Australian Government
Department of Agriculture, Water and the Environment

Consultation on Species Listing Eligibility and Conservation Actions

Monotoca rotundifolia

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

1) the eligibility of *Monotoca rotundifolia* 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 1 February 2022.

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General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at: https://www.awe.gov.au/environment/biodiversity/threatened/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 *MONOTOCA ROTUNDIFOLIA*

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:

   ☐ 0–1000 ☐ 1000–3000 ☐ 3000–5000 ☐ 5000–10,000 ☐ >10,000

   Level of your confidence in this estimate:

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

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

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

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

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

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:

☐ 0–1000 ☐ 1000–3000 ☐ 3000–5000 ☐ 5000–10,000 ☐ >10,000

Level of your confidence in this estimate:

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

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

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

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

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

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

    Level of your confidence in this estimated extent of occurrence

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

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

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

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

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

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

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

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

Level of your confidence in this estimated extent of occurrence:

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

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

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

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

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

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

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

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

    Level of your confidence in this estimated extent of occurrence

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

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

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

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

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

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

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

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

    Level of your confidence in this estimated extent of occurrence:

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

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

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

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

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

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

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

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 actions 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?

Conservation Advice for *Monotoca rotundifolia* (trailing Monotoca)

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.

Monotoca rotundifolia, Andre Messina © Copyright, Royal Botanic Gardens Board (from VicFlora 2021) CC BY-NC-SA 4.0

Conservation status

Monotoca rotundifolia (trailing Monotoca) is proposed to be listed in the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999.*

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

- Criterion 1: Insufficient data
- Criterion 2: B1ab(iii)+2ab(iii): Endangered
- Criterion 3: C1: Vulnerable
- Criterion 4: Ineligible
- Criterion 5: Insufficient data

The main factors that make the species eligible for listing in the Endangered category are its restricted area of occupancy and extent of occurrence, restricted number of locations, and continuing decline of area, extent and/or quality of habitat due to projected increasing fire frequency and projected *P. cinnamomi* infection.

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

Species information

Taxonomy

Conventionally accepted as *Monotoca rotundifolia* J.H.Willis (1967).

Description

Trailing Monotoca (family: Ericaceae) is a prostrate or ascending shrub to 30 cm high with finely hairy branchlets. Leaves are near-round, 1.8–6 mm long, 1.4–5.5 mm wide, with the upper surface flat to convex and lower surface bluish and distinctly 3-ribbed. Flowers are usually solitary (rarely 2-3 flowered spikes) small and cream.

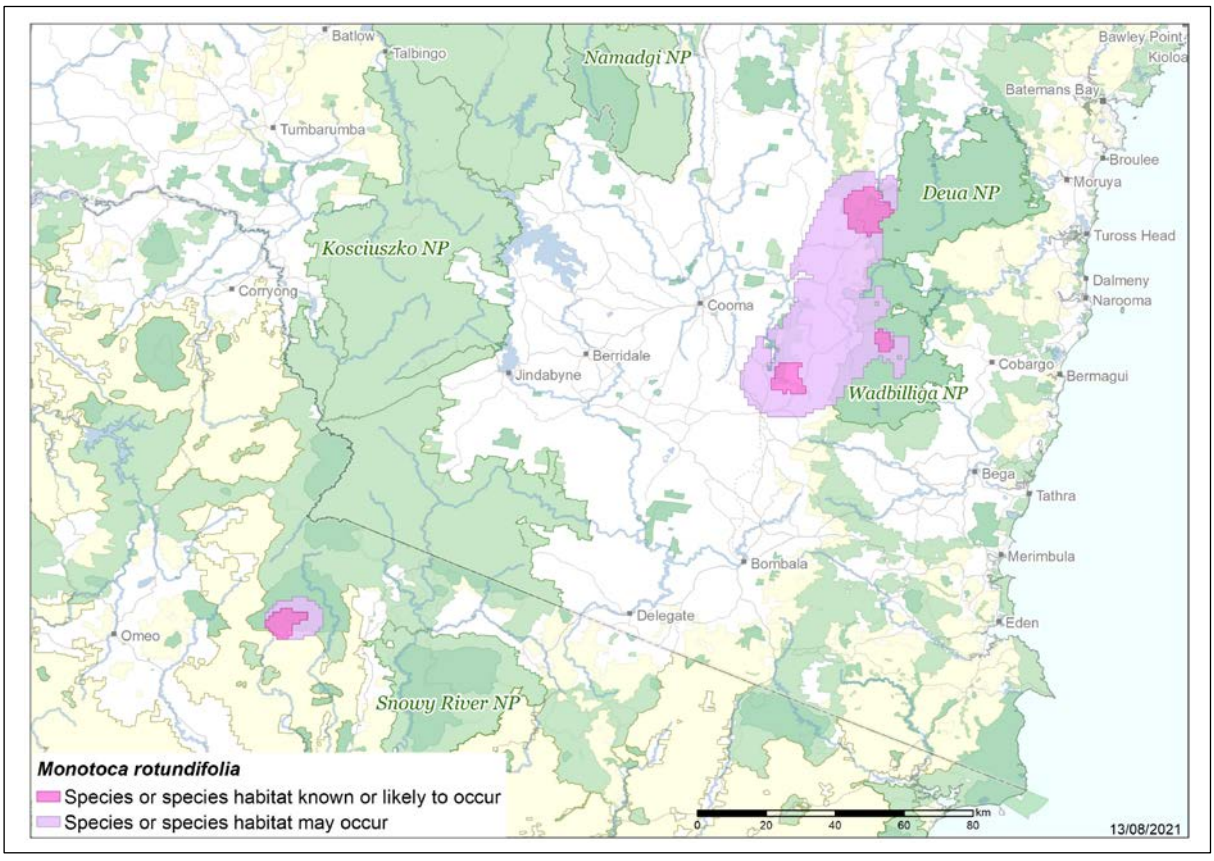
Distribution

Trailing Monotoca is known from four subpopulations, one in eastern Victoria, and three in south-east New South Wales (NSW) (Table 1). Additional records exist in NSW, but have not been recently confirmed, and are likely to represent misidentifications or inaccurate records (UNSW 2019). Prior to the 2019-20 bushfires, the total population was likely around 10,000 mature individuals (Table 1). Three of the four known subpopulations were burnt in the 2019-20 bushfires. Post-fire surveys have been undertaken at the Victorian subpopulation, but are yet to be undertaken for subpopulations in NSW.

Table 1 Known subpopulations of trailing Monotoca

Site	Count	Fire history
New South Wales		
Dangelong Nature Reserve	7946 ± 2628 (2018) (UNSW 2019)	Unburnt by recent fires (GEEBAM 2021)
Wadbilliga National Park	260 ± 226 (2019, pre-fire) (UNSW 2019) Average 17 seedlings per 1 m^2 in Oct 2021 (D Albrecht 2021 18 Oct)	Burnt in 2019-20 (GEEBAM 2021)
Deua National Park	135 (2018) (UNSW 2019)	Burnt in 2019-20 (GEEBAM 2021)
Victoria		
Alpine National Park	Very uncertain estimate of 1000–2000 plants prior to 2019-20 bushfires (N Walsh 2021. pers comm 3 August) ~250 unburnt plants post-2019-20 bushfires (A Messina 2021. pers comm 29 July)	Burnt in 1965, 2003 and 2019-20

Map 1 Modelled distribution of trailing Monotoca



Source: Base map Geoscience Australia; species distribution data Species of National Environmental Significance database.

Cultural and community significance

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

Indigenous Australians have a long and profound history of management of the country on which the trailing Monotoca occurs. The species occurs in the Merrimans Aboriginal Land Council in NSW (New South Wales Aboriginal Land Council 2021). Traditional Owners have not been formally recognised for the Victorian subpopulation (Aboriginal Victoria 2021).

Relevant biology and ecology

Habitat ecology

Trailing Monotoca grows in montane heath on shallow, skeletal soils (UNSW 2019; VicFlora 2021). The vegetation communities where the species has been recorded are Southern Montane Heath in NSW (UNSW 2019) and Subalpine Woodland (Ecological Vegetation Class 43) in Victoria (DELWP 2021a).

At Deua National Park, the habitat for the species includes *Leptospermum grandifolium* (mountain tea-tree), *Epacris robusta*, *Kunzea badjaensis*, *Acrotriche leucocarpa* (tall acrotriche), *Platysace lanceolata* (shrubby platysace), *Gahnia subaequiglumis*, *Lepidosperma laterale* (variable sword-sedge), *Deyeuxia monticola* and *Boronia algida* (alpine boronia). At Wadbilliga National Park, associated species include *Eucalyptus pauciflora* (snow gum), *Banksia canei* (mountain banksia), *Allocasuarina nana* (dwarf sheoak), *K. badjensis*, tall acrotriche, *Persoonia silvatica* (forest geebung), *Hakea dactyloides* (finger hakea), mountain tea-tree, *Hibbertia pedunculata* and *Lepidosperma tortuosum* (tortuous rapier-sedge). At Dangelong Nature Reserve, associated species include *Eucalyptus dives* (broad-leaf peppermint), *Eucalyptus rubida* (candlebark), dwarf sheoak, *K. badjaensis*, mountain banksia, *Micrantheum hexandrum* (box micrantheum), *Phebalium squamulosum* subsp. *ozothamnoides* (mountain phebalium), *Oxylobium ellipticum* (common shaggy pea), *Bossiaea foliosa* s.l. (leafy bossiaea), *Brachyloma daphnoides* (daphne heath), *Lepidosperma gunnii* (little sword-sedge). The Victorian subpopulation occurs in heath that alternates with strips of mallee eucalypts along a barren slaty ridge on harsh skeletal soils with snow gum, *Eucalyptus kybeanensis* (mallee ash), *Eucalyptus forresterae* (brumby sallee), *Eucalyptus glaucescens* (tingaringy gum), mountain banksia, leafy bossiaea, *Daviesia ulicifolia* (gorse bitter-pea), *Podolobium alpestre* (alpine shaggy-pea) and *Mirbelia oxylobioides* (mountain mirbelia) (UNSW 2019; ALA 2021).

Reproductive ecology

The reproductive ecology of trailing Monotoca is not well understood and requires further investigation. The species has been recorded flowering between January to March in Victoria (VicFlora 2021) and in March in NSW (PlantNet 2021). Germination requirements are unknown, but may be similar to other Ericaceae where fire is required to break seed dormancy in many species (Gilmour et al. 2000). Many seedlings were observed at the Victorian population in 2004, following bushfires in the previous year (J Eichler & J Turner pers comm in UNSW 2019), and it's possible the species displays delayed seed germination following fire, as has been observed in other Ericaceae species (Keith 2002; Ooi 2010). The primary juvenile period is unknown, but has been reported as 3–11 years in *Leucopogon* (Ooi 2019). Other *Monotoca* species are slow

growing (Falster & Westoby 2005) and, given its montane habitat, it is possible that the primary juvenile period for trailing Monotoca is relatively long compared to other heathland shrubs.

The species is suspected to be long-lived with an estimated generation length of 30–50 years (DELWP 2021b), which appears consistent with observations by UNSW (2019) that subpopulations of the species are capable of persisting for at least 40 years in the absence of fire. Both monoecious (male and female flowers on the same plant) and dioecious plants (separate male and female plants) occur within subpopulations (UNSW 2019), with dioecious plants apparently more common (VicFlora 2021). Other *Monotoca* species are protandrous (different sex flowers on the same plant receptive at different times) and reliant on outbreeding (Keighery 1996). The pollinators and seed dispersal methods are unknown, but flies have been observed to be pollinators of other *Monotoca* species (Keighery 1996) and seed dispersal in other *Monotoca* species may be undertaken by birds (Keighery 1996) and ants (Berg 1975).

Fire and disturbance ecology

Trailing Monotoca is an obligate seeder, with adults killed by fire (A Messina 2021. pers comm 29 July; D Albrecht 2021 pers comm 18 Oct; J Eichler & J Turner pers comm in UNSW 2019). Germination of soil-stored seeds of other *Monotoca* species is triggered by fire-related cues, particularly heat and possibly smoke and scarification (Penman et al. 2008). There is no information on the persistence of soil-stored seed following fire. Extensive seedling recruitment was observed at the Victorian population in 2004 following bushfires in the previous year (J Eichler & J Turner pers comm in UNSW 2019). Trailing Monotoca subpopulations are capable of surviving for long periods without fire (at least 40 years; UNSW 2019). It is unclear if the species is capable of recruiting in the absence of fire, although some other southeast Australian Ericaceae species produce a small percentage of seed lacking physiological dormancy mechanisms, which could allow occasional recruitment in the absence of fire (Keith 1997).

As obligate-seeding species are usually killed by fire, they can undergo natural fluctuations in the number of mature individuals, and there must be sufficient intervals between fires to allow new seedlings to reach maturity and replenish the seedbank (Whelan 1995). The primary juvenile period for trailing Monotoca is unknown, but typically, the fire-free interval required by woody species is approximately 15 years (Keith 1996).

Habitat critical to the survival

Trailing Monotoca occurs in montane heath in eastern Victoria and southeast NSW. Habitat critical to the survival of trailing Monotoca includes the area occupied by all known populations (see the species distribution in Map 1), areas of similar habitat surrounding known populations, additional occurrences of similar habitat that may contain undiscovered subpopulations of the species or be suitable for future translocations.

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

Important populations

In this section, the word population is used to refer to subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

There is sufficient evidence through the species eligibility for listing, to declare 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

The main threats to the trailing Monotoca currently are inappropriate fire regimes, infection by *Phytophthora cinnamomi* and climate change (Table 2).

Table 2 Threats impacting trailing Monotoca

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

Threat	Status [a]	Evidence
Habitat disturbance and modification		
Inappropriate fire regimes	• Timing: current • Confidence: inferred • Consequence: major • Trend: increasing • Extent: across the entire range	Trailing Monotoca is an obligate seeder (A Messina 2021. pers comm 29 July; J Eichler & J Turner pers comm in UNSW 2019). The mature plants of obligate-seeding species are usually killed by fire, so a fire-free interval is required to allow new seedlings to reach maturity and replenish the seedbank (Whelan 1995). Germination of soil-stored seeds of other *Monotoca* species is triggered by fire-related cues (Penman et al. 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. A high frequency fire regime is likely to lead to declines in, or cause the extinction of, subpopulations of obligate seeders (Gallagher et al. 2021). This could be exacerbated by shortened fire-free intervals and earlier fire season (Gallagher et al. 2021) and fire-granivore interactions (Regan et al. 2003). Although the primary juvenile period for trailing Monotoca is unknown, typically, the fire-free interval required by woody species is approximately 15 years (Keith 1996). Heathland shrubs can also be threatened by overly long fire-free periods (Whelan 1995). However, trailing Monotoca appears able to tolerate very long fire-free intervals (at least 40 years, UNSW 2019). Therefore, too infrequent fire appears unlikely to be a substantial threat to this species. Additionally, for obligate-seeding species, interactions between fire and seed predators may also elevate risks of decline, especially under small or patchy fires (Regan et al. 2003). Three of the four known subpopulations burnt in the 2019-20 bushfires (Table 1). Post-fire surveys have been undertaken at the Victorian

		subpopulation, but are yet to be undertaken for subpopulations in NSW. The number of mature individuals in the Victorian subpopulation declined from 1000–2000 plants pre-fire to an estimated 250 unburnt mature plants post-fire (Table 1). However, as trailing Monotoca is an obligate seeder, its natural ecology is for adult plants to be killed by fire, and then recruit from soil-stored seed, a process that was observed in the Victorian population in 2004 following bushfires in the previous year (J Eichler & J Turner pers comm in UNSW 2019). Therefore, the loss of mature individuals following the 2019-20 bushfires is considered part of a natural fluctuation. However, burnt subpopulations remain highly susceptible to future fire events until juvenile plants reach maturity and can replenish the soil seed bank. The effect of post-fire drought may particularly threaten the survival of recruited seedlings, and is often a major cause of seedling mortality in obligate seeding shrubs.
Recreational/management activities	• Timing: current • Confidence: observed • Consequence: moderate • Trend: static • Extent: across its entire range	Disturbance from recreation and associated walking tracks threatens the Wadbilliga and Deua National Park subpopulations. Walking tracks run through these two subpopulations and trampling of plants has been observed (UNSW 2019). Any ground disturbance to upgrade or maintain trails could impact plants along the edge of existing trails (UNSW 2019).
Disease		
Dieback caused by *Phytophthora cinnamomi*	• Timing: future • Confidence: suspected • Consequence: major • Trend: unknown • Extent: across the entire range	*Phytophthora cinnamomi* is an introduced soil-borne pathogen, which infects a large range of plant species and may contribute to plant death, especially when other are stressors present, such as waterlogging, drought and fire (DOEE 2018). *Phytophthora cinnamomi* can migrate through zoospores via soil moisture/water and by direct hyphal infection from susceptible species with infected roots. and mud clinging to vehicles, animals and walkers and movement of infected plant materials or soil (DOEE 2018). Dieback caused by *P. cinnamomi* is listed as a Key Threatening Process under the EPBC Act (DOEE 2018). The susceptibility of trailing Monotoca to *P. cinnamomi* is not known and has not been tested. However, the Ericaceae known to possess highly susceptible species and other species of *Monotoca* are known to be highly susceptible to the disease (Weste 1986; Schahinger et al. 2003). Disease expression is often highest on nutrient poor soils (Weste & Marks 1987), similar to those on which trailing Monotoca occurs. Therefore, *P. cinnamomi* is thought to be a threat to trailing Monotoca, particularly given the small number of subpopulations (UNSW 2019). All NSW subpopulations are near either walking tracks or management tracks, and are therefore susceptible to the pathogen being introduced by bushwalkers, management vehicles, or in gravel introduced during track upgrades.
Climate change		

Increased temperatures and change to precipitation patterns	• Timing: current • Confidence: inferred • Consequence: moderate • Trend: increasing • Extent: across the entire range	From 2017-19, south-eastern NSW and eastern Victoria experienced severe drought (Bureau of Meteorology 2020; DPIE 2021). This drought is suspected to have caused dieback or death of some trailing Monotoca individuals at Dangelong Nature Reserve (UNSW 2019). Such events are increasingly likely to occur due to climate change (CSIRO & Bureau of Meteorology 2015) and cause widespread plant mortality, as plants may be vulnerable to drought stress and hydraulic failure (Allen et al. 2010; Choat et al. 2012). Following severe drought, catastrophic bushfire conditions resulted in unprecedented, extensive bushfires across south-eastern Australia in 2019-20. These fires burnt three of the four known subpopulations of trailing Monotoca (Table 1). While the trailing Monotoca is capable of surviving occasional fire events, as fire frequency and severity are predicted to continue to increase due to climate change (Dowdy et al. 2019; Bureau of Meteorology & CSIRO 2020; van Oldenborgh et al. 2021), the species may decline in future if fire-free intervals shorten (i.e. through interval squeeze) (Enright et al. 2015; Gallagher et al. 2021). Warmer temperatures, changes to precipitation patterns and fire interactions may also favour the spread and increase severity of *P. cinnamomi* infection (Moore et al. 2015; Homet et al. 2019).

Timing—identify the temporal nature of the threat;

Confidence—identify the extent to which we have confidence about the impact of the threat on the species;

Consequence—identify the severity of the threat;

Trend—identify the extent to which it will continue to operate on the species;

Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 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 Trailing Monotoca 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
Likely	Low risk	Moderate risk	High risk **Increased temperatures and change to precipitation patterns**	Very high risk **Inappropriate fire regimes** **Dieback caused by *Phytophthora cinnamomi***	Very high risk
Possible	Low risk	Moderate risk **Recreational/ management activities**	High risk	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

Categories for likelihood are defined as follows:
Almost certain – expected to occur every year
Likely – expected to occur at least once every five years
Possible – might occur at some time
Unlikely – such events are known to have occurred on a worldwide bases but only a few ties
Unknown – currently unknown how often the incident will occur
Categories for consequences are defined as follows:
Not significant – no long-term effect on individuals or populations
Minor – individuals are adversely affected but no effect at population level
Moderate – population recovery stalls or reduces
Major – population decreases
Catastrophic – population extirpation/extinction

Priority actions have then been developed to manage the threat particularly where the risk was deemed to be 'very high' (red shading) or 'high' (yellow shading). For those threats with an unknown or low risk outcome (green and blue shading) it may be more appropriate to identify further research or undertake monitoring.

Conservation and recovery actions

Primary conservation objective

By 2030, the population of the trailing Monotoca will have increased in abundance and subpopulations are sustained in habitats in which very high threats are managed effectively.

Conservation and management priorities

Habitat loss, disturbance and modifications

- Ensure locations of subpopulations are kept updated on state databases, in particular those used by fire, road and land management agencies.
- Implement measures to reduce trampling and impacts from recreational activities where appropriate, such as fencing and signage.

Fire

- Develop and implement a fire management strategy that optimises the survival of the trailing Monotoca.
  - Avoid planned burns in all subpopulations (particularly recently burnt subpopulations), until the fire ecology of the species is better understood and unless there is evidence to show the species is declining due to lack of fire.
  - Avoid impacts to subpopulations during fire-fighting operations, or other fire management works, by ensuring accurate location information of the species is available on databases used by the relevant fire management agencies.

Disease

- Implement a *P. cinnamomi* management plan in accordance with the Threat Abatement Plan (DOEE 2018) to ensure that:
  - the pathogen is not introduced into subpopulations (e.g. by contaminated water used for firefighting, or contaminated gravel used in road maintenance). Gravel used in track maintenance must be sourced from 'accredited' *P. cinnamomi*-free sources, or tested for the presence of the disease and not used if *P. cinnamomi* is present.
  - the spread of the pathogen in areas outside of, but adjacent to, subpopulations of trailing Monotoca is mitigated (DOEE 2018).
  - potential translocation sites are free of, and do not become infested by, *P. cinnamomi*.
  - mitigation measures (e.g. treatment with phosphite) are implemented if required (phosphite has been shown to be effective for the short-term protection of another Ericaceae species, prickly broom-heath; Aberton et al. 2003, although concerns around its long term use persist; Lambers et al. 2013).
- Survey for *P. cinnamomi* within wild subpopulations and potential conservation translocation sites.
- Limit access to sites by bushwalkers (e.g. close nearby walking tracks) and close nearby vehicle management tracks.
- Refer to existing guidelines and management plans when planning or implementing actions which may impact the species, e.g. the threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DOEE 2018).

Ex situ recovery

- Collect and store sufficient quantities of seed from all known subpopulations in long-term storage to preserve genetic material, in accordance with Plant Germplasm Conservation Guidelines (Martyn Yenson et al. 2021).
- 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). Translocations should be monitored to document recruitment and show that the translocated subpopulation(s) are self-sustaining and contribute to the conservation of the species.

Climate change and severe weather

- Identify and protect current and future habitat likely to remain or become suitable habitat due to climate change.

Stakeholder engagement/community engagement

- Engage and involve Traditional Owners in conservation actions, including surveying for new populations and management actions.
- Liaise with the local community and government agencies to ensure that up-to-date population data and scientific knowledge inform the implementation of conservation actions for this species.
- Engage community groups by encouraging participation in surveys or monitoring for the species.
- Inform managers of sites where there are known populations and consult with these groups regarding options for conservation management and protection of the species.

Survey and monitoring priorities

- Conduct targeted surveys to locate any unknown subpopulations.
- Maintain a monitoring program to:
  - document the number of plants in all subpopulations;
  - record response to future bushfires (particularly the length of the primary juvenile period);
  - determine trends in population size and distribution;
  - determine threats and their impacts; and,
  - monitor the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Quantify the susceptibility of trailing Monotoca to *P. cinnamomi* and investigate the efficacy of phosphite treatment to reduce future disease impacts.
- Increase survey effort to locate additional populations.
- Investigate the population genetics and pollination biology of the species.
- Investigate recruitment (particularly the length of the primary juvenile period), seedling survival and plant longevity/generation length.
- Identify fire regimes that are detrimental and those that allow population persistence.
- Understand factors influencing survival and development of translocated populations.

Recovery plan decision

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

Department of the Environment (2015) *Arrive Clean. Leave Clean. Guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems.* Department of the Environment, Canberra.

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DELWP (2021b) Conservation Status Assessment for *Monotoca rotundifolia*. Department of Environment, Land, Water and Planning, Victoria. Viewed 8 September 2021. Available from https://www.environment.vic.gov.au/biodiversity/naturekit

DOE (2015) *Arrive Clean. Leave Clean. Guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems.* Department of the Environment, Canberra.

DOEE (2018) *Threat abatement plan for disease in natural ecosystems caused by* Phytophthora cinnamomi. Department of the Environment and Energy, Canberra.

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

Attachment A: Listing Assessment for *Monotoca rotundifolia*

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	9841	6487	13195	Using the midpoint of population size estimates from UNSW (2019) and the midpoint of the very uncertain pre-fire estimate of 1000-2000 plants in Victoria, a total population of 9841 plants is estimated. The minimum plausible value has been calculated using the minimum estimates from the above sources, which gives an estimate of 6487 mature individuals. The maximum plausible value has been calculated using the maximum estimates from the above sources, which gives an estimate of 13,195 mature individuals.
Trend	Unknown			There are no monitoring data available for any subpopulation.
Generation time (years)	40	30	50	The generation length is estimated by DELWP (2021b) at 30–50 years, which appears consistent with observations by UNSW (2019) that subpopulations of the species are capable of persisting for at least 40 years in the absence of fire.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Extent of occurrence	3062 km^2	3062 km^2	<5000 km^2	The current estimated EOO is 3062 km^2. This estimate is based on the mapping of point records from a 10-year period (2010–2020) obtained from state governments, museums and CSIRO. A ten-year period was used, as older records were not confirmed by UNSW (2019), who suggested they were likely to represent misidentifications or spatially inaccurate records. Therefore, the ten-year period from 2010-2020 captures all known subpopulations. The EOO was then calculated using a minimum convex hull. The maximum EOO may be larger than currently known if additional subpopulations are discovered.
Trend	Unknown			There has been no confirmed loss of subpopulations, with unconfirmed subpopulations in New South Wales likely to have been misidentifications or inaccurate records (UNSW 2019).
Area of Occupancy	16 km^2	16 km^2	<50 km^2	The current estimated AOO is 16 km^2. This estimate is based on the mapping of point records from a ten-year period (2010–2020) obtained from state governments, museums and CSIRO. A ten-year period was used, as numerous older records were not confirmed by UNSW (2019), who suggested they were likely to represent misidentifications or spatially inaccurate records. The AOO itself was calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines (IUCN 2019). The maximum AOO may be larger than currently known if additional subpopulations are discovered.
Trend	Unknown			There has been no confirmed loss of subpopulations, with unconfirmed subpopulations in New South Wales likely to have been misidentifications or inaccurate records (UNSW 2019).
Number of subpopulations	4	4	4–10	Three subpopulations have been confirmed in New South Wales (UNSW 2019) and a single known subpopulation exists in Victoria (DELWP 2021b).

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Unknown			There has been no confirmed loss of subpopulations, with unconfirmed subpopulations in New South Wales likely to have been misidentifications or inaccurate records (UNSW 2019).
Basis of assessment of subpopulation number	Three subpopulations have been confirmed in New South Wales (UNSW 2019) and a single known subpopulation exists in Victoria (DELWP 2021b).			
No. locations	3–4	1	4–5	Inappropriate fire regimes and potential infection by *Phytophthora cinnamomi* are the most serious threats to the species. Infection by *P. cinnamomi* is likely to result in four threat-defined locations (*sensu* IUCN 2019), as the threat operates at small spatial scales (e.g. Wilson et al. 2012) and each subpopulation is separated by a large distance (shortest interpopulation distance of 25 km). The species is susceptible to a high fire frequency regime (e.g. two fires less than 15 years apart) that damages or causes the extinction of subpopulations before they can replenish the soil seed bank (Keith 1996; Gallagher et al. 2021) The very large size of the 2019-20 bushfires, which burnt three of the four known subpopulations, illustrated that a single fire season could impact the majority of subpopulations, and could conceivably result in a single location in future bushfire events. However, it is more likely that several (e.g. 3–4) bushfire events would be required to instigate fire intervals of <15 years at all subpopulations due to most subpopulations being separated by large distances or wide tracts of agricultural land through which fires may not burn. Accordingly, the most likely number of locations is three or four. Additional subpopulations are probably unlikely to occur outside of the south-east NSW or eastern Victoria regions, and so their discovery may not result in a substantially larger number of locations.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Decreasing			The 2019-20 bushfires burnt three of the four known subpopulations and 67% of modelled suitable habitat (Gallagher 2020). Prior to the 2019-20 bushfires it may not have been conceivable for a single fire season to impact all known subpopulations, and the minimum number of locations is likely to have been more than one. However, the large size of these bushfires illustrated that the minimum number of locations is plausibly one, as all subpopulations could be burnt in a single fire season.
Basis of assessment of location number	Inappropriate fire regimes and infection by *Phytophthora cinnamomi* are the most serious potential threats to the species and are likely to result in three to four threat-defined locations. However, the large size of the 2019-20 bushfires, which burnt three of the four known subpopulations, illustrated that a single fire season could possibly impact all subpopulations, and could conceivably result in a single location, therefore the minimum number of locations is one. It is also plausible that additional, undocumented subpopulations may exist, resulting in a slightly larger number of maximum locations (maximum of five).			
Fragmentation	Not severely fragmented. All known subpopulations are more than 25 km distant from one another. Due to the relatively short distance of seed dispersal and pollinator movement (Keighery 1996), it is likely that all subpopulations are isolated from each other. However, although two subpopulations (Deua National Park and Wadbilliga National Park) are smaller than rudimentary estimates of minimum viable populations of 1000 individuals (Frankham et al. 2014), the Dangelong Nature Reserve and Victorian subpopulations are larger than 1000 individuals (using pre-fire estimates for the Victorian subpopulation; Table 1). Therefore, as not more than 50% of the known subpopulations are smaller than a rudimentary minimum viable population size estimate, the species is not considered severely fragmented (IUCN 2019).			
Fluctuations	Not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals – no parameter was changed by an order of magnitude by the 2019/20 fire.			

Criterion 1 Population size reduction

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

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

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

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

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

Based on any of the following

(a) direct observation [except A3]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Criterion 1 evidence

Insufficient data to determine eligibility

There are an estimated 9841 individuals of the trailing Monotoca (Table 3). There has been no monitoring of any subpopulation and, therefore, it is unclear whether there has been a decline in the total population size. Three of the four known subpopulations were burnt in the 2019-20 bushfires (Table 1). Post-fire surveys have only been conducted at the Victorian subpopulation, where only about 250 unburnt adult plants were observed (down from a very uncertain estimate of 1000–2000 plants pre-fire). However, as trailing Monotoca is an obligate seeder, its natural ecology is for adult plants to be killed by fire, and then recruit from soil-stored seed, a process that has occurred following previous bushfire events at the Victorian subpopulation (J Eichler & J Turner pers comm in UNSW 2019). Therefore, the reduction in the number of mature plants at burnt subpopulations is likely to be a natural fluctuation, although post-fire monitoring should be undertaken to document the recovery of all burnt subpopulations. The Committee considers that there is insufficient information to determine the eligibility of the trailing Monotoca for listing in any category 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 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy

		Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1.	Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2.	Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:				
(a)	Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b)	Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c)	Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Criterion 2 evidence

Eligible under Criterion 2 B1ab(iii)+B2ab(iii) for listing as Endangered

AOO and EOO

The AOO and EOO of trailing Monotoca are considered restricted and are estimated at 16 km² and 3062 km² respectively (Table 4). These estimates are based on the mapping of point records from a ten-year period (2010–2020) obtained from state governments, museums and CSIRO. A ten-year period was used, as numerous older records were not confirmed by UNSW (2019), who suggested they were likely to represent misidentifications or spatially inaccurate records. Therefore, the ten-year period from 2010-2020 captures all known subpopulations. The AOO itself was calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines (IUCN 2019). The EOO was calculated using a minimum convex hull following IUCN (2019).

Severely fragmented

Not severely fragmented. All known subpopulations are more than 25 km distant from one another. Due to the relatively short distance of seed dispersal and pollinator movement (Keighery 1996), it is likely that all subpopulations are isolated from each other. However, although two subpopulations (Deua National Park and Wadbilliga National Park) are smaller than rudimentary estimates of minimum viable populations of 1000 individuals (Frankham et al. 2014), the Dangelong Nature Reserve and Victorian subpopulations are larger than 1000 individuals (Table 1). Therefore, the number of subpopulations smaller than a rudimentary minimum viable population size estimate is not more than 50 per cent, and the species is not considered severely fragmented (IUCN 2019).

Locations

Infection by *P. cinnamomi* and inappropriate fire regimes and are the most serious threats to the species.

It is unknown if trailing Monotoca is susceptible to infection by *P. cinnamomi* as the susceptibility of the species has not been tested. However, other species of *Monotoca* are known to be highly susceptible to the disease (Schahinger et al. 2003), with infection resulting in severe declines or local extinctions of infected subpopulations (Weste 1986). Therefore, based on the assumption that trailing Monotoca is susceptible to *P. cinnamomi* infection like many congeneric species, infection by *P. cinnamomi* is likely to result in four threat-defined locations, as the threat operates at small spatial scales (e.g. Wilson et al. 2012) and each subpopulation is separated by a large distance (shortest interpopulation distance of 25 km).

Trailing Monotoca is an obligate-seeder, with adults killed by fire (A Messina 2021. pers comm 29 July; J Eichler & J Turner pers comm in UNSW 2019). The primary juvenile period for trailing Monotoca is unknown, but other *Monotoca* species are slow growing (Falster & Westoby 2005) and other Ericaceae (e.g. *Leucopogon*) have primary juvenile periods of 3–11 years (Ooi 2019). Given its montane habitat where conditions for growth may be temperature limited, it is possible that the primary juvenile period for trailing Monotoca is relatively long compared to other heathland shrubs (possibly toward the longer end of the 3–11 year range given for *Leucopogon* by Ooi (2019). Typically, the fire-free interval required by woody species is approximately 15 years (Keith 1996) and this may be applicable to trailing Monotoca, given its obligate seeder fire response and likely long primary juvenile period. Therefore, the species is susceptible to a high fire frequency regime (e.g. intervals of <15 years between fires) that damages or causes the extinction of subpopulations before they can replenish the soil seed bank (Keith 1996; Gallagher et al. 2021).

The 2019-20 bushfires burnt three of the four known subpopulations (GEEBAM 2021; Table 1). This illustrates the large spatial scale at which this threat operates and illustrates that a single fire season could impact the majority of subpopulations. It is possible that two fires within a 15-year timeframe could both impact the entire trailing Monotoca population, with the 2019-20 bushfires illustrating the large spatial scale at which climate change-driven fire events can occur (Nolan et al. 2020). Therefore, the minimum plausible number of locations is one. However, the 2019-20 fires, while extremely large, only burnt three of the four known subpopulations, illustrating the heterogeneous impacts within the overall extent of large bushfires. Therefore, the likelihood of two bushfire events impacting all four subpopulations of trailing Monotoca within a 15-year period is low, and it is more likely that several (e.g. 3–4) bushfire events would be required to instigate a fire interval of <15 years at all subpopulations. Accordingly, the most likely number of locations is three or four.

Additionally, post-fire surveys at the Victorian subpopulation showed that not all plants were burnt in the fire, suggesting that multiple fires may be required to affect all individuals within this subpopulation (presumably due to its rocky habitat). This supports the conclusion that the most plausible number of locations due to the threat of fire is likely to be more than one, probably more likely three or four.

It is possible that additional, undocumented subpopulations may exist, resulting in a slightly larger number of maximum locations. However, additional subpopulations are unlikely to occur outside of the southeast New South Wales or eastern Victoria regions, and so their discovery

may not result in a substantially larger number of locations due to the threat of fire acting at large spatial scales in these regions.

Therefore, the most plausible number of locations is estimated at three to four, meeting the threshold of Endangered under subcriterion under (a).

Continuing decline

Decline of the extent and quality of habitat is projected due to the impacts of high fire frequency and *P. cinnamomi*.

High fire frequency is likely to result in previously suitable habitat for trailing Monotoca becoming unsuitable, as the species is an obligate seeder likely to require fire-free intervals in the order of 15 years (Keith 1996). The frequency of bushfires in southeast NSW and eastern Victoria is likely to increase, due to increasing numbers of days with severe fire weather and increasing Forest Fire Danger Index in spring and summer due to climate change in the region (DPIE 2021). Therefore, projected increasing fire frequency is likely to result in a decline in the extent and quality of habitat for trailing Monotoca.

The susceptibility of trailing Monotoca to *P. cinnamomi* is not known and has not been tested. However, other species of *Monotoca* are known to be highly susceptible to the disease (Weste 1986; Schahinger et al. 2003). The distribution and/or severity of *P. cinnamomi* infection is projected to increase in high elevation regions of southeast Australia, such as the montane heathland habitat of trailing Monotoca, due to the impact of climate change (Burgess et al. 2017). Warmer mean temperatures of 0.6°C by 2039 and 2°C by 2079 are almost certain to occur as a result of climate change in southeast New South Wales (DPIE 2021). Such increases in temperature are likely to drive increased disease severity in montane habitats (Burgess et al. 2017), particularly on nutrient-poor soils (Weste & Marks 1987), similar to those on which trailing Monotoca occurs. Therefore, it is likely that disease expression of *P. cinnamomi* will increase in the habitat of trailing Monotoca, resulting in decreased extent and quality of habitat for this species.

Conclusion

The Committee considers that the species' AOO and EOO are restricted, the number of locations is restricted, and continuing decline is projected in area, extent and/or quality of habitat. Therefore, the species appears to be 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:				
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals				

Criterion 3 evidence

Eligible under Criterion 3 C1 for listing as Vulnerable

The total number of mature individuals is 9841 which is limited.

The rate of decline of the species is unknown. However, given the long generation length (40 years) and the threats posed by *P. cinnamomi* infection and inappropriate fire regimes (detailed under Criterion 2 above), the population of trailing Monotoca is projected to decline by at least 10 percent (984 individuals) over the next 100 years.

The species' distribution is not precarious for its survival, as there are >1000 individuals in two of the four known subpopulations.

Therefore, the species appears to be 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 4 Number of mature individuals

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2.[1] *Only applies to the Vulnerable category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time			D2. Typically: area of occupancy < 20 km² or number of locations ≤ 5

[1] The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a 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

Not eligible

The Committee considers that the total number of mature individuals is 9841 which is not low. Therefore, the species appears ineligible 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.

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. Therefore, there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

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

Adequacy of survey

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

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 Monotoca rotundifolia* (trailing Monotoca), Canberra. 

This publication is available at the SPRAT profile for *Monotoca rotundifolia* (trailing Monotoca).

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

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