

NSW Threatened Species Scientific Committee

Conservation Assessment of *Hibbertia circinata* K.L.McDougall & G.T.Wright (Dilleniaceae)

K Turner, 31 October 2019
NSW Threatened Species Scientific Committee

***Hibbertia circinata* K.L.McDougall & G.T.Wright (Dilleniaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Not listed

Proposed listing on NSW BC Act and EPBC Act: Critically Endangered

Conservation Advice: *Hibbertia circinata*

Summary of Conservation Assessment

Hibbertia circinata was found to be eligible for listing as Critically Endangered under IUCN Criterion B1ab(iii) and B2ab(iii) and C2 a (ii) equating to Biodiversity Conservation Act 2016 Clauses 4.3 (a)+(d)+(e)(iii) and 4.4 (a)+(e)(i)+(e)(ii)(B).

The main reasons for this species being eligible are i) small population; ii) restricted geographical range and iii) serious threat of irreversible habitat degradation.

Description and Taxonomy

Hibbertia circinata is described by McDougall *et al.* (2018) as:

“Shrubs 1–1.5 m tall, with several to many \pm erect stems, pubescent with simple, spreading to subappressed, straight, crisped or coiled hairs to 1.25 mm long (rarely to 2 mm long around leaf bases); new growth villous, vestiture persistent to lower branches. Leaves sessile with broad, partly stem-clasping bases which remain when the lamina separates at a distinct abscission line; lamina oblanceolate (or occasionally oblong to almost spathulate), entire (or rarely, irregularly toothed near apex), 15–55 mm long, 5–10(–12) mm wide, discolorous; adaxial surface dark green, pubescent, with semi-appressed hairs ranging from tightly coiled (to 0.2 mm diameter) to curled or \pm straight, mostly to 0.5 mm long, but up to 2.5 mm long towards base and margin, abaxial surface pale grey-green, with hairs similar to those on adaxial surface but usually less appressed, apex obtuse, but the midrib protruding as a straight or recurved callus point to 1 mm long; margins flat in vivo, but often recurving on drying. Flowers apparently axillary, solitary (rarely paired), sessile, subtended by 2–4 hypsophylloids (*sensu* Toelken 2000), 3–12 mm long, grading toward normal leaves at the base. Sepals 5, ovate to obovate, obtuse to subacute, sometimes minutely apiculate, 5–6.5 mm long and 2.5–3.5 mm wide; outer 3 sepals sparsely to densely pubescent with simple hairs on both surfaces, at least distally but not on hyaline margins, c. 0.5 mm wide; inner 2 sepals usually slightly longer than outer sepals, glabrous or with a few scattered hairs distally on outer surface. Petals 5, yellow, obovate, 9–13 mm long, 7–11 mm wide, broadly emarginate, glabrous. Stamens 9–13, surrounding carpels, \pm equal in length; filaments c. 1.5 mm long, free; anthers \pm rectangular, c. 1.0 mm long, obtuse, dehiscing by terminal slits c. 0.5 mm long and extending down lateral margin for up to c. 0.2 mm. Staminodes absent. Carpels 3, laterally compressed, glabrous; style divergent, flattened, 1.0–2.0 mm long. Ovules 2 per carpel. Fruit not seen.”

McDougall *et al.* (2018) provide the following guidance to differentiate *Hibbertia circinata* from three related taxa (*H. linearis*, *H. obtusifolia* and *H. saligna*):

“*Hibbertia circinata* differs from *H. linearis* in its villous rather than shortly tomentose, often soon glabrous stems and young branches, its broader leaves with conspicuous persistent

NSW Threatened Species Scientific Committee

indumentum (those of *H. linearis* being glabrous or glabrescent), larger petals (to 13 mm long, compared with c. 10 mm long in *H. linearis*) and fewer stamens (9–13 compared with 15–25 in *H. linearis*). The nearest known locality for *H. linearis* (and the southern-most extent for that species) is in coastal hinterland west of Pambula (CANB867000) about 30 km north of Mt Imlay. Some forms of the variable *H. obtusifolia* superficially resemble *H. circinata* but the leaves of *H. obtusifolia* are usually concolorous, glabrous or glabrescent. The stamen number for *H. obtusifolia* (>30 per flower) exceeds that of both *H. circinata* and *H. linearis*. *Hibbertia circinata* differs from *H. saligna* in having pubescent upper leaf surfaces, smaller, partly glabrous sepals (to 6.5 mm long, compared with 12–16 mm long and silky in *H. saligna*), and fewer stamens (9–13 compared with 20–35 in *H. saligna*). With *H. saligna* collections from Mt Imlay now being assigned to *H. circinata*, the southern limit for *H. saligna* is in hinterland forest north-west of Batemans Bay.”

Distribution and Abundance

Hibbertia circinata has a highly restricted geographic distribution, known only from ridges immediately below the summit of Mount Imlay, south-west of Eden on the south coast of NSW (McDougall *et al.* 2018). These authors estimated the species’ total population to be about 200 plants, based on a count of individuals during flowering in October 2016 (K. McDougall *in litt.* 2018). This population represents a single threat-defined location (see NSW TSSC, 2018).

The species’ area of occupancy (AOO) is estimated to be 4 km², with all known records of the species contained within a single 2 x 2 km grid cell, the spatial scale of assessment recommended by IUCN (2017). This includes collection locations of older herbarium specimens (previously assigned to other taxa) that were examined by McDougall *et al.* (2018) and identified as belonging to *H. circinata*.

The extent of occurrence (EOO) is also 4 km². The EOO is reported as equal to AOO despite the range of the species, measured by a minimum convex polygon containing all the known sites of occurrence, being less than AOO. The two figures are reported as equal in order to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (IUCN 2017).

Ecology

There is little information currently available on the ecology and biology of *Hibbertia circinata*. It is a perennial shrub growing to 1.5 m tall, with a generation length of “at least 15 years ...and probably a few decades” (K. McDougall *in litt.* March 2018). Flowering may occur throughout the year but is reported to be most prolific in spring (McDougall *et al.* 2018). K. McDougall (*in litt.* March 2018) indicates that the population does not appear to be even aged, but that recruitment of juvenile plants into the population may be rare, possibly because of the dense shrub cover of its habitat. The species’ response to fire is unknown. The closely related *H. obtusifolia* is known to resprout after fire (K. McDougall *in litt.* March 2018). In the Sydney region many *Hibbertia* species are known to resprout from plant bases following fire, and most species are also reported to recruit from soil-stored seedbanks; a small number of species have been observed to be killed by high intensity fire (Benson and McDougall 1995).

Hibbertia circinata is restricted to the summit ridges of Mount Imlay, where individuals have been recorded at elevations of between c. 800 and 850 metres above sea level (McDougall *et al.* 2018). The summit and upper slopes of Mount Imlay have shallow, loose sandy soils dominated by rock fragments, derived from Merimbula Group rocks of sedimentary origin including sandstone, conglomerate, quartzite, siltstone and shale (NSW National Parks and Wildlife Service 1998). The species’ habitat is described by McDougall *et al.* (2018) as shrubby woodland, with a tree canopy commonly dominated by *Eucalyptus sieberi* and a diverse shrub layer that includes *Boronia imlayensis*, *Oxylobium ellipticum*, *Xanthorrhoea australis*, *Tetratheca subaphylla*, *Dillwynia glaberrima* and *Amperea xiphoclada*. Individuals of *H.*

NSW Threatened Species Scientific Committee

circinata have also been observed growing beneath other eucalypts, including plants on Mount Imlay's eastern face under the canopy of mallee *E. imlayensis* and several plants below the northern edge of the summit ridge growing beneath *E. fraxinoides*.

Threats

Pathogens

Targeted surveys confirmed the presence of the introduced plant pathogen *Phytophthora cinnamomi* (also known as root-rot fungus or cinnamon fungus) in Mount Imlay National Park in 2001 (McDougall and Summerell 2003). "Infection of native plants by *Phytophthora cinnamomi*" is listed as a Key Threatening Process under the NSW Biodiversity Conservation Act 2016 and is recognised as a specific threat (likely to result in death of plants and reduction in habitat complexity) for the tree species *Eucalyptus imlayensis* (NSW Scientific Committee 2002), which is also restricted to the summit of Mount Imlay. Under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999, "Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)" is also listed as a key threatening process at a national level.

McDougall *et al.* (2018) report that *Hibbertia circinata* occurs predominantly in the Mount Imlay summit ridge area not infested with *Phytophthora cinnamomi*. The species' direct susceptibility to *P. cinnamomi* has not yet been tested. Australian plant families with many species known to be susceptible to the pathogen include the Dilleniaceae (Weste 1994), of which *Hibbertia* is a member. A review of published and unpublished records and observations of Australian plant species responses to *P. cinnamomi* suggests that the susceptibility of *Hibbertia* is variable across the genus, but a number of species were categorised as Highly Susceptible – "species that are frequently and consistently killed in the wild following infection by *P. cinnamomi*, and/or appear to decline or be rare" (O'Gara *et al.* 2005, Appendix 4). The current population of *H. circinata* occurs in areas containing a diverse shrub layer, and K. McDougall (*in litt.* March 2018) notes that it occurs almost exclusively in areas where plants of *Xanthorrhoea australis* are healthy (showing no signs of *P. cinnamomi* infection). In contrast, *H. circinata* is absent from areas of the Mount Imlay summit that have been invaded by *P. cinnamomi* and from which *X. australis* (a species known to be susceptible) is absent. These areas now have low shrub diversity in a simplified understorey dominated by sedges and grasses (K. McDougall *in litt.* March 2018).

It is inferred from the above that *Hibbertia circinata* is highly likely to be negatively affected by *Phytophthora cinnamomi* indirectly through changes to vegetation structure and habitat. There also appears to be a reasonable potential that the species might also be directly affected, through the death or decline of infected plants, but this requires confirmation by species-specific testing of the susceptibility of *H. circinata*.

To date, there are no practical methods available to eradicate *Phytophthora cinnamomi* from areas of infestation in native vegetation, and limited methods to contain the spread of the pathogen at infected sites (DECC 2008). Dunstan *et al.* (2008) found the most effective treatment was an intensive regime that involved complete vegetation destruction (to create a 'dead zone'), application of fungicide and soil fumigation, after which the pathogen was not detectable in samples of soil and root material after 6 months; however they cautioned that the pathogen "may be present in a dormant form in large root material at depth and hence survived the chemical treatments" and cautioned that effectiveness depends on many factors including soil type and depth.

NSW Threatened Species Scientific Committee

Fire

The response of *Hibbertia circinata* to fire is currently unknown. K. McDougall (*in litt.* March 2018) reports that fires have occurred on the summit of Mount Imlay, at infrequent intervals, and suggests that recruitment of juvenile *H. circinata* individuals into the population does not appear to be tied to disturbance such as fire. The closely related *H. obtusifolia* is known to resprout from plant bases following fire, as do many other *Hibbertia* species, but some other *Hibbertia* species are reported to be killed by high intensity fire (Benson and McDougall 1995). The single population of *H. circinata* occurs within Mount Imlay National Park and the Plan of Management for this reserve (NPWS 1998) records an intention that fire will be managed to ensure "...conservation of threatened and biogeographically significant plant and animal species and communities" – although the specific fire regime requirements of *H. circinata* are unknown. Frequent fire is a potential threat due to exposure of the site to lightning strikes and the risk of escape of planned fires and aerial ignitions in the surrounding production forest downslope. However, the current NPWS Fire Management Strategy applying to Mount Imlay National Park (NPWS 2010) indicates a Time Since Fire of between 26 and 40 years for the Mount Imlay peak area (at the time of map production) and a Vegetation Threshold Analysis that the peak's fire history is 'Within Threshold' for the vegetation mapped in this area – 'A burn is neither required nor should one necessarily be avoided'.

Feral Herbivores

Feral herbivores are not currently known to be a threat to *Hibbertia circinata*. Based on the species' locality and restriction to dry shrubby forest on a high stony peak in coastal ranges, the feral herbivores with potential for impacts on the species are deer and goats. The nomination and the paper describing *H. circinata* do not raise grazing/browsing by feral herbivores as a current threat. The Plan of Management for Mount Imlay National Park (NPWS 1998) records a general intention that "Introduced animals will be controlled as far as practicable where they have a significant impact on native animals or habitats" and that "The impact of introduced animals in the park will be assessed and control programs will be undertaken if necessary."

Weeds

Weeds are not currently known to be a threat to *Hibbertia circinata*. The population is only accessible by walking track, with no vehicular access, and its sandy, rocky habitat on the peak of Mount Imlay is dominated by native plant species.

Climate change

Climate change projections by CSIRO (Grose *et al.* 2015) for the subregion encompassing Mount Imlay infer, with very high confidence, that average temperatures will continue to increase in all seasons, with more hot days and warm spells. Fewer frosts, lower cool season rainfall totals and a harsher fire-weather climate is projected in the future with high confidence in the region. With *Hibbertia circinata* restricted to a single small population within a very narrow altitudinal band on the summit of an isolated mountain, there appears to be little potential for the species to shift its distribution in response to any of these changes, and therefore a high potential that climate change represents a real threat to the long-term survival of the species. "Anthropogenic Climate Change" is listed as a Key Threatening Process under the NSW Biodiversity Conservation Act 2016.

NSW Threatened Species Scientific Committee

Assessment against IUCN Red List criteria

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

Criterion A Population Size reduction

Assessment Outcome: Data Deficient

Justification: The strongest case for a threatened status for *Hibbertia circinata* under this criterion is via A3 (c), "Population reduction inferred... to be met in the future based on (c) a decline in ... habitat quality." However, it is not currently possible to estimate the % of likely decline over 3 generation lengths with any certainty. The direct susceptibility of *H. circinata* to decline or death resulting from *Phytophthora cinnamomi* infection has not yet been tested, however there is strong evidence to support an inference that invasion of its habitat by *P. cinnamomi* will lead to a significant decline in habitat quality. The pathogen is confirmed to be present in close proximity to the population of *H. circinata* and has been observed to cause drastic changes to habitat in infected areas within 20 years, which is within the estimated range of one generation length for this shrub species. If *P. cinnamomi* were to infect the habitat of the entire population of *H. circinata*, the resulting decline in habitat quality could potentially lead to very large population reductions. However, the risk of such widespread habitat infection is unknown - lesser proportions of invasion would lead to lower population reductions. The simple hygiene measures now in place to limit the spread of *P. cinnamomi* could potentially slow or delay its movement into current *H. circinata* areas. Although *P. cinnamomi* is strongly inferred to have negative effects on *H. circinata* habitat quality, and those effects are not reversible and are likely to be ongoing, it is not currently possible to reliably quantify the likely extent of reduction against the numerical thresholds under criterion A3 (c).

Criterion B Geographic range

Assessment Outcome: Critically Endangered under both criteria B1+a+b(iii) and B2+a+b(iii)

Justification: *Hibbertia circinata* has both an extent of occurrence and an area of occupancy of 4km², which are below the thresholds for the Critically Endangered category (EOO <100 km², AOO <10 km²). In addition to these thresholds, the species meets the following 2 conditions:

- a) The population exists at a single threat-defined location (CR)

Justification: The species occurs only around the summit of Mount Imlay.

- c) Continuing decline is ...inferred... in ...(iii) area, extent and/or quality of habitat.

Justification: There is evidence to support an inference that invasion of habitat by *P. cinnamomi* leads to a decline in habitat quality for *H. circinata*.

Criterion C Small population size and decline

Assessment Outcome: Critically Endangered under criteria C + C2 a (ii)

Justification: Estimated total number of mature individuals of *Hibbertia circinata* in the wild is 200, based on direct counts while the species was in flower. This is within the threshold for the Critically Endangered category (mature individuals <250).

NSW Threatened Species Scientific Committee

In addition to this threshold, at least one of the following conditions must be met:

- C1. An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generation (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: Data Deficient.

Justification: Although there is strong evidence that *H. circinata* habitat will be negatively affected by *Phytophthora cinnamomi*, the actual or likely rate of infection of that habitat is unknown and it is not currently possible to estimate or project a quantitative rate of decline for comparison against the numerical thresholds in criterion C1.

- C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Subcriterion is met.

Justification: *Phytophthora cinnamomi* is strongly inferred to have negative effects on *H. circinata* habitat quality and thereby lead to decline in numbers of mature individuals. Those effects are likely to be ongoing in the absence of active management, and there is a real risk (greater than negligible, although currently unpredictable) that ongoing spread of infection and consequent negative effects may not be preventable even with active management. There are no known practical means currently available to eradicate the pathogen from areas of *H. circinata* habitat once infected.

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

- a (i). Number of mature individuals in each subpopulation ≤ 50 (CR); ≤ 250 (EN) or ≤ 1000 (VU).

Assessment Outcome: Endangered

Justification: *H. circinata* has a single population of 200 mature individuals.

- a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: Critically Endangered

Justification: All mature individuals (100%) occur in the single known population.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient

Justification: There is no evidence of extreme fluctuations in the single population of *Hibbertia circinata*.

Criterion D Very small or restricted population

Assessment Outcome: Endangered under Criterion D1

Justification: *H. circinata* has a population of 200 mature individuals, estimated by direct counts while the species was in flower. This is within the threshold for the Endangered category under this criterion (mature individuals < 250).

NSW Threatened Species Scientific Committee

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient

Justification: Quantitative analysis to estimate the probability of extinction in the wild of *Hibbertia circinata* has not been undertaken, as there appear to be insufficient data available to support such an analysis.

Conservation and Management Actions

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

General principle

- All visits to and activities within the habitat of *Hibbertia circinata* must follow current best practice protocols for minimising the spread of *Phytophthora cinnamomi*. This includes minimising human access to the Mount Imlay summit area as far as practically possible and applying hygiene protocols to all visits to this area.

Ex-situ conservation

- Develop a targeted seed collection program for *ex-situ* seed banking and to create and maintain living collections of *Hibbertia circinata* in multiple Australian botanic gardens (insurance populations). These will also allow for research on the species' biology as outlined below including response to *Phytophthora cinnamomi* infection, to be carried out *ex situ*.

Stakeholder Management

- Ensure that NPWS staff, fire management authorities and any external contractors involved in management of the Mount Imlay peak area are aware of and follow strict hygiene protocols.
- Review the current Mount Imlay National Park Plan of Management (NPWS 1998) and in particular the objective of "promotion of the Mount Imlay summit track as an ecotourism and educational feature." This past objective may now be inconsistent with the presence of multiple threatened plant species in the Mount Imlay summit area and the risk posed to these species by the spread of *Phytophthora cinnamomi* including by walkers visiting the summit.

Site management

- Fire regimes in the Mount Imlay summit area must be managed to ensure that they do not disrupt the life cycle of *Hibbertia circinata*, and that they do not degrade the habitat of *H. circinata* and do not promote invasion of exotic species.
- Physical damage to the habitat and individuals of *H. circinata* (and other threatened species on Mount Imlay) must be avoided during and after fire operations.

Survey and Monitoring priorities

- Annual surveys to monitor the population of *Hibbertia circinata*, including data on age structure, reproductive status and recruitment, and any evidence of disturbance including herbivory and impacts from fire (planned and unplanned) and from walkers and illegal collections. This monitoring to include assessment of any changes in *Phytophthora* infection boundaries. Monitoring visits must be minimised and follow low impact procedures and strict hygiene protocols.

NSW Threatened Species Scientific Committee

Information and Research priorities

- *Ex-situ* testing of the response of *Hibbertia circinata* plants to infection by *Phytophthora cinnamomi* strains present on Mount Imlay.
- Ongoing research to identify effective methods to control the spread of *P. cinnamomi* will be critical to the long-term survival of this and other threatened species. Any changes to best practice infection controls stemming from research elsewhere in Australia should be applied to management of the Mount Imlay area as soon as they become available.
- Research into *H. circinata* pollination/breeding biology and factors influencing recruitment/seedling survival (including climatic factors) will have value for future management.
- Research into the fire responses of *H. circinata* and/or related or functionally similar species will be valuable to identify appropriate fire regimes for conservation of the species.
- All *in-situ* research undertaken at Mount Imlay peak, on *H. circinata* and other species, must follow current best practice protocols for minimising the spread of *P. cinnamomi*, and must be co-ordinated between researchers in order to efficiently minimise habitat disturbance and number of visits.

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NSW Threatened Species Scientific Committee

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Expert Communications

Keith McDougall – NSW Office of Environment and Heritage – 26/03/2018

Kirsty Woodman - Australian Government Department of the Environment and Energy – 26/07/2018

APPENDIX

Assessment against BC Act criteria

Overall Assessment Outcome (Clauses with the highest category of threat)

Critically Endangered under Clauses 4.3 (a)+(d)+(e)(iii) and 4.4 (a)+(e)(i)+(e)(ii)(B).

Clause 4.2 – Reduction in population size of species

(Equivalent to IUCN criterion A)

Assessment Outcome: Data Deficient

(1) – The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
(2) – The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

Clause 4.3 - Restricted geographic distribution of species and other conditions

(Equivalent to IUCN criterion B)

Assessment Outcome: Critically Endangered under Clause 4.3 (a) (d) (e) iii).

NSW Threatened Species Scientific Committee

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species,
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

Clause 4.4 - Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion C)

Assessment Outcome: Critically Endangered under Clause 4.4 (a), (e)(i ii B).

The estimated total number of mature individuals of the species is:			
	(a)	for critically endangered species	very low, or
	(b)	for endangered species	low, or
	(c)	for vulnerable species	moderately low,
and either of the following 2 conditions apply:			
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):	
		(i)	for critically endangered species very large, or
		(ii)	for endangered species large, or
		(iii)	for vulnerable species moderate,
	(e)	both of the following apply:	
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and
		(ii)	at least one of the following applies:
		(A)	the number of individuals in each population of the species is:
			(I) for critically endangered species extremely low, or
			(II) for endangered species very low, or
			(III) for vulnerable species low,
		(B)	all or nearly all mature individuals of the species occur within one population,
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.

Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)

Assessment Outcome: Endangered under Clause 4.5 (b).

NSW Threatened Species Scientific Committee

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 - Quantitative analysis of extinction probability

(Equivalent to IUCN criterion E)

Assessment Outcome: Data Deficient.

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 - Very highly restricted geographic distribution of species–vulnerable species
(Equivalent to IUCN criterion D2)

Assessment Outcome: Vulnerable

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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Notice of and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list the shrub *Hibbertia circinata* K.L.McDougall & G.T.Wright as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Hibbertia circinata is eligible for listing as Critically Endangered, as the highest threat category met by the taxon across all categories, under Clauses 4.3(a) (d) (e iii) and 4.4 (a) (e i) (e ii B), because: i) the geographic range of the species is very highly restricted with an area of occupancy and extent of occurrence of 4 km²; ii) the species has a small population at a single location; and iii) there are inferred continuing declines in habitat area and quality and in the number of mature individuals of the species, resulting from the effects of an introduced plant pathogen.

The NSW Threatened Species Scientific Committee has found that:

1. *Hibbertia circinata* K.L.McDougall & G.T.Wright (family Dilleniaceae) was described by McDougall *et al.* (2018) as “Shrubs 1–1.5 m tall, with several to many ±erect stems, pubescent with simple, spreading to subappressed, straight, crisped or coiled hairs to 1.25 mm long (rarely to 2 mm long around leaf bases); new growth villous, vestiture persistent to lower branches. Leaves sessile with broad, partly stem-clasping bases which remain when the lamina separates at a distinct abscission line; lamina oblanceolate (or occasionally oblong to almost spatulate), entire (or rarely, irregularly toothed near apex), 15–55 mm long, 5–10(–12) mm wide, discolorous; adaxial surface dark green, pubescent, with semi-appressed hairs ranging from tightly coiled (to 0.2 mm diameter) to curled or ±straight, mostly to 0.5 mm long, but up to 2.5 mm long towards base and margin, abaxial surface pale grey-green, with hairs similar to those on adaxial surface but usually less appressed, apex obtuse, but the midrib protruding as a straight or recurved callus point to 1 mm long; margins flat in vivo, but often recurving on drying. Flowers apparently axillary, solitary (rarely paired), sessile, subtended by 2–4 hypsophylloids (sensu Toelken 2000), 3–12 mm long, grading toward normal leaves at the base. Sepals 5, ovate to obovate, obtuse to subacute, sometimes minutely apiculate, 5–6.5 mm long and 2.5–3.5 mm wide; outer 3 sepals sparsely to densely pubescent with simple hairs on both surfaces, at least distally but not on hyaline margins, c. 0.5 mm wide; inner 2 sepals usually slightly longer than outer sepals, glabrous or with a few scattered hairs distally on outer surface. Petals 5, yellow, obovate, 9–13 mm long, 7–11 mm wide, broadly emarginate, glabrous. Stamens 9–13, surrounding carpels, ±equal in length; filaments c. 1.5 mm long, free; anthers ± rectangular, c. 1.0 mm long, obtuse, dehiscing by terminal slits c. 0.5 mm long and extending down lateral margin for up to c. 0.2 mm. Staminodes absent. Carpels 3, laterally compressed, glabrous; style divergent, flattened, 1.0–2.0 mm long. Ovules 2 per carpel. Fruit not seen. Flowering has been observed at most times of the year but seems most prolific in spring.”
2. *Hibbertia circinata* is endemic to New South Wales where it is currently known to occur in a single population on the summit ridges of Mount Imlay, south west of Eden in the South East Corner Bioregion (SEWPaC 2012) between elevations of 800 and 850 metres above sea level (McDougall *et al.* 2018). The summit and upper slopes of Mount Imlay have shallow, loose

NSW Threatened Species Scientific Committee

sandy soils dominated by rock fragments, derived from Merimbula Group rocks of sedimentary origin including sandstone, conglomerate, quartzite, siltstone and shale (NSW National Parks and Wildlife Service 1998).

3. *Hibbertia circinata* occurs in habitat described as shrubby woodland, with a tree canopy commonly dominated by *Eucalyptus sieberi* and a diverse shrub layer that includes *Boronia imlayensis*, *Oxylobium ellipticum*, *Xanthorrhoea australis*, *Tetralochea subaphylla*, *Dillwynia glaberrima* and *Amperea xiphoclada* (McDougall *et al.* 2018).
4. The single known population of *Hibbertia circinata* is estimated to comprise about 200 plants, based on a count of individuals during flowering in October 2016 (K. McDougall *in litt.* 2018). This population represents a single threat-defined location (see NSW TSSC, 2018). The geographic distribution of *H. circinata* is highly restricted, with an area of occupancy (AOO) of 4 km², based on 2 km x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2017). The extent of occurrence (EOO) is also estimated to be 4 km². The EOO is reported as equal to AOO despite the range of the species, measured by a minimum convex polygon containing all the known sites of occurrence, being less than AOO. The two figures are reported as equal in order to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (IUCN 2017).
5. The primary immediate threat to *Hibbertia circinata* is the introduced plant pathogen *Phytophthora cinnamomi*, also known as root-rot fungus or cinnamon fungus, which has invaded the Mount Imlay summit area adjacent to the single known population of *H. circinata* (McDougall *et al.* 2018). Although the direct susceptibility of *H. circinata* to *P. cinnamomi* has not yet been tested, other *Hibbertia* species have been shown to be susceptible. Further more, the species is likely to be negatively affected by *P. cinnamomi* indirectly through changes to vegetation structure and habitat. To date, there are no practical methods available to eradicate *Phytophthora cinnamomi* from areas of infestation in native vegetation, and limited methods to contain the spread of the pathogen at infected sites (DECC 2008). "Infection of native plants by *Phytophthora cinnamomi*" is listed as a Key Threatening Process under the Act.
6. A significant longer-term threat to the survival of *Hibbertia circinata* is anthropogenic climate change. The species is restricted to a single small population within a very narrow altitudinal band on the summit of an isolated mountain. Climate change projections by Grose *et al.* (2015) for the subregion encompassing Mount Imlay infer, with very high confidence, continued increases in average temperatures in all seasons, lower cool season rainfall totals and a harsher fire-weather climate. "Anthropogenic climate change" is listed as a Key Threatening Process under the Act.
7. *Hibbertia circinata* K.L.McDougall & G.T.Wright is eligible to be listed as a Critically endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely high risk of extinction in Australia in the immediate future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

NSW Threatened Species Scientific Committee

Clause 4.2 – Reduction in population size of species
 (Equivalent to IUCN criterion A)
 Assessment Outcome: Data Deficient

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

Clause 4.3 - Restricted geographic distribution of species and other conditions
 (Equivalent to IUCN criterion B)
 Assessment Outcome: Critically Endangered under Clause 4.3 (a) (d) (e iii).

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species,
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

NSW Threatened Species Scientific Committee

Clause 4.4 - Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion C)

Assessment Outcome: Critically Endangered under Clause 4.4 (a) (e i ii B).

The estimated total number of mature individuals of the species is:			
	(a)	for critically endangered species	very low, or
	(b)	for endangered species	low, or
	(c)	for vulnerable species	moderately low,
and either of the following 2 conditions apply:			
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):	
		(i)	for critically endangered species very large, or
		(ii)	for endangered species large, or
		(iii)	for vulnerable species moderate,
	(e)	both of the following apply:	
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and
		(ii)	at least one of the following applies:
		(A)	the number of individuals in each population of the species is:
			(I) for critically endangered species extremely low, or
			(II) for endangered species very low, or
			(III) for vulnerable species low,
		(B)	all or nearly all mature individuals of the species occur within one population,
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.

Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)

Assessment Outcome: Endangered under Clause 4.5 (b).

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

NSW Threatened Species Scientific Committee

Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data deficient.

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 - Very highly restricted geographic distribution of species—vulnerable species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Vulnerable

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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Dr Anne Kerle
Chairperson
NSW Threatened Species Scientific Committee

Supporting document:

Turner K (2019) Conservation Assessment of *Hibbertia circinata* K.L.McDougall & G.T.Wright (Dilleniaceae). NSW Threatened Species Scientific Committee.

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NSW Threatened Species Scientific Committee

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