

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 *Hibbertia praemorsa* Toelken as an Endangered species in Part 2 of Schedule 1 of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that *Hibbertia praemorsa* Toelken has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method, as provided by Section 4.14 of the Act. After due consideration of DCCEEW (2023), the NSW Threatened Species Scientific Committee has made a decision to list the species as Endangered.

Summary of Conservation Assessment

Hibbertia praemorsa Toelken was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3 (b)(d)(e i, iii) and Clause 4.4 (b)(d ii)(e i, ii(A II)) because: i) the species has a highly restricted geographic distribution with an Extent of Occurrence estimated between 300–500 km² and an Area of Occupancy estimated at between 20–30 km²; ii) it is known from 2–3 threat-defined locations; iii) continuing decline is inferred in the quality of habitat, and estimated in the number of mature individuals due to increased occurrences of drought resulting from climate change and adverse fire regimes; iv) the total population is low in number with <1000 mature individuals; and v) the number of mature individuals in each subpopulation is low, with <250 in each.

The NSW Threatened Species Scientific Committee has found that:

1. *Hibbertia praemorsa* Toelken (family Dilleniaceae) is a small shrub to 1.3 m in height, with dark green oblong-elliptic leaves 6.5–9.5 mm long and 3–4.5 mm wide that have a recurved apex and are hairy (villous to sericeous) on both the upper and lower surface. Flowers are yellow, with broadly obovate petals, and are produced singly at the end of branchlets. Fruits are hairy (villous), and seeds are broadly obovoid, laterally compressed, 2.2 x 2.4 mm (Toelken 2000; PlantNet 2022).
2. *Hibbertia praemorsa* is restricted to the Southern Highlands of New South Wales (NSW), where it is known from four subpopulations around Bundanoon and Wingello, and one isolated subpopulation in the northern Budawang Range (Toelken 2000; ALA 2022; AVH 2022). All known subpopulations are located within Morton National Park. The three subpopulations at Bundanoon occur roughly in a line and are separated by ~900 m and 1.4 km, while the Wingello subpopulation occurs ~6 km south-east of the Bundanoon subpopulations. The Budawang Range subpopulation occurs ~60 km south of the Bundanoon and Wingello subpopulations.

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3. In the 1990s, the total known population size of the Bundanoon guinea flower was approximately 325 plants, including 260 plants at View Point/Hell Hole (1996), 30 plants at Lovers Walk (1999), 13 plants at Tooth Lookout (2000) and 22 plants at Wingello Gap Road (1992) (BioNet 2022). All known subpopulations were burnt during the 2019-20 bushfires, and the species is in the process of regenerating from seedlings and resprouting plants. On current knowledge, the estimated number of mature individuals in 2021 is 234, including 165 plants at View Point/Hell Hole (assuming 60% seedling mortality, last estimate 2021), 5 plants at Lovers Walk and 29 plants at Wishing Well (last estimate 2011), 13 plants at Tooth Lookout (last estimate in 2000) and 22 plants at Wingello Gap Road (last estimate 1992; S. Douglas pers. comm. December 2021, March 2022; BioNet 2022), representing a decline of 28% compared to estimates from the 1990s.
4. *Hibbertia praemorsa* grows in heath or open heathy woodland. At Wingello, the species grows in shallow sandy soil on undisturbed sandstone rock shelves with heathy vegetation. At Bundanoon, the species grows in heath or heathy eucalypt woodland, in association with *Hakea dactyloides* (Finger Hakea), *Leptospermum trinervium* (Flaky-barked Tea-tree), *Lambertia formosa* (Mountain Devil), and *Banksia serrata* (Old-man Banksia). In the Budawangs, the species grows on a steep rocky slope with north-west aspect in shrubland dominated by *Eucalyptus multicaulis* (Whipstick Ash), *H. dactyloides* and *B. spinulosa* (Hairpin Banksia).
5. Native bees are thought to be the primary pollinators of most *Hibbertia* species (Bernhardt 1984, 1986; Tucker and Bernhardt 2000). The bright yellow flowers do not produce nectar (Bernhardt 1984, 1986). Instead, depending on floral morphology, the bees collect pollen by directly feeding on exposed pollen, or by buzz pollination (using thoracic vibrations to dislodge pollen) (Tucker and Bernhardt 2000).
6. The germination requirements of *Hibbertia* species are complex, with seed dormancy imposed by the seed coat as well as by the embryo (Ralph 2011). The relative effects of various treatments (e.g., scarification, smoke water, gibberellic acid) appear variable between species and even individual seeds, although in many species germination is increased by scarification and/or smoke water (Dixon *et al.* 1995; Schatral 1996; Schatral *et al.* 1997; Allan *et al.* 2004). Variation in dormancy length among individual seed may result in naturally staggered germination over several years (Schatral *et al.* 1997; Ralph 2011; Hidayati *et al.* 2012). The 2019-20 fires resulted in a flush of seedling regeneration, suggesting that fire cues may trigger germination in *Hibbertia praemorsa*, and the survival and establishment of germinants may be low in unburnt conditions compared to the post-fire environment as in other species (Keith 1996).
7. Seed dispersal in other *Hibbertia* species is by ants (myrmecochory), which are likely to move the seed only short distances (Berg 1975; Rice and Westoby 1981), and *Hibbertia praemorsa* is likely to be similarly dispersal-limited.
8. After the 2019-20 bushfires, adult *Hibbertia praemorsa* plants were observed resprouting and seedlings were observed emerging in clumps. In burnt areas, seedling recruitment appeared to be greater than the number of resprouting plants (S. Douglas pers. comm. December 2021). The regenerating plants at View

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Point/Hell Hole were observed to be growing in small, dense clusters. The combination of post-fire resprouting and fire-killed/seedling emergence is typical of other *Hibbertia* species (Bell *et al.* 1993). Little is known about the primary or secondary juvenile period of *H. praemorsa*, or the longevity of adult plants, however many species of *Hibbertia* are believed to have longevity of <50 years and secondary juvenile periods of 3 or more years (Knox and Clarke 2004; Falster *et al.* 2021).

9. The threats to *Hibbertia praemorsa* include increased frequency, intensity and duration of drought due to climate change, and adverse fire regimes, most notably too frequent fire. 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' and 'Anthropogenic climate change' are listed as Key Threatening Processes under the Act.
10. *Hibbertia praemorsa* occurs at an estimated 2–3 threat-defined locations based on the threat of fire and the combination of fire and drought. The extent of the 2019–20 fires overlapped with all known subpopulations, and another threatening event within the minimum fire-free interval may result in population reduction. Although it is possible that a single fire may rapidly impact all known subpopulations, as seen during the 2019–20 fires, the likelihood that a single fire affecting all known subpopulations again soon is low, suggesting that an estimate of two to three locations is more plausible.
11. Increasing frequency, intensity and duration of droughts due to climate change are inferred to be contributing to continuing decline in the number of mature individuals and habitat quality of *Hibbertia praemorsa*. Although the causes of the estimated continuing decline are unclear, drought is considered to be a likely contributing factor (S. Douglas pers. comm. December 2021). Over the past 20 years, south-east Australia has been impacted by two significant drought events: the Millennium drought (2001–2009) and the 2017–2019 drought (BoM 2020). *Hibbertia praemorsa* grows in areas that are likely to have low water holding capacity (e.g., rock shelves, shallow soils), so it may be at risk from hydraulic failure during severe drought. Seed set may also be diminished in times of high water stress, leading to reduced recruitment.
12. In addition, the impacts of drought are likely to interact with fire. Droughts following fire events may result in reduced seedling emergence and survival, and generally lower health of surviving plants (DAWE 2022). Seedlings are particularly prone to post-fire drought before they develop substantial root systems, and *Hibbertia praemorsa* appears to recruit primarily via seedling regeneration post-fire. Droughts preceding fire events may also impact the species by limiting seed production and starch reserves, limiting both the soil seed bank and resprouting capacity of adults, and leading to reduced recruitment post-fire (DAWE 2022).
13. It is also possible that *Hibbertia praemorsa* may be negatively affected by high frequency fires where they cause mortality among adult plants and occur at short enough timescales to kill regenerating seedlings and resprouting plants before they are able to replenish the soil seed bank or develop sufficient woody tissue to withstand further fires. The secondary juvenile period of other *Hibbertia* species

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has been estimated at 3+ years (Knox and Clarke 2004), suggesting that repeated fires within 4–5+ years may cause population decline, depending on seed bank accumulation rates.

14. Climate change is projected to lead to changes in rainfall precipitation patterns and an increase in the frequency of drought events in the region occupied by *Hibbertia praemorsa* (OEH 2014). In addition, there has been an increase in the number of dangerous fire weather days between the periods 1950–1985 and 1985–2020, and the number of extreme fire events are likely to continue to increase (Dowdy *et al.* 2019; BoM and CSIRO 2020). Accordingly, a decline in the quality of habitat is inferred for *H. praemorsa* due to the impacts of drought and drought/fire interactions.
15. *Hibbertia praemorsa* Toelken is not eligible to be listed as a Critically endangered species.
16. *Hibbertia praemorsa* Toelken is eligible to be listed as an Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a very high risk of extinction in Australia in the near future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Endangered under Clause 4.3 (b)(d)(e i, iii) and Clause 4.4 (b)(d ii)(e i,ii(A II)).

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: Endangered under Clause 4.3 (b)(d)(e i, iii)

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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 Clause C)

Assessment Outcome: Endangered under Clause 4.4 (b)(d ii)(e i,ii(A II)).

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.

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

Assessment Outcome: Vulnerable under Clause 4.5 (c).

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: Not met.

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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Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

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