Australian Government
Department of Agriculture, Water and the Environment

Consultation on Species Listing Eligibility and Conservation Actions

Eucalyptus pachycalyx subsp. *banyabba* (Banyabba shiny-barked gum)

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

1) the eligibility of *Eucalyptus pachycalyx* subsp. *banyabba* (Banyabba shiny-barked gum) for inclusion on the EPBC Act threatened species list in the Endangered category; and

2) the necessary conservation actions for the above subspecies.

The purpose of this consultation document is to elicit additional information to better understand the status of the subspecies 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@awe.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 29 July 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: https://www.awe.gov.au/sites/default/files/env/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 *Eucalyptus pachycalyx* subsp. *banyabba* (Banyabba shiny-barked gum

SECTION A - GENERAL

1. Is the information used to assess the nationally threatened status of the subspecies 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 subspecies? 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 SUBSPECIES? (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 subspecies not in the current advice?

SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SUBSPECIES? (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 subspecies? 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 subspecies (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 subspecies 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 ☐ 251–1,000 ☐ >1,000 ☐ >10 000

   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 SUBSPECIES? (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 prior to June 2019? 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 subspecies 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 ☐ 251–1,000 ☐ >1,000 ☐ >10,000

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 subspecies' total population size over the last approximately 300 years (3 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 SUBSPECIES? (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 subspecies? If not, please provide justification for your response.

14. Has the survey effort for this subspecies 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 – 200 km^2 ☐ 200 – 500 km^2 ☐ >500 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 SUBSPECIES? (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:

    ☐ <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

    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:

☐ <100 km^2 ☐ 100 – 200 km^2 ☐ 200 – 500 km^2 ☐ >500 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 SUBSPECIES? (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 subspecies 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 subspecies 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 SUBSPECIES? (If no, skip to section I)

25. What planning, management and recovery actions are currently in place supporting protection and recovery of the subspecies? 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 subspecies?

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

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

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 subspecies has?

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

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

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

    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 subspecies?

Conservation Advice for *Eucalyptus pachycalyx* subsp. *banyabba* (Banyabba shiny-barked gum)

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

The purpose of this consultation document is to elicit additional information to better understand the status of the subspecies 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 subspecies. It provides a foundation for conservation action and further planning.

Eucalyptus pachycalyx subsp. *banyabba* (Banyabba shiny-barked gum) © Copyright, P. Sheringham (2021)

Conservation status

Eucalyptus pachycalyx subsp. *banyabba* (Banyabba shiny-barked gum) was listed in the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999* effective from 16 July 2000. The subspecies was eligible for listing because prior to the EPBC Act, it was listed as Endangered under the *Endangered Species Protection Act 1992* (Cwlth). There was no listing advice prepared for this subspecies at that time.

Eucalyptus pachycalyx subsp. *banyabba* is proposed to remain in the Endangered category of the threatened species list under the EPBC Act.

Eucalyptus pachycalyx subsp. *banyabba* was assessed by the Threatened Species Scientific Committee to be eligible for listing as Endangered under criteria 2, 3 and 4. The Committee's assessment is at Attachment A. The Committee's assessment of the subspecies' eligibility against each of the listing criteria is:

- Criterion 1: Insufficient data
- Criterion 2: B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v): Endangered
- Criterion 3: C2a(i): Endangered
- Criterion 4: D1:Endangered
- Criterion 5: Insufficient data

The main factors that make the subspecies eligible for listing in the Endangered category are: a very low number of mature individuals; a restricted geographic distribution; occurrence at two locations; and continuing decline inferred in the subspecies' area of occupancy, extent and area of habitat, number of subpopulations and 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 subspecies under relevant state or territory legislation, see the Species Profile and Threat Database.

Species information

Taxonomy

Conventionally accepted as *Eucalyptus pachycalyx* subsp. *banyabba* K.D. HILL.

While this taxon is accepted in the Australian Plant Census, it is not accepted in EUCLID (CANBR 2020). The authors of EUCLID do not regard *Eucalyptus pachycalyx* subsp. *banyabba* as significantly different from *E. pachycalyx* subsp. *waajensis*, described in 1991.

Description

The Banyabba shiny-barked gum (family Myrtaceae) grows up to 10 m tall but is usually shorter, and sometimes forms mallee-like multiple trunks. The bark is smooth from the base and its colour is a metallic light or dark grey, yellow and orange. It sheds bark in scales, somewhat like *Corymbia maculata* (spotted gum). The juvenile leaves are broad and rounded and dull grey-green. Adult leaves are similar in colour but are lance-shaped and broader, with thin, drawn-out

tips, that are 5–13 cm long. The buds, in clusters of seven, are egg-shaped with a warty surface and the fruits are lumpy and cup-shaped (OEH 2018).

Eucalyptus pachycalyx (shiny-barked gum) is a taxonomically isolated species most closely allied to *E. squamosa* (scaly bark). These two taxa represent eastern outliers in the large and otherwise primarily Western Australian section Bisectaria (Pryor & Johnson 1970 cited in Hill 1997).

Distribution

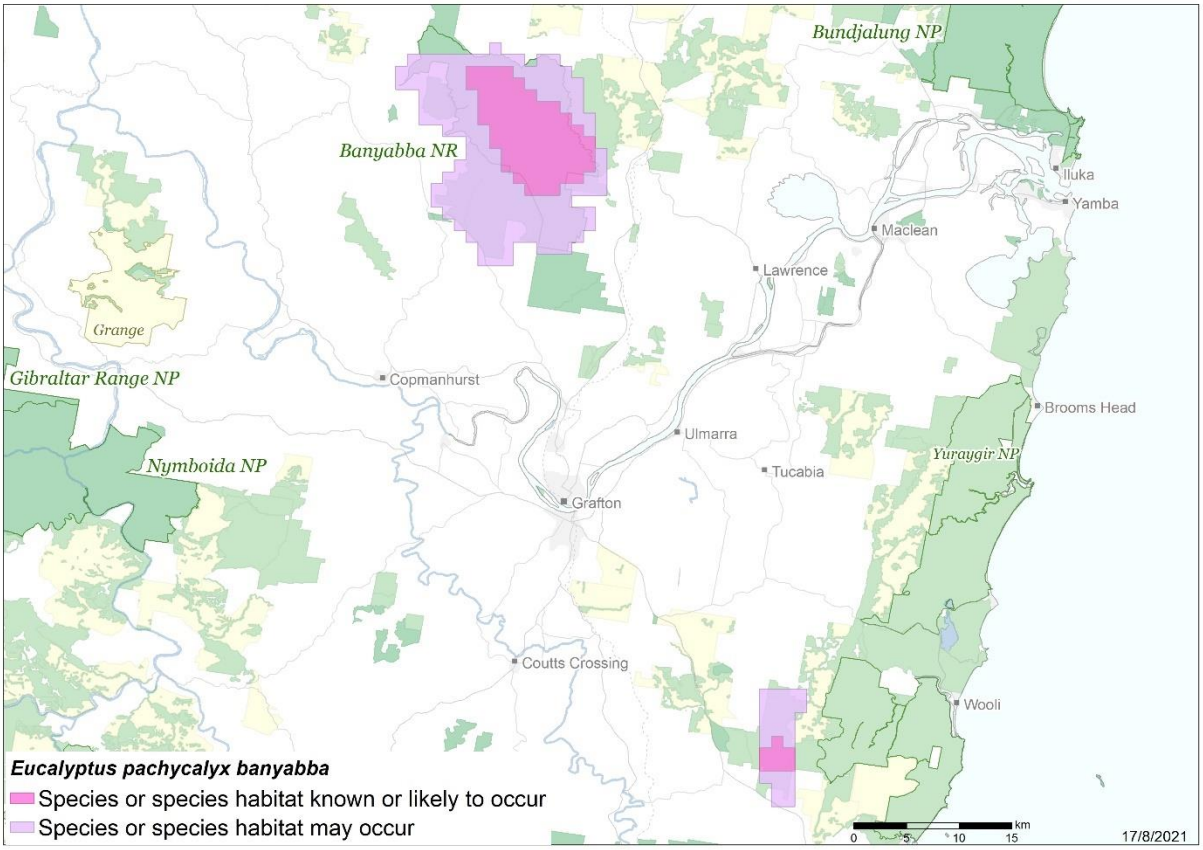
The subspecies is known from three subpopulations, two in Banyabba Nature Reserve (NR), north-west of Grafton and one in Yuraygir State Conservation Area (SCA) south-east of Grafton discovered in 2021. In Banyabba NR, one subpopulation occurs to the east of Lardner Trail and the other on the Sportsmans Creek Trail. The latter is the larger subpopulation at 2 ha in extent (OEH 2018).

The subpopulations in Banyabba NR were extensively burnt in the 2019-2020 bushfires, whereas the Yuraygir SCA subpopulation was not burnt (P. Sheringham, pers comm. 27 July 2021). There are an estimated 226 mature individuals of Banyabba shiny-barked gum, with further surveys required to determine the exact number of mature individuals in the Sportsman Creek Trail subpopulation (see Table 1). Additional subpopulations may exist as not all suitable habitat has been surveyed (P. Sheringham, pers comm. 27 July 2021; C. Blackmore, pers comm. 9 September 2021).

Table 1. Subpopulations of Banyabba shiny-barked Gum

	No. of mature individuals (survey date)	**Comments**
Lardner Trail, Banyabba NR	5 (June 2020) 28 (June 2019)	Within monitoring plot 23 individuals were partially or fully consumed by the 2019-2020 fires, but have all been observed resprouting from lignotubers; 73 resprouts observed in total. Five mature individuals left standing outside monitoring plot.
Sportsman Creek Trail, Banyabba NR	45 (August 2020) 58 (June 2019)	As a result of the 2019-2020 fires, six individuals died and nine survived in monitoring plot. Seven died and 16 survived adjacent to the monitoring plot. 345 resprouts from ground observed in total. Area east of Sportsman's Creek Trail requires further survey to accurately determine numbers, but are estimated at no more than 20 (C. Blackmore, pers comm. 9 September 2021).
Yuraygir SCA	176 (November 2021)	All adult trees. Fresh buds and fruiting. Discovered in 2021 (P. Sheringham, pers comm. 27 July 2021).
Total	226	

Map 1 Modelled distribution of Banyabba shiny-barked gum



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 specific habitat type or geographic feature that represents to recent observed locations of the species (known to occur) or preferred 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

The cultural, customary and spiritual significance of species and the ecological communities they form are diverse and varied for Indigenous Australians and their stewardship of Country. This section describes some examples of this significance but is not intended to be comprehensive or applicable to, or speak for, Indigenous Australians. Such knowledge may be held by Indigenous Australians who are the custodians of this knowledge and have the rights to decide how this knowledge is shared and used.

The Banyabba shiny-barked gum and its habitat in Banyabba NR occur on the Country of the Bandjalung People. The Bandjalung People have lived on Country since the beginning of the Dreaming. Native title rights of the Bandjalang People over Banyabba NR have been legally recognised by the Federal Court of Australia (2013). This reserve is part of a landscape of cultural importance to the Bandjalung People and these lands will continue to be places of ceremony, learning and inspiration for generations to come. The NSW National Parks and Wildlife Service is working with the Bandjalang People to help promote culture and reconciliation within the Banyabba NR (NPWS 2020a).

One subpopulation of the Banyabba shiny-barked gum occurs in Yuraygir State Conservation Area, which is traditional Country of the Yaegl and Gumbaingirr People. Many Gumbaingirr and Yaegl People still live in the area and retain traditional knowledge of the landscape, its resources and locations of places of mythological and spiritual significance (NPWS 2003).

Relevant biology and ecology

Reproductive biology

There is limited information on the Banyabba shiny-barked gum's reproductive biology or pollinators, although the subspecies has been observed fruiting in May (P. Sheringham, pers comm. 27 July 2021). Although it produces viable seed (some of which is stored at NSW Plant Bank), no seedling recruitment has been observed in wild populations. The subspecies regenerates from basal and lignotuber sprouting, as well as epicormic shoots when burnt (C. Blackmore, pers comm. 6 August 2021).

Habitat ecology

The Banyabba shiny-barked gum is found in slight rises on shallow to skeletal sandstone soils in dry sclerophyll forests and woodlands (OEH 2018; P. Sheringham, pers comm. 27 July 2021). The subspecies can be locally dominant, though sparse, over a low heathy understorey (OEH 2018).

In Banyabba NR Banyabba shiny-barked gum is found in very open woodlands on sandstone benches. Associated tree species include *Corymbia gummifera* (red bloodwood), and *Angophora woodsiana* (smudgee). The shrub layer differs somewhat from the Yuraygir SCA subpopulation with *Leptospermum microcarpum* (small-fruited tea-tree), *Dodonaea crucifolia, Cryptandra propinqua* (silky cryptandra), *Acacia juncifolia* (rush-leaf wattle) and *Isopogon mnoraifolius* occurring. The ground layer consists of grasses and sedges including *Ptilothrix deusta* (feather sedge) and *Prostanthera sejuncta* (spiny mintbush) (P. Sheringham, pers comm. 2 August 2021).

In Yuraygir State Conservation Area, associated tree species are red bloodwood and *Eucalyptus planchoniana* (needlebark stringybark). The shrub layer comprises small-fruited tea-tree, *Pultenaea rostrata*, silky cryptandra, *Calytrix tetragona* (common fringe myrtle) and *Dillwynia retorta* (eggs and bacon) (P. Sheringham, pers comm. 2 August 2021).

Fire ecology

As in many *Eucalyptus* species, the Banyabba shiny-barked gum resprouts after disturbance. The subspecies has been observed resprouting from both epicormic buds and lignotubers following the 2019-2020 fires (NPWS 2020b). Some plants were fully consumed in these fires (including the stump) however they have since been observed resprouting from lignotubers. In some instances, shoots have been found sprouting at a distance from the parent tree (NPWS 2020b). The subspecies has not been observed germinating from seeds since the 2019-2020 fires (C. Blackmore, pers comm. 6 August 2021). The Banyabba shiny-barked gum has a canopy seed bank from which fire promotes seed release.

High frequency fires and severe fires are likely to pose a threat to Banyabba shiny-barked gum and this subspecies was ranked being at high vulnerability to poor recovery after the 2019-2020 fires (Gallagher 2022). The secondary juvenile period (fire-free interval required by resprouts of the Banyabba shiny-barked gum to reach maturity and bear a crop of seeds) is unknown. Keith (1996) states that for most plant species, up to 15 years between successive fires is needed to ensure that a seed bank is sufficiently replenished to maintain future post-fire populations, although some trees may require longer fire-free periods. The Sportsmans Creek subpopulation was burnt in 2013 and again six years later in 2019. Epicormic growth and shoots that had emerged following the 2013 fire were destroyed by fire in 2019-2020 before they could reach reproductive maturity and had not resprouted by August 2020 (C. Blackmore, pers comm. 6 August 2021), and thus the plants may have been killed. At Lardner Trail, only five mature trees of Banyabba shiny-barked gum showed epicormic regrowth on standing trunks after the 2019-2020 bushfires. If future fires burn regrowth and juveniles before they re-establish their fire-resistance, this could pose a threat to the future viability of this subpopulation (C. Blackmore, pers comm. 6 August 2021).

Short intervals between fires may also kill juveniles of the Banyabba shiny-barked gum before they become large enough to develop regenerative structures (e.g. lignotubers) needed to survive subsequent fires. At least 15 years between successive fires is needed to ensure the juveniles of most plant species can develop their fire-regenerative organs, although some tree species may require at least 25 years (Keith 1996). This suggests that the fire-free interval required for the successful recruitment of the Banyabba shiny-barked gum may be 25 years or longer if seedlings emerge after fire.

Although adult trees are more resilient to high fire frequency, the cumulative effects of multiple fires in a short period of time can cause substantial mortality of adult trees. Fairman et al. (2017) recorded 50 percent mortality of mature lignotuberous *Eucalyptus pauciflora* (snow gum) following three bushfires in 10 years. Therefore, increasing fire frequency may also cause increasing mortality of mature Banyabba shiny-barked gum.

Habitat critical to the survival

The Banyabba shiny-barked gum is found on slight rises on shallow to skeletal sandstone soils, in dry sclerophyll forests and woodlands over a low heathy understorey. Accordingly, the habitat critical to the survival of the subspecies includes areas that conform with this description where the subspecies currently occurs, may have occurred in the past or could occupy in future once it became established.

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 are important for the conservation of the subspecies, due to its very low number of mature individuals and restricted geographic range.

Threats

The main threat to this subspecies is fire regimes that cause declines in biodiversity. Other threats include road and trail maintenance, damage by visitors, climate change and myrtle rust (*Austropuccinia psidii*).

Threats in Table 2 are noted in approximate order of highest to lowest impact, based on available evidence.

Table 2 Threats impacting Banyabba shiny-barked gum

Threat	Status[a]	Evidence
Habitat disturbance and modification		
Fire regimes that cause declines in biodiversity[b]	• Timing: current/future • Confidence: inferred • Likelihood: almost certain • Consequence: major • Trend: increasing • Extent: across the entire range	'Fire regimes that cause declines in biodiversity' is listed as a key threatening process under the EPBC Act (DAWE 2022). High frequency fires and severe fires pose a threat to the Banyabba shiny-barked gum (Gallagher 2022). Frequent fires appear to cause incremental mortality and limit recruitment in the Banyabba shiny-barked gum (see *Fire ecology* section above). Although the subspecies is capable of surviving fire and resprouting post-fire, the apparent lack of recruitment from seedlings suggests that individuals that are lost due to disturbance events may not be replaced, leading to population decline. Individual trees may also be at risk from fire suppression and mop-up operations. In 2019-2020, catastrophic bushfire conditions resulted in extensive bushfires across eastern Australia. Gallagher (2022) suggests that approximately 98% of the subspecies' range in Banyabba NR was within the extent of these fires. This agrees with on-ground observations that found both subpopulations in Banyabba NR were burnt in the 2019–20 bushfires. The Yuraygir SCA subpopulation, which was discovered in 2021, wasn't affected by these fires. These bushfires were partially caused by the 2017–2019 droughts in NSW through low fuel moisture content, leaf senescence and shedding, and lack of moist impediments to fire spread (Nolan et al. 2020).

Threat	**Status**[a]	**Evidence**
Road and trail maintenance	• Timing: future • Confidence: inferred • Likelihood: likely • Consequence: moderate • Trend: stable • Extent: across part of its range	Inappropriate road or trail maintenance including clearing, spraying and soil disturbance pose a threat to the Banyabba shiny-barked gum individuals in close proximity to roadsides (OEH 2016; OEH 2018).
Damage by visitors	• Timing: future • Confidence: suspected • Likelihood: possible • Consequence: minor • Trend: stable • Extent: across part of its range	Camping and visitation in close proximity to roadsides and trails within the subspecies' distribution may damage Banyabba shiny-barked gum individuals (OEH 2016; OEH 2018).
Climate Change		
Increased frequency of extreme temperatures, droughts and fire danger weather, and changes in precipitation	• Timing: current and future • Confidence: observed and inferred • Likelihood: almost certain • Consequence: major • Trend: increasing • Extent: across the entire range	From 2017-19, north-eastern NSW experienced severe drought (Bureau of Meteorology 2020; DPI 2020). Approximately 48% of the subspecies' modelled distribution in Banyabba NR was in drought in the six months preceeding the 2019-2020 bushfires (Gallagher 2022). This modelling did not include the Yuraygir SCA subpopulation as it was discovered in 2021. The north coast of NSW is expected to undergo an increase in severe and average Forest Fire Danger Index values, which are used as an indicator of fire risk. These increases are projected for summer and spring, which represent peak fire risk season (DPIE 2014a). These changes to fire conditions will likely increase the probability of frequent and high severity bushfires impacting the Banyabba shiny-barked gum into the future. In this region of NSW there is also a projected increase in minimum and maximum temperatures and the number of hot days (above 35°C). Rainfall is projected to decrease in winter and increase in autumn and spring (DPIE 2014b). The long-term impact of drought on Banyabba shiny-barked gum is uncertain. However, drought may cause widespread plant mortality in forest ecosystems, as many plants are vulnerable to drought stress and hydraulic failure of their vascular system (Allen et al. 2010; Choat et al. 2012; De Kauwe et al. 2020). Post-fire recruitment and seedling survival can also be threatened by drought, as environments with higher precipitation may have greater capacity to regenerate compared to environments where drought conditions are present pre- or post-fire (Auld 2020; Gallagher 2022).
Disease		
Myrtle rust	• Timing: future	Myrtle rust threatens plants in the Myrtaceae family and can cause deformed leaves, heavy

Threat	Status[a]	Evidence
	• Confidence: suspected • Likelihood: possible • Consequence: major • Trend: unknown • Extent: across the entire range	defoliation of branches, reduced fertility, dieback, stunted growth and plant death (Makinson 2018; 2020). Banyabba shiny-barked gum is in the family Myrtaceae and occurs within a myrtle rust prone area. Gallagher (2022) notes that the subspecies is at medium risk of infection by myrtle rust based on intersecting burnt areas of the subspecies' range (from the 2019-2020 bushfires) and national mapping of suitable habitat for myrtle rust from Berthon et al. (2018).

[a]Timing—identifies the temporal nature of the threat
Confidence—identifies the nature of the evidence about the impact of the threat on the species
Likelihood—identifies the likelihood of the threat impacting on the whole population or extent of the species
Consequence—identifies the severity of the threat
Trend—identifies the extent to which it will continue to operate on the species
Extent—identifies its spatial context in terms of the range of the species

[b]Fire regimes that cause declines in biodiversity include the full range of fire-related ecological processes that directly or indirectly cause persistent declines in the distribution, abundance, genetic diversity or function of a species or ecological community. 'Fire regime' refers to the frequency, intensity or severity, season, and types (aerial/subterranean) of successive fire events at a point in the landscape

Categories for likelihood are defined as follows:
Almost certain – expected to occur every year
Likely – expected to occur at least once every five years
Possible – might occur at some time
Unlikely – known to have occurred only a few times
Unknown – currently unknown how often the threat will occur

Categories for consequences are defined as follows:
Not significant – no long-term effect on individuals or populations
Minor – individuals are adversely affected but no effect at population level
Moderate – population recovery stable or declining
Major – population decline is ongoing
Catastrophic – population trajectory close to extinction

Each threat has been described in Table 2 in terms of the extent that it is operating on the subspecies. 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 3 Risk Matrix

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain				Fire regimes that cause declines in biodiversity Increased frequency of extreme temperatures, droughts and fire danger weather, and changes in precipitation	
Likely			Road and trail maintenance		
Possible		Damage by visitors		Myrtle rust	
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 2032, the population of Banyabba shiny-barked gum will have increased in abundance and subpopulations are sustained in habitats in which key threats are managed effectively.

Conservation and management priorities

Fire impacts

- Develop and implement a fire management strategy that maintains an appropriate fire regime for the subspecies, that protects all subpopulations burnt during fires (including planned burns and bushfires) from further fire (including planned burns and bushfires) for approximately 15-25 years (i.e. the estimated minimum fire interval) until seedlings and regrowth matures, and the soil-stored seed bank is rebuilt.

- Avoid impacts to subpopulations during fire-fighting operations, or other fire management works, by ensuring accurate subspecies location information is available to relevant fire management agencies.

Habitat disturbance and modifications

- Ensure land managers, relevant state agencies and utility service providers have access to adequate information regarding the location of Banyabba shiny-barked gum (e.g. up to date databases of known subpopulations) and are aware of its occurrence.
- Provide physical protection measures against accidental destruction where necessary (e.g. bollards demarcating the extent of a subpopulation), particularly for plants in close proximity to roadsides and trails.

Climate change and severe weather impacts

- Investigate options for maintaining in situ persistence as the climate changes, for example by minimising other population pressures, enhancing resilience and promoting recruitment or supplementing existing subpopulations.

Disease

- Monitor subpopulations for signs of myrtle rust, especially during post-fire regrowth phases.
- Implement suitable hygiene protocols to protect known subpopulations from outbreaks of myrtle rust, such as the Saving our Species Hygiene Guidelines (DPIE 2020) or Arrive Clean, Leave Clean guidelines (DoE 2015).

Ex situ recovery actions

- To manage the risk of losing genetic diversity, undertake appropriate seed collection and storage, and monitor the viability of stored seed. For species where few seed are produced, seed quality is low, or seeds are difficult to store long-term, undertake alternative ex situ storage such as tissue culture and cryopreservation, vegetative propagation or cultivation of living collections. Seed/tissue collection and storage should be conducted in accordance with best practice guidelines and procedures (refer to Martyn Yenson et al. 2021 or Commander 2021).
- If appropriate, investigate the feasibility of establishing translocated subpopulations that will improve the conservation outlook of the subspecies. Translocations should be conducted in accordance with best practice guidelines and procedures (refer to Commander et al. 2018), including monitoring translocated subpopulations through to recruitment to ensure they are viable.

Stakeholder engagement/community engagement

- Conduct a publicity campaign using physical and electronic media to increase local community awareness of the subspecies' conservation.
- Identify and implement opportunities for community involvement in the conservation of the subspecies.

- Liaise with relevant land managers and landowners to ensure that populations are not accidentally damaged or destroyed. The approval and assistance of land managers should also be sought to implement recovery actions.
- Engage and involve Traditional Owners in conservation actions, including the implementation of Indigenous fire management and other survey, monitoring and management actions.

Survey and monitoring priorities

- Conduct surveys for Banyabba shiny-barked gum in suitable habitat within any proposed development areas.
- Conduct further surveys in potential sandstone habitat in areas such as Yuraygir SCA, Banyabba NR and Fortis Creek National Park to locate additional populations.
- Continue and extend subpopulation monitoring at known sites to identify trends in health, subpopulation size and structure, and habitat condition.
- Survey known subpopulations affected by bushfires to monitor ongoing impacts from fires.

Information and research priorities

- Undertake vulnerability assessments of the subspecies' sensitivity and adaptive capacity to changing climatic conditions which draw on genetic, physiological or ecological evidence.
- If vulnerability assessments indicate the subspecies has a high likelihood of extinction due to climate change, undertake research to identify climate refuges that may be suitable for translocations, including both modelling and experimental approaches (e.g. trial translocations). Consideration should be given to the benefits to the subspecies in mitigating climate change related threats, as well as the risks to the recipient site (e.g. introduction of diseases, pests and/or pathogens, and invasiveness of the subspecies).
- Conduct research into the history, effects and responses of Banyabba shiny-barked gum to fire, to better understand the fire ecology of the subspecies and develop fire management prescriptions.
- Investigate options for linking, enhancing or establishing additional subpopulations.
- Investigate ecological requirements of the Banyabba shiny-barked gum that are relevant to persistence, including:
    - primary and secondary juvenile periods and longevity,
    - factors that may limit seedling recruitment, establishment and development of fire-resistant organs.
    - population genetic structure, levels of genetic diversity and minimum viable population size,
    - soil seedbank dynamics and the role of seed predators and various disturbances (including fire), competition, rainfall in germination and recruitment,
    - reproductive strategies, phenology and seasonal growth, and
    - pollinator biology and requirements.

Recovery plan decision

No recovery plan is in place for the Banyabba shiny-barked gum. A Saving Our Species Strategy is in place for the subspecies in NSW where it is listed as Endangered under state legislation (OEH 2018). A decision about whether there should be a Recovery Plan for this subspecies 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

Northern Rivers Regional Biodiversity Management Plan (DECWW 2010)

Banyabba shiny-barked gum (*Eucalyptus pachycalyx* subsp. *banyabba*) Saving our Species Strategy

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

Attachment A: Listing Assessment for *Eucalyptus pachycalyx* subsp. *banyabba*

Reason for assessment

The Banyabba shiny-barked gum 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 4 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

Table 4 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	226	226	262	The total population is estimated at 262 mature individuals prior to the 2019-2020 fires. The post-fire population is estimated to be 226 mature individuals (see Table 1).

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Declining			The subspecies can resprout from epicormic buds and lignotubers following fires and therefore is subject to natural fluctuations in mature individuals. However, climate change is predicted to increase both the frequency and intensity of bushfires in northern NSW (DPIE 2014b). If future fires burn regrowth and juveniles before they can reach reproductive maturity, this is likely to cause a decline in the number of mature individuals. This has occurred in the Sportsmans Creek subpopulation, where epicormic growth and shoots which had developed following a fire in 2013 were destroyed six years later by fire in 2019 before they could reach maturity and hadn't resprouted by August 2020 (C. Blackmore, pers comm. 6 August 2021). The cumulative effects of multiples fires in a short period of time may also cause substantial mortality of adult trees. The deaths of 13 mature plants were recorded following the 2019-2020 fires and no recruitment was observed from seeds.
Generation time (years)	100	100	Unknown	The subspecies' generation length is unknown. However, based on the generation length of other lignotuberous *Eucalyptus* species, for example *E. forresterae* (brumby sallee) (DELWP 2021), the generation length is estimated to be 100 years.
Extent of occurrence	356 km^2	356 km^2	unknown	The extent of occurrence (EOO) is estimated at 326 km^2. This figure is based on the mapping of point records from a 26-year period (1995–2021) obtained from state governments, museums and CSIRO. A period longer than 20 years was used as the subspecies is slow growing with a long generation length. The EOO was calculated using a minimum convex hull, based on the IUCN Red List Guidelines (IUCN 2019).
Trend	Stable			All of the subspecies' distribution occurs within reserved tenure in either Banyabba NR or Yuraygir State Conservation Area. There have been no recorded declines in the subspecies' EOO and it is considered stable.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Area of Occupancy	20 km^2	20 km^2	Unknown	This estimate used in the assessment is based on the mapping of point records from 1995–2021 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			While the subspecies can resprout from epicormic buds and lignotubers following fire, high frequency fires and severe fires pose a threat. The subspecies' AOO is likely to be contracting due to a decline in mature individuals as a result of recent fires in the subspecies distribution (see above).
Number of subpopulations	3	3	3	The subspecies is known from three subpopulations, two in Banyabba NR, north-west of Grafton and one in Yuraygir State Conservation Area (SCA) south-east of Grafton.
Trend	Contracting			At Lardner Trail, only five mature trees of Banyabba shiny-barked gum showed epicormic regrowth on standing trunks after the 2019-2020 bushfires. If future fires burn regrowth and juveniles before they again reach reproductive maturity, this could pose a threat to the future viability of this subpopulation (C. Blackmore, pers comm. 6 August 2021).
Basis of assessment of subpopulation number	There are three known subpopulations, two in Banyabba NR located north-west of Grafton, and one in Yuraygir State Conservation Area (SCA) south-east of Grafton.			
No. locations	2	1	2	The most plausible threat to the subspecies is high fire frequency (see above). Given the potential for large scale fires to occur in the subspecies' distribution in future and impact at least 2 and possibly all subpopulations, the number of locations is estimated as 1-2. The maximum plausible value of 2 has been used in the assessment.
Trend	Declining			
Basis of assessment of location number	The most plausible threat to the subspecies is high fire frequency (see above). Given the potential for large scale fires to occur in the subspecies' distribution in future and impact at least 2 and possibly all subpopulations, the number of locations is estimated as 1-2. The maximum plausible value of 2 has been used in the assessment.			

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Fragmentation	Not considered severely fragmented. The phrase 'severely fragmented' refers to the situation in which increased extinction risks to the taxon results from the fact that most of its individuals are found in small and relatively isolated subpopulations (IUCN 2012). The two subpopulations in Banyabba NR are isolated from the Yuraygir subpopulation by a distance of approximately 60 km and genetic exchange between them is unlikely to occur (P. Sheringham, pers comm. 7 September 2021). While the two subpopulations in Banyabba NR are small (5 and 45 mature individuals), the largest subpopulation in Yuraygir SCA contains 176 mature individuals and is surrounded by relatively intact habitat. Therefore the taxon is not considered severely fragmented.			
Fluctuations	Not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals – no parameter was changed by an order of magnitude by the 2019-2020 bushfires.			

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

Insufficient data to determine eligibility

The subspecies' generation length is unknown. However, based on the generation length of other lignotuberous *Eucalyptus* species, for example brumby sallee (DELWP 2021), the generation length is estimated to be 100 years. Therefore, three generations represents 300 years for the purposes of this criterion.

The number of mature individuals of Banyabba shiny-barked gum was estimated to be 262 prior to the 2019-2020 fires and 226 in June 2020, 18 months after the fires. However, a number of

individuals (fully or partially consumed by fire) have been observed resprouting from lignotubers and roots. Some individuals have also been observed resprouting from epicormic growth following the fires. This growth will need a substantial fire-free period to positively contribute to the resistance of individuals to future fires.

The Sportsman Creek Trail subpopulation was burnt in 2013 and again six years later in 2019. Epicormic growth and shoots which had developed following the 2013 fire were destroyed by fire in 2019-2020 before they could reach maturity and hadn't resprouted by August 2020 (C. Blackmore, pers comm. 6 August 2021). The deaths of 13 mature plants were also recorded at Sportsman Creek Trail following the 2019-2020 fires and no recruitment was observed from seeds (see Table 1). This represents a 7% reduction in the number of mature individuals across the subspecies' total population. Given that the cumulative effects of multiples fires in a short period of time can cause substantial mortality of adult resprouting *Eucalyptus* species (Fairman et al. 2017), this could be attributable to an ongoing decline, rather than a natural post-fire fluctuation.

The north coast of NSW is expected to undergo an increase in average and severe Forest Fire Danger Index values, which are used as an indicator of fire risk. These increases are projected for summer and spring, which represent peak fire risk season (DPIE 2014a). These changes to fire conditions will likely increase the probability of frequent and high severity bushfires impacting the Banyabba shiny-barked gum into the future. The subspecies' tolerable fire interval is likely to be similar to other woody species (15–25 years) (Keith 1996). If future fires burn regrowth and juveniles before they can reach reproductive maturity, as has already occurred at the Sportsman Creek Trail subpopulation, this is likely to cause a decline in the number of mature individuals through lack of recruitment and mortality of adults. However, there are a lack of data available to determine the rate of this decline under future fire regimes.

Conclusion

While the Banyabba shiny-barked gum has undergone a reduction in population size of 7 percent following the 2019-2020 bushfiers, this is below the 30 percent threshold for listing as Vulnerable under this Criterion. The subspecies is likely to undergo decline in future as a result of increasing fire frequency and intensity. However, there is insufficient evidence (e.g. modelling) at the time of this assessment to provide an estimate of projected decline in the Banyabba shiny-barked gum under future fire regimes. The purpose of this consultation document is to elicit additional information to better understand the subspecies' 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(ii,iii,iv,v)+2ab(ii,iii,iv,v) for listing as Endangered

The EOO and AOO of the Banyabba shiny-barked gum are estimated at 356 km² and 20 km² respectively (see Table 4). These estimates meet the thresholds for Endangered under B1 (EOO < 5,000 km²) and Endangered under B2 (AOO < 500 km²).

Severely fragmented and number of locations

The two subpopulations in Banyabba NR are isolated from the Yuraygir subpopulation by a distance of approximately 60 km and genetic exchange between them is unlikely to occur (P. Sheringham, pers comm. 7 September 2021). While the two subpopulations in Banyabba NR are small (5 and 45 mature individuals), the largest subpopulation in Yuraygir SCA contains 176 mature individuals and is surrounded by relatively intact habitat. Therefore the taxon is not considered severely fragmented.

The number of locations is likely to be two, given the likely extent of future bushfires across the subspecies' distribution (see Table 4). Therefore, the subspecies appears to meet the threshold for listing as Endangered under sub-criterion (a).

Continuing decline

The Banyabba shiny-barked gum is subject to ongoing threats of frequent and high severity bushfires, the effects of which are further exacerbated by drought in the subspecies' distribution. Drought depletes carbohydrate resources held within plant tissues and reduces reproductive output and capacity to resprout after disturbance, particularly fire (Nolan et al. 2021). The subspecies can resprout from epicormic buds and lignotubers following fires and therefore is subject to natural fluctuations in mature individuals. However, climate change is predicted to

increase both the frequency and intensity of bushfires in northern NSW (DPIE 2014b). If future fires burn regrowth and juveniles before they can reach reproductive maturity, this is likely to cause a decline in the number of mature individuals through lack of recruitment and mortality of adults. This has occurred in the Sportsmans Creek subpopulation, where epicormic growth and shoots which had developed following a fire in 2013 were destroyed six years later by fire in 2019 before they could reach maturity and hadn't resprouted by August 2020 (C. Blackmore, pers comm. 6 August 2021). The deaths of 13 mature plants were recorded in the Sportsmans Creek subpopulation following the 2019-2020 fires and no recruitment was observed from seeds. The apparent lack of recruitment suggests that individuals that die are unlikely to be replaced in the population, leading to a decline in individuals. At the Lardner Trail subpopulation only five of the original 28 mature trees of Banyabba shiny-barked gum showed epicormic regrowth on standing trunks after the 2019-2020 bushfires.

Extreme Fluctuations

While the number of mature individuals naturally fluctuates following fire, the subspecies is not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals.

Conclusion

The Committee considers that the subspecies' EOO and AOO are restricted, and continuing decline is inferred in the subspecies' AOO (ii), area, extent and/or quality of habitat (iii), number of subpopulations and number of mature individuals (v) due to ongoing threats of frequent and severe bushfires, the effects of which are further exacerbated by drought in the subspecies' distribution.

The data presented above appear to demonstrate that the subspecies 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 subspecies' 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) as Endangered

There are an estimated 226 mature individuals of Banyabba shiny-barked gum, and some level of continuing decline is likely due to a combination of fire and drought (see Criterion 1). All subpopulations are equal to or fewer than 250 mature individuals (Table 1). Based on this information, the subspecies meets the threshold for listing as Endangered under criterion C2(a)(i).

Conclusion

The data presented above appear to demonstrate that the subspecies 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 subspecies' 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 km² 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 subspecies under D2. As such, a subspecies 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 subspecies' 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 250 which is very low. Therefore, the subspecies 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 subspecies' AOO is less than 20 km² and the number of locations is less than or equal to five (see Criterion 2), the subspecies 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 subspecies' 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 subspecies is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' 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.

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the Environment 2022, *Conservation Advice for Eucalyptus pachycalyx* subsp. *banyabba* (Banyabba shiny-barked gum), Canberra.

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