The Threatened Species Scientific Committee finalised this assessment on DD Month Year.

Consultation on Species Listing Eligibility and Conservation Actions

Acacia constablei (Narrabarba wattle)

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

1) the eligibility of *Acacia constablei (Narrabarba wattle)* for inclusion on the EPBC Act threatened species list in the Critically Endangered category; and

2) the necessary conservation actions for the above species.

The purpose of this consultation document is to elicit additional information to better understand the status of the species and help inform on conservation actions and further planning. As such, the below draft assessment should be considered to be **tentative** as it may change following responses to this consultation process.

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.

Responses are to be provided in writing by email to:
species.consultation@environment.gov.au

Please include species scientific name in Subject field.

or by mail to:

The Director
Bushfire Affected Species Assessments Section
Department of Agriculture, Water and the Environment
John Gorton Building, King Edward Terrace
GPO Box 858
Canberra ACT 2601

Responses are required to be submitted by 24 March 2022.

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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: https://www.awe.gov.au/environment/biodiversity/threatened.

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.awe.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2021.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: https://www.awe.gov.au/environment/biodiversity/threatened/nominations.

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: https://www.awe.gov.au/environment/biodiversity/threatened/recovery-plans.

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' (CAM). 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: https://www.awe.gov.au/about/commitment/privacy .

Information about this consultation process

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.

CONSULTATION QUESTIONS FOR *Acacia constablei* (Narrabarba wattle)

SECTION A - GENERAL

1. Is the information used to assess the nationally threatened status of the species robust? Have all the underlying assumptions been made explicit? Please provide justification for your response.

2. Can you provide additional data or information relevant to this assessment?

3. Have you been involved in previous state, territory or national assessments of this species? If so, in what capacity?

PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT

SECTION B DO YOU HAVE ADDITIONAL INFORMATION ON THE ECOLOGY OR BIOLOGY OF THE SPECIES? (If no, skip to section C)

Biological information

4. Can you provide any additional or alternative references, information or estimates on longevity, average life span and generation length?

5. Do you have any additional information on the ecology or biology of the species not in the current advice?

SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SPECIES? (If no, skip to section D)

Population size

6. Has the survey effort for this taxon been adequate to determine its national adult population size? If not, please provide justification for your response.

7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the species? If not, please provide justification for your response.

8. If not, can you provide a further estimate of the current population size of mature adults of the species (national extent)? Please provide supporting justification or other information.

   If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible species numbers, and also choose the level of confidence you have in this estimate:

   Number of mature individuals is estimated to be in the range of:

   ☐ 1–50 ☐ 51–250 ☐ 251–1000 ☐ >1000

   Level of your confidence in this estimate:

   ☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

   ☐ 31–50% - more than a guess, some level of supporting evidence

   ☐ 51–95% - reasonably certain, information suggests this range

   ☐ 95–100% - high level of certainty, information indicates quantity within this range

   ☐ 99–100% - very high level of certainty, data are accurate within this range

SECTION D ARE YOU AWARE OF TRENDS IN THE OVERALL POPULATION OF THE SPECIES? (If no, skip to section E)

9. Does the current and predicted rate of decline used in the assessment seem reasonable? Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.

Evidence of total population size change

10. Are you able to provide an estimate of the total population size? Please provide justification for your response.

    If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible species numbers, and also choose the level of confidence you have in this estimate.

    Number of mature individuals is estimated to be in the range of:

☐ 1–50 ☐ 51–250 ☐ 251–1000 ☐ >1000

Level of your confidence in this estimate:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, information suggests this range

☐ 95–100% - high level of certainty, information indicates quantity within this range

☐ 99–100% - very high level of certainty, data are accurate within this range

11. Are you able to comment on the extent of decline in the species total population size over the last approximately 63 years (i.e. three generations)? Please provide justification for your response.

If, because of uncertainty, you are unable to provide an estimate of decline, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of decline, and also choose the level of confidence you have in this estimated range.

Decline estimated to be in the range of:

☐ 1–30% ☐31–50% ☐51–80% ☐81–100% ☐90–100%

Level of your confidence in this estimated decline:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, suggests this range of decline

☐ 95–100% - high level of certainty, information indicates a decline within this range

☐ 99–100% - very high level of certainty, data are accurate within this range

12. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

SECTION E ARE YOU AWARE OF INFORMATION ON THE TOTAL RANGE OF THE SPECIES? (If no, skip to section F)

Current Distribution/range/extent of occurrence, area of occupancy

13. Does the assessment consider the entire geographic extent and national extent of the species? If not, please provide justification for your response.

14. Has the survey effort for this species been adequate to determine its national distribution? If not, please provide justification for your response.

15. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.

16. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate? Please provide justification for your response.

17. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the extent of occurrence and/or area of occupancy?

    If, because of uncertainty, you are unable to provide an estimate of extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of extent of occurrence, and also choose the level of confidence you have in this estimated range.

    Current extent of occurrence is estimated to be in the range of:

    ☐ <100 km^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

    Level of your confidence in this estimated extent of occurrence

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% - high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

If, because of uncertainty, you are unable to provide an estimate of area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of area of occupancy, and also choose the level of confidence you have in this estimated range.

Current area of occupancy is estimated to be in the range of:

☐ <10 km^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

Level of your confidence in this estimated extent of occurrence:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% - high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

SECTION F ARE YOU AWARE OF TRENDS IN THE TOTAL RANGE OF THE SPECIES? (If no, skip to section G)

Past Distribution/range/extent of occurrence, area of occupancy

18. Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.

19. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the former extent of occurrence and/or area of occupancy?

    If, because of uncertainty, you are unable to provide an estimate of past extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past extent of occurrence, and also choose the level of confidence you have in this estimated range.

    Past extent of occurrence is estimated to be in the range of:

    ☐ <100 km^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

    Level of your confidence in this estimated extent of occurrence

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, data suggests this range of decline

    ☐ 95–100% - high level of certainty, data indicates a decline within this range

    ☐ 99–100% - very high level of certainty, data is accurate within this range

    If, because of uncertainty, you are unable to provide an estimate of past area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past area of occupancy, and also choose the level of confidence you have in this estimated range:

    Past area of occupancy is estimated to be in the range of:

    ☐ <10 km^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

    Level of your confidence in this estimated extent of occurrence:

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% -high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

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

SECTION G DO YOU HAVE INFORMATION ON THREATS TO THE SURVIVAL OF THE SPECIES? (If no, skip to section H)

20. Do you consider that all major threats have been identified and described adequately?

21. To what degree are the identified threats likely to impact on the species in the future?

22. Are the threats impacting on different populations equally, or do the threats vary across different populations?

23. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the species at any stage of its life cycle?

24. Can you provide supporting data/justification or other information for your responses to these questions about threats?

SECTION H DO YOU HAVE INFORMATION ON CURRENT OR FUTURE MANAGEMENT FOR THE RECOVERY OF THE SPECIES? (If no, skip to section I)

25. What planning, management and recovery actions are currently in place supporting protection and recovery of the species? To what extent have they been effective?

26. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species?

27. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species?

SECTION I DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SPECIES?

28. Are you aware of other knowledge (e.g. traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?

29. Are you aware of any cultural or social importance or use that the species has?

30. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species?

31. How aware of this species are land managers where the species is found?

32. What level of awareness is there with individuals or organisations around the issues affecting the species?

    a. Where there is awareness, what are these interests of these individuals/organisations?

    b. Are there populations or areas of habitat that are particularly important to the community?

PART 3 – ANY OTHER INFORMATION

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

Conservation Advice for *Acacia constablei* (Narrabarba wattle)

This draft document is being released for consultation on the species listing eligibility and conservation actions

The purpose of this consultation document is to elicit additional information to better understand the status of the species and help inform conservation actions, further planning and a potential recovery plan. The draft assessment below should therefore be considered **tentative** at this stage, as it may change as a result of responses to this consultation process.

Note: Specific consultation questions relating to the below draft assessment and preliminary determination have been included in the consultation cover paper for your consideration.

This document combines the draft conservation advice and listing assessment for the species. It provides a foundation for conservation action and further planning.

Acacia constablei (Narrabarba wattle) at Australian National Botanic Gardens © Copyright, Fagg, M. (2009) (from Australian National Botanic Gardens)

Conservation status

Acacia constablei (Narrabarba wattle) is proposed to be transferred from the Vulnerable category to the Critically Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999.*

Acacia constablei (Narrabarba wattle) was listed in the Vulnerable category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999* effective from 16 July 2000. The species was eligible for listing because prior to the EPBC Act, it was listed as Vulnerable under the *Endangered Species Protection Act 1992* (Cwlth). There was no listing advice prepared for this species at that time.

Acacia constablei was assessed by the Threatened Species Scientific Committee to be eligible for listing as Critically Endangered under Criterion 2. The Committee's assessment is at Attachment A. The Committee's assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: A2a: Endangered
- Criterion 2: B1ab(v): Critically Endangered
- Criterion 3: C2a(i): Endangered
- Criterion 4: D1: Endangered
- Criterion 5: Insufficient data

The main factors that make the species eligible for listing in the Critically Endangered category are a very restricted distribution, occurrence at a single location, and projected continuing decline in the number of mature individuals.

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the Species Profile and Threat Database.

Species information

Taxonomy

Conventionally accepted as *Acacia constablei* Tindale, Family: Fabaceae.

Description

The Narrabarba wattle is an erect or spreading shrub or small tree with bipinnate leaves comprising 6–15 pairs of pinnae each with 9–30 pairs of pinnules (leaflets). The bark is smooth and light-grey and the branchlets are covered in a dense mat of short fine hairs and have characteristic knobbly ridges about 0.5 mm high (Briggs & Leigh 1990). The species has pale yellow to white/cream flower heads which are globular and 5–7 mm in diameter (Harden 2002). Individuals mostly range from 1 to 3 m high but can grow to 7 m in sheltered situations (Orchard & Wilson 2001).

The Narrabarba wattle is most closely related to the widespread *Acacia mearnsii* (black wattle) with which it occurs at the type locality, and to *Acacia nanodealbata* (dwarf silver-wattle), a Victorian endemic species (NPWS 2002).

Distribution

The Narrabarba wattle is endemic to the Narrabarba and Green Cape areas south of Eden on the South Coast of New South Wales (NSW). The species is known from three subpopulations. One occurs across seven rocky outcrops on and around Narrabarba Hill, and another occurs on one rocky outcrop 1.4 km to the north of Narrabarba Hill on the other side of the Wonboyn River (see Table 1). Both these subpopulations are in the Narrabarba Hill Flora Reserve, which is located in Nadgee State Forest and managed by the Forestry Corporation of NSW (Forestry Corporation of NSW 2015). The third subpopulation is located near a clifftop at Green Cape in Ben Boyd National Park (G Phillips, pers comm. 23 November 2021) (see Table 1). However, the plants at Green Cape show variable characteristics that intergrade between the Narrabarba wattle and black wattle and identification can be difficult (Miles 2022).

The Narrabarba wattle occurs within the South East Corner Bioregion (DAWE 2012) and South East Local Land Services region (NRM Regions Australian 2021).

Table 1. Narrabarba wattle survey data*

Date	No. of rocky outcrops surveyed	Subpopulation	Seedlings (approx.)	Mature individuals
July 1986	4	Narrabarba Hill	3200+ (small plants)	200 (described as several hundred)
		North of Wonboyn River	-	1000+
2002	6	Narrabarba Hill	-	5701**
		North of Wonboyn River	-	40*
April 2015	8	Narrabarba Hill & North of Wonboyn River	220+	168
May 2017	8	Narrabarba Hill	90	226
		North of Wonboyn River	3	10
July 2020	8	Narrabarba Hill & North of Wonboyn River	3200+	85
April 2021	8	Narrabarba Hill and North of Wonboyn River	3500	88
November 2021	1	Green Cape	5	4

*From Briggs & Leigh 1990; NPSW 2002; DPIE 2021a; G Phillips, pers comm. 23 November 2021

** Assumed to be mature individuals, as NPWS (2002) states that all sites are assumed to be comprised of a predominantly even-aged cohort which recruited from soil stored seed after the last major fire event, which was in the early 1980's.

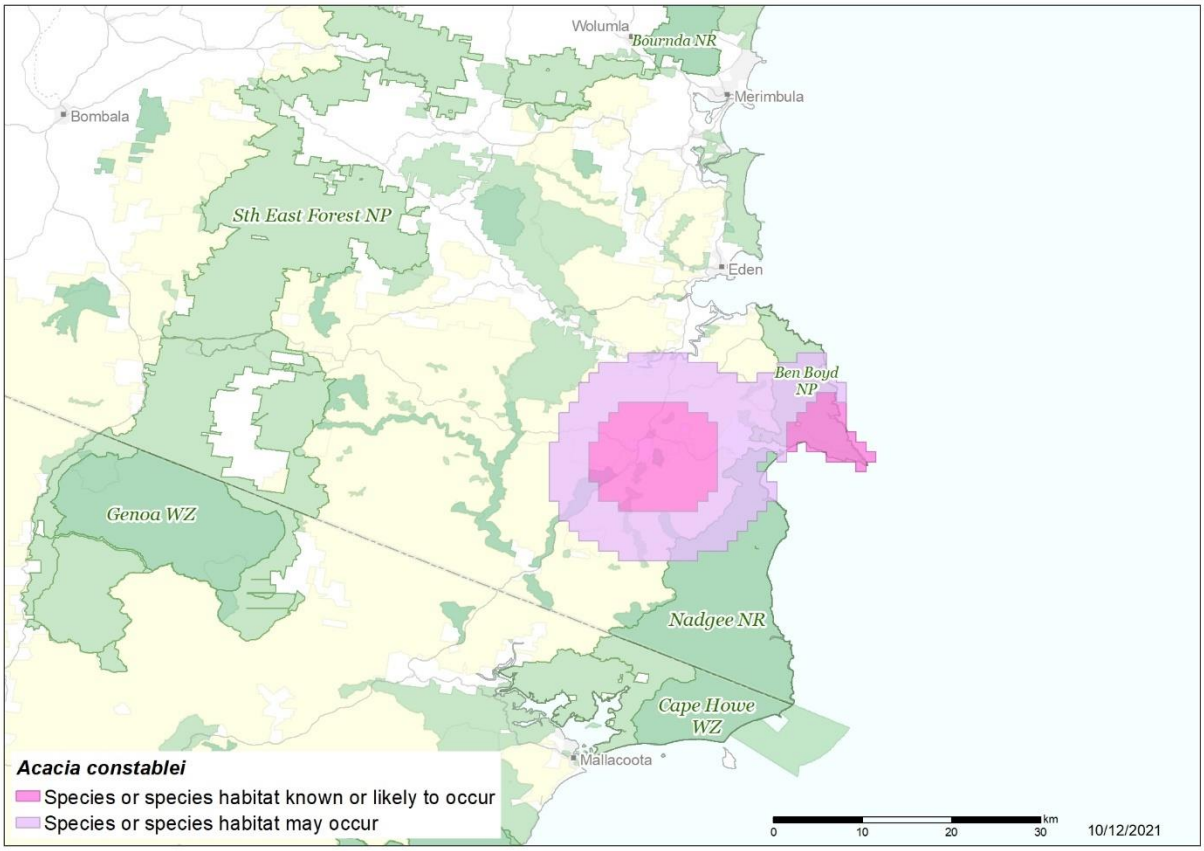
Table 2. Narrabarba wattle survey information, across two rocky outcrops*

Date	Seedlings	Mature individuals
Autumn 2014	168	66
April 2015	220	87
Autumn 2016	139	77
May 2017	90	62

Autumn 2018	20	53
Autumn 2019	26	40
July 2020	3273	10
April 2021	2234	28

*From DPIE 2020a. This survey data is from 17 plots of 10x10m across 2 rocky outcrops, 8 of these plots were burnt in Jan 2020

Map 1 Modelled distribution of Narrabarba wattle



Source: Base map Geoscience Australia; species distribution data Species of National Environmental Significance database.
Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.
Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the habitat or geographic feature that represents to recent observed locations of the species (known to occur) or habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

This statement of significance is not intended to be comprehensive, applicable to, or speak for, all Indigenous Australians and it is acknowledged that Indigenous groups and individuals are the custodians of this knowledge.

The area where the Narrabarba wattle occurs is part of the lands of the Bidwell People (AIATSIS 1996). Archaeological evidence confirms that Indigenous Australians have had a long and continuous association with the South Coast region for thousands of years. Before settlement, they would travel from as far away as Wollongong, Mallacoota and Monaroo to places like Bay Cliff and Greenglade near Wonboyn. Middens can be seen around Wonboyn Lake and along the shore (NPWS 2021). Within Ben Boyd National Park a large number of Indigenous sites have been recorded, mainly middens, but also campsites, rock shelters, scarred trees and long distance travel routes (DPIE 2021b). The Disaster Bay to Green Cape area is particularly significant for its large number of Indigenous sites, and its historic, spiritual and contemporary values to local Indigenous Australians (DPIE 2021b).

Wattles are part of the Australian identity. The Australian national floral emblem is *Acacia pycnantha* (the golden wattle), and the emblem of the Order of Australia is also a wattle. Australia's national colours are green and gold, and so the wattle is a symbol of unity, remembrance and reflection (Australian Government 2018). The first of September is National Wattle Day when Australians can celebrate their floral heritage by planting wattles (Australian Government 2018).

Relevant biology and ecology

Habitat

The Narrabarba wattle is found primarily on rhyolite and aplite rocky outcrops, but occasionally occurs on sandstone. The species grows mostly in nutrient poor, skeletal soils but sometimes in rich, brown to black loams (Briggs & Leigh 1990; Orchard & Wilson 2001; NPWS 2002; OEH 2021a). The species is associated with a large expanse of bare rock (NPWS 2002) and grows on all aspects but predominantly on westerly-facing slopes (Briggs & Leigh 1990). The largest site where the species is currently known from is in Narrabarba Hill Flora Reserve and occurs on a long, narrow razorback ridge running north-west to south-east, with very steep exposed rocky slopes (Briggs & Leigh 1990). Other sites occupied by the species contain large expanses of fairly flat rock. The Narrabarba wattle is likely to be susceptible to extreme drought since the water-carrying capacity of the soil associated with the outcrops is generally low (NPWS 2002).

The Narrabarba wattle forms almost impenetrable whipstick-like (tall spindly) scrub (Tindale 1980; Orchard & Wilson 2001) and is the dominant or co-dominant shrub or small tree where it occurs on rocky outcrops (NPWS 2002). The species can form an open shrubland of sparsely-branched shrubs up to approximately 3 m high (though individual plants are much larger where more favourable conditions allow, such as at the edges of outcrops with deeper soils). The rocky outcrops are bounded by forests dominated by *Eucalyptus sieberi* (silvertop ash). *Allocasuarina littoralis* (black sheoak) is also abundant here, often forming dense stands to 8 m high. These black sheoak stands appear to compete strongly with the Narrabarba wattle and mortality of the subordinate Narrabarba wattle is commonly observed, possibly resulting from the combined effects of light and moisture competition (NPWS 2002). Other common woody plant species occurring with the Narrabarba wattle include *Melaleuca armillaris* subsp*. armillaris* (giant honey-myrtle), *Kunzea ambigua* (tick bush), *Zieria littoralis* (coastal zieria) and *Platysace lanceolata* (lance-leaf platysace) (NPWS 2002; OEH 2021a). The herbaceous component of the vegetation is dominated by *Rytidosperma longifolium* (long-leafed wallaby grass) and *Lepidosperma urophorum* (tailed rapier-sedge) (NPWS 2002; OEH 2021a).

Pollination ecology

The Narrabarba wattle can have a variable flowering season depending on environmental conditions. Flowering has been observed in June-August, and a few specimens have also been recorded flowering in February and March (NPWS 2002). Subpopulations burnt in the 2019-2020 bushfires have been recorded flowering in January (D Bain, pers comm. 28 January 2022). The species' pollinators are unknown, however they are assumed to be insects as is common in other *Acacia* species (Stone et al. 2003). Birds seeking extra-floral nectar may also be involved in pollination (NPWS 2002). The most important pollinators for acacias are usually social and solitary bees (including the widely distributed European honeybee (*Apis millifera*) and *Apoidea* wasps, followed by flies, beetles and nectar-feeding birds in some cases (Stone et al. 2003). Seeds of the Narrabarba wattle are assumed to ripen about three months after pollination, as is typical in the genus (NPWS 2002).

Seed dispersal

Seed dispersal in acacias often occurs through passive methods via water, wind, and gravity, though some species also have adaptations for dispersal by birds and/or ants (Gibson et al. 2011). Aside from dispersal, birds and ants also assist with germination. Scarification of the hard seed coat occurs in the bird gut, and ants bury seeds in subterranean nests where the seed will stay until ideal conditions (heat and moisture) are met for germination (Gibson et al. 2011).

Fire and disturbance ecology

The Narrabarba wattle is an obligate seeder – it is killed by fire and regenerates only from seed (J Miles, pers comm. 9 December 2021). The species has been observed occasionally resprouting in the absence of fire, with some resprouting observed lower down the stem where the top of a plant has died as a result of drought (J Miles, pers comm. 9 December 2021). The species is assumed to develop a long-lived soil-stored seed bank (as does the related black wattle), but no data are available on the size or seed longevity of the seed bank (NPWS 2002). Like other *Acacia* species, the seeds of the Narrabarba wattle are likely to require heat to break seed dormancy (Bradstock & Auld 1995). However the rate of fire-induced germination depends on seed depth and fire intensity (Auld & Denham 2006).

While further research is required on the species' fire ecology, the recommended fire-free interval for the Narrabarba wattle to mature and replenish the soil stored seedbank is 15 years (OEH 2021a). The survival rate of seedlings to maturity for the Narrabarba wattle is unknown, but is being investigated following the 2019-2020 bushfires (D Bain, pers comm. 4 November 2021). Plants burnt in the 2019-2020 bushfires were observed flowering in January 2022, therefore time to first flowering is two years (D Bain, pers comm. 28 January 2022).

Some recruitment in the absence of fire has been observed in the Narrabarba wattle following heavy rainfall events and disturbance (Miles 2017).

Habitat critical to the survival

The Narrabarba wattle is found primarily on rhyolite and aplite rocky outcrops or their edges and occasionally occurs on sandstone. The species occurs in mostly poor, skeletal soils but sometimes in rich, brown to black loams (Briggs & Leigh 1990; Orchard & Wilson 2001; NPWS 2002; OEH 2021a). Within the distribution of the Narrabarba wattle in south-eastern NSW, such

habitat is likely to be necessary for dispersal, long-term maintenance of populations and evolutionary development of the species.

Habitat critical to the survival of the species includes the area of occupancy of the extant subpopulations; areas of similar habitat surrounding these subpopulations that provide potential habitat for natural range extension and are necessary to provide habitat for pollinators; and additional occurrences of similar habitat in the known distribution of the species that may contain the species or be suitable sites for future translocations.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

Important populations

In this section, the word population is used to refer to subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation. An 'important population' is a population that is necessary for a species' long-term survival and recovery (DotE 2013).

All populations of the Narrabarba wattle are important for the long-term recovery and survival of this species due to its very restricted distribution and the presence of ongoing threats.

Threats

The main threats to the Narrabarba wattle include drought, inappropriate fire regimes and competition from native shrubs. These threats also interact to influence recovery potential of the species. Auld et al. (2020) ranked the Narrabarba wattle as vulnerable to post-fire herbivory and recommended exclusion or removal of feral grazers, stock and excessive native herbivores. On-ground observations show that while browsing by herbivores appeared initially to be a threat, at 16 months post-fire browsing pressure had largely ceased and was not considered significant (Miles 2021).

Phytophthora dieback is a potential threat to the Narrabarba wattle (NPWS 2002).

Threats in Table 3 are noted in approximate order of highest to lowest impact, based on available evidence.

Table 3 Threats

Threat	Status [a]	Evidence
Climate change		
Increased temperature and decreased rainfall	• Timing: current and future • Confidence: observed • Consequence: major • Trend: increasing • Extent: across the entire range	The Narrabarba wattle is vulnerable to drought as soils associated with rocky outcrops have a low water-carrying capacity (NPWS 2002). Following drought in 1997 and 1998, an estimated 25% of plants at Narrabarba Hill died and other sites were similarly affected (NPWS 2002). Severe drought conditions across NSW from early 2017 to late 2019 also impacted the species with the number of mature individuals declining substantially during these years (see Tables 1 and 2 above). The entire modelled range of Narrabarba wattle was subject to high accumulated drought severity in the twelve

Threat	Status [a]	Evidence
		months prior to the September 2019 (Gallagher et al. 2021). In the South East region of NSW, there is a projected increase in minimum and maximum temperatures (maximum temperature increases of 0.5–1.0°C by 2039 and 1.8–2.5°C by 2060–2079) and an increase in the number of hot days in summer and spring. Rainfall is projected to decrease in spring and winter and increase in summer and autumn (NSW Government 2014). This is likely to adversely affect the species. The Narrabarba wattle is also ranked as highly vulnerable to the interactive effects of fire and drought (Gallagher et al. 2021). Pre-fire drought can reduce reproductive output in fire free periods, impacting the size of the seed bank available for post-fire recruitment. Post-fire drought may also negatively impact post-fire recruitment success by reducing seed germination and seedling survival (Gallagher et al. 2021). The effects of drought may also be exacerbated by other factors such as changes to vegetation structure caused by fire or competition from black sheoak and other native shrubs (see below).
Fire		
Inappropriate fire regimes	• Timing: current and future • Confidence: observed and inferred • Consequence: major • Trend: increasing • Extent: across the entire range	Obligate seeders like the Narrabarba wattle require a minimum fire-free interval to reach reproductive maturity and maintain population size. Keith (1996) identified several fire driven mechanisms of plant population decline and extinction for obligate seeding shrubs. These mechanisms included death of standing plants and seeds, failure of seed release and/or germination, failure of seedling establishment, interruption of maturation or developmental growth, and failure of seed production. Keith (1996) also identified fire regimes associated with multiple mechanisms of plant population decline and extinction, including both high frequency and low frequency fires. *High frequency fires* High frequency fires are recognised as a threat to fire-dependent species, especially as climate change increases the likelihood of large scale fires (Ooi et al. 2006; Enright et al. 2015; Gallagher et al. 2021). Bradstock et al. (1998) found that extinction probabilities in obligate seeding shrubs increased with fire frequency and scale, indicating that too-frequent fire is responsible for extinction more often than too-infrequent fire. Fires that are high in frequency and low in severity could pose a particular threat to the Narrabarba wattle as they can kill mature individuals without stimulating large levels of germination (Keith 1996) and increase competition from native shrubs (see below). While further research is required on the species' fire ecology, the recommended fire-free interval for the Narrabarba wattle to mature and replenish the soil-stored seed bank is 15 years (OEH 2021a).

Threat	Status [a]	Evidence
		Low frequency fires Low frequency fires also pose a threat to the Narrabarba wattle as it appears to have limited recruitment in the absence of fire. The maximum tolerable fire-free interval for the species is unknown. *Fire history* In 2019–2020, catastrophic bushfire conditions resulted in extensive bushfires across eastern Australia and the species was prioritised for urgent management intervention (Gallagher et al. 2021). On-ground observations showed that eight rocky outcrops where the species occurs were burnt to some degree, although the fire varied in extent and intensity across each site (Miles 2021). The subpopulation at Green Cape wasn't burnt, however the fire impact came within 100m of this site (G Phillips, pers comm. 3 December 2021). These bushfires were partially caused by severe drought conditions in 2017–2019 in NSW leading to low fuel moisture content, leaf senescence and shedding, and lack of moist impediments to fire spread (Nolan et al. 2020).
Impacts of native species		
Competition from native shrubs	• Timing: current and future • Confidence: known • Consequence: moderate • Trend: unknown • Extent: across the entire range	Black sheoak stands appear to compete strongly with the Narrabarba wattle and mortality of Narrabarba wattle is common, possibly resulting from the combined effects of light and moisture competition (NPWS 2002). Black sheoak may also use leaf litter allelopathy to dominate ecosystems. Although true allelopathic compounds have yet to be identified, the thick and slowly decomposing litter layer produced by Allocasuarina species such as black sheoak is considered to suppress seed germination by shading and then inhibiting seedling establishment (Audet et al. 2013). The effects of competition could be more significant in drought conditions (see above). Low severity fire may also increase competition, especially from black sheoak, which suppresses or kills many Narrabarba wattle plants at the edges of outcrops. Black sheoak, at least when young, is responsive to low severity burns, and the burns may stimulate high levels of recruitment in this species to the detriment of Narrabarba wattle. It may be that these low severity burns are too cool to stimulate significant recruitment of Narrabarba wattle (NPWS 2002).
Disease		
Phytophthora dieback caused by the introduced soil-borne pathogen *Phytophthora cinnamomi* and other *Phytophthora* spp.	• Timing: future • Confidence: suspected • Consequence: major • Trend: unknown • Extent: across the entire range	*P. cinnamomi* is an introduced soil-borne pathogen which infects a large range of plant species, and which may contribute to plant death directly or when other stresses are present such as waterlogging, drought and bushfire. *Phytophthora cinnamomi* is listed as a Key Threatening Process under the EPBC Act (DoEE 2018). *Acacia* species are known to be susceptible to *P. cinnamomi* and areas of forest adjacent to the Narrabarba wattle have shown symptoms of

Threat	Status [a]	Evidence
		infection with the pathogen. However the susceptibility of the Narrabarba wattle to *P. cinnamomi* is unknown (NPWS 2002).

Timing—identify the temporal nature of the threat;
Confidence—identify the extent to which we have confidence about the impact of the threat on the species;
Consequence—identify the severity of the threat;
Trend—identify the extent to which it will continue to operate on the species;
Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 4 in terms of the extent that it is operating on the species. The risk matrix (3) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life stage they affect; the duration of the impact; and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed in consultation with experts and using available literature.

Table 4 Risk Matrix for the Narrabarba wattle

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain			**Competition from native shrubs**	**Increased temperature and decreased rainfall;** **Inappropriate fire regimes**	
Likely					
Possible				**Dieback caused by *P. cinnamomi***	
Unlikely					
Unknown					

Risk Matrix legend/Risk rating:

Low Risk	Moderate Risk	High Risk	Very High Risk

Priority actions have then been developed to manage the threats, particularly where the risk was deemed to be 'very high' (red shading) or 'high' (orange shading). For those threats with an unknown or low risk (blue and green shading respectively) research and monitoring actions have been developed to understand and evaluate the impact of the threats, where appropriate.

Conservation and recovery actions

Primary conservation objective

- By 2031, the population of Narrabarba wattle will have increased in abundance and sustained in habitats where threats are managed effectively.

Conservation and management priorities

Climate change and severe weather impacts

- Map the exposure of the species to climate change using distribution modelling and climate change projections, to locate existing habitat patches and identify future habitat that would be suitable for the species.
- Undertake vulnerability assessments of the species' sensitivity and adaptive capacity to changing climate conditions which draw from genetic, physiological or ecological evidence.

Fire impacts

- Implement a fire management strategy to protect subpopulations from further fire within 15 years of the 2019–2020 bushfires. Exclude planned fire (and bushfire where possible) from subpopulations until seedlings mature and the soil-stored seed bank is replenished.
- If planned fire impacts subpopulations, managers must ensure that subsequent unplanned fires do not occur within the critical regeneration period, to allow the species to replenish its soil seed bank to sustain subpopulations through the next fire event.
- Ensure that the location of subpopulations are recorded in relevant state databases, including those used by land managers and fire response agencies.
- If required, undertake supplementary watering of post-fire seedlings to protect against drought-induced mortality.

Native species impacts

- Consider biomass reduction of competing native vegetation where evidence demonstrates this has a positive benefit to the species and does not adversely affect the long term survival of other native species.

Disease impacts

- Ensure appropriate phytohygiene protocols are adhered to when entering or exiting sites for survey, monitoring and management activities.
- If found to be susceptible to *P. cinnamomi,* develop and implement a *P. cinnamomi* management plan to ensure it is not introduced into known locations of Narrabarba wattle.

Ex situ recovery actions

- Collect and store sufficient quantities of seed in long-term storage to preserve genetic material, in accordance with the plant germplasm conservation guidelines (Martyn Yenson et al. 2021).
- Identify additional sites suitable for the establishment of new subpopulations through translocation.
- If appropriate, undertake ex situ propagation and translocations in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018). Monitor all translocated individuals to maturity, seed set and recruitment to ensure they are viable and are contributing to a reduction in the extinction risk for the species.

Stakeholder engagement/community engagement

- Liaise with land managers and Indigenous communities regarding the management of the Narrabarba wattle. Engage and involve Traditional Owners in conservation actions, including surveying for new subpopulations and management actions.
- Liaise with the local community and government agencies to ensure that up-to-date subpopulation data inform the implementation of management actions.
- Promote public awareness of biodiversity conservation and protection by disseminating information through physical and digital media.

Survey and monitoring priorities

- Identify and map habitat critical to the survival of the Narrabarba wattle.
- Continue subpopulation monitoring at known sites to identify trends in health, subpopulation size and structure, and habitat condition.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Identify, map, and survey potential habitat across the range of the species, looking for previously undiscovered subpopulations within this habitat.

Information and research priorities

- Undertake research to address information gaps on the species' biology and ecology, including:
  - soil seed bank dynamics and the role of fire (and other disturbance) and rainfall in germination and recruitment,
  - longevity of ex situ seed bank collections: ensure monitoring and storage conditions are optimal for long-term conservation of the species,
  - the survival rate of seedlings to maturity
  - Investigate the specificity of nitrogen fixing bacteria for survival and growth of the seedlings and that the seedlings are capable of securing appropriate levels and diversity of inocula,
  - longevity,
  - pollinator biology and requirements, and
  - appropriate fire regimes for the species (and amendments to the minimum recommended fire interval of 15 years if necessary).
- Undertake additional work, including genetic analysis if required, to comprehensively determine the presence and extent of the population at Green Cape
- Investigate the role of competition from other native vegetation in the decline of subpopulations and develop appropriate response strategies if demonstrated to be necessary to preserve the species
- Determine the impact of drier, hotter conditions on the species, and identify and protect modelled potential areas of climate refuges for the species under projected climate change scenarios.
- Determine the susceptibility of the Narrabarba wattle to *Phytophthora cinnamomi*.

Recovery plan decision

A draft recovery plan was in place for the Narrabarba wattle which also covered other threatened flora of rocky outcrops in south-eastern NSW (NPWS 2002).

A Saving Our Species Strategy is in place for the species in NSW where it is listed as Vulnerable under state legislation (OEH 2021b).

A decision about whether there should be an updated recovery plan for this species has not yet been determined. The purpose of this consultation document is to elicit additional information to help inform this decision.

Links to relevant implementation documents

Recovery Plan for Threatened Flora of Rocky Outcrops in South Eastern New South Wales (NPWS 2002)

Saving our Species Strategy – Narrabarba Wattle (*Acacia constablei*)

Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (2018)

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Attachment A: Listing Assessment for *Acacia constablei*

Reason for assessment

Acacia constable was listed as Endangered under the *Endangered Species Protection Act 1992* and transferred to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) when it commenced in July 2000.

This assessment follows prioritisation of a nomination from the TSSC.

Assessment of eligibility for listing

This assessment uses the criteria set out in the EPBC Regulations. The thresholds used correspond with those in the IUCN Red List criteria except where noted in criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing assessments through the Common Assessment Method (CAM).

Key assessment parameters

Table 5 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

Table 5 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	<236	92	236	The Narrabarba wattle undergoes natural fluctuations in the number of mature individuals, as mature individuals are killed following fire and germination from soil-stored seeds is stimulated (Gallagher 2021; OEH 2021a) The minimum estimate of the number of mature individuals is the 2021 post-fire estimate (DPIE 2021a); the maximum estimate is the 2017 pre-fire estimate (DPIE 2021a). The estimate used in this assessment is <236 mature individuals (i.e., less than estimated number of mature individuals in 2017), as a net loss of mature individuals is projected due to the impacts of drought, inappropriate fire regimes and competition from native shrubs (see criteria 1 and 2).
Trend	Declining			A net loss of mature individuals is projected, due to the impacts of drought, inappropriate fire regimes and competition from native shrubs. (see Criterion 2 for further information).
Generation time (years)	21	21	Unknown	The species generation length is estimated to be 21 years based on calculations under Criterion 1 below.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Extent of occurrence	20 km^2	20 km^2	Unknown	The extent of occurrence (EOO) is estimated at 20 km^2. This figure is based on the mapping of point records from a 22-year period (1999–2021) obtained from state governments, museums and CSIRO. The EOO was calculated using a minimum convex hull, based on the IUCN Red List Guidelines (IUCN 2019).
Trend	Stable			While the number of sites where the species has been recorded has increased in the last 20 years, this is likely to represent increased survey effort rather than establishment of new sites. All of the species' distribution occurs within the Narrabarba Hill Flora Reserve and Ben Boyd National Park. There have been no recorded declines in the species' EOO and it is considered stable.
Area of Occupancy	>20 km^2	>20 km^2	Unknown	The estimate used in the assessment is based on the mapping of point records from 1999–2021 obtained from state governments, museums and CSIRO. The area of occupancy (AOO) was calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines (IUCN 2019).
Trend	Contracting			The species' AOO is likely to be contracting due to a decline in mature individuals which is ongoing as a result of drought and other ongoing threats (see Criteria 1 and 2).
Number of subpopulations	3	3	3	The species is known from three subpopulations which are found on and around Narrabarba Hill, to the north of Narrabarba Hill on the other side of the Wonboyn River, and at Green Cape.
Trend	Declining			The number of subpopulations may decline due to the threat of drought and inappropriate fire regimes driven by climate change.
Basis of assessment of subpopulation number	The number is based on three geographically separated subpopulations.			

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
No. locations	1	1	1	The number of locations is estimated at one. Drought and bushfires have impacted at least two of the three known subpopulations. Future drought and/or a bushfire event could cause the rapid extinction of all remaining subpopulations of this species, particularly while subpopulations contain mostly immature individuals.
Trend	Stable			The number of locations is estimated at one, which is unlikely to increase and cannot decline.
Basis of assessment of location number	The number of locations is based on the most plausible serious threats of drought and fire impacting all known subpopulations. These threats may occur separately or together.			
Fragmentation	Not severely fragmented – A taxon can be considered to be severely fragmented if most (>50%) of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a viable population, and (2) separated from other habitat patches by a large distance" (IUCN 2019). The Narrabarba wattle occurs in three subpopulations. Two of these are found across eight rocky outcrops within close distance of each other. While the third subpopulation occurs approximately 20 km from the other two, it only contains four mature individuals and therefore most of the species' subpopulations are not separated by a large distance. Therefore this species is not considered to be severely fragmented.			
Fluctuations	Though the Narrabarba wattle does undergo fluctuations in mature individuals through fire events, there is no evidence to suggest that these fluctuations exceed one order of magnitude. Furthermore, in order for plants that germinate from soil-stored seed to experience extreme fluctuations under IUCN criteria, stored seed must be exhaustible in a single event (IUCN 2019). It is unknown whether Narrabarba wattle seeds are exhausted by a single fire.			

Criterion 1 Population size reduction

Reduction in total numbers (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	**Endangered Severe reduction**	**Vulnerable Substantial reduction**
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 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.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]

A4 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.

Based on any of the following

(a) direct observation [except A3]
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Criterion 1 evidence

Eligible under Criterion 1 A2a for listing as Endangered

Generation length

An equation for generation time given in IUCN (2019) is: Generation time = age of first reproduction + [0.5 * (length of reproductive period)].

The longevity of the Narrabarba wattle is unknown. Most plants that were recruited from seed following the fire in 1980 had died or were senescing prior to the 2019-2020 fire. Based on these observations, it is assumed plants can live a maximum of 40 years (J Miles, pers comm. 10 December 2021). Plants burnt in the 2019-2020 bushfires were observed flowering in January 2022, therefore time to first flowering is two years (D Bain, pers comm. 28 January 2022). Based on these figures the generation length is estimated as:
Generation time = 2 + [0.5 * (40-2)] =21, assuming a juvenile period of two years and longevity of 40 years. This gives an estimated three-generation period of approximately 63 years.

Past population reduction

As the Narrabarba wattle is an obligate seeder, it undergoes natural fluctuations in numbers of mature individuals as plants are killed by fire and regeneration occurs from soil-stored seed. The number of mature individuals has fluctuated over the past 41 years (see below). During this time there were two recorded bushfire events, one in 1980 and another in 2020. There are no

data on number of mature individuals or fire history prior to the 1980 bushfire event. However, two sites with 1200+ mature individuals recorded in 1986-87 were unburnt during the 1980 bushfire, suggesting that the number of mature individuals prior to this bushfire could have been thousands.

Table 6. No. of mature individuals across all survey sites over past 39 years

Mature individuals	Date	Years since fire
1200+ (approximately)	1986-87 (across four sites, two burnt)	6-7
5700 (approximately)	2002 (across six sites)	22
236	2017 (across eight sites)	37
92	2021 (across nine sites, eight of these burnt but fire extent and severity varied)	1

*The mature individuals were recorded across the two unburnt sites. At the two burnt sites, only young plants were recorded.

Comparing the number of mature individuals post-fire in 1986-87 (1200+) with the number post-fire in 2021 (92), it's likely the species has undergone a decline in mature individuals that is beyond natural fluctuations. Declines over this period are attributable to more severe or longer periods of drought and possibly competition from native shrubs (which is exacerbated during drought conditions).

Following drought in 1997 and 1998, an estimated 25 percent of plants at the Narrabarba Hill site died and other sites were similarly affected (NWPS 2002). Further drought occurred from early 2017 to late 2019. While survey data for these years are only available across two sites (see Table 2 under Distribution section), the number of mature individuals declined across these years from 77 in 2016 to 40 in 2019. This represents a 48 percent reduction in mature individuals across these two sites. A similar rate of decline could be assumed across all subpopulations given drought conditions were likely to have impacted all known sites. Across the population the species is estimated to have undergone a 64 percent decline over 22 years due to the impacts of drought (based on an initial 25 percent decline in 1997-1998 and then a 48 percent decline of the remaining population from 2016-2019).

Future population reduction

The 2019-20 bushfire stimulated a large germination event, which was enhanced by the favourable conditions over the following 18 months (D Bain, pers comm. 4 November 2021). Approximately 3500 seedings were recorded across eight sites in April 2021 (see Table 1). However, it is difficult to project future population numbers as no data are available on seedling survival rates or rates of adult senescence.

The risk of future fires occurring before seedlings can mature and replenish seed banks may threaten the species. Changes to fire conditions under climate change may expose the species to "interval squeeze", which is a narrowing of the favourable interval between fires, accelerating population decline (Enright et al. 2015). The species is especially vulnerable to the impacts of high frequency, low severity fires as these kill mature individuals without promotion large levels of germination (Keith 1996).

In Australia, average temperatures have increased by approximately 1.5°C since 1910, leading to increased frequency of extreme heat events (Bureau of Meteorology & CSIRO 2020). Additionally, in south-eastern Australia, rainfall has declined by approximately 12 percent in the cool season (April–October) since the late 1990s–2020 (Bureau of Meteorology & CSIRO 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 (Bureau of Meteorology & CSIRO 2020).

In the South East region of NSW, there is a projected increase in minimum and maximum temperatures (maximum temperature increase of 0.5–1.0°C by 2039 and 1.8–2.5°C by 2060–2079) and an increase in the number of hot days and severe fire weather days in summer and spring. Rainfall is projected to decrease in spring and winter and increase in summer and autumn (NSW Government 2014). Given the species is vulnerable to drought (as soils associated with rocky outcrops have a low water-carrying capacity), changes to rainfall patterns and temperature, and more time in drought are likely to result in a net loss of mature individuals and an ongoing decline in population size of the species in the future. However, there is insufficient evidence (e.g., modelling) at the time of this assessment to determine the rate of decline under these projected climate conditions. As such, there appears to be is insufficient evidence to consider the species under A3 (future reduction).

Conclusion

The Narrabarba wattle has undergone an estimated decline of at least 64 percent over the last 22 years due to drought.

Therefore, the species has met the relevant elements of Criterion 1 A2a to make it eligible for listing as **Endangered**. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy

		Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1.	Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2.	Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:				
(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			

Criterion 2 evidence

Eligible under Criterion 2 B1ab(i) for listing as Critically Endangered

Extent of occurrence (EOO) and area of occupancy (AOO)

The EOO and AOO of the Narrabarba wattle gum are estimated at 20 km² and equal or less than 20 km² respectively (see Table 5). The species' EOO appears to meet the requirements for listing as Critically Endangered under B1 (<100 km²). The species' AOO appears to meet the requirements for listing as Endangered under B2 (<500 km²).

Number of locations and severe fragmentation

The number of locations used in this assessment is one. This is based on the most plausible serious threats of drought and fire impacting all known subpopulations (see Table 5) . The species' number of locations meets the requirement for listing as Critically Endangered under this criterion.

A taxon can be considered to be severely fragmented if most (>50%) of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a viable population, and (2) separated from other habitat patches by a large distance" (IUCN 2019). As most subpopulations of the Narrabarba wattle occur across eight rocky outcrops within close distance of each other, it is not considered to be severely fragmented.

Continuing decline

The Narrabarba wattle is subject to ongoing threats including more time in drought as a result of climate change. The species is estimated to have undergone 64 percent decline over 22 years (from 1997 to 2019) due to the impacts of drought (see Criterion 1). This is likely to continue

given there is a projected increase in maximum temperatures in the South East region of NSW, and an increase in the number of hot days and severe fire weather days in summer and spring. Rainfall is also projected to decrease in spring and winter and increase in summer and autumn (NSW Government 2014).

The risk of future fires occurring before seedlings can mature and replenish seed banks may also threaten the species. Changes to fire conditions under climate change may expose the species to "interval squeeze", which is a narrowing the favourable interval between fires, accelerating population decline (Enright et al. 2015). While further research is required on the species fire ecology, the recommended fire free interval for the Narrabarba wattle to mature and replenish the soil stored seed bank is 15 years (OEH 2021a).

The effects of bushfires can be further exacerbated by drought across the species' distribution. Drought depletes carbohydrate resources held within plant tissues and reduces reproductive output in the years leading up to a fire event, impacting on the size of the seed bank available for post-fire recruitment (Nolan et al. 2021). Post-fire drought can negatively impact post-fire recruitment success by reducing seed germination and seedling survival (Gallagher et al. 2021). The species is also threatened by competition from native shrubs, particularly the black sheoak, with such interactions intensifying during drought as plants compete for soil moisture.

Conclusion

The Narrabarba wattle's EOO is very restricted, the species is known from one location and continuing decline is inferred in the number of mature individuals.

The data presented above appear to demonstrate that the species is eligible for listing as **Critically Endangered** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 3 Population size and decline

		Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
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)		**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
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:				
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals				

Criterion 3 evidence

Eligible under Criterion 3 C2a(i) for listing as Endangered

Number of mature individuals

The total number of mature individuals is estimated to be fewer than 236 which is considered very low under this Criterion (≤ 250).

Continuing decline

As discussed in Criterion 2 above, the species appears to be undergoing continuing decline in the number of mature individuals due to the threats of drought, inappropriate fire regimes and competition from native shrubs. These threats also interact to influence recovery potential of the species. However, the rate of this decline is unknown. Accordingly, the species appears to only meet the C2 continuing decline requirement for listing under this criterion and not C1.

Number of mature individuals

The species is known from three subpopulations. The Narrabarba Hill subpopulation contains an estimated 226 mature individuals, the Wonboyn River subpopulation contains 10 and the Green Cape subpopulation contains 4 (See Table 1). Therefore all subpopulations have fewer than 250

mature individuals. The species has met the requirements for listing as Endangered under C2a(i) under this Criterion.

Proportion of mature individuals

The percentage of mature individuals in each subpopulation is 94 percent (Narrabarba Hill subpopulation), 4 percent (Wonboyn River subpopulation) and 2 percent (Green Cape subpopulation). Therefore the percentage of mature individuals in one subpopulation doesn't met the value required for this Criterion (95 – 100 percent).

Extreme fluctuations

There are no known extreme fluctuations in the number of mature individuals (see Table 5). The species does not appear to meet the extreme fluctuations requirement for listing under this criterion.

Conclusion

The data presented above appear to demonstrate that the species is eligible for listing as **Endangered** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 4 Number of mature individuals

	Critically Endangered **Extremely low**	**Endangered** **Very Low**	**Vulnerable** **Low**
D. Number of mature individuals	< 50	< 250	< 1,000
D2.[1] *Only applies to the Vulnerable category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time			D2. Typically: area of occupancy < 20 km^2 or number of locations ≤ 5

[1] The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the *common assessment method*.

Criterion 4 evidence

Eligible under Criterion 4 D as Endangered

The total number of mature individuals is estimated to be fewer than 236 which is considered very low under this Criterion. Therefore, the species has met the relevant elements of sub-criterion D to make it eligible for listing as **Endangered**.

Species cannot be listed under sub-criterion D2 in the EPBC Act (see [1]). However, given the species' AOO is 20 km^2 and the number of locations is one (see Table 5), the species may meet the requirements for listing in the Vulnerable category under D2 in other legislation.

However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 5 Quantitative analysis

	Critically Endangered **Immediate future**	**Endangered** **Near future**	**Vulnerable** **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

Criterion 5 evidence

Insufficient data to determine eligibility

Population viability analysis has not been undertaken.

There are insufficient data to demonstrate if the species is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Adequacy of survey

The survey effort has been considered adequate and there is sufficient scientific evidence to support the assessment.

Public consultation

Notice of the proposed amendment and a consultation document is made available for public comment for a minimum of 30 business days. Any comments received relevant to the survival of the species/subspecies are considered by the Committee as part of the assessment process.

Listing and Recovery Plan Recommendations

A decision about whether there should be a Recovery Plan for this species has not yet been determined. The purpose of this consultation document is to elicit additional information to help inform this decision.

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the Environment 2021, *Conservation Advice for Acacia constablei* (Narrabarba wattle), Canberra.

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Version history table

[Only include any previous approved listing advices, conservation advices (not drafts) and published consultation draft assessments.]

Document type	Title	Date [dd mm yyyy]
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