



Consultation on Species Listing Eligibility and Conservation Actions

Bertya sp. Clouds Creek

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

- 1) the eligibility of *Bertya* sp. Clouds Creek for inclusion on the EPBC Act threatened species list in the 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@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 5 January 2022.

Contents of this information package	Page
General background information about listing threatened species	1
Information about this consultation process	2
Consultation questions specific to the assessment	4
Information about the species and its eligibility for listing	11
Conservation actions for the species	22
References cited	25
Listing assessment	31

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/recovery-plans>.

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 *BERTYA* SP. CLOUDS CREEK (M. FATEMI 4)

Please note, this list of questions is provided as a guide only. Respondents are not required to address every question.

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:

0–100 100–250 250–500 >500 >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

9. Do you consider the five subpopulations that did not undergo recruitment during the 2019–20 bushfires to be extinct?

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

10. 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

11. Are you able to provide an estimate of the total population size during the late 2010s? 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:

0–100 100–250 250–500 >500 >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

12. Are you able to comment on the extent of decline in the species' total population size over the last approximately 10 years? 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

13. 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

14. Does the assessment consider the entire geographic extent and national extent of the species? If not, please provide justification for your response.
15. Has the survey effort for this species been adequate to determine its national distribution? If not, please provide justification for your response.
16. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.
17. 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.
18. 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 km² 100 – 5 000 km² 5 001 – 20 000 km² >20 000 km²

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 km² 11 – 500 km² 501 – 2000 km² >2000 km²

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

19. Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.
20. 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 km² 100 – 5 000 km² 5 001 – 20 000 km² >20 000 km²

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 km² 11 – 500 km² 501 – 2000 km² >2000 km²

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)

21. Do you consider that all major threats have been identified and described adequately?
22. To what degree are the identified threats likely to impact on the species in the future?
23. Are the threats impacting on different populations equally, or do the threats vary across different populations?
24. 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?
25. 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)

26. What planning, management and recovery actions are currently in place supporting protection and recovery of the species? To what extent have they been effective?
27. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species?

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

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

29. 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?

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

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

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

33. 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

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

35. Are you aware of any other individuals/groups who may be able to provide information?

Conservation Advice for *Bertya* sp. Clouds Creek

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 approved conservation advice and listing assessment for the species. It provides a foundation for conservation action and further planning.



Photo of male *Bertya* sp. Clouds Creek flower © Copyright Gavin Phillips

Conservation status

Bertya sp. Clouds Creek (M.Fatemi 4) (hereafter *Bertya* sp. Clouds Creek) is being assessed by the Threatened Species Scientific Committee to be eligible for listing as Endangered under

Criteria 2 and 3. 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: Not eligible
- Criterion 2: B1ab(i,ii,iii,iv,v)+B2ab(i,ii,iii,iv,v): Endangered
- Criterion 3: C1+C2a(i): Endangered
- Criterion 4: D: Vulnerable
- Criterion 5: Insufficient data

The main factors that make the species eligible for listing in the Endangered category are: a restricted Area of occupancy (AOO) below 500 km²; a severely fragmented population that occurs at one location; and continuing estimated decline in AOO, extent of occurrence (EOO), extent and area of habitat, number of subpopulations and number of mature individuals. The total number of mature individuals is also below 2500, and there is a precarious geographic distribution based on the presence of less than 250 mature individuals in each subpopulation.

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

Bertya sp. Clouds Creek (family Euphorbiaceae) is yet to be formally described. Until 2007, the species was included in the more broadly defined *Bertya* sp. A (*sensu* James & Harden 1990). Taxonomic research by Fatemi et al. (2007) demonstrated that *Bertya* sp. A included two distinct species: one occurring to the west of the Great Dividing Range and another restricted to the east. Subpopulations from western New South Wales (NSW) (e.g. Cobar, Coolabah and Narrabri) were assigned to *Bertya opponens* (Coolabah *bertya*), a species previously thought to be endemic to Queensland (Qld). The subpopulations occurring east of the Great Dividing Range were recognised as *Bertya* sp. Clouds Creek (Fatemi et al. 2007).

Description

Bertya sp. Clouds Creek is a shrub growing to 3 m tall, with densely hairy stems. The leaves are opposite, dark green, and 50–75 mm long by 9–17 mm wide. The species has separate male and female flowers on the same plant. Fruits are globe-shaped, densely hairy, 3-seeded, and 12 mm long by 10 mm wide. *Bertya* sp. Clouds Creek is distinguished from Coolabah *bertya* by the presence of stalked glands at the base of the leaves, and the mostly golden (rather than white) colour of hairs (Fatemi et al. 2007; OEH 2020a).

Distribution

Bertya sp. Clouds Creek is endemic to north-eastern NSW. Prior to the 2019–20 bushfires, it occurred from the Gibraltar Range, east of Glen Innes, to the Macleay Gorges, south-east of Armidale (Map 1) in eight subpopulations (Table 1). The most northerly subpopulation is in Barool National Park (NP) at the south-western edge of the Gibraltar Range, and the distribution extends approximately 150 km south to two sites at Oxley Wild Rivers National Park (OWRNP) (Copeland 2008). It is possible that further subpopulations may occur, as the species' habitat is

typically very steep and relatively inaccessible (Copeland 2008). The 2019–20 bushfires intersected with 97 percent of the species’ modelled distribution (Gallagher 2020; Auld et al. 2020; DPIE 2020, 2021).

An unconfirmed subpopulation with “many hundreds of mature plants” may also be present on the steep slopes near Clouds Creek Falls in Clouds Creek State Forest (SF), although the area has not been fully surveyed and may have been burnt since this observation was made ‘a few years ago’ (D. Binns 2021. pers comm 6 June). It is unclear if this is the same subpopulation as the confirmed site in Clouds Creek SF. Further survey is required to determine if these sites are independent of each other.

Subpopulation information

Post-fire information is available for all of the eight confirmed localities. A pre-2019–20 bushfire lower bound estimate of the total population is approximately 480 mature plants, which excludes the poorly known subpopulation along Sara River (Copeland 2008). An upper bound estimate is approximately 560 mature plants, assuming that the Sara River subpopulation is a similar size to the other two subpopulations nearby in Mann River NR. This figure also allows for an additional 50 mature individuals in the Kangaroo River SF population which is plausible given that the estimate by Austen (1999) was cited as being a minimum estimate (Copeland 2008). The estimate for the total *Bertya* sp. Clouds Creek population prior to the 2019–20 bushfires is therefore 480–560 mature individuals (Copeland 2008).

Post-fire surveys indicate that all known subpopulations were burnt in the 2019–20 bushfires. In five of the eight known subpopulations, no individuals were found (Table 1). As of 2021, the sum of all known individuals is c. 32 mature adults and c. 504 seedlings (DPIE 2021).

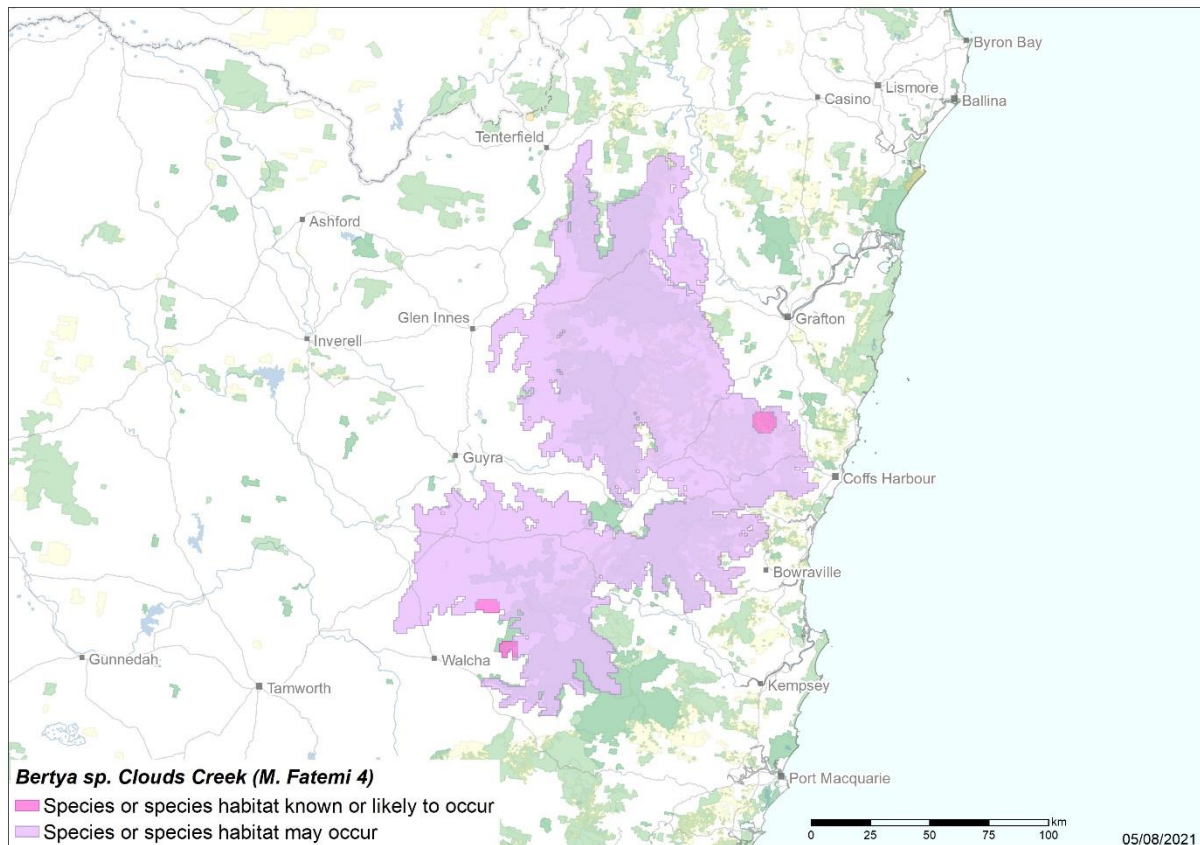
Table 1: Details of confirmed subpopulations of *Bertya* sp. Clouds Creek

Subpopulation	Locality	Habitat	Survey date	Population notes	Source
1	Barool NP, rocky bluff South east of Barool Creek.	Edge of rocky outcrop – skeletal soil derived from granite.	1999 10/6/2021	20 mature adults and no juveniles 0 plants	Austen (1999, cited in Copeland 2008) DPIE (2021)
2	Mann River NR, western side of Tommy’s Rock Lookout	Shallow sandy loam over granite, steep northerly aspect.	23/9/07 9/6/2021	c. 30 mature adults and several seedlings 0 plants	NE Herbarium specimen., cited in Copeland 2008 L. Copeland pers. obs (2008). DPIE (2021)
3	Mann River NR, 4 km SW of Tommy’s Rock Lookout	Steep rocky slope on granite – Westerly aspect.	2004 9/6/2021	c. 30 mature adults and several seedlings 0 plants	J.T. Hunter pers comm., cited in Copeland (2008). DPIE (2021)

Bertya sp. Clouds Creek Conservation Advice

4	Sara River [c. 50 km SE of Glen Innes]	Steep rocky slope. Growing in shrubland amongst sedimentary rocks.	15/11/ 94 30/6/2021	Population size unknown but as area was said to be less than 0.5 ha. 0 plants	CFSHB Herbarium specimen, cited in Copeland (2008). DPIE (2021).
5	Clouds Creek SF, gorge above Clouds Creek Falls	Steep rocky slope with sparse shrubs.	28/8/00 14/6/2021	c. 50 mature adults. 0 plants	NE Herbarium specimen, M. Fatemi pers. comm., cited in Copeland (2008). DPIE (2021)
6	Kangaroo River SF, Devils Face	Skeletal soil amongst crevices of a metasedimentary outcrop.	1999 15/6/2021	At least 500 plants in 1999, approximately half of which were mature adults. 0 mature adults, c.267 seedlings	Austen (1999, cited in Copeland 2008) NE Herbarium specimen (2008) I. Telford pers. comm, cited in Copeland (2008). DPIE (2021)
7	Winterbourne Gorge (OWRNP)	Shallow loamy soil over metasediments. Steep slope. Edge of dry rainforest.	2/6/07 28/6/2021	c. 50 plants 12 mature adults, c. 230 seedlings	NE Herbarium, cited in Copeland 2008 L. Copeland pers. comm (2021). DPIE (2021).
8	Rowleys Creek (OWRNP)	Skeletal soil on edge of gorge rims, on metasediments or granite	17/10/13 30/6/2021	c. 50 plants c. 20 mature adults, c. 17 seedlings	L. Copeland pers. comm (2021). DPIE (2021).

Map 1 Modelled distribution of *Bertya* sp. Clouds Creek.



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

This section describes some published examples of cultural significance but is not intended to be comprehensive, applicable to, or speak for, all Indigenous people. Such knowledge may be only held by Indigenous groups and individuals who are the custodians of this knowledge.

Mann River NR is thought to be a significant place for the Ngarbul People of the northern tablelands, as well as the Gumbaynggir People (NSW NPWS 2021). Oxley Wild Rivers NP is thought to be on the lands of the Dunghutti People, and archaeological excavations have established that Indigenous Australians have occupied the area for at least 4200 years (NSW NPWS 2005). Clouds Creek SF also has an Aboriginal Cultural Heritage Site (Forestry Corporation 2016). Ascertaining the cultural significance of *Bertya* sp. Clouds Creek is a research priority identified in the conservation actions.

Relevant biology and ecology

Habitat

Bertya sp. Clouds Creek grows on steep, rocky slopes in shallow soil, on granitic or metasedimentary geology. The species typically occurs within heath or low shrubland vegetation surrounded by stunted *Eucalyptus* spp. (eucalypts) from 300 to 1000 m above sea level (Copeland 2008; DPIE 2019). Habitat at the Barool NP site is recorded as a ridge crest immediately above a cliff, with *Eucalyptus campanulata* (New England blackbutt), *Eucalyptus notabilis* (mountain mahogany) and *Allocasuarina littoralis* (black sheoak) woodland (OEH 2020a). Surveys in 2021 indicate that one Mann River subpopulation consists of Heath with *Leucopogon juniperinus* (prickly beard-heath) and *Sannantha* sp. (baeckeke), whilst the Kangaroo River subpopulation is found in scrubland dominated by *Acacia fimbriata* (fringed wattle), and occurs with *Persoonia stradbrokeensis*, *Themeda triandra* (kangaroo grass), *Plectranthus graveolens* (native coleus), *Hoya australis* (waxvine) and *Cheilanthes sieberi* (Bionet 2021). The Sara River subpopulation grows in *Acacia blakei* subsp. *diphylla* (Blake's wattle) scrubland (DPIE 2021).

Reproduction and life-history

Little is known about the reproductive biology and life-history of *Bertya* sp. Clouds Creek. Austen (1999, cited in Copeland 2008) suggests that the plants are wind-pollinated, as are other *Bertya* species in northern NSW, including Coolabah bertya, *B. ingramii* (narrow-leaved bertya) and *B. rosmarinifolia* (Fatemi & Gross 2009; DoEE 2016). Austen (1999, cited in Copeland 2008) also suggests that *Bertya* sp. Clouds Creek is relatively long-lived. The related Coolabah bertya is also considered long-lived, surviving for more than 26 years (DoEE 2016). Herbarium records suggest that mass flowering of Coolabah bertya may occur in response to periods of above average rainfall (NSW NPWS 2002), though it is unknown if *Bertya* sp. Clouds Creek also undergoes mass flowering. *Bertya* sp. Clouds Creek flowers slightly later than Coolabah bertya (late Spring to early Summer) and seed ripens in January and February (OEH 2020a; PlantNet 2021).

Seed germination in other *Bertya* species suggests that the seeds of this taxon may be physically dormant, as indicated by their hard seed coats that require heat or abrasion to assist with germination (Scott 1997 cited in NSW NPWS 2002; Scott & Gross 2004; Copeland 2008). *Bertya* sp. Clouds Creek individuals are usually killed by fire and germination should occur from a soil seedbank in the following months in suitable abiotic conditions (Copeland 2008).

Although *Bertya* sp. Clouds Creek is specialised for post-fire recruitment, artificial disturbance may encourage germination and benefit the species (NSW NPWS 2002). Austen (1999, cited in Copeland 2008) noted that recruitment in Coolabah bertya and *Bertya* sp. Clouds Creek (at the time considered a single species) may be initiated by processes such as earthworks. For example, germination of Coolabah bertya plants was observed after an adjacent firebreak was graded (NSW NPWS 2002), suggesting that soil disturbance can stimulate germination in the species.

Habitat critical to the survival

At this point in time there is insufficient information available to describe, with spatial information, areas of habitat that are critical to the survival of the species. Further research is

needed to do this (see conservation actions). Until such information is available, all habitat for this species in all known extant and historical subpopulations should be considered important for the species' long-term survival.

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.

There is sufficient evidence through the species eligibility for listing as Endangered to consider all populations/the national population as important populations of this species under particular pressure of survival and which therefore require protection to support the recovery of the species.

Threats

Bertya sp. Clouds Creek is threatened by inappropriate fire regimes, human-induced habitat disturbance, unmanaged (feral) goats (*Capra hircus*), weed invasion and climate change.

Table 2: Threats impacting *Bertya* sp. Clouds Creek

Threat	Status and severity ^a	Evidence
Habitat disturbance and modification		
Inappropriate fire regimes	<ul style="list-style-type: none"> • Timing: current • Confidence: inferred • Consequence: catastrophic • Trend: increasing • Extent: across the entire range 	<p><i>Bertya</i> sp. Clouds Creek is an obligate seeder, and resprouts from seed after fires kill mature plants (Copeland 2008). Keith (1996) identified several fire driven mechanisms of plant population decline and extinction for obligate seeder 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.</p> <p>As an obligate seeder, <i>Bertya</i> sp. Clouds Creek requires an appropriate interval between fires to reach reproductive maturity and produce sufficient seed for the next generation whilst not senescing (tolerable fire interval). In Coolabah <i>Bertya</i>, there is a risk of population decline if fires occur more than once every three years and less than once every 20 years (OEH 2020b). Given that both species were previously considered one taxon, it is likely <i>Bertya</i> sp. Clouds Creek has similar fire requirements. However, management strategies should utilise a precautionary approach that ensures ecosystem health does not decline due to fire management practices targeted at this species.</p>

		<p><i>Bertya</i> sp. Clouds Creek subpopulations are threatened by a high frequency fire regime that does not allow plants to sexually mature and produce a sufficient seed bank seed, ultimately leading to a lack of recruitment of juveniles. Subpopulations may also be threatened by too infrequent fire that allows plants to senesce and the seed bank to decline before recruitment occurs (Whelan 1995; Bond & van Wilgen 1996; DoEE 2016; OEH 2020b), however this depends on seedbank decay rates, which are currently unknown. Bradstock et al. (1998) found that extinction probabilities in obligate seeder shrubs increased with fire frequency and scale, indicating that too-frequent fire is responsible for extinction more often than too-infrequent fire. However, prior to the 2019–20 bushfires, the main concern for <i>Bertya</i> sp. Clouds Creek was that most subpopulations were relatively small, and the lack of disturbances may have been a limiting factor for subpopulation growth (Copeland. 2008).</p> <p>The 2019-20 bushfires burnt all known subpopulations (Gallagher 2020; DPIE 2021). Recruitment was not stimulated at five of the eight known sites and the causes of recruitment failure are unknown. No subpopulations had experienced recent fire prior to 2019–20 meaning that all subpopulations should have stored a substantial seed bank. It is unknown why recruitment failed at so many sites, though it has been suggested that the lack of recruitment may be due to the high severity of the 2019–20 fires in the area (DPIE 2021). Seedling recruitment of other species has been shown to vary with fire severity (Hodgkinson 1991; Moreno & Oechel 1991; Vivian et al. 2008; Morgan & Nield 2011) and it is possible that high severity fire contributed to recruitment failure in some subpopulations of <i>Bertya</i> sp. Clouds Creek by killing soil-stored seed. Alternatively, as many sites were last surveyed during the 1990s and 2000s, it is possible that some subpopulations went extinct via senescence some time ago and the remaining soil-stored seed died or was predated prior to the 2019–20 fires. However, there appears to have been a long absence of fire at all subpopulations, and it is therefore unclear why recruitment occurred at some subpopulations and not others. Furthermore, post-fire surveys took place approximately 18 months post-fire, with the presence of seedlings at some subpopulations indicating sufficient time and rainfall for germination had occurred. This suggests the lack of seedling emergence was not due to recruitment lag of a physiologically dormant seedbank. Four of the five subpopulations with no recruitment are not affected by any additional known threats that would explain their pre-fire decline. The exception to this is Sara River, where the presence of lantana (<i>Lantana camara</i>) and</p>
--	--	---

		feral pigs were observed adjacent to the known site (DPIE 2021), and these interacting threats may have limited seedling recruitment or killed seedlings prior to surveys such as grazing, weeds and pathogens (see below; Auld et al. 2020; Gallagher 2021). However, why recruitment failed at other sites remains unclear. Interactions between fire and drought may also threaten the species.
Human-induced habitat disturbance	<ul style="list-style-type: none"> • Timing: current • Confidence: inferred • Consequence: minor • Trend: unknown • Extent: across parts of the range 	Though human-induced disturbance may stimulate recruitment (NSW NPWS 2002), too frequent artificial disturbance (e.g. regular road or track maintenance) may be detrimental to persistence. Though two of the known <i>Bertya</i> sp. Clouds Creek subpopulations occur in State Forests (Table 1), these subpopulations occur on rocky outcrops surrounded by low, stunted trees of little value for forestry activities, and it is considered unlikely they will be directly impacted by forestry (Copeland 2008).
Invasive species		
Grazing and trampling by feral goats	<ul style="list-style-type: none"> • Status: current • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across parts of the range 	<p>Feral goats are found in all states and territories of Australia and have been listed as a Key Threatening Process under the EPBC Act (DEWHA 2008). The highest densities are seen in the semi-arid hilly and rocky regions of Qld, NSW, South Australia and Western Australia (DSEWPC 2011). Feral goats have a major impact on native plants communities through soil damage and overgrazing of herbs, grasses, shrubs and trees. This grazing can cause erosion and prevent regeneration. They may also spread weeds and diseases (Bayne et al. 2005; DEWHA 2008).</p> <p>Feral goats are considered a threat to <i>Bertya</i> sp. Clouds Creek (OEH 2020a). Unlike many other feral herbivores, goats graze on the rocky outcrops and slopes that the species grows on, and goat browsing of stems and lower branches has been observed at the Nurrungal subpopulation of Coolabah <i>Bertya</i> (DoEE 2016). Grazing by herbivores can act to significantly limit recruitment and establishment of seedlings, constraining post-fire recovery (Legge et al. 2019).</p> <p>It is unclear which <i>Bertya</i> sp. Clouds Creek subpopulations are affected by feral goats. As of 2007, Barool NP did not have feral goats present, and Warra NP (which Sara river runs through) also contained no feral goats (DECC 2007). Isolated subpopulations were known to be present in Mann River NR (DECC 2007). Recent reports confirm Mann River NR have them s in low-moderate density, whilst Barool NP may have them in small numbers. Feral goats have not observed at Sara River, though there is a possibility they are present (A Fawcett. pers comm 21 June) and the <i>Bertya</i> sp. Clouds Creek subpopulations in this area may be impacted.</p> <p>In OWRNP, small feral goat subpopulations are confined to the upper Chandler, Styx, Oaky,</p>

		<p>Warnes and Apsley River gorge areas, and controlled by ground and aerial shooting (NSW NPWS 2005). Based on this distribution, it is unlikely that the sites in OWRNP are impacted by feral goats. It is unclear if feral goats occur in Clouds Creek SF and Kangaroo River SF.</p> <p>No herbivory or grazing impacts have been observed in 2021 surveys, suggesting feral goats are not currently threatening seedlings recruited by the 2019–20 bushfires (DPIE 2021).</p>
Erosion by feral pigs (<i>Sus scrofa</i>)	<ul style="list-style-type: none"> • Status: current • Confidence: suspected • Consequence: minor • Trend: unknown • Extent: across parts of the range 	<p>Feral pigs were observed rooting on the ridge above the Sara River subpopulation (DPIE 2021) and have likely caused some erosion at the site. Feral pigs can directly damage the subspecies and its habitat when digging in search of food. They can also introduce weed seeds and nutrients to native habitat and disturb the soil, encouraging the establishment of weeds (DoEE 2017). Feral pigs are listed as a Key Threatening Process (KTP) under the EPBC Act (DoEE 2017).</p>
Weed invasion	<ul style="list-style-type: none"> • Status: current • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across parts of the range 	<p>Lantana has been recorded at the Sara River site (DPIE 2021). Lantana forms dense thickets and suppresses native vegetation and seedlings through shading, nutrient competition, smothering and allelopathy (DPIE 2019). Lantana also can change fire patterns in forest ecosystems by altering fuel load, causing a build-up of fuel that increases the risk of fires spreading to the canopy (Berry et al. 2011). It readily invades disturbed sites with canopy breaks and becomes a dominant understorey species. In 2006, the invasion of native plant communities by lantana was listed as a Key Threatening Process under the Biodiversity Conservation Act in NSW (DPIE 2019).</p> <p>Pokeweed (<i>Phytolacca</i>) plants were observed at Winterbourne Gorge, though were growing adjacent to seedlings, are short lived after fire, and do not appear to have caused any negative impacts to <i>Bertya</i> sp. Clouds Creek (DPIE 2021).</p>
Climate Change		
Increased temperature and decreased rainfall	<ul style="list-style-type: none"> • Timing: current • Confidence: observed • Consequence: catastrophic • Trend: increasing • Extent: across the entire range 	<p>The CSIRO & Bureau of Meteorology (2015) predict that the eastern coast of Australia will be exposed to increased average temperatures, and increased frequency of droughts due to climate change. These climatic changes were evidenced by the severe drought conditions in eastern Australia from early 2017 to late 2019 (BOM 2021b). In northern NSW, maximum temperatures are projected to increase by 0.7°C by 2030 and 1.9°C by 2070, with more hot days and fewer cool nights (DPIE 2014).</p> <p>The long-term impact of drought on <i>Bertya</i> sp. Clouds Creek is uncertain. Assessments of other <i>Bertya</i> species suggest that they may be threatened by climatic drying and warming</p>

		<p>which act synergistically with inappropriate fire regimes to increase the risk of repeat fire events at intervals below or approaching the tolerable fire interval for the taxon, leading to seedbank depletion, exhaustion and local extinction. The species may also be at increasing risk of recruitment failure in response to extreme drought events, particularly during the early stages of post-fire recruitment (DELWP 2021a). Post-fire recruitment and seedling survival is 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 et al. 2021). Recruitment failure can occur in response to extreme drought events, particularly during the early stages of post-fire recruitment (DELWP 2021a). However, seedlings that germinated after the 2019–20 fires have likely been unaffected by drought, as post-fire conditions have been drought free (BOM 2021a). Thus, it is unlikely that drought is responsible for the lack of post-fire recruitment at five sites, especially as all sites are likely similarly impacted by drought due to their geographic proximity.</p> <p>Changes to fire and drought conditions are evidenced by the catastrophic bushfires of 2019–20, in which an unusually large area of eastern Australia burned at high intensity (DPI 2020). These bushfires were caused by the catastrophic 2017–2019 drought conditions, through low fuel moisture content, leaf senescence and shedding, and lack of moist impediments to fire spread (Nolan et al. 2020). <i>Bertya</i> sp. Clouds Creek is identified as a species severely impacted by the fires and has been identified as a priority plant species that requires urgent management intervention (DAWE 2020). Gallagher (2020) suggests that approximately 97–100% of the species’ range was burnt by the fire, and Auld (2020) and DPIE (2020) conclude 100% of the range was burnt. This agrees with on-ground observations that found all known subpopulations of <i>Bertya</i> sp. Clouds Creek were burnt in the 2019–20 bushfires. The north coast of NSW is also expected to undergo an increase in severe and average Forest Fire Danger Index values, which are used as an indicator of fire risk. These increases are projected for summer and spring, which represent peak fire risk season (DPIE 2014). These changes to fire conditions will likely increase the probability of frequent and high severity bushfires impacting <i>Bertya</i> sp. Clouds Creek into the future.</p>
--	--	--

Each threat has been described in Table 2 in terms of the extent that it is operating on the species. The risk matrix (Table 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 *Bertya* sp. Clouds Creek risk matrix

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain	Low risk	Moderate risk	Very high risk	Very high risk	Very high risk Inappropriate fire regimes Increased temperatures and decreased rainfall
Likely	Low risk	Moderate risk	High risk	Very high risk	Very high risk
Possible	Low risk	Moderate risk Human-induced habitat disturbance Erosion by feral pigs	High risk Grazing and trampling by feral goats Weed invasion	Very high risk	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	High risk	Very high risk

Priority actions have then been developed to manage the threat particularly where the risk was deemed to be ‘very high’ or ‘high’.

Conservation and recovery actions

Primary conservation outcome

By 2030, the population of *Bertya* sp. Clouds Creek will have increased in abundance and viable subpopulations are sustained in habitats where threats are managed effectively.

Conservation and management priorities

Climate change and fire

- Implement a fire management strategy to protect all known subpopulations from further fire within three to five years of the 2019–20 bushfires. Exclude planned fire (and bushfire where possible) from all subpopulations until seedlings mature and the soil-stored seed bank is rebuilt. If planned fire impacts the subpopulations, managers must ensure that subsequent unplanned fires do not occur within the critical regeneration period to allow the species to rebuild its soil seed bank to sustain the population through the next fire event.

- If required, undertake supplementary watering of post-fire seedlings to protect against drought-induced mortality.

Habitat loss, disturbance and modification

- Ensure that the locations of all subpopulations are recorded on relevant state databases, including those used by land management and fire response agencies.
- Ensure the Forestry Corporation is aware of the presence of *Bertya* sp. Clouds Creek in Clouds Creek SF and Kangaroo River SF, and that appropriate prescriptions (pre-harvest surveys and protection (with large buffers) of all subpopulations are followed to ensure that the species is not impacted by forestry activities.
- Protect subpopulations near tracks from trampling and accidental damage using signage, track markers or fencing.

Invasive species (including threats from grazing and trampling)

- Install and maintain cages or fencing around subpopulations impacted by feral goats to protect against grazing and habitat disturbance.
- Develop or maintain feral goat and feral pig population control measures in National Parks and State Forests where *Bertya* sp. Clouds Creek is found, including through the use of aerial and ground shooting, mustering and trapping (DEWHA 2008).
- Implement site-based weed control using appropriate methods to ensure that there is no impact on *Bertya* sp. Clouds Creek individuals.

Ex situ conservation

- Collect and store seed from known subpopulations to preserve genetic material.
- Investigate the requirements of the species for ex situ recovery, including the establishment of a seed orchard if current seed collections are limited.
- 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

- Engage and involve Traditional Owners in conservation actions, including surveying for new populations and management actions.
- Liaise with relevant land managers to ensure that subpopulations are not accidentally damaged or destroyed. The approval and assistance of land managers should also be sought to implement recovery actions, and recent population data should inform management.
- Engage community groups by encouraging participation in surveys or monitoring for the species.

- Promote public awareness of biodiversity conservation and protection through dissemination of information through print and digital media.

Survey and monitoring priorities

- Maintain a monitoring program to:
 - monitor species recruitment and plant health after fire events (including the 2019–20 bushfires);
 - determine trends in population size;
 - document the post-fire recovery and causes of recruitment failure;
 - determine threats and their impacts; and,
 - monitor the effectiveness of management actions and the need to adapt them if necessary.
- Survey suitable habitat for new subpopulations and to locate suitable sites for translocations.

Information and research priorities

- Increase knowledge surrounding the ecology of *Bertya* sp. Clouds Creek. This includes improving understanding of habitat requirements, recruitment and soil-seed bank dynamics (especially seed bank longevity and germination cues), appropriate fire frequency, pollination biology, seed and plant longevity, genetic structure, and minimum viable population size.
- Investigate potential causes for lack of recruitment at five sites after 2019–20 bushfires, including the size of the soil-stored seed bank, levels of seed predation or emerging diseases.
- Investigate the presence of feral goats and determine which subpopulations are most likely to be impacted.
- Understand the potential influence of climate change on the long-term survival prospects of the species, due to altered temperatures, rainfall patterns, bushfires, and environmental stressors.
- Investigate the impact of drought on *Bertya* sp. Clouds Creek recruitment and seedling growth.
- Ascertain the cultural significance of *Bertya* sp. Clouds Creek.
- Determine habitat critical to the survival of *Bertya* sp. Clouds Creek.

Recovery plan decision

There is currently an existing NSW Saving Our Species strategy for the species that focusses on the Mann River NR and Kangaroo River SF subpopulations (OEH 2014).

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.

Links to relevant implementation documents

[Help save Bertya sp. \(Clouds Creek, M. Fatemi 4\)](#)

[Threat abatement plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs \(*Sus scrofa*\) \(2017\)](#)

Conservation Advice references

Auld TD & Denham AJ (2005) A technique to estimate the pre-fire depth of burial of *Grevillea* seeds by using seedlings after fire. *Australian Journal of Botany* 31, 401–405.

Auld TD, Mackenzie BE, Le Breton T, Keith DA, Ooi MK, Allen S & Gallagher R (2020) A preliminary assessment of the impact of the 2019/2020 fires on NSW plants of national significance. Department of Planning Industry and Environment (NSW), Paramatta.

Austen JA (1999). *The management of Bertya opponens – a vulnerable shrub: A precursor to the Draft Recovery Plan for the vulnerable shrub Bertya opponens*. Unpublished B.Nat.Res thesis available from the University of New England, Armidale.

Ayre DJ, Ottewell KM, Krauss SL & Whelan RJ (2009) Genetic structure of seedling cohorts following repeated wildfires in the fire-sensitive shrub *Persoonia mollis* ssp. *nectens*. *Journal of Ecology* 97, 752–760.

Bayne P, Harden R & Davies I (2005) Feral goats (*Capra hircus* L.) in the Macleay River gorge system, north-eastern New South Wales, Australia. I. Impacts on soil erosion. *Wildlife Research* 1, 519–525.

Berry ZC, Wevill K & Curran TJ (2011) The invasive weed *Lantana camara* increases fire risk in dry rainforest by altering fuel beds. *Weed Research* 51, 525–533.

Bionet - Atlas of NSW Wildlife. *Bertya sp. Clouds Creek*. Viewed: 2 August 2021. Available on the internet at : <https://www.environment.nsw.gov.au/atlaspublicapp>

Binns D (2021) Personal communication by email, 6 June. Ecologist and botanist based in NSW.

Bond WJ & van Wilgen BW (1996) *Fire and plants*. Chapman and Hall, London.

Boyes B (2004) *Biodiversity Recovery Plan for Gatton & Laidley Shires, South-east Queensland 2003–2008*. Lockyer catchment Association Inc., Forest Hill.

Bradstock RA, Gill AM, Kenny BJ & Scott J (1998) Bushfire risk at the urban interface estimated from historical weather records: consequences for the use of prescribed fire in the Sydney region of southeastern Australia. *Journal of Environmental Management*, 52, 259–271.

BOM (Bureau of Meteorology) (2021a) *Drought rainfall deficiencies and water availability*. Viewed: 6 August 2021. Available on the internet at: <http://www.bom.gov.au/climate/drought/drought.shtml>

- BOM (Bureau of Meteorology) (2021b) *Previous Droughts*. Viewed: 6 September 2021. Available on the internet at: <http://www.bom.gov.au/climate/drought/knowledge-centre/previous-droughts.shtml>
- Copeland L (2008) *Conservation and taxonomic status of Bertya sp. A Cobar-Coolabah (Cunningham & Milthorpe s.n., 2/8/73 - Euphorbiaceae) in NSW*. Report to the Scientific Committee (NSW TSC Act 1995).
- Copeland L (2021) Personal communication by email, 3 June 2021. Botanist based in northern NSW.
- CSIRO and Bureau of Meteorology (2015) *Climate Change in Australia Information for Australia's Natural Resource Management Regions*. Technical Report, CSIRO and Bureau of Meteorology, Australia.
- DAWE (2020) *Final list of plants requiring urgent management intervention*. Department of Agriculture, Water and the Environment (Cwth), Canberra.
- DECC (2007) *Northern Tablelands Region Pest Management Strategy 2008-2011*. Department of Environment and Climate Change (NSW), Sydney.
- DELWP (2021a) *Threatened Species Assessment Bertya cunninghamii subsp. pubiramula Sticky Bertya*. Department of Environment, Land, Water and Planning (Vic), Melbourne.
- DELWP (2021b) *Threatened Species Assessment Bertya grampiana Grampians Bertya*. Department of Environment, Land, Water and Planning (Vic), Melbourne.
- DELWP (2021c) *Threatened Species Assessment Bertya findlayi Mountain Bertya*. Department of Environment, Land, Water and Planning (Vic), Melbourne.
- DEWHA (2008) Threat abatement plan for competition and land degradation by Unmanaged goats. Department of the Environment, Water, Heritage and the Arts (Cwth), Canberra.
- DoEE (2016) *Conservation advice Bertya Opponens*. Department of the Environment and Energy (Cwth), Canberra. Viewed: 9 June 2021. Available on the internet at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/13792-conservation-advice-16122016.pdf>.
- DoEE (2017) *Threat abatement plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (Sus scrofa)*. Department of the Environment and Energy (Cwth), Canberra.
- DPI (NSW Department of Primary Industries) (2020) *Drought in NSW*. Department of Primary Industries (NSW), Sydney. Viewed: 16 June 2020. Available on the internet at: <https://www.dpi.nsw.gov.au/climate-and-emergences/droughthub/drought-in-nsw>.
- DPIE (NSW) (2019) *Bertya sp. (Clouds Creek, M. Fatemi 4) - endangered species listing*. Department of Planning, Industry and Environment (NSW), Sydney. Viewed: 12 June 2021. Available on the internet at: <https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final->

[determinations/2008-2010/bertya-sp-clouds-creek-m-fatemi-4-endangered-species-listing](#).

DPIE (2019) *Invasion, establishment and spread of Lantana (Lantana camara)- key threatening process listing*. Department of Planning, Industry and Environment (NSW), Sydney. Viewed 14 July 2021. Available on the internet at:

<https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2004-2007/invasion-establishment-and-spread-of-lantana-key-threatening-process-listing>

DPIE (2014) *North Coast Climate change snapshot*. Department of Planning Industry and Environment (NSW), Sydney. Viewed: 12 June 2021. Available on the internet at: <https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/North-Coast-Climate-Change-Downloads>.

DPIE (2020) *Wildlife and Conservation Bushfire Recovery*. Department of Planning Industry and Environment (NSW), Sydney. Viewed: 10 June 2021. Available on the internet at: <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Fire/wildlife-and-conservation-bushfire-recovery-immediate-response-january-2020-200027.pdf>.

DPIE (2021) *Priority NSW plant post-fire surveys*. Unpublished data sheets, Department of Planning Industry and Environment (NSW), Sydney.

DSEWPC (Department of Sustainability, Environment, Water, Population and Communities) (cwth) (2011) *The Feral Goat (Capra Hircus)*. Viewed: 12 June 2021. Available on the internet at: <https://www.awe.gov.au/sites/default/files/documents/feral-goat.pdf>.

DTA (2021) *NationalMap*. Digital Transformation Agency (Cwth). Viewed: 10 June 2021. Available on the internet at: <https://nationalmap.gov.au/>

Enright NJ, Fontaine JB, Bowman DM, Bradstock RA & Williams RJ (2015) Interval squeeze: altered fire regimes and demographic responses interact to threaten woody species persistence as climate changes. *Frontiers in Ecology and the Environment* 13, 265–272.

Fawcett A (2021) Personal communication by email, 21 June 2021. Senior Saving our Species project officer.

Fatemi M & Gross CL (2009) Life on the edge – high levels of genetic diversity in a cliff population of *Bertya ingramii* are attributed to *B. rosmarinifolia*. *Biological Conservation* 142, 1461–1468.

Fatemi M, Gross CL & Bruhl JJ (2007) The first phenetic analysis of species limits in *Bertya* (Euphorbiaceae) *Australian Systematic Botany* 20, 448–463.

Ferrandis P, Herranz JM & Martínez-Sánchez JJ (1999) Effect of fire on hard-coated Cistaceae seed banks and its influence on techniques for quantifying seed banks. *Plant Ecology* 144, 103–114.

- Flather C, Hayward G, Beissinger S & Stephens P (2011) Minimum viable populations: is there a 'magic number' for conservation practitioners? *Trends in ecology & evolution* 26, 307–316.
- Forestry Corporation (2016) *Grafton Management Area Harvest Plan Operational Map Compartments 167, 168, 170 171, 172, 173 & 174 Clouds Creek State Forest*. Viewed: 12 June. Available on the internet at: https://www.forestrycorporation.com.au/_data/assets/pdf_file/0005/731264/clouds_creek_state_forest_compartments_167_168_170_171_172_173_174_harvest_haulage_road_plans.pdf.
- Frankham R, Bradshaw C & Brook B (2014) Genetics in conservation management: revised recommendations for the 50/500 rules, Red List criteria and population viability analyses. *Biological Conservation* 170, 56–63.
- Gallagher RV (2020) *National prioritisation of Australian plants affected by the 2019-2020 bushfire season*. Report to Department of Agriculture, Water and Environment (Cwth), Canberra. Accessed 3 December 2020. Available on the Internet at: <https://www.awe.gov.au/environment/biodiversity/bushfire-recovery/bushfire-impacts/priority-plants>.
- Gallagher RV, Allen S, Mackenzie BDE, Yates CJ, Gosper CR, Keith DA, Merow C, White MD, Wenk E, Maitner BS, He K, Adams VN & Auld TD (2021) High fire frequency and the impact of the 2019–2020 megafires on Australian plant diversity. *Diversity and Distributions* 27, 1166–1179.
- Hodgkinson KC (1991) Shrub recruitment response to intensity and season of fire in a semi-arid woodland. *Journal of Applied Ecology*, 28, 60–70.
- IUCN (2019) *Guidelines for Using the IUCN Red List Categories and Criteria. Version 14*. Prepared by the Standards and Petitions Committee. Viewed: 17 June 2021. Available on the internet at: <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.
- James TA & Harden GJ (1990) Euphorbiaceae in GJ Harden (ed) *Flora of New South Wales Vol. 1*. University of New South Wales Press, Sydney. pp. 389–430.
- Keith D (1996) Fire-driven extinction of plant populations: a synthesis of theory and review of evidence from Australian vegetation. *Proceedings of the Linnean Society of New South Wales* 116, 37–78.
- Legge S, Smith JG, James A, Tuft KD, Webb T & Woinarski JC (2019) Interactions among threats affect conservation management outcomes: Livestock grazing removes the benefits of fire management for small mammals in Australian tropical savannas. *Conservation Science and Practice* 1, e52.
- Moreno JM & Oechel WC (1991) Fire intensity effects on germination of shrubs and herbs in southern California chaparral. *Ecology* 72, 1993–2004.

- Morgan JW & Nield C (2011) Contrasting effects of fire severity on regeneration of the dominant woody species in two coastal plant communities at Wilsons Promontory, Victoria. *Cunninghamia* 12, 53–60.
- Natale S (2016) The role of fire in the population dynamics of the threatened plant species *Pomaderris walshii* and *Pomaderris adnata*. BEnvSc Hons, School of Earth and Environmental Sciences, University of Wollongong.
- Nolan RH, Boer MM, Collins L, Resco de Dios Victor, Clarke H, Jenkins M, Kenny B & Bradstock RA (2020) Causes and consequences of eastern Australia's 2019–20 season of mega-fires. *Global change biology*.
- NSW NPWS (2002) *Bertya sp. Cobar-Coolabah (Cunningham & Milthorpe s.n., 2/8/73) Approved Recovery Plan*. NSW National Parks & Wildlife Service: Hurstville.
- NSW NPWS (2005) *Oxley Wild Rivers National Park, Oxley Wild Rivers State Conservation Area, Cunnawarra National Park and Georges Creek Nature Reserve*. National Parks and Wildlife Service (NSW), Sydney Viewed: 12 June. Available on the internet at: <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Parks-plans-of-management/oxley-wild-rivers-cunnawarra-georges-creek-parks-plan-of-management-050627.pdf>.
- NSW NPWS (2021) *Mann River Nature Reserve*. National Parks and Wildlife Service (NSW) Viewed: 12 June. Available on the internet at: <https://www.nationalparks.nsw.gov.au/visit-a-park/parks/mann-river-nature-reserve>.
- NSW SEED (Sharing and Enabling Environmental Data in NSW) (2021) *SEED Map*. Viewed: 10 June 2021. Available on the internet at: <https://geo.seed.nsw.gov.au/PublicViewer/index.html?viewer=PublicViewer&locale=en-AU>
- OEH (2020a) *Bertya sp. (Clouds Creek, M. Fatemi 4)* – profile. Office of Environment and Heritage (NSW) Viewed: 7 June 2021. Available on the internet at: <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20121>.
- OEH (2020b) *Coolabah Bertya*– profile. Office of Environment and Heritage (NSW). Viewed: 7 June 2021. Available on the internet at: <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10093>.
- OEH (2014) *Help save Bertya sp. (Clouds Creek, M. Fatemi 4)*. Office of Environment and Heritage (NSW) Viewed: 10 June 2021. Available on the internet at: <https://www.environment.nsw.gov.au/savingourspeciesapp/ViewFile.aspx?ReportProjectID=135&ReportProfileID=20121>.
- Scott B & Gross CL (2004) Recovery directions for monoecious and endangered *Bertya ingramii* using autecology and comparisons with common *B. rosmarinifolia* (Euphorbiaceae) *Biodiversity & Conservation* 13, 885–899.

Trall L, Bradshaw C & Brook B (2007) Minimum viable population size: a meta-analysis of 30 years of published estimates. *Biological conservation* 139, 159–166.

Vivian LM, Cary GJ, Bradstock RA & Gill AM (2008) Influence of fire severity on the regeneration, recruitment and distribution of eucalypts in the Cotter River Catchment, Australian Capital Territory. *Austral Ecology* 33, 55–67.

Whelan RJ (1995) *The ecology of fire*. Cambridge University Press, Cambridge.

Attachment A: Listing Assessment for *Bertya* sp. Clouds Creek

Reason for assessment

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	350	Unknown	650	<p>The estimated number of mature individuals has been reduced from 480–560 plants in 2013 to c. 32 mature plants and 504 seedlings in 2021. However, as <i>Bertya</i> sp. Clouds Creek is an obligate seeder, it is killed by fire and recruits from soil-stored seed.</p> <p>Seedling survival rates following fire in this and other <i>Bertya</i> species are unknown. Therefore, post-fire population size must be estimated using historical subpopulation sizes combined with presence/absence data of post-fire recruitment to determine if these subpopulations are still extant.</p> <p>Post-fire recruitment was not observed at five of the eight known subpopulations (Barool NP, Mann River NR, Clouds Creek SF and Sara River) after the 2019–20 bushfires (DPIE 2021). Therefore, these subpopulations may have gone extinct. It is possible the species may experience delayed post-fire seed germination, but the presence of seedlings at other sites suggests this is unlikely. The loss of mature individuals without subsequent recruitment at these sites suggests a decline of 130 mature plants (see subpopulation figures in Table 1). Notably, the pre-fire subpopulation at Sara River was little-surveyed, and it is unknown how many plants died at this site.</p> <p>The remaining three subpopulations (Kangaroo River RF, Winterbourne</p>

				<p>Gorge and Rowley's Creek) contained 350 mature individuals prior to the 2019–20 bushfires. Post-fire monitoring has recorded post-fire seedlings at these subpopulations (a sufficient number that could potentially replace the pre-fire population size), and therefore these subpopulations are considered extant. Data on seedling mortality, rates of adult senescence, and pre- 2019–20 fire history at all sites, would be required to project the post-fire population size at the three extant subpopulations. In the absence of these data, the pre-fire estimate of subpopulation size has been used.</p> <p>The maximum plausible value is affected by the unconfirmed subpopulation in Clouds Creek SF. This subpopulation was estimated to consist of 'many hundreds of mature plants' (Binns 2021, pers comm 6 June). However, as this subpopulation is not confirmed and its post-fire status is not known, it has been omitted from the estimate used in this assessment.</p>
Trend	Decreasing			<p>The number of mature individuals has decreased following the 2019–20 bushfires (DPIE 2021). The loss of five subpopulations containing at least 130 plants represents a decline of 27 percent relative to the 480 known plants prior to the bushfires. This estimate does not include the loss of an unknown number of mature individuals at Sara River, and may therefore be an underestimated.</p>
Generation time (years)	20 years	10 years	50 years	<p>The generation length of <i>Bertya</i> sp. Clouds Creek is unknown. However, the generation length of <i>Bertya findlayi</i> (mountain bertya) is suspected to be 20 to 30 years, the generation length of <i>Bertya grampiana</i> (Grampians bertya) is estimated to be 10 to 30 years and the generation length of <i>Bertya cunninghamii</i> subsp. <i>pubiramula</i> (sticky bertya) is estimated to be 35 to 50 years (DELWP 2021a, b, c). Accordingly, the generation length of <i>Bertya</i> sp. Clouds Creek is tentatively suggested at 10–50 years.</p>
Extent of occurrence	1520 km ²	1520 km ²	>6372 km ²	<p>The extent of occurrence (EOO) is estimated at 1520 km². This figure is based on the mapping of point records from 2021 obtained from the NSW state government. Only records from 2021 were used due to the loss of five subpopulations during the 2019-2020 bushfires. The</p>

				EEO was calculated using a minimum convex hull, based on the IUCN Red List Guidelines (IUCN 2019). As the species occurs in remote areas, additional subpopulations could exist, which could result in a slightly larger EEO. The maximum plausible value represents the plausible EEO if unknown subpopulations exist, all subpopulations are still extant, and recruitment was missed during post-fire surveys.
Trend	Declining			There is no evidence of post-fire recruitment in five of the eight known subpopulations, and these may have become extinct, which would decrease the EEO of this species.
Area of Occupancy	12 km ²	12 km ²	>28 km ²	The AOO is estimated at 12 km ² . This figure is based on the mapping of point records from 2021 obtained from the NSW state government. Only records from 2021 were used due to the loss of five subpopulations during the 2019-2020 bushfires. The AOO is calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines (IUCN 2019). The AOO prior to the 2019-20 bushfires was estimated at 28 km ² . As the species occurs in remote areas, additional subpopulations may exist, which would increase the AOO,
Trend	Declining			There is no evidence of post-fire recruitment in five of the eight known subpopulations and these may have become extinct, which would decrease the AOO of this species.
Number of subpopulations	3	3	>9	Prior to the 2019-20 bushfires the species was known from eight subpopulations (Table 1). However, no post-fire recruitment has been observed in five of these subpopulations, therefore the current number of subpopulations with confirmed extant plants is three. There may be another unconfirmed subpopulation in Clouds Creek SF and, as the species occurs in remote areas, additional unknown subpopulations may also exist.
Trend	Declining			There is no evidence of post-fire recruitment in five of the eight known subpopulations, and these may have become extinct.
Basis of assessment of	Prior to the 2019-20 bushfires the species was known from eight subpopulations (Table 1). However no post-fire recruitment has been observed in five of these subpopulations, therefore the current number of subpopulations with confirmed extant plants is three.			

population number	There may be another unconfirmed subpopulation in Clouds Creek SF and as the species occurs in remote areas, additional unknown subpopulations may exist.			
No. locations	1	1	1	The number of locations is estimated at one. A single large bushfire event impacted all known subpopulations in 2019–20, evidence that all known subpopulations can be affected by a singular threat. The 2019–20 bushfire has apparently caused the likely extinction of five of eight known subpopulations. While the exact mechanism for this impact is not known, it is evidence that a future bushfire event could cause the rapid extinction of all remaining subpopulations of this species, particularly while the three remaining subpopulations contain mostly immature individuals.
Trend	declining			The number of locations has declined as the scale of bushfires has increased. Previously, the number of locations was considered to be six (Copeland 2008), as it was not considered plausible that subpopulations in different areas could be affected by the same event.
Basis of assessment of location number	The number of locations is estimated at one. A single large bushfire event impacted all known subpopulations in 2019–20, evidence that all known subpopulations can be affected by a singular threat. The 2019–20 bushfire has apparently caused the likely extinction of five of eight known subpopulations. While the exact mechanism for this impact is not known, it is evidence that a future bushfire event could cause the rapid extinction of all remaining subpopulations of this species, particularly while the three remaining subpopulations contain mostly immature individuals.			
Fragmentation	The population is likely severely fragmented. Each subpopulation is isolated, it is not likely that less than 50% of the AOO is in habitat patches that are not supporting minimum viable population. The species may be wind pollinated like other members of the genus (Fatemi & Gross 2009), and there is the possibility of interbreeding between subpopulations, as Winterbourne Gorge and Rowley’s Creek are relatively close together (c. 12 km apart). However, all surviving subpopulations are small, and pollen movement among more distant subpopulations would be unlikely.			
Fluctuations	It is unknown whether <i>Bertya</i> sp. Clouds Creek experiences extreme fluctuations. In order to experience extreme fluctuations under IUCN criteria, stored seed must be exhaustible in a single event (IUCN 2019), and it is unknown if <i>Bertya</i> sp. Clouds Creek seeds can be exhausted by one large fire. In plants with soil-stored seed banks, some residual seed is expected to remain after fire (Ferrandis et al. 1999; Auld & Denham 2005; Ayre et al. 2009), particularly if the seeds are in deeper soil (Auld & Denham 2005). However, this is not always the case, and some plants with soil-stored seed banks can be exhausted by one fire (Natale 2016). Five <i>Bertya</i> sp. Clouds Creek subpopulations haven’t produced seedlings post-fire (DPIE 2021), and it is possible that the soil seed bank is small or subject to high seed predation, so could potentially be exhausted. However, further evidence is required to confirm this.			

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%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>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.</p> <p>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]</p> <p>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.</p>	<p>Based on any of the following</p>		<p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>

Criterion 1 evidence

Not eligible

Generation time

The generation time of *Bertya* sp. Clouds Creek was estimated at approximately 20 years (Table 4). This gives a period of approximately 60 years for Criterion 1.

Decline prior to the 2019–20 bushfires

Until the 2019–20 bushfires, *Bertya* sp. Clouds Creek was not considered to have experienced a substantial reduction (Copeland 2008). Austen (1999, cited in Copeland 2008) concluded that neither of the two subpopulations known at the time (Barool NP and Kangaroo River SF) were under any active threat. However, the Barool NP subpopulation was thought to be senescent with limited germination and seedling recruitment, and it was stated that “the outlook for the population does not seem good” and that the population is “in danger of disappearing” without a disturbance event to stimulate recruitment. Copeland (2008) suggested that, given this subpopulation only consisted of 20 mature adults, even if it did become extinct, an overall reduction of 5 percent would not be enough to be qualify the species for listing under Criterion 1. Surveys of the northern Mann River NR, Cloud Creeks SF and Winterbourne Gorge subpopulations failed to identify any major threats (Copeland 2008).

Decline due to the 2019–20 bushfires

The 2019–20 bushfires impacted all known subpopulations (Table 5). Post-fire surveying suggests that five of the eight known subpopulations now have zero mature individuals and no

seedling recruitment. Kangaroo River SF, Winterbourne Gorge and Rowleys Creek are the only subpopulations with seedlings, and only Winterbourne Gorge and Rowleys Creek have mature plants. These were found in small unburnt patches of protected cliff, which burnt at a lower intensity than the surrounding forest (DPIE 2021).

Table 5: Summary of fire history in known *Bertya* sp. Clouds Creek subpopulations

Subpopulation	Subpopulation	2019–20 Fire intensity (DPIE 2021)	Pre-fire subpopulation size	Post-fire population notes (DPIE 2021)	Recent fire history prior to 2019 (gathered from NSW SEED (2021) and DTA (2021))
1	Barool NP, rocky bluff SE of Barool Ck.	High	20 mature adults and no juveniles	0 <i>Bertya</i> sp. Clouds Creek plants, other species regenerating.	No recorded fires.
2	Mann River NR, western side of Tommy's Rock Lookout	Extreme	c. 30 mature adults and several seedlings	0 <i>Bertya</i> sp. Clouds Creek plants. Very hot fire in the area, signs of regeneration in some other species.	No fires since approximately 1981.
3	Mann River NR, 4 km SW of Tommy's Rock Lookout	Extreme	c. 30 mature adults and several seedlings	0 <i>Bertya</i> sp. Clouds Creek plants. Very hot fire in the area, signs of regeneration in some other species	No fires since approximately 1981.
4	Sara River [c. 50 km SE of Glen Innes]	Low	Population size unknown but as area was said to be less than 0.5 ha.	0 <i>Bertya</i> sp. Clouds Creek plants. Lower intensity fire. Habitat is different to other sites.	No recorded fires.
5	Clouds Creek SF, gorge above Clouds Creek Falls	High	c. 50 mature adults.	0 mature adults. Site was hard to traverse and unstable.	No recorded fires.
6	Kangaroo River SF, Devils Face	Moderate–Extreme	At least 500 plants in 1999, approximately half of which were mature adults.	0 mature adults, c. 267 seedlings. Extreme fire severity in forest but moderate on cliff face. Possibly two germination cohorts or continual germination pattern, plants 0.2–0.6 m high.	No recorded fires.
7	Winterbourne Gorge (OWRNP)	High	c. 50 plants	12 mature adults c. 230 seedlings. Adults found in small unburnt patch.	No recorded fires.
8	Rowleys Creek* (OWRNP)	High	c. 50 plants	20 mature plants, 17 seedlings. There may have been more seedlings, but accessing the site further was too dangerous.	No recorded fires.

*subpopulation discovered in 2013

The estimated number of mature individuals was reduced from 480–560 known mature plants in 2013 to c. 32 mature plants in 2021. This represents a loss of over 90 percent of mature individuals due to the 2019–20 bushfires. However, *Bertya* sp. Clouds Creek is killed by fire and recruits from soil-stored seed, which occurred to some degree after the 2019–20 bushfires in three subpopulations. To appropriately determine the true impact of the 2019–20 bushfires, the

number seedlings that survive to become mature individuals at the same life stage as those destroyed by the fires must be projected, based on seedling survival rates, rates of adult senescence and with knowledge of the pre-2019–20 fire history of all sites. As the taxon has not been impacted by fires since it was described, the survival rates of post-fire recruits are unknown. Post-fire survival of other *Bertya* species is also unknown, as species in the genus are little-studied and usually rare. The rate of senescence of mature individuals is also unknown, as is the fire history of some subpopulations. Therefore, in the absence of these data, the current population size of *Bertya* sp. Clouds Creek has been inferred from pre-fire estimates of subpopulation size, combined with presence/absence data on post-fire recruitment (to determine if subpopulations are extant or extinct).

Post-fire recruitment was not observed at five of the eight known subpopulations (Barool NP, Mann River NR, Clouds Creek SF and Sara River) after the 2019–20 bushfires (DPIE 2021). Therefore, these subpopulations may have gone extinct. The loss of mature individuals without recruitment at these sites suggests a decline of 130 mature plants. The remaining three subpopulations (Kangaroo River SF, Winterbourne Gorge and Rowley’s Creek) contained 350 mature plants prior to the 2019–20 bushfires, and have since recruited a sufficient number of seedlings to potentially replace the pre-fire population size. Therefore, the number of mature individuals at a similar life-stage in the future (current population size) is inferred as 350. The loss of 130 plants from a total pre-fire population of 480 represents a decline of 27 percent due to the 2019–20 bushfires. This may be an underestimate, as the number of mature individuals lost at Sara River is unknown, and if the subpopulation was of a similar size to those at Mann River NR (30 mature individuals), then the loss of 160 mature individuals out of 510 represents decline of 31 percent. However, the maximum plausible pre-fire population size (560) includes an additional 50 mature individuals in the Kangaroo River SF subpopulation (Copeland 2008). If these are included, population decline is estimated at 29 percent.

Mechanism of subpopulation decline

Recruitment was not stimulated at five of the eight sites, despite the lack of fires prior to the 2019–20 bushfires (Table 5) meaning that all subpopulations have been able to mature and store a large seed bank for the next generation. It is suggested that the lack of recruitment at some sites (e.g., Barool NP, Clouds Creek SF, Mann River NR) may be due to the high intensity of fires in the area, which burnt very hot (DPIE 2021). Previous studies have identified that seedling recruitment can vary with fire severity (Hodgkinson 1991; Moreno & Oechel 1991; Vivian et al. 2008; Morgan & Nield 2011), and it is plausible that high severity fires have limited *Bertya* sp. Clouds Creek recruitment. At Sara River, no recruitment was observed despite the site burning at low severity. The presence of lantana and feral pigs were observed adjacent to the known site (DPIE 2021), and these threats may have limited seedling recruitment or killed seedlings prior to surveys.

The observation that bushfires have killed adults and not stimulated germination suggests that the 2019–20 bushfires have caused a true decline in these subpopulations, and not simply fluctuations in the age class of the individuals present. 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). However, given that the minimum fire-free interval for the species is likely around three years (Table 2), this is unlikely.

Conclusion

The 2019–20 bushfires appear to have caused a decline in *Bertya* sp. Clouds Creek due to post-fire recruitment failure at five of eight known sites. Using pre-fire population estimates at the three known extant sites, there has been an estimated decline of 27 percent based on minimum population size estimates and 29 percent based on maximum population size estimates. Based on the above evidence, the species appears to be not eligible for listing under Criterion 1.

Further research on seedling survival in *Bertya* species and rates of adult senescence would be required to more accurately project the number of mature individuals and enable a comparison with pre-fire population estimates.

The data presented above appear to demonstrate the subspecies is not 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.

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 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
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 populations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or populations; (iv) number of mature individuals			

Criterion 2 evidence

Eligible under Criteria B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) as Endangered

EOO and AOO

Bertya sp. Clouds Creek and is known only from eight subpopulations. The EOO of the known sites is estimated at 1520 km² and the AOO of known sites is 12 km². The figures for EOO and Area of Occupancy (AOO) are based on the mapping of point records from 2021, obtained from the NSW state government. Only records from 2021 were used due to the apparent extinction of five subpopulations caused by the 2019–20 bushfires. The EOO was calculated using a minimum convex hull, as outlined in the IUCN Guidelines (IUCN 2019). The AOO was calculated using the 2x2 km grid cell method as outlined in the IUCN Guidelines (IUCN 2019).

Given that the AOO is less than 500 km² and EOO is less than 5000 km², the species meets the threshold for listing as Endangered under and sub- criterion B1 and sub-criterion B2.

Severely fragmented and number of locations

Bertya sp. Clouds Creek is likely severely fragmented, as it occurs at small, isolated sites and has limited dispersal ability. To be considered severely fragmented, over 50 percent of the AOO must be in small and isolated patches that cannot support a minimum viable population (IUCN 2019). The species may be wind pollinated like other members of the genus (Fatemi & Gross 2009), and there is the possibility of interbreeding between subpopulations, as Winterbourne Gorge and Rowley's Creek are relatively close together (c. 12 km apart). However, all surviving subpopulations are small, and pollen movement among disparate subpopulations is unlikely. All extant subpopulations contain less than 1000 individuals (DPIE 2021), and Frankham et al. (2014) estimates that 1000 individuals are required as general minimum viable population size for resilience to genetic threats associated with small populations. Larger minimum viable population estimates of 5000 individuals (Flather et al. 2011) or a few thousand individuals (Traill et al. 2007) have also been made, both of which eclipse all known *Bertya* sp. Clouds Creek subpopulation sizes. It is therefore likely that the majority (>50 percent) of AOO of the species is in habitat patches supporting small subpopulations less than a rudimentary estimate of minimum viable population size.

Bertya sp. Clouds Creek is considered to occur at one location, based on the most plausible serious threat (fire) as per the IUCN Guidelines (IUCN 2019) (Table 4). The 2019-20 bushfires burnt all known subpopulations, and this may occur again in the future (Gallagher 2020; Auld et al. 2020). Therefore, the species meets the threshold for listing as Endangered under sub-criterion (a).

Continuing decline

The EOO, AOO, number of subpopulations, habitat quality and number of mature individuals are inferred to be declining, thereby meeting sub-criterion (b) (i,ii,iii,iv, v) (Table 2). The 2019–20 fires appear to have reduced the number of extant subpopulations, resulting in declines in EOO, AOO and the number of mature individuals (Table 4). Habitat quality is likely declining at one site (Sara River) due to the presence of weeds and erosion by feral pigs, and weeds are also present in one of the three sites with seedlings (Winterbourne Gorge). Herbivory from feral goats is also likely to contribute to continuing decline in habitat quality. Feral goats are a known threat to *Bertya* sp. Clouds Creek (OEH 2020a), as they are present at several subpopulations, graze on the rocky outcrops and slopes that the species grows on and are known to impact congeneric species (DoEE 2016). Post-fire threats from future fire and weeds may lead to continuing decline in the number of extant seedlings, which will ultimately lead to continuing declines in the number of mature individuals.

Fluctuations

There are no known extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals. Though there are fluctuations in that mature individuals are killed by fire and replaced by juveniles, it is not known if the soil seed bank is exhausted by a single fire event (Table 4).

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 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:			
(i) Number of mature individuals in each population	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in 1 population =	90 - 100%	95 - 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

Criterion 3 evidence

Eligible under Criteria C1 + C2a(i) as Endangered

The number of mature individuals of *Bertya* sp. (Clouds Creek) prior to the 2019–20 bushfires was estimated to be approximately 480-560, which meets the threshold for Endangered under Criterion 3.

Post-fire observations in 2021 suggest there are only c. 32 mature plants. However, *Bertya* sp. Clouds Creek survives fire by seedling recruitment, and there are around c. 504 seedlings known from post-fire surveys across three subpopulations. If these seedlings reach maturity, the number of mature individuals at a comparable point in the future is likely to be 350 (see Criterion 1).

Using estimates of population decline based on the loss of five known subpopulations and pre-fire subpopulation sizes (see Criterion 1), there has been a population reduction of 27 percent in

one generation (~20 years). Therefore, the species is eligible for listing as Endangered under subcriterion C1.

There are projected to be around 350 mature individuals after the 2019–20 fires, and some level of continuing decline is likely due to a combination of fire, weeds, feral animals and drought (Table 2; Criterion 1). All extant subpopulations are equal to or fewer than 250 mature individuals (Table 1). Using this information, the species is eligible for the Endangered category under criterion C2(a)(i).

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 D as Vulnerable

Though the number of mature individuals as of 2021 is c. 32, a pre-fire population count should be used to estimate the future number of mature individuals (excluding the subpopulations which have not undergone recruitment; see Criterion 1, 3). The number of mature individuals of *Bertya* sp. Clouds Creek pre-fire in currently extant sites was estimated to be approximately 350. As such the species meets the requirements for listing as Vulnerable under Criterion 4.

Conclusion

The data presented above appear to demonstrate that the species is eligible for listing as Vulnerable 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 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 for *Bertya* sp. (Clouds Creek)

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 is considered adequate and there is sufficient scientific evidence to support the assessment.

Listing and Recovery Plan Recommendations

There is currently an existing NSW Saving Our Species strategy for the species that focusses on the Mann River NR and Kangaroo River SF subpopulations (OEH 2014)

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.

THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

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

© Commonwealth of Australia 2021 

Ownership of intellectual property rights


Unless otherwise noted, copyright (and any other intellectual property rights) in this publication is owned by the Commonwealth of Australia (referred to as the Commonwealth).

Creative Commons licence

All material in this publication is licensed under a [Creative Commons Attribution 4.0 International Licence](#) except content supplied by third parties, logos and the Commonwealth Coat of Arms.

Inquiries about the licence and any use of this document should be emailed to copyright@awe.gov.au.

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 Bertya* sp. Clouds Creek, Canberra. 

This publication is available at the [SPRAT profile for Bertya sp. Clouds Creek](#).

Department of Agriculture, Water and the Environment
GPO Box 858, Canberra ACT 2601
Telephone 1800 900 090
Web awe.gov.au

The Australian Government acting through the Department of Agriculture, Water and the Environment has exercised due care and skill in preparing and compiling the information and data in this publication. Notwithstanding, the Department of Agriculture, Water and the Environment, its employees and advisers disclaim all liability, including liability for negligence and for any loss, damage, injury, expense or cost incurred by any person as a result of accessing, using or relying on any of the information or data in this publication to the maximum extent permitted by law.

Version history table

Document type	Title	Date [dd mm yyyy]
-	-	-
-	-	-