010 and 2014 reported that the ratio of juveniles to mature Kogan waxflowers is low, probably less than 1:9 (QGC 2015, pers comm, 26 March). This may indicate low recruitment and/or a senescing population. This estimate is based on observations that individuals as small as 300 mm high have had flowers (considered a sign of maturity) (QGC 2015, pers comm, 26 March). This analysis has not been published.

If these relative proportions are accurate, a conservative estimate for the number of mature individuals would be 52 000, based on the lower end of the range of total population estimate, up to an estimate of 68 000, based on the higher end of the range. This estimate would be well above the 10 000 threshold for eligibility as Vulnerable, but must remain a hypothetical without published data.

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

| Criterion 4. Number of mature individuals |  |                        |                   |
|---|--|------------------------|-------------------|
|   | Critically Endangered<br>Extremely low | Endangered<br>Very Low | Vulnerable<br>Low |
| Number of mature individuals              | < 50                                   | < 250                  | < 1,000           |

#### **Evidence:**

#### **Insufficient data to determine eligibility**

As under Criterion 3, while population estimates have been determined, there is no definitive information on the number of mature individuals across the species' range. A conservative estimate of approximately 52 000 mature individuals could be inferred, based on a reported proportion of mature (reproducing) Kogan waxflowers to juveniles of > 80 percent (QGC 2015, pers comm 26 March). This estimate is well above the 1000 threshold for eligibility as Vulnerable under this criterion, but is hypothetical without published data.

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

| Criterion 5. Quantitative Analysis                          |  |  |                                  |
|---|--|--|----------------------------------|
|   | Critically Endangered<br>Immediate future                                | Endangered<br>Near future  | Vulnerable<br>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               |

### Evidence:

#### Insufficient data to determine eligibility

A quantitative analysis which estimates the extinction probability of the Kogan waxflower has not been undertaken.

## Conservation Actions

### Recovery plan

The Committee recommends that there should not be a recovery plan for *Philothea sporadica* (Kogan waxflower). An approved Conservation Advice provides sufficient direction to implement priority actions, mitigate key threats and enable recovery. A recovery plan would not add significant benefit.

### Primary conservation actions

1. Prevent and/or reduce fragmentation of Kogan waxflower habitat to enable genetic exchange, as populations are increasingly isolated and likely to be at risk from a loss of genetic diversity.
2. Protect extant populations to the greatest extent possible, through conservation covenants or other legal mechanisms, so that the current area of occupancy can be maintained.
3. Investigate mechanisms for enhancing existing populations, such as disturbance trials, and/or creating new populations through propagation and translocations, where possible, to promote recruitment.

Further habitat fragmentation, for example, as a result of infrastructure development, is likely to have a significant impact on the species, particularly if it results in the loss of any extant population.

### Conservation and management priorities

#### Habitat Loss, Disturbance and Modification

- Minimise adverse impacts from changed land use at known sites, and protect from grazing and frequent fire, where necessary.
- Protect areas of native vegetation which contain populations/occurrences/remnants of the Kogan waxflower.
- Ensure road widening and maintenance activities in areas where the Kogan waxflower occurs do not adversely impact on known populations.
- Investigate formal conservation arrangements, such as covenants or inclusion in reserve tenure.

#### Grazing or Browsing

- Prevent total grazing pressure at known sites through exclusion fencing or other barriers.

### Invasive Weeds

- Develop and implement a management plan for the control of weeds, including mother of millions (*Bryophyllum* sp.), in the local region.
- Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on Kogan waxflower populations.
- Manage sites to prevent introduction of invasive weeds, which could become a threat to the Kogan waxflower, using appropriate methods.

### **Survey and monitoring priorities**

- Monitor sites to identify and manage threats.
- Monitor the progress of recovery, including effectiveness of management actions and the need to adapt them, if necessary.
- Identify sites of high conservation priority, for example, where recruitment is taking place.

### **Information and research priorities**

- Investigate options for linking, enhancing or establishing additional populations.
- Undertake disturbance trials, including using fire, to determine appropriate triggers for unlocking physiological dormancy.
- Undertake appropriate seed collection and storage to facilitate propagation and translocation.
- Implement national translocation protocols (Vallee et al., 2004), if establishing additional populations is considered necessary and feasible.

### **Stakeholder engagement and governance**

- Raise awareness of the Kogan waxflower within the local community, particularly land owners and managers, as well as local authorities and industry, to promote the species' protection.

## **Collective list of questions – your views**

### **PART 1 – INFORMATION TO AID LISTING ASSESSMENT**

1. Do you have any additional information about the **ecology or biology** of the species?
2. Can you provide any additional information or estimates on **longevity, average life span or generation length** for the species?
3. Do you have additional information to support an **estimate of the current population size** of mature adults of the species (national extent)?
4. Do you have additional information on **population trends** over 3 generations, or an historic population size for the species (national extent)?
5. Do you have additional information on **current range** (national extent) or **location of populations** for the species?
6. Can you provide additional information on any **change in range or location of populations**, or an **historic range** (national extent)?

### **PART 2 – INFORMATION FOR CONSERVATION ADVICE ON THREATS AND CONSERVATION ACTIONS**

7. Do you have further information on the historic, current or potential **threats** facing the species?
8. Do you have further information on current or potential **management actions** to support protection and recovery of the species?
9. Do you have further information on current or potential **monitoring or research activities** for the species?
10. Are you aware of **other knowledge** (e.g. traditional ecological knowledge) that may help better understand the threats and management actions to aid recovery of the species?
11. Are you aware of any **cultural importance or use** that the species has?
12. What **individuals or organisations** are currently, or potentially could be, involved in management and recovery of the species?

### **PART 3 – ANY OTHER INFORMATION**

13. Do you have comments on any other matters relevant to the assessment of this species?

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