



## Consultation on Species Listing Eligibility and Conservation Actions

### *Gentiana wissmannii* (New England gentian)

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

- 1) the eligibility of *Gentiana wissmannii* (New England gentian) for inclusion on the EPBC Act threatened species list in the **Critically Endangered** category; and
- 2) the necessary conservation actions for the above species.

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

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment.

Responses are to be provided in writing by email to: [species.consultation@awe.gov.au](mailto: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 8 July 2022.**

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## **General background information about listing threatened species**

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

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at: <https://www.awe.gov.au/sites/default/files/env/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2021.pdf>.

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at: <https://www.awe.gov.au/environment/biodiversity/threatened/nominations>.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at: <https://www.awe.gov.au/environment/biodiversity/threatened/recovery-plans>.

## **Privacy notice**

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the '[Common Assessment Method](#)' (CAM). As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: <https://www.awe.gov.au/about/commitment/privacy> .

### **Information about this consultation process**

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

## **CONSULTATION QUESTIONS FOR *GENTIANA WISSMANNII* (New England gentian)**

### **SECTION A - GENERAL**

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

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

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

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

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

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

☐ 1–50 ☐ 51–250 ☐ 251–1000 ☐ >1000 ☐ >10 000

Level of your confidence in this estimate:

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, information suggests this range
- ☐ 95–100% - high level of certainty, information indicates quantity within this range
- ☐ 99–100% - very high level of certainty, data are accurate within this range

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

- 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**

- Are you able to provide an estimate of the total population size during the early 2010s (*at or soon after the start of the most recent 10 year period*)? Please provide justification for your response.

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

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

☐ 1–50 ☐ 51–250 ☐ 251–1000 ☐ >1000 ☐ >10 000

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- ☐ 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

- 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

- 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**

- Does the assessment consider the entire geographic extent and national extent of the species? If not, please provide justification for your response.
- Has the survey effort for this species been adequate to determine its national distribution? If not, please provide justification for your response.
- Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.
- 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.
- 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<sup>2</sup> ☐ 100 – 5 000 km<sup>2</sup> ☐ 5 001 – 20 000 km<sup>2</sup> ☐ >20 000 km<sup>2</sup>

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<sup>2</sup> ☐ 11 – 500 km<sup>2</sup> ☐ 501 – 2000 km<sup>2</sup> ☐ >2000 km<sup>2</sup>

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**

- Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.
- 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<sup>2</sup> ☐ 100 – 5 000 km<sup>2</sup> ☐ 5 001 – 20 000 km<sup>2</sup> ☐ >20 000 km<sup>2</sup>

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<sup>2</sup> ☐ 11 – 500 km<sup>2</sup> ☐ 501 – 2000 km<sup>2</sup> ☐ >2000 km<sup>2</sup>

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)**

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

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

- 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?
- Are you aware of any cultural or social importance or use that the species has?
- What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species?
- How aware of this species are land managers where the species is found?
- What level of awareness is there with individuals or organisations around the issues affecting the species?
  - Where there is awareness, what are these interests of these individuals/organisations?
  - Are there populations or areas of habitat that are particularly important to the community?

**PART 3 – ANY OTHER INFORMATION**

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

## Consultation Document on Listing Eligibility and Conservation Advice for *Gentiana wissmannii* (New England gentian)

***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 eligibility of the species for listing and inform conservation actions, further planning and the potential need for a 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

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



*Gentiana wissmannii* (New England gentian) © Copyright, Copeland, L.

## Conservation status

*Gentiana wissmannii* (New England gentian) is proposed to be transferred from the Vulnerable category to the Critically Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999*.

The New England gentian was assessed by the Threatened Species Scientific Committee to be eligible as Critically 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: Insufficient data
- Criterion 2: B1ab(i,ii,iii,v)+2ab(i,ii,iii,v): Critically Endangered
- Criterion 3: C2a(ii): Critically Endangered
- Criterion 4: D1: Endangered
- Criterion 5: Insufficient data

The main factors that make the species eligible for listing in the Critically Endangered category are: a very restricted Area of Occupancy (AOO), Extent of Occurrence (EOO); a population that occurs at one location; and continuing estimated decline in distribution, extent and area of habitat, and number of mature individuals. The total estimated number of mature individuals is below 250, and it has a precarious geographic distribution as 100% of the mature individuals are found within a single 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

Conventionally accepted as *Gentiana wissmannii* J.B. Williams, Family: *Gentianaceae*

### Description

The New England gentian is a small upright annual herb 3–8 cm tall, usually with a single soft, hairless stem, occasionally with two to four short branches. The species has three to ten pairs of leaves which are oval shaped, 4–10 mm long and 3–6 mm wide, curving away from the stem towards the ground. The species has one to five flowers which are greenish on the outside and sky blue on the inside, 8–15 mm long. The flower grows on a stalk c. 2 mm long that elongates to 10–15 mm when in fruit (Adams and Williams 1988, OEH 2018b; PlantNET 2021).

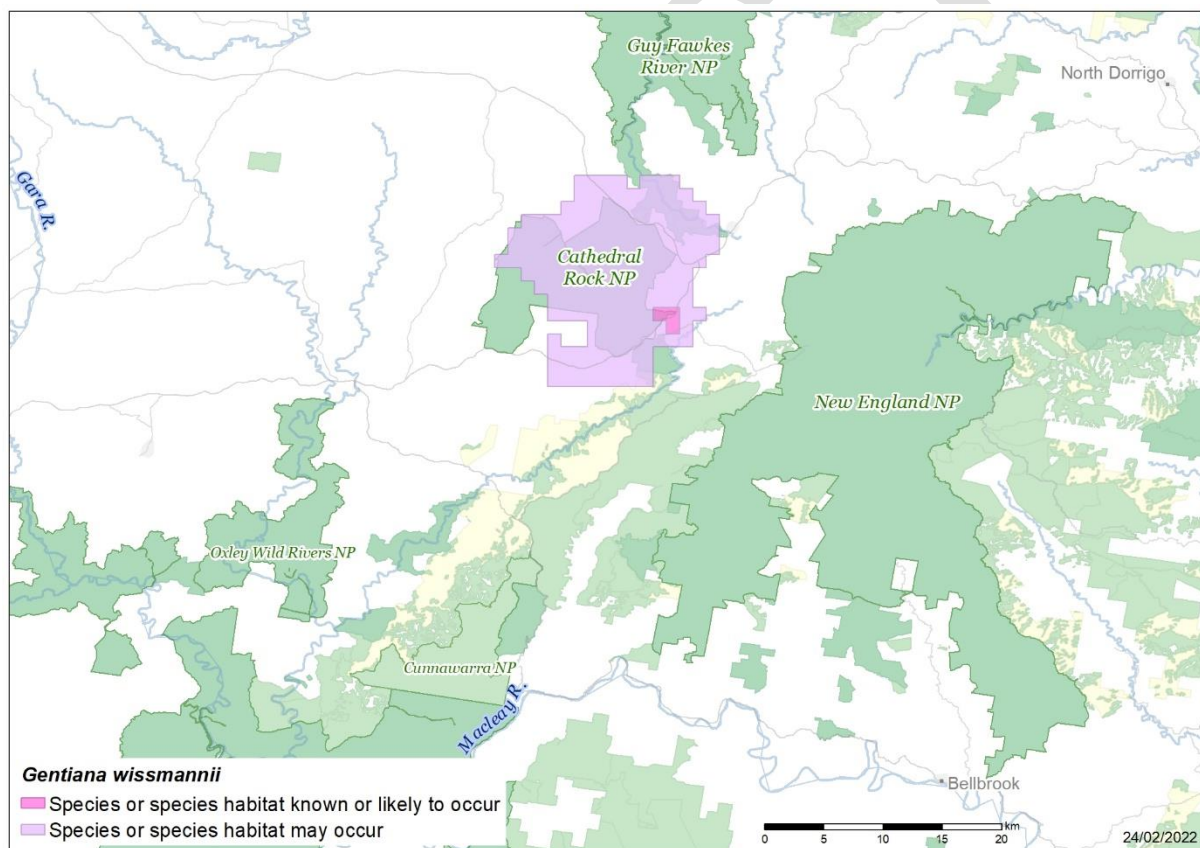
### Distribution

The New England gentian is endemic to the New England Tablelands in northern New South Wales (NSW), specifically in the Cathedral Rock and Round Mountain area between Wollomombi and Ebor (OEH 2018b). Only one occurrence has been reported of the species outside of this area, with coordinates placing it in the New England National Park (NP)

approximately 10km away. However, locality remarks on this survey record state that it was found at Sandy Creek, 10km west of Ebor, which locates the record in, or very near to Cathedral Rock NP (Bionet 2022).

Post-fire surveys were conducted for the species in November 2021 at most of its previously documented locations and a number of opportunistic sites thought to contain suitable habitat. In total, 14 sites were surveyed however the species was located at only one. At least 90 individuals were observed, covering approximately 30 square metres. All sites surveyed were burnt by an intense wildfire in November 2019 (Eco Logical Australia 2021). Prior to this survey, the species had not been observed since 2005 (Eco Logical Australia 2021). Other historical observations exist in recently unsurveyed areas of the Cathedral Rock NP, and it is possible that the species still persists in some of these sites. However, the species has not been observed in many of these sites since the late 1970s or early 1980s (Quinn et al, 1995; Bionet 2022).

**Map 1 Modelled distribution of New England gentian**



**Source:** Base map Geoscience Australia; species distribution data [Species of National Environmental Significance](#) database.

**Caveat:** The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.

**Species distribution mapping:** The species distribution mapping categories are indicative only and aim to capture (a) the habitat or geographic feature that represents to recent observed locations of the species (known to occur) or habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

## Cultural and community significance

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

The Cathedral Rock NP lies within the territory of the Gumbaynngir Aboriginal People (NSW NPWS 2002). The cultural significance of New England gentian is currently unknown. However, given the acknowledged importance to Aboriginal peoples of Connection to Country and the widespread importance of Caring for Country (which includes biodiversity, 'place', custom and totemic elements) it is considered likely that the species has or is associated with some cultural and/or community significance. Ascertaining the cultural significance of New England gentian is a research priority identified in the conservation actions.

This statement of significance is not intended to be comprehensive, applicable to, or speak for, all Indigenous Australians. It is acknowledged that Indigenous Australians who are the custodians of this knowledge have the rights to decide how it is shared and used.

## Relevant biology and ecology

### Habitat

The New England gentian is found in short herbfields and wet heath areas on the margins of acid swamps in moist sandy soils on granitic sedimentation at altitudes of 1100-1450 m (Quinn et al. 1995; OEH 2018b). The species may depend on the presence of open patches of short, grazed vegetation and is known to occur among *Leptospermum* sp., *Restio* sp., and *Sphagnum* sp. (Quinn et al. 1995; DEWHA 2008).

### Reproductive Ecology

Little is known about the reproductive ecology of the New England gentian. A close relative, *Gentiana zollingeri*, has been shown to be mycoheterotrophic, meaning that it is completely or partially non-photosynthetic, relying instead on carbon gained from fungi in the soil for growth and seed germination (Yamato et al. 2021). Phylogenetic analysis by Yamato et al. (2021) showed that the New England gentian was almost identical to, and formed a clade with, *G. zollingeri*, suggesting that the New England gentian may also rely on fungi for carbon to some extent. Seeds of the species are minute and usually found within the top few centimetres of soil. Many other species of *Gentiana* have seeds with complex physiological dormancy that require a specific suite of environmental conditions to trigger germination. Studies have found that most commonly a period of cold (0–5 °C) is required to break seed dormancy in many *Gentiana* species (Kim et al. 2021; Cuena-Lombrana et al. 2018; Simpson & Webb 1980). The longevity of the species' seeds within the seedbank is unknown. However, prior to surveys completed in November 2021 the species had not been observed since 2005. The reason why there were no observations of the species for 16 years is unknown. This may have been due to its size and inconspicuous nature, or perhaps is due to environmental cues not triggering germination. The latter suggests the seeds of the species are quite long lived. This is supported by Miller (2004), who found that seeds of *Gentiana nivalis* (Alpine gentian) had a half-life of 15 to 32 years.



Some *Gentiana* species, including *G. zollingeri*, rely on rain for seed dispersal (Nakanishi 2002). Raindrop-dispersed species rely on the energy provided by falling raindrops to bounce the seeds out of the flower. Dispersal distance with this method is short, usually one metre or less. The seed dispersal method employed by New England gentian is unknown, however, could be similar to that of *G. zollingeri*. The mean annual rainfall of Cathedral Rock and Round Mountain is c. 1100 – 1250 mm (Quinn et al. 1995), suggesting this may be an effective dispersal method for the species.

The species flowers between September and November (OEH 2018b). Little is known about the pollination requirements of the species, however, many other species of *Gentiana* rely on insects for pollination (Cuean-Lombrana et al. 2018; Olsson et al. 2015; Mu et al. 2011). It is likely that New England gentian also relies on insects for pollination, however, the type of pollinators that visit the species is unknown.

### **Fire ecology**

New England gentian is likely not a fire-adapted species. As mentioned above, the species is an annual herb and relies on germination from a seedbank for persistence, similar to that of obligate seeders. Unlike obligate seeders, however, New England gentian requires cold stratification to break seed dormancy (Cuenca-Lombrana et al 2018; Simpson & Webb 1980). The maximum temperature thresholds for seeds of the species are unknown, however, it is unlikely that they survive the high temperatures experienced during fires.

### **Habitat critical to the survival**

New England gentian is found on Round Mountain, Cathedral Rock, and the surrounding area at c. 1450 m elevation. Given the restricted distribution, habitat critical to the survival includes the area of occupancy of the species, areas of similar habitat surrounding the subpopulations (as these areas provide potential habitat for pollinators or biota essential to the continued existence of the species and enables the movement of pollinators between localities), areas of similar habitat that may contain other individuals or be suitable sites for future conservation translocations, and the local catchment for the surface/groundwater that maintains the habitat of the taxon. Further research is needed to define habitat critical to the survival of New England gentian (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 a subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation. Given the restricted distribution and small area of occupancy, every wild population of the species should be considered as important populations for this species under particular pressure of survival and which therefore require protection to support the recovery of the species.



## Threats

New England gentian is threatened by fire regimes that cause declines in biodiversity, clearing and drainage of acid swamps for agriculture, trampling and over-grazing by domestic stock, disturbance of habitat by feral pigs (*Sus scrofa*), browsing by rabbits (*Oryctolagus cuniculus*), infestation by weeds, and climate change. Early collection records for the species suggested ringbarking of nearby tress to be a threat to the species (Bionet 2022); however, more information is needed to understand the implications of this threat and as such has not been included in the table below.

**Table 1 Threats**

Threats in Table 1 are noted in approximate order of highest to lowest impact, based on available evidence.

Threat	Status <sup>a</sup>	Evidence
Habitat disturbance and modification		
Fire regimes that cause declines in biodiversity†	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: inferred</li> <li>• Likelihood: likely</li> <li>• Consequence: catastrophic</li> <li>• Trend: increasing</li> <li>• Extent: across the entire range</li> </ul>	<p>New England gentian may not be fire tolerant. As an annual herb, it relies on germination from a seedbank, similar to that of an obligate seeder. However, the exact temperature thresholds tolerated by the species' seeds are unknown, and it may require periods of cold to break dormancy like other members of the genus instead of heat or abrasion. New England gentian is threatened by high fire severity, the interactive effects of fire and drought, post-fire herbivory, interactive effects of fire and weeds, and fire effects on habitat suitability and facilitation interactions with fungal symbionts.</p> <p><i>High fire severity</i> New England gentian is an annual herb, completing its life cycle of germination, reproduction and death within one year. The species relies on a seedbank similar to that of obligate seeders; however, it most likely requires different triggers to break dormancy. Seeds are minute, reducing the likelihood of survival in the top layers of the soil during fires. The adults of the species are also susceptible to fire and usually do not survive.</p> <p>During surveys in late 2021, only one of fourteen sites surveyed was found to have the species present. Several of the sites where the species had previously been found, were absent of the species and showed signs of severe fire in 2019-20, with damage to the top 10–15 cm of soil. As the seeds of the species are probably found within the first few centimetres of soil, damage this deep would kill most seeds, as well as promote erosion resulting in the displacement of surviving seeds.</p> <p><i>Interactive effects of fire and erosion</i> Wildfires are one of the main causes of soil erosion and degradation (Shakesby 2011). The incineration of vegetation and litter, along with the formation of an ash layer reduces the protective cover of soil and promotes erosion from rainfall (Girona-García et al. 2021). Furthermore, moderate to high severity fire can alter soil structure through the destruction of organic matter and mineral bindings (Fernández et al. 2010; Larsen and MacDonald 2007). As New England</p>

Threat	Status <sup>a</sup>	Evidence
		<p>gentian seeds are usually located within the first few centimetres of soil, the species is at risk from post-fire erosion. New England gentian has also been predicted to be at high risk from erosion following fires (Gallagher 2020). Prescribed burning of peatlands such as the habitat for this species has been shown for southwest Australian <i>Empodisma</i> peatlands to lead to combustion of the peats as a result of aerial incendiaries creating an ignition pattern that is different to a wildfire front (Dixon 2022 pers comm 23 March). Thus, planned fire needs to consider such unintended impacts.</p> <p><i>Interactive effects of fire and drought</i> Pre or post-fire drought can inhibit flowering and seedling germination, and increase mortality of seedlings and immature plants (DAWE 2021). New England gentian is an annual plant and relies on a seedbank to persist after fire. This puts the species at further risk, as seedlings have rudimentary root systems prone to desiccation in the establishment phase. As the species grows on the margins of acid swamps, it requires sufficient moisture in order to thrive. Fires that occur within droughts during late-spring to summer when the species is in flower can be especially detrimental (OEH 2018b).</p> <p><i>Interactive effects of fire and herbivory</i> New England gentian relies on the presence of open patches of short, grazed turf, suggesting that moderate grazing may be necessary (Quinn et al. 1995). Fire may then act positively in this regard, opening up available habitat for the species. However, Leigh et al. (1991) found empirical evidence of strong fire-herbivore interactions suppressing survival, growth and reproduction in subalpine herbs. Further research is required to understand the extent of this threat.</p> <p><i>Interactive effects of fire and weeds</i> Fire can mediate competition between species and allow competitors such as weeds to dominate, making conditions unsuitable for plant growth and survival (DAWE 2021). New England gentian is likely dispersed over short distances, as well as requiring open patches. This puts the species at risk as weeds such as blackberry (<i>Rubus fruticosus</i>) (see Weed invasion below) can outcompete the species and make habitat unsuitable.</p> <p><i>Fire effects on habitat suitability and facilitation interactions</i> The life history of the New England gentian is unknown. However, it is possible that it relies on carbon from fungi to aid in growth and seed germination (Yamato et al. 2021). Arbuscular mycorrhizal (AM) fungi are one of the most widespread mutualistic fungi and play an essential role in the cycling of carbon, nitrogen, phosphorous and other nutrients (McMullan-Flisher et al. 2011). The response of AM fungi to fire has been shown to be quite variable; however, more often than not, the impacts are negative, especially in the short term (Hart et al. 2005; Torpy et al. 1999). Given the potential importance of fungi for early seed development in the New England gentian, negative impacts on fungi due to fire could have consequences</p>

*Gentiana wissmannii* (New England gentian) Conservation Advice

Threat	Status <sup>a</sup>	Evidence
		<p>on the post-fire recovery of the species. Torpy et al. (1999) found negative effects of high and low fire frequency on AM fungi root colonisation. A balance between the two effects occurred at a fire interval of ca. 6 years, which also coincided with the maximal AM colonisation levels. As New England gentian is an annual herb, a six year recovery would span six generations if there was annual stimulation of the substrate seed bank.</p> <p>New England gentian is restricted to Cathedral Rock National Park, which was affected in its entirety by the 2019-20 bushfires (NSW NPWS 2021).</p>
Clearing and draining of swamps for agriculture	<ul style="list-style-type: none"> <li>• Timing: historical/current</li> <li>• Confidence: suspected</li> <li>• Likelihood: possible</li> <li>• Consequence: moderate</li> <li>• Trend: unknown</li> <li>• Extent: across part of its range</li> </ul>	<p>Although the majority of the species is confined within Cathedral Rock NP it is still at risk from habitat clearing and drainage of acid swamps for agriculture (OEH 2018b). Prior to the 1980s many observations were made on private property adjacent to the NP (Bionet 2022; Adams &amp; Williams 1998) and if still extant would be especially affected by this threat. It was estimated that over 80 percent of the wetlands on the New England Tablelands have been destroyed since settlement (Brock et al. 1999).</p> <p>The current extent of this threat is unknown. However, the clearing and drainage of swamps around Cathedral Rock NP may harm undiscovered populations, or deplete suitable habitat for the species.</p>
Climate Change		
Increased temperatures, droughts and fire danger weather, and changes in precipitation	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: observed</li> <li>• Likelihood: likely</li> <li>• Consequence: major</li> <li>• Trend: increasing</li> <li>• Extent: across the entire range</li> </ul>	<p>The CSIRO &amp; Bureau of Meteorology (2015) predicted that eastern Australia will be exposed to increased average temperatures, and increased frequency of droughts due to climate change. For the New England Tablelands in NSW, maximum temperatures have been projected to increase by 0.7–1°C by 2030 and 1.9–2.7°C by 2070, with more hot days and fewer cool nights (OEH 2014). This could have negative impacts on the species as it is thought to rely on periods of low temperature to break seed dormancy.</p> <p>Decreasing rainfall may also impact the flowering and dispersal of New England gentian if it does rely on rain for seed dispersal. The species flowers during spring, which was predicted to see a decrease in rainfall of between 21 and 28% by 2070 (OEH 2014).</p> <p>Increasing temperature and decreasing rainfall will likely impact the habitat availability of New England gentian. High altitude swamps like those the species occupies depends upon the natural hydrology regime of the area and may be particularly vulnerable to species loss under future climate predictions (DECCW 2010). Although it is an unpredictable environment with alternating periods of flooding and dry spells, significant changes in the frequency and severity of these processes pose a threat to the species (Nielsen &amp; Brock 2009). Increasing severe rain events and floods may bring increased impact of erosion to the species, especially following fire.</p>
Invasive Species		

*Gentiana wissmannii* (New England gentian) Conservation Advice

Threat	Status <sup>a</sup>	Evidence
Disturbance of habitat by feral pigs	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: observed</li> <li>• Likelihood: likely</li> <li>• Consequence: major</li> <li>• Trend: unknown</li> <li>• Extent: across parts of the range</li> </ul>	Feral pigs occur within Cathedral Rock NP and are known to be destructive to habitat, particularly in the wetlands of the park (NSW NPWS 2002). Feral pigs can directly damage the species and its habitat when digging in search of food or creating wallows. They can also introduce weed seeds and nutrients to native habitat and disturb soil, encouraging the establishment of weeds (DoEE 2017). Feral pigs are listed as a Key Threatening Process under the EPBC Act (DoEE 2017). During surveys in November 2021, one site was found to have evidence of damage from feral pigs (Eco Logical Australia 2021).
Browsing by rabbits	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: suspected</li> <li>• Likelihood: likely</li> <li>• Consequence: moderate</li> <li>• Trend: unknown</li> <li>• Extent: across parts of the range</li> </ul>	<p>Rabbits are found in all states and territories of Australia and have been listed as a Key Threatening Process under the EPBC Act (DoEE 2016). Rabbits inflict substantial damage upon plants and communities. They prefer green grass and herbs, and are also known to dig into soil to reach roots and seeds (DSEWPC 2011). Other direct impacts of rabbits include preventing plant regeneration, overgrazing, altering ecological communities and changing soil structure and nutrient cycling (DoEE 2016). Indirectly, they aid in the promotion and growth of introduced and unpalatable species, such as weeds.</p> <p>New England gentian is likely threatened by rabbits due to herbivory of both adult plants and seeds (OEH 2018; DoEE 2016). Promotion of weeds due to rabbits may also impact the species negatively, as their habitat risks becoming overgrown.</p>
Weed invasion	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: suspected</li> <li>• Likelihood: likely</li> <li>• Consequence: moderate</li> <li>• Trend: unknown</li> <li>• Extent: across parts of the range</li> </ul>	<p>Blackberry is known to occur within Cathedral Rock NP in similar habitat to New England gentian (NSW NPWS 2002). Blackberry forms dense thickets that exclude native species, leading to its complete dominance of the vegetation understorey (DPIE 2021). Blackberry can also change fire patterns by altering fuel load (DPIE 2021).</p> <p>The extent that weeds affect New England gentian is unknown. However, given the species' requirements for short, grazed habitats, there is a significant risk of weeds outcompeting the species.</p>
Trampling and over-grazing by domestic stock	<ul style="list-style-type: none"> <li>• Timing: historical/current</li> <li>• Confidence: suspected</li> <li>• Likelihood: possible</li> <li>• Consequence: moderate</li> <li>• Trend: unknown</li> <li>• Extent: across parts of the range</li> </ul>	Prior to the 1980s New England gentian was located in many sites on private property adjacent to Cathedral Rock NP (Bionet 2022; Adams & Williams 1988). These sites were vulnerable to trampling and over-grazing by domestic stock, especially during times of drought (Adams & Williams 1988). The species had multiple observation and collection records from the 1970s, many of which found evidence of grazing and trampling from cattle (Bionet 2022). Although the species has not been observed at any of these sites since the late 1970s, it is possible that it still persists at some.

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

<sup>a</sup>Timing—identifies the temporal nature of the threat

Confidence—identifies the nature of the evidence about the impact of the threat on the species

Likelihood—identifies the likelihood of the threat impacting on the whole population or extent of the species

Consequence—identifies the severity of the threat

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

Extent—identifies its spatial context in terms of the range of the species

**Categories for likelihood are defined as follows:**

Almost certain – expected to occur every year

Likely – expected to occur at least once every five years

Possible – might occur at some time

Unlikely –known to have occurred only a few times

Unknown – currently unknown how often the threat will occur

**Categories for consequences are defined as follows:**

Not significant – no long-term effect on individuals or populations

Minor – individuals are adversely affected but no effect at population level

Moderate – population recovery stable or declining

Major – population decline is ongoing

Catastrophic – population trajectory close to extinction

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) 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; the spatial extent, 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 2 Risk Matrix**

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain					
Likely			Browsing by rabbits  Weed invasion	Increased temperatures, droughts and fire danger weather, and changes in precipitation  Disturbance of habitat by feral pigs	Fire regimes that cause declines in biodiversity
Possible			Clearing and draining of acid swamps for agriculture  Trampling and over-grazing by domestic stock		
Unlikely					
Unknown					

Risk Matrix legend/Risk rating:

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

## Conservation and recovery actions

### Primary conservation objective

By 2032, the population of New England gentian will have increased in abundance and viable subpopulations are sustained in habitats where threats are managed effectively.

### Conservation and management priorities

#### Fire impacts

- Develop and implement a fire management strategy to protect all known subpopulations from further fire including:
  - Exclude planned fire (and bushfire where possible) from all subpopulations until the population has grown sufficiently and the soil-stored seedbank 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 population enough to sustain through the next fire event.

- Planned fire must demonstrate that peat substrates are not negatively impacted or ignited that could lead to a decline in the substrate seed bank of the species or negatively impact subsequent regenerative capacity.
- Avoid impacts to subpopulations during fire-fighting operations, or other fire management works, by ensuring accurate species location information is available to relevant fire management agencies.

#### **Climate change and severe weather impacts**

- Identify and protect habitat likely to remain or become suitable for the species under future climate change scenarios.
- Identify climate refuges suitable for translocation, ensuring some geographically distant enough to increase the number of the locations of the species (see “Ex situ recovery actions” below) if suitable habitat exists elsewhere. Where translocations are used, 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

#### **Habitat loss, disturbance and modifications impacts**

- Ensure that the locations of all subpopulations are recorded on relevant state databases, including those used by land management and fire response agencies.
- Protect subpopulations near tracks from trampling and accidental damage using signage, track markers or fencing.

#### **Invasive species impacts (including from grazing, trampling, predation)**

- Install and maintain cages or fencing around subpopulations impacted by feral pigs and/or rabbits to protect against grazing, trampling, and habitat disturbance.
- Maintain weed management programs in Cathedral Rock National Park and monitor all known subpopulations.

#### **Ex situ recovery actions**

- Continue to collect and store seed from known subpopulations to preserve genetic material.
- Identify additional sites suitable for the establishment of new subpopulations through translocation.
- If appropriate, undertake ex situ propagation and translocation in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018). Monitor all translocated individuals to ensure they are viable and are contributing to a reduction in the extinction risk for the species.
- Collect and store AM fungi required by the species for growth and germination.

#### **Stakeholder engagement/community engagement**

- Engage and involve Traditional Owners in conservation actions, including the implementation of Indigenous fire management practices and 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 of the species.
- Promote public awareness of biodiversity conservation and protection through dissemination of information through print and digital media.

### **Survey and monitoring priorities**

- Develop and 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;
  - 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.
- Survey private property adjacent to Cathedral Rock NP where the species has been recorded in the past and if relocated then implement conservation actions around land acquisition or conservation covenants to provide additional security to relocated subpopulations.

### **Information and research priorities**

- Increase knowledge surrounding the ecology of New England gentian. This includes improving understanding of fire ecology, recruitment and soil seed-bank dynamics (especially seed bank longevity), pollination biology, seed longevity, genetic structure, minimum viable population size, and life history traits associated with ecophysiology.
- Investigate the presence of feral pigs and rabbits and determine which sites, extant or historic, 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, bushfire, drought, and other environmental stressors.
- Investigate the impact of drought on New England gentian recruitment and seed growth.
- Ascertain the cultural significance of New England gentian.
- Determine habitat critical to the survival of New England gentian.

### **Recovery Plan decision**

There is currently an existing NSW Saving Our Species strategy for the species.



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

[Blackberry](#)

[Feral European rabbit \(\*Oryctolagus cuniculus\*\)](#)

[Help save the New England Gentian](#)

[Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs \(\*Sus scrofa\*\)](#)

This Conservation Advice is developed to be able to subsequently inform other planning instruments such as a Bioregional Plan or a multi-entity Conservation Plan.

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## Attachment A: Listing Assessment for *Gentiana wissmannii*

### 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 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria. The definition of each of the parameters follows the [Guidelines for Using the IUCN Red List Categories and Criteria](#).

**Table 3 Key assessment parameters**

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	90	90	Unknown	<p>Surveys conducted in November 2021 found 90 individuals at one site. Despite a minimum of 20 search hours at the remaining 13 sites the species could not be located. However, given the species' tiny size and inconspicuous nature it may be present at other sites. The species may also persist within the seedbank at other sites, although it is unknown how long the seeds of the species survive. Many of the sites also showed evidence of burning deep into the peat layer and post-fire erosion following the fires, which may have caused significant mortality to the seedbank.</p> <p>Pre-fire population estimates are unavailable as the species had not been surveyed prior to 2021. A maximum plausible value is therefore unknown. However, as the species had not been observed since 2005 it is unlikely to be far greater than the minimum plausible value. The estimate used in this assessment is the minimum value, as this reflects the current data available for the species.</p>



Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	declining			Surveys conducted in November 2021 searched 14 sites, targeting most of the species' previously known habitat, as well as some potential sites thought to contain suitable habitat. However, the species was present at only one site. The cause of this decline from numerous healthy subpopulations is unknown. However, all of the sites had been burnt by a single wildfire event in November 2019, which appeared to have burnt deep into the peat layer. Significant rainfall occurred between the time of the burn and survey which lead to excessive run off and erosion of much of the peat layer. Much of the seedbank being destroyed by the wildfire and subsequent erosion removing any surviving seeds is thought to be a possible cause to this decline. However, as no pre-fire surveys had ever been completed for the species, it is impossible to tell if this decline was due to the wildfire or if it had already occurred before 2019 (Eco Logical Australia). As the species has not been re-observed at many sites since records were made, other threats such as grazing and trampling by domestic cattle or clearing of swamps for agriculture are thought to have possibly caused declines prior to the 2019-20 bushfires.
Generation time (years)	1	1	1	New England gentian is an annual herb, meaning that it completes its entire life cycle from germination to reproductive maturity and senescence within one year.



Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Extent of occurrence	4 km <sup>2</sup>	4 km <sup>2</sup>	<88 km <sup>2</sup>	<p>The minimum plausible value is based on mapping of point records from the survey in November 2021 where only one site was found to have the species present.</p> <p>The maximum plausible value represents the extent of occurrence (EOO) of all historically known sites. As the species can be extremely difficult to locate among dense vegetation, or may still be present within the seedbank, it is possible that it persists at other sites. However, even if the species persists at all historic sites, the outcome of this assessment would remain the same as all figures meet the threshold for Critically Endangered under Criterion 2.</p> <p>The estimate used in this assessment therefore reflects the current available data.</p> <p>The EOO was calculated using a minimum convex hull, based on the IUCN Red List Guidelines (IUCN 2019). However, IUCN Red List Guidelines state that: "If EOO is less than AOO, EOO should be changed to make it equal to AOO to ensure consistency with definition of AOO as an area within EOO" (IUCN 2019). Therefore, EOO values presented here have been increased to match AOO values (see below).</p>
Trend	contracting			<p>New England gentian was found in numerous healthy populations observed in 1976 (J. Smith pers. comm. 2021 cited in Eco Logical Australia 2021). Post-fire surveys found only one site to have the species present. The cause of this decline is unknown.</p>



Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Area of Occupancy	4 km <sup>2</sup>	4 km <sup>2</sup>	<68 km <sup>2</sup>	<p>The minimum plausible value is based on mapping of point records from surveys completed in November 2021 where only one site was found to have the species present. Due to the tiny size and inconspicuous nature of the species it is possible that it is extant at other sites, or that it survives in the seedbank.</p> <p>The maximum plausible value represents the area of occupancy (AOO) of all historically known sites. As the species can be extremely difficult to locate among dense vegetation it is possible that it is extant at other sites. However, it is unlikely that this range exceeds all historic sites as the species has not been observed since 2005.</p> <p>The estimate used in this assessment therefore reflects the current available data.</p>
<p>AOO is a standardised spatial measure of the risk of extinction, that represents the area of suitable habitat known, inferred or projected to be currently occupied by the taxon. It is estimated using a 2 x 2 km grid to enable comparison with the criteria thresholds. The resolution (grid size) that maximizes the correlation between AOO and extinction risk is determined more by the spatial scale of threats than by the spatial scale at which AOO is estimated or shape of the taxon's distribution. It is not a fine-scale estimate of the actual area occupied. In some cases, AOO is the smallest area essential at any stage to the survival of existing populations of a taxon (e.g. breeding sites for migratory species).</p>				
Trend	Contracting			<p>New England gentian was observed to be found in numerous healthy populations in 1976 (J. Smith pers. comm. 2021 cited in Eco Logical Australia 2021). Post-fire surveys in 2021 found only one site to have the species present. The cause of this decline is unknown but possibly due to a sequence of wildfires.</p>
Number of subpopulations	1	1	Unknown	<p>New England gentian was found at only one site in 2021. Although the species may be present at other sites, the species is likely invertebrate pollinated and therefore may still share genetic information. The species of pollinators to visit New England gentian is unknown, therefore the degree of separation between possible sites is also unknown.</p> <p>Due to the restricted nature of the species and the results of survey efforts completed in November 2021, the number of subpopulations is estimated at one.</p>





Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Unknown			<p>Although the New England gentian was found at numerous sites historically, it is unknown which of these were extant prior to the 2019 wildfire and also if any regeneration may occur in future. New England gentian is likely invertebrate pollinated similar to other gentian species. The types of invertebrates pollinating the species is unknown, therefore, the degree to which each site is isolated is also unknown. If the species is pollinated by a generalist pollinator such as a honeybee (<i>Apis mellifera</i>) then even the most distant historic sites (ca. 12 km apart) may still experience gamete exchange to some degree. Beekman and Ratnieks (2001) found the median foraged distance for honeybees was 6.1 km, however, the maximum distance they observed was 14.5 km.</p> <p>There are insufficient data available to estimate a trend in the number of subpopulations for the species.</p>
Basis of assessment of subpopulation number	Surveys conducted in November 2021 found only one population of New England gentian. It is unknown how many subpopulations existed prior to the 2019-20 bushfires.			
No. locations	1	1	1	<p>The number of locations is estimated at one. All known sites of the New England gentian were burnt by a single wildfire in November 2019, evidence that the entire population can be affected by a single threatening event. As there is only a single existing site known to contain individuals it is at risk of extinction from a single fire event should one occur before the plants have time to build up a sufficient seed bank, or if the fire is hot enough to burn a few centimetres into the soil causing seed mortality. Other subpopulations may exist; however, the species arrangement is very restricted and no other subpopulations have been found in recent surveys.</p>
Trend	Stable			<p>Given the species is found in a very restricted area, the number of locations can only decline if the species goes extinct.</p>
Basis of assessment of location number	The New England gentian is found in a restricted area around Cathedral Rock NP. All known sites of the species were burnt in an intense wildfire event in November 2019 (Eco Logical Australia 2021). With an increasing fire threat due to climate change (Canadell et al. 2021), another event similar to this one could threaten the species with extinction.			



Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Fragmentation	New England gentian was found at only one site, and historic sites are all within a very restricted area. Therefore, the species should not be considered severely fragmented.			
Fluctuations	In 1976 the New England gentian was found in numerous healthy sites, however, prior to surveys completed in 2021 the species had not been observed since 2005. The survey conducted in 2021 found 90 individuals at a single site. The number of mature individuals may fluctuate following fire. However, based on available information, it is not possible to determine if the species exhibits extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals.			

## 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	Based on any of the following			(a) direct observation [except A3]
A2				(b) an index of abundance appropriate to the taxon
A3				(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
A4				(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

Post-fire surveys were conducted on the New England gentian in November 2021. Seven sites known to previously have the species present were surveyed, as well as seven other areas of suitable habitat; however, the species was found to be present at only one site. On first inspection, 23 plants were found at this site. Two days later another search yielded 44. A final follow up survey found a total population of 90 individuals present at the site. All individuals found during these surveys were mature and fruiting. These findings from repeat surveys of the same site imply that the species is cryptic and inconspicuous. This site showed signs of recent



fire; however, fire severity may have varied between sites based on observations of the resprouting response of other species present (Copeland 2022 pers comm 2 February). . There was no evidence of post-fire erosion (Copeland 2022 pers comm 2 February). All other surveyed sites showed signs of recent high severity fires with erosion present and evidence of damage to a depth of 10–15 cm in the peat layer. Seeds of the species are usually located within the first few centimetres of soil and the combination of heat and erosion is believed to be the cause of the apparent local extinctions of the species at those 13 sites. However, no pre-fire surveys were conducted so there is insufficient evidence to support this theory or data available to estimate a reduction in population size.

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

## Criterion 2 evidence

### Eligible under Criterion 2 B1ab(i,ii,iii,v)+2ab(i,ii,iii,v) for listing as Critically Endangered

#### *EOO and AOO*

New England gentian was found at a single site during surveys conducted in November 2021. Thirteen other sites were searched during this time; however, the species could not be located at any of them. It is possible that the species persists at some of these sites, as it is cryptic and seeds may still be present within the seedbank. However, these sites showed evidence of burning 10-15 cm deep into the peat layer, as well as subsequent erosion from severe rain experienced after the fires. These events may have caused the apparent local extinction of



mature individuals at these sites and may have caused severe mortality in the seedbank. Therefore, the EOO and AOO of the species is estimated at 4 km<sup>2</sup> as this reflects the current available data. The EOO was calculated using a minimum convex hull, as outlined in the IUCN Guidelines (IUCN 2019). The AOO was calculated using a 2x2 km grid cell method as outlined in the IUCN Guidelines (IUCN 2019).

Given that the EOO is less than 100 km<sup>2</sup> and the AOO is less than 10 km<sup>2</sup> the species meets the threshold for listing as Critically Endangered under sub-criterion B1 and sub-criterion B2.

The species may be present at other sites which would increase the EOO and AOO. However, even if all historic sites were extant the EOO would only be ca. 88 km<sup>2</sup> and would not affect the outcome of this criterion.

#### *Severely fragmented and number of locations*

New England gentian is not considered to be severely fragmented. All historic sites exist within a restricted area and gamete exchange is likely to occur between these populations.

New England gentian was found at one site and therefore occurs at one location, based on the most plausible serious threat (fire) as per the IUCN Guidelines (IUCN 2019) (Table 1). The 2019-20 bushfires burnt all known sites for the species, and this may occur again in the future (Canadell et al. 2021). If the species does rely on fungi for some aspect of germination, fires within six years of each other could negatively affect the recovery of these fungi and therefore the recovery of the species. All sites surveyed were burnt in a single wildfire event in 2019, evidence that the entire population, even if extant at other sites, can be affected by a single threat. Therefore, the species meets the threshold for listing as Critically Endangered under sub-criterion (a).

#### *Continuing decline*

The EOO, AOO, habitat quality and number of individuals are inferred or projected to be declining due to ongoing threats, thereby meeting sub-criterion (b)(i,ii,iii,v). The species is restricted to Cathedral Rock NP and its surrounding area, with an estimated EOO and AOO of 4 km<sup>2</sup>. The species is found on the margins of acid swamps which rely on the natural hydrology regime of the region and may be at risk under future climate projections (Nielson & Brock 2009). Both high severity bushfires and extreme weather events are expected to become more frequent due to climate change (CSIRO & Bureau of Meteorology 2015), suggesting that decline in distribution and habitat quality due to these factors is likely to occur in the future. Periods of severe drought, such as those experienced during 2017-2019, may impact the wet habitats needed for the survival of the species. The exact dynamics of the species within the soil seedbank are unknown. However, changes to the frequency and severity of disturbances may lead to a 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.

#### *Conclusion*

The data presented above appear to demonstrate that the species is eligible for listing as



**Critically Endangered** under this criterion. However, the purpose of this consultation document is to elicit additional information to better 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

	<b>Critically Endangered Very low</b>	<b>Endangered Low</b>	<b>Vulnerable Limited</b>
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
<b>C1.</b> An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	<b>Very high rate 25% in 3 years or 1 generation (whichever is longer)</b>	<b>High rate 20% in 5 years or 2 generation (whichever is longer)</b>	<b>Substantial rate 10% in 10 years or 3 generations (whichever is longer)</b>
<b>C2.</b> 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 subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

### Criterion 3 evidence

#### Eligible under Criterion 3 C2a(ii) for listing as Critically Endangered

Post-fire surveys of the New England gentian found a total of 90 individuals at one site. Due to the inconspicuous nature of the species this count should be considered as a minimum and not as the total population size. However, at least 20 hours were spent at each site during the survey and the species was unable to be located at the remaining 13 sites. It is possible that the New England gentian still occurs at other sites and was not located during this survey, although it is unlikely that any contain as many individuals, and even less likely that they would contain significantly more individuals as the current known site. Therefore, it is likely that the entire population of New England gentian is less than 250 individuals.

Historically the species was found at numerous sites across its range, however, was only located at a single site in 2021. The cause of this apparent decline in range and inferred number of individuals is unknown as no pre-fire surveys were ever completed. The species is an annual



herb, and at the time of the survey all individuals were at the end of their flowering period. One hundred percent of mature individuals are in one subpopulation.

### Conclusion

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

### Criterion 4 Number of mature individuals

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2. <sup>1</sup> 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 <sup>2</sup> or number of locations ≤ 5

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

### Criterion 4 evidence

#### Eligible under Criterion 4 D1 for listing as Endangered

Post-fire surveys found 90 individuals. In total 14 sites were surveyed; however, only one was found to have the species present. As the species is small and can be hard to locate, it is possible that it is present at surveyed or unsurveyed sites, as Cathedral Rock NP contains suitable habitat throughout. However, as the species has not been observed since 2005, it is unlikely that any other sites contain significantly more individuals. As such, the total number of individuals is likely less than 250.

Therefore, the species has met the relevant elements of criterion 4 to make it eligible for listing as **Endangered** under this criterion. However, the purpose of this consultation document is to elicit additional information to better 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.



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