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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 *Hibbertia cistiflora* subsp. *quadrisminea* 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 cistiflora* subsp. *quadrisminea* 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 cistiflora subsp. *quadrisminea* Toelken was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3 (b)(d)(e iii) because: i) the species has a highly restricted geographic distribution with an Extent of Occurrence estimated between 150–250 km² and an Area of Occurrence estimated at between 32–50 km²; ii) it is known from a single threat-defined location; and iii) continuing decline in the quality of habitat is inferred due to adverse fire regimes and changed seasonality of rainfall due to climate change.

The NSW Threatened Species Scientific Committee has found that:

1. *Hibbertia cistiflora* subsp. *quadrisminea* Toelken (family Dilleniaceae) is a small shrub growing to 0.3 m in height, with erect-spreading to decumbent branches up to 0.4 m long (Toelken 2012). The alternating leaves up the stem are 1.6–15 mm long and 1 mm wide with the upper surface being hairless. The flowers are terminal on main and lateral branches with flowering occurring from August to October (Toelken 2012). *Hibbertia cistiflora* subsp. *quadrisminea* is often wrongly identified as *H. serpyllifolia*, but the subspecies has few stamens only in one dorsal cluster. The subspecies can be distinguished from the nominate subspecies and other *Hibbertia* species by simple hairs on the stems, its glabrous ovary, and usually having 4 stamens (Toelken 2012).
2. *Hibbertia cistiflora* subsp. *quadrisminea* has been recorded from two subpopulations in New South Wales (NSW), from the Blue Mountains National Park and on the Newnes Plateau in the Gardens of Stone State Conservation Area (formerly Newnes State Forest). The subpopulation discovered in the Blue Mountains National Park grows in the vicinity of Butterbox Point within the Mount Hay area (AVH 2021). The subpopulation at Newnes Plateau grows near Old Bells Line of Rd and Bald Trig Point (AVH 2021). A survey of the subpopulation at Newnes Plateau in May 2021 found 10,000 plants resprouting from the base

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following fire (AVH 2021). The number of plants in the Blue Mountains National Park subpopulation is unknown.

3. *Hibbertia cistiflora* subsp. *quadristaminea* has a highly restricted geographic distribution. The EOO of known sites is estimated to be approximately 150–250 km² and the AOO of known sites is 32–50 km². The EOO was calculated using a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022). The AOO was based on 2 km x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2022).
4. *Hibbertia cistiflora* subsp. *quadristaminea* is known to grow on dry sandy or gravelly slopes, seepage areas and low heath open woodlands (Toelken 2012). Herbarium specimens indicate it is associated with *Dampiera stricta* (Blue Dampiera), *Schizaea bifida* (Forked Comb Fern), *Xanthorrhoea* spp. (Grass Tree), *Pultenaea tuberculata* (Wreath Bush-pea), *Patersonia* spp. (Native Iris), *Isopogon anemonifolius* (Drumsticks), *Petrophile canescens* (Conesticks), *Hakea laevipes* subsp. *Laevipes* and *Epacris microphylla* (Coral Heath) (AVH 2021). The subpopulation at Newnes Plateau has been recorded growing on the uppermost hilltops and adjoining slopes in open low *Allocasuarina* dominated heath with little canopy cover (G. Phillips pers. comm. December 2021).
5. *Hibbertia cistiflora* subsp. *quadristaminea* flowers from August to October. Although little is known about the reproductive ecology of *H. cistiflora* subsp. *quadristaminea*, native bees are thought to be the primary pollinators for most *Hibbertia* species (Bernhardt 1984, 1986; Tucker and Bernhardt 2000; Falster *et al.* 2021). 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). The presentation of the stamens in *H. cistiflora* subsp. *quadristaminea* is similar to that of *H. rufa*, therefore they likely share the same pollination syndrome using native bees (Threatened Species Section 2011; Toelken 2012).
6. The exact germination requirements for *Hibbertia cistiflora* subsp. *quadristaminea* are unknown. The germination requirements of other *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 seeds may result in naturally staggered germination over several years (Schatral *et al.* 1997; Ralph 2011; Hidayati *et al.* 2012).
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 cistiflora* subsp. *quadristaminea* is likely to be similarly dispersal-limited.

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8. There is limited published information on the specific fire ecology of *Hibbertia cistiflora* subsp. *quadrisminea*. However, a May 2021 survey of the Newnes State Forest subpopulation found that plants appear to resprout readily post-fire and were flowering strongly only 18 months following the 2019-20 bushfires (G. Phillips pers. comm. December 2021). Similar observations have been made for the Blue Mountains National Park subpopulation, with resprouting occurring after fire from a woody base (R. Miller pers. comm. November 2021).
9. *Hibbertia cistiflora* subsp. *quadrisminea* may vary in response to fire intensity, and survival and resprouting may depend on other biological and ecological factors such as age, plant health and post fire environmental conditions (e.g., precipitation and temperature). In other *Hibbertia* species, adults are assumed to be long-lived, as some sites had not been burnt in >50 years and seedlings are only observed in burnt patches (Toelken and Robinson 2015), although given the variation in seed dormancy between individual seeds, low levels of spontaneous germination could occur in the absence of fire. Survival and establishment of such germinants may be low in unburnt conditions compared to the post-fire environment (Keith 1996). In the closely related species, *H. spanantha*, fire is required for successful reproduction. Medium intensity summer fires triggered germination and recruitment three months later, and post fire rainfall was attributed to the success of the recruitment event. The same medium intensity fire resulted in the death of some above ground plants, and the resprouting in others (via coppicing or suckering from rootstock; Toelken and Robinson 2015).
10. The threats to *Hibbertia cistiflora* subsp. *quadrisminea* include adverse fire regimes, most notably too frequent or out of season fire, and changes in the seasonality of rainfall due to climate change. '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.
11. *Hibbertia cistiflora* subsp. *quadrisminea* is considered to occur at one threat-defined location, based on known distribution records and the most plausible serious threat of adverse fire regimes (IUCN 2022). As the 2019-20 fire overlapped with 75% of the modelled range of the subspecies and the subspecies has limited dispersal capabilities, it is feasible for a single fire to affect the subspecies' entire distribution. Although one fire event is unlikely to kill all adult plants and seed, repeated fires are likely to cause a decline in the population. Given climate change is predicted to increase both the frequency and severity of bushfires, it is plausible that the entire population will experience a similar change in fire regime that will result in decline, meaning the entire distribution of *H. cistiflora* subsp. *quadrisminea* is regarded as one threat-defined location.
12. Adverse fire regimes, particularly too frequent and/or out of season fire, is inferred to be contributing to continuing decline in the quality of habitat available to *Hibbertia cistiflora* subsp. *quadrisminea*. It is possible that *H. cistiflora* subsp. *quadrisminea* may be negatively affected by high frequency fires, where they cause mortality among adult plants and occur at short enough intervals to kill

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regenerating seedlings and resprouting plants before they are able to replenish the soil seed bank or develop sufficient woody tissue to withstand further fires. Fires preceding dry conditions can also affect plants which germinate in response to fire, as the vulnerable seedlings are exposed to desiccation and thus post-recruitment mortality (Keith 1996). Further, given the complex physiological seed dormancy of *Hibbertia* species (Schatral *et al.* 1997; Toelken and Robinson 2015), out of season fires will likely negatively impact germination for the species.

13. In south-eastern Australia, rainfall has declined by approximately 12% in the cool season (April–October) from the late 1990s–2020 (CSIRO and BOM 2020). In southern and eastern Australia, cool season rainfall is predicted to continue to decrease, while temperatures are predicted to continue to increase, leading to more time in drought (as well as more intense, short duration heavy rainfall events) due to climate change (NSW Government 2014; CSIRO and BOM 2020). This decline in cool-season rainfall could result in reduced recruitment events or the failure of seedlings, especially given *Hibbertia* typically rely on rainfall following summer fires for recruitment success (Toelken and Robinson 2015).
14. In the south-east and tablelands region of NSW, there is a projected increase in minimum and maximum temperatures, the number of hot days (above 35°C), fire danger weather and extreme events (e.g., drought), and changes to precipitation patterns (increased precipitation in autumn and decreased precipitation in spring) (OEH 2014). The south-east of NSW is also expected to undergo an increase in severe and average Forest Fire Danger Index values, which are used as an indicator of fire risk (OEH 2014). These increases are projected for summer and spring, which represent peak fire risk season (OEH 2014). Additionally, both high severity bushfires and extreme weather events are expected to become more frequent as a result of climate change (CSIRO 2015). Bushfires followed by periods of drought or intense rainfall events resulting from these changes may have an adverse effect on *H. cistiflora* subsp. *quadristaminea* by impacting the species at critical life stages. Therefore, an inferred continuing decline in the distribution and habitat quality of *H. cistiflora* subsp. *quadristaminea* due to changes in fire regimes and precipitation seasonality is likely to occur in the future.
15. *Hibbertia cistiflora* subsp. *quadristaminea* Toelken is not eligible to be listed as a Critically endangered species.

16. *Hibbertia cistiflora* subsp. *quadristaminea* 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 iii)

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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 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.

Clause 4.4 – Low numbers of mature individuals of species and other conditions

(Equivalent to IUCN criterion Clause C)

Assessment Outcome: Not met.

The estimated total number of mature individuals of the species is:
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	(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: Not met.

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	the geographic distribution of the species or the number of
species,		locations of the species is very highly restricted such that the

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species is prone to the effects of human activities or stochastic events within a very short time period.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Commonwealth DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2023). Conservation Advice for *Hibbertia cistiflora* subsp. *quadristaminea*. Australian Government, Canberra, ACT.

References:

Allan SM, Adkins SW, Preston CA, Bellairs SM (2004) Improved germination of the Australian natives: *Hibbertia commutata*, *Hibbertia amplexicaulis* (Dilleniaceae), *Chameascilla corymbosa* (Liliaceae), and *Leucopogon nutans* (Epacridaceae). *Australian Journal of Botany*, **44**: 213–222.

AVH (Australasian Virtual Herbarium) (2021) Occurrence records for *Hibbertia cistiflora* subsp. *quadristaminea*. URL: https://avh.ala.org.au/occurrences/search?taxa=Hibbertia+cistiflora+subsp.+quadristaminea#tab_recordsView (accessed 1 December 2021).

Berg RY (1975) Myrmecochorous plants in Australia and their dispersal by ants. *Australian Journal of Botany*, **23**: 475–508.

Bernhardt P (1984) The pollination biology of *Hibbertia stricta* (Dilleniaceae). *Plant Systematics and Evolution*, **147**: 267–277.

Bernhardt P (1986) Bee-pollination in *Hibbertia fasciculata* (Dilleniaceae). *Plant Systematics and Evolution*, **152**: 231–241.

CSIRO (Commonwealth Scientific & Industrial Research Organisation) (2015) Climate Change in Australia Technical Report. URL: <https://www.climatechangeinaustralia.gov.au/en/communication-resources/reports/>

CSIRO (Commonwealth Scientific & Industrial Research Organisation) and BOM (Bureau of Meteorology) (2020) Climate Change in Australia Technical Report. URL: <https://www.climatechangeinaustralia.gov.au/en/communication-resources/reports/>

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- Dixon KW, Roche S, Pate JS (1995) The promotive effect of smoke derived from burnt native vegetation on seed germination of Western Australian plants. *Oecologia*, **101**: 185–192.
- Falster D, Gallagher R, Wenk EH, Wright IJ, Indiaro D, Andrew SC, O'Sullivan OS (2021) AusTraits, a curated plant trait database for the Australian flora. *Scientific data*, **8(1)**: 1-20.
- Hidayati SN, Walck JL, Merritt DJ, Turner SR, Turner DW, Dixon KW (2012) Sympatric species of *Hibbertia* (Dilleniaceae) vary in dormancy break and germination requirements: implications for classifying morphophysiological dormancy in Mediterranean biomes. *Annals of Botany*, **109**: 1111–1123.
- IUCN Standards and Petitions Subcommittee (2022). Guidelines for Using the IUCN Red List Categories and Criteria. Version 15.1 (July 2022). Standards and Petitions Committee of the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- Keith D (1996) Fire-driven extinction of plant populations: a synthesis of theory and review of evidence from Australian vegetation. *Proceedings of the Linnean Society of New South Wales* **116**: 37–78.
- NSW Government (2014) New South Wales Climate change snapshot. URL: <http://climatechange.environment.nsw.gov.au/climate-projections-for-nsw/climate-projections-for-your-region/nsw-climate-change-downloads> (accessed 7 March 2022).
- Ralph M (2011) 'Growing Australian native plants from seed (2nd ed.)'. (Bloomings Books, Australia).
- Rice B, Westoby M (1981) Myrmecochory in sclerophyll vegetation of the West Head, New South Wales. *Australian Journal of Ecology*, **6**: 291–298.
- Schatral A (1996) Dormancy in seeds of *Hibbertia hypericoides* (Dilleniaceae). *Australian Journal of Botany*, **44**: 213–222.
- Schatral A, Osborne JM, Fox JED (1997) Dormancy in seeds of *Hibbertia cuneiformis* and *H. huegelii* (Dilleniaceae). *Australian Journal of Botany*, **45**: 1045–1053.
- Threatened Species Section (2011) Listing Statement for *Hibbertia rufa* (brown guineaflower). Department of Primary Industries, Parks, Water and Environment, Tasmania.
- Toelken H (2012) Notes on *Hibbertia* (Dilleniaceae) 8. Seven new species, a new combination and four new subspecies from subgen. *Hemistemma*, mainly from the central coast of New South Wales. *Journal of the Adelaide Botanic Gardens* **25**: 71-96.

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Toelken HR, Robinson AF (2015) Notes on *Hibbertia* (Dilleniaceae) 11. *Hibbertia spanantha*, a species from the central coast of New South Wales. *Journal of the Adelaide Botanic Gardens*, **29**: 11–14.

Tucker SC, Bernhardt P (2000) Floral ontogeny, pattern formation, and evolution in *Hibbertia* and *Andrastaea* (Dilleniaceae). *American Journal of Botany*, **87**: 1915–1936.