

Consultation on Species Listing Eligibility and Conservation Actions

Corokia whiteana

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

1) the eligibility of *Corokia whiteana* for inclusion on the EPBC Act threatened species list in the Endangered category; and

2) the necessary conservation actions for the above species.

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

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

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

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

Please include species scientific name in Subject field.

or by mail to:

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

Responses are required to be submitted by 5 January 2022.

Contents of this information package	Page
General background information about listing threatened species	2
Information about this consultation process	3
Consultation questions specific to the assessment	4
Information about the species and its eligibility for listing	12
Conservation actions for the species	22
References cited	24
Listing assessment	28

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 <u>'Common Assessment Method' (CAM)</u>. 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: <u>https://www.awe.gov.au/about/commitment/privacy</u>.

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 Corokia whiteana (Corokia)

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

<u>SECTION B</u> 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?

Ecological information

6. Can you provide any additional or alternate references, information or estimates on pollination ecology, pollinator biology, or dispersal.

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

Population size (N.B. there is no total population size estimate for this species in the Conservation advice)

- 7. To your knowledge have there been estimates of adult population size?
- 8. Can you provide recent data on the species or an 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:

□ <500 □ 500-1000 □ 1000-10 000 □ 10 000 - 20 000 □ >20 000

Level of your confidence in this estimate:

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

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

 \Box 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

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

- 9. Does the current and predicted rate of decline (3%) estimated from the 2019-2020 bushfires used in the assessment seem accurate?
- 10. Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.
- 11. Is there knowledge of a historical decline due to land use changes in the northern NSW area?
- 12. Is the estimate of total population size (<1000 individuals) used in the assessment reasonable?
- 13. Do you have unpublished sightings and abundance records of Corokia whiteana?

Evidence of total population size change

14. Are you able to provide an estimate of the total population size in 2010 (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:

□ <500 □ 500-1000 [□ 1000–10 000 □] 10 000 – 20 000 l	□ >20 000
---------------------	-----------------	---------------------	-----------

Level of your confidence in this estimate:

- \Box 0–30% low level of certainty/ a bit of a guess/ not much information to go on
- \Box 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
- \Box 99–100% very high level of certainty, data are accurate within this range
- 15. 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:

- \Box 0–30% low level of certainty/ a bit of a guess/ not much information to go on
- \Box 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
- \Box 99–100% very high level of certainty, data are accurate within this range
- 16. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

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

<u>Current</u> Distribution/range/extent of occurrence, area of occupancy

- 17. Can you identify and list separate subpopulations for the species using IUCN definition of subpopulation –'geographically or genetically distinct groups with little demographic or genetic exchange of less than one migrant per year'
- 18. Can you provide presence/absence or abundance data for any of the subpopulations of this species?
- 19. Does the assessment consider the entire geographic extent and national extent of the species? Or is the current geographic extent smaller than that presented? Please provide justification for your response.
- 20. Has the survey effort for this species been adequate to determine its national distribution? If not, please provide justification for your response.
- 21. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.
- 22. Are you aware of any subpopulations that are no longer extant (particularly the smaller subpopulations at Upper Duroby, Yelgun, Brunswick Heads and The Channon).
- 23. 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.
- 24. 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:

 \Box <100 km² \Box 100 – 5 000 km² \Box 5 001 – 20 000 km² \Box >20 000 km²

Level of your confidence in this estimated extent of occurrence

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

 \Box 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:

 \Box <10 km² \Box 11 – 500 km² \Box 501 – 2000 km² \Box >2000 km²

Level of your confidence in this estimated extent of occurrence:

- \Box 0–30% low level of certainty/ a bit of a guess/ not much data to go on
- \Box 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
- \Box 99–100% very high level of certainty, data is accurate within this range

<u>SECTION F</u> 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

- 25. Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.
- 26. 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:

 \Box <100 km² \Box 100 – 5 000 km² \Box 5 001 – 20 000 km² \Box >20 000 km²

Level of your confidence in this estimated extent of occurrence

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

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

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

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

 \Box 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:

 \Box <10 km² \Box 11 – 500 km² \Box 501 – 2000 km² \Box >2000 km²

Level of your confidence in this estimated extent of occurrence:

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

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

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

 \Box 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

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

- 27. Do you consider that all major threats have been identified and described adequately?
- 28. Are you aware of any specific weeds or invasive herbivores which may be known or suspected to impact Corokia?
- 29. To what degree are the identified threats likely to impact on the species in the future?
- 30. Are the threats impacting on different populations equally, or do the threats vary across different subpopulations?
- 31. 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?
- 32. Can you provide additional information on the historical loss of suitable habitat and the causes (e.g. land use change)?
- 33. Can you provide supporting data/justification or other information for your responses to these questions about threats?

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

- 34. What planning, management and recovery actions are currently in place supporting protection and recovery of the species? To what extent have they been effective?
- 35. Can you provide any information on cultivated Corokia in Australia? Specifically numbers of living mature individuals, and also growth and reproductive information which may be relevant to the Conservation Advice and Listing Assessment.
- 36. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species?

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

<u>SECTION I</u> DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SPECIES?

- 38. 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?
- 39. Are you aware of any cultural or social importance or use that the species has?
- 40. Are there any sub-populations of species that are co-managed by First Nations Peoples which are not currently recognised in the Cultural and Community Significance section of the Draft Conservation Advice.
- 41. Can you provide information on the tenure, land use and threats specific to the most southerly subpopulation near-by The Channon.
- 42. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species?
- 43. How aware of this species are land managers where the species is found?
- 44. 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

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

Conservation Advice for Corokia whiteana

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.

<u>Note</u>: 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.

Corokia whiteana flower (left) and fruit (right) © Copyright, M. Fagg (from Australian Plant Image Index, Australian National Botanic Gardens).

Conservation status

Corokia whiteana is proposed to be transferred from the Vulnerable category to the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999.*

Corokia whiteana 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(i,ii,iii,iv,v) +2ab(i,ii,iii,iv,v): Endangered
- Criterion 3: Insufficient data
- Criterion 4: Vulnerable
- Criterion 5: Insufficient data

The main factors that make the species eligible for listing in the Endangered category are the restricted geographic distribution in both extent of occurrence (EOO) and area of occupancy (AOO), a severely fragmented population and projected future decline in EOO, AOO, quality of habitat, number of subpopulations and number of mature individuals.

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

Species information

Taxonomy

Conventionally accepted as *Corokia whiteana* L.S.Smith (1958) and belongs to the family Argophyllaceae.

Description

<u>Corokia whiteana</u> is a sparse shrub, recorded to four meters high (PlantNET 1992), although more often is between 2–3 m high (Robert Kooyman & Andrew Benwell 2021. pers comm. 28 July). New growth is scattered with T-shaped hairs, which are lost with age. Leaves are shiny on the upper surface and oblong-lanceolate in shape. Leaves are 2–7 cm long and 6–20 mm wide. The margins of the leaves are entire, but some may have 1–3 coarse teeth. The cream-coloured flowers appear in spring and summer; they are scented, usually have four petals each 5 mm long. The fleshy red fruit are ovoid in shape, 8–12 mm long and 3–5 mm in diameter. Each fruit has a single spindle-shaped seed (PlantNET 1992).

Six divergent *Corokia* species occur on several isolated South Pacific Islands (Webb 1994). For this reason, dispersal mechanisms, evolutionary divergence, and taxonomic placement of the *Corokia* species are of scientific interest.

Distribution

Corokia whiteana is restricted to north-east NSW between Upper Duroby in the north to nearby The Channon in the south (see Table 1, Figure 1). *Corokia whiteana* does not occur in stands and individuals are sparsely distributed (Justin Mallee 2021. pers comm. 27 July) and are in low abundance (see Table 1). *Corokia whiteana* subpopulations are isolated by distance, and often separated by unsuitable landscapes (valleys and rivers or agriculture and urban environments). Small, fragmented subpopulations of *Corokia whiteana* are less likely to recover or recruit postdisturbance, as fecundity is very low (few fruits with seeds available) and germination conditions are very specific (Graeme Errington 2021. pers comm 2 Aug). For example, coastal occurrences are geographically isolated from most of the population and are considered atypical subpopulations. The connectivity between these and higher altitude populations is probably very low or non-existent.

Sighting records of *Corokia whiteana* available via the Global Biodiversity Information Facility (Bachman et al. 2011) suggest that some locations have not been confirmed since 2010 (sites near The Channon) and 1994 (Upper Duroby and Yelgun), while others (particularly Nightcap Range) are sampled more frequently, and recently (2019).

Location	Latitude	Longitude	Tenure	Number of plants	Survey Year
Hogan's Scrub (Upper Duroby)	-28°15'19"	153°26'25"	Private Property	6	1985
Tumbulgum (Upper Duroby)	-28°27'	153°46'	~	Voucher	1894
Yelgun	-28°28'51"	153°32'26"	~	6	1994
Mt Jerusalem	-28°31'	153°22'	State Forest		1990
Blackbutt Plateau, Nullum	-28°31'39"	153°22'16"	State Forest		1991
Tyagarah	-28°32'	153°32'	Nature Reserve	5 to 10	1995
Pholis Walk, Nightcap	-28°32'22''	153°17'18"	National Park		1991
Mt Nardi, Nightcap	-28°33'	153°19'	National Park	Voucher	1979
Mt Matheson, Nightcap	-28°33'	153°19'	National Park	10	1979
Turntable Creek, Nightcap	-28°33'	153°17'21"	National Park		1991
Terania	-28°33'	153°16'19"	Private Property		1991
Gibbergunyah Range, Whian Whian	-28°34'	153°22'	State Forest	Voucher	1923
Rocky Creek, Whian Whian	-28°35'	153°20'33"	State Forest		1994
Blue Fig Road, Whian Whian	-28°34'44''	153°20'55"	State Forest		1991
Gibbergunyah Range, Whian Whian	-28°35'	153°2'	State Forest		1994
Whian Whian State Forest	-28°35'	153°22'	State Forest	Voucher	1957
Nightcap National Park	-28°35'	153°3'	National Park	12	1983
Terania Creek, NNE of The Channon	-28°35'	153°18'	~	Voucher	1980
Whian Whian State Forest	-28°35'23"	153°19'12"	State Forest		1994
Whian Whian State Forest	-28°36'38"	153°21'10"	State Forest		1991
Whian Whian State Forest	-28°37'	153°23'	State Forest, Flora Reserve	Voucher	1976
Whian Whian State Forest	-28°37'36"	153°23'12"	State Forest, Flora Reserve		1986
Big Scrub (west of Wollumbin National Park)	-28°38'	153°19'	Flora Reserve	Voucher	1966

Table 1. Original <i>Corokia whiteana</i> sightings, tenure, number of plants and survey year
(Quinn et al. 1995).

Some of the sites mentioned in Table 1 may have since undergone clearing for agricultural or urban and peri-urban land uses. Further south of the known distribution is an area known as "Big Scrub", which was 75,000 hectares of lowland subtropical rainforest prior to European settlement (Big Scrub Landcare 2020). Big Scrub was simple and complex notophyll vine forest (warm temperate and subtropical rainforest, respectively) habitat, similar to that at Nightcap National Park, where *Corokia whiteana* occurs (Kooyman & Mallee 2020)

In 1995, 19 specimens of *Corokia whiteana* were in cultivation at Australian National Botanic Gardens, Canberra; North Coast Regional Botanic Garden, Coffs Harbour; and Mt Annan Botanic Gardens (L. Meredith, A. Floyd & R. Johnstone pers comm, in Quinn et al. 1995). Five *Corokia whiteana* are currently planted at the Mt Annan Botanic Gardens in Sydney (Graeme Errington 2021. pers comm 2 Aug).



Map 1 Modelled distribution of Corokia whiteana

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

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

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

Cultural and community significance

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

Corokia whiteana occurs on Bundjalung nation country. The Bundjalung peoples are a large First Nation group on the far northern coast of NSW and consist of many language groups. The language groups closest to the sites where *Corokia whiteana* occur are Nganduwal, Minyanbal and Wiyabal (Bundjalung of Byron Bay Aboriginal Corporation 2011, State Library NSW 2014). The Bundjalung people have many sacred sites important to their identity, spirituality, connection and resource history in the Nightcap Range and Mount Jerusalem areas. The region is rich with cultural history, and significant sites are interrelated and bound together by dreaming (NSW Government 2004). The plants and animals feature prominently in dreaming stories, and the protection of connected sites is vital, if one site in the dreaming is damaged, all sites associated with that dreaming are affected (NSW Government 2004).

In New Zealand, Māori peoples use *Corokia spp*. to relieve stomachache and also in spiritual ceremonies. The hardwood of *Corokia spp*. was used to carve hooks and knives (Te Rūnanga o Ngāi Tahu 2016). It's not known if Australian *Corokia* has similar traditional uses.

Relevant biology and ecology

Biology

There are six species in the genus, five of which are endemic to New Zealand, Lord Howe, Rapa Ita and Chatham Islands (Webb 1994). *Corokia whiteana* is the only member occurring on mainland Australia; *Corokia carpodetoides* is endemic to Lord Howe Island. There is very little biological or ecological research on the Australian *Corokia*.

At a maximum of four metres high, it is typically a smaller (2–3 m), sparsely vegetated understorey shrub. It has low fecundity, producing a small number of fruit during spring and summer, each with only a single seed (DEWHA 2008). Observations of more than approximately ten fruit at a time are rare (Justin Mallee 2021. pers comm. 27 July). Individuals in ideal conditions (e.g. on creek lines) may have larger fruit crops of up to 20 fruits, though this is unusual (Robert Kooyman 2021. pers comm. 28 July). There are no records or direct observations which may indicate how *Corokia whiteana* is dispersed. However, the size and colour of the fleshy fruit suggest that birds may take it, possibly rainforest Columbidae species (Pigeons and Doves), *Sphecotheres viridis* (Fig Bird) and *Ailuroedus crassirostris* (Catbird), or similar sized frugivores which occur in the region.

Pollination

Corokia whiteana flowers in spring and summer and has small, fragrant cream-coloured flowers (Quinn et al. 1995). A related species, *Corokia cotoneaster*, is endemic to New Zealand, has yellow flowers and is self-compatible and pollinated by a wide range of insects, but only a single species of native bee (Webb 1994). The fruit of *C. cotoneaster* matures in late summer or autumn and is taken by birds (Webb 1994). No observations of pollination or herbivory have been noted for the species in the field (Robert Kooyman, Andrew Benwell, Justin Mallee 2021. pers comm 27-28 July).

Habitat

Corokia whiteana grows in subtropical (warm temperate) rainforests and wet sclerophyll forests with a rainforest understorey. *Corokia whiteana* occurs between 10–800 m altitude, mostly on soils derived from rhyolite, rarely on basalt and quartzite sands (Andrew Benwell 2021, pers

comm 28 July) (Quinn et al. 1995, NSW Government 2004, DEWHA 2008). The habitats with the greatest abundance of *Corokia whiteana* are warm temperate rainforests, specifically in the Nightcap Range. *Corokia whiteana* may disperse into wet sclerophyll forests only to decline when these habitats are fire-affected, recolonising post-fire(Justin Mallee 2021. pers comm. 27 July). *Corokia whiteana* will often also occur on the boundary between rainforest and sclerophyll forests (Robert Kooyman 2021. pers comm. 28 July). *Corokia whiteana* does not form stands and mainly occurs as a single individual or a sparsely arranged cluster of a few individuals at a site (Quinn et al. 1995; Justin Mallee 2021. pers comm. 27 July, Sally Cooper 2021. pers comm. 3 Aug;).The maximum number of individuals observed in one cluster was 18 (Sally Cooper 2021. pers comm. 3 Aug).

In warm-temperate rainforests, *Corokia whiteana* may co-occur with *Doryphora sassafras* (sassafras), *Ceratopetalum apetalum* (coachwood) and *Schizomeria ovata* (crabapple). In these habitats, it may also co-occur with other threatened plant species such as *Endiandra hayesii* (rusty rose walnut), *Symplocos baeuerleni* (small-leaved hazelwood), *Uromyrtus australis* (peach myrtle) as well as *Eidothea hardeniana* (Nightcap oak) and *Elaeocarpus* species(quondong) in the Nightcap National Park (NSW Government 2004). In open forest with littoral rainforest understories, *Corokia whiteana* may co-occur with *Lophostemon confertus* (brush box), *Callicoma serr*atifolia (black wattle) and *Tristaniopsis collina* (mountain water gum) (Quinn et al. 1995, NSW Government 2004, DEWHA 2008).

The most northern current occurrence of Corokia whiteana is in the floristically diverse lowland rainforest known as Duroby Nature Reserve (north of Tumbulgum; NSW Government 2010b) with other occurrences recorded at Nullum State Forest and Uki (Sheringham & Westaway 1995 cited in (Kingston et al. 2004). Land use surrounding these areas has been modified for grazing and agriculture (NSW Government 2010b) and so it is likely that historical records of Corokia whiteana in areas surrounding Duroby reserve (ALA 2021) have been since cleared. During 2016 vegetation surveys around Clarrie Hall Dam (north-west of Mount Jerusalem National Park), clusters of Corokia whiteana occurred in the ecotone between gully rainforest and upslope wet sclerophyll. Here, Corokia whiteana co-occurred with Eucalyptus grandis (flooded gum), *Corymbia intermedia* (pink bloodwood), brush box and *Syncarpia flomulifera* (turpentine) mixed forest adjacent to the dam waterline. In the gully rainforest community, Corokia whiteana co-occurred with warm temperate rainforest species dominated by Coachwood and subtropical rainforest Archontophoenix cunninghamiana (Bangalow palm) on the Kunghur soil landscape and Bundamba sandstone sediments. Corokia whiteana did not occur in comparable habitats on rhyolite soils that were densely vegetated (Sally Cooper 2021, pers comms 3 Aug) and may have been too light-limited for establishment.

Sighting records of *Corokia whiteana* (Bachman et al. 2011) at Mount Jerusalem National Park, Koonyum Range, Nightcap National Park and Whian Whian State Conservation Area overlapped with mapped habitats of Northern Moist Blackbutt, Wet *Lophostemon confertus* (brushbox), wet Bangalow-brushbox, and turpentine forest types (NSW Government 2005). Further south, near The Channon, records overlapped with Northern Ranges dry *Eucalyptus microcorys* (tallowwood) forests (NSW Government 2005).

Coastal subpopulations of *Corokia whiteana* at Billinudgel occur with *Callitris columellaris* (coastal Cypress pine) and Northern Moist *Eucalyptus pilularis* (blackbutt) forest types on Kurosol soils and Sedgeland/Rushland and Lowland *Eucalyptus sp.* (red gum) forest types on

Hydrosol soils. Further south at Brunswick Heads occurrences overlap with mapped *Melaleuca sp.* (paperbark) forest types on podosol soils and coastal acacia on ferosol soils (NSW Government 2005, 2012).

Five *Corokia whiteana* individuals are part of the living collection at the Mount Annan Botanical Gardens, Sydney. These individuals were sourced from the Nightcap Ranges in 1987. (Graeme Errington 2021 pers comm. 2 Aug). These have been further propagated from cuttings several times with success. Seed germination trials were attempted for ten seeds in 2013; two germinated but did not survive. *Corokia whiteana* seeds may have physiological dormancy, which would limit germination except under specific environmental conditions (Graeme Errington 2021 pers comm. 2 Aug). This is a common trait of rainforest taxa and so may explain the low germination rate observed. Low germination rates may also be due to low viability due to constraints on storage in fleshy fruited rainforest taxa (Sommerville et al. 2021). Currently, trials to maintain tissue cultures of *Corokia whiteana* are underway at the Australian PlantBank as part of a broader rainforest species germplasm conservation project (Graeme Errington 2021. pers comm 2 Aug).

Habitat critical to the survival

Both rainforest and wet sclerophyll forest types are critical for the survival of *Corokia whiteana*, particularly at ecotonal boundaries on low nutrient soils. Other habitat types are open moist eucalypt forest with a rainforest understorey. *Corokia whiteana* subpopulations are spatially patchy and may occur in habitats not typically characteristic of rainforest taxa (coastal Eucalypt or Melaleuca forests). Habitat where species currently occur, or have occurred in the past (e.g., possibly Big Scrub, where rainforest was extensively cleared between Byron Bay and Lismore) should be considered critical to their survival.

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

Important populations

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

Given the restricted distribution and small area of occupancy, every wild population should be considered important.

Threats

The main identified threats to *Corokia whiteana* are loss of habitat from clearing for urban expansion and agriculture, risk of extinction caused by stochastic events, inappropriate fire regimes, and invasion of habitat by weeds (DECC, 2005). History of timber harvesting and land clearing is suspected of causing the current fragmentation between subpopulations (Quinn et al. 1995), though timber harvesting is no longer a threat as areas that were previously NSW Forestry tenures are now Conservation Areas. The lack of monitoring, biological and ecological data makes it to identify existing threats as key knowledge gaps inhibit the ability to understand and predict threats and develop suitable recovery actions.

Table 2 Threats

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

Threat factor	Threat status and severity a	Evidence base		
Climate change and fire				
Increased temperatures and changes in rainfall patterns	 Timing: current Confidence: suspected Consequence: moderate Trend: increasing Extent: across the entire range 	On the north coast region of NSW, there is a projected increase in minimum and maximum temperatures (an increase of 0.4–1°C by 2039 and 1.5–2.4°C in the far future (2060-2079) and the number of hot days (above 35°C). Rainfall is projected to decrease in winter and increase in autumn and spring (NSW Government 2014a). Such changes in climate are currently occurring and projected to increase in the future. These changes are causing widespread plant mortality in forest ecosystems, as many plants are vulnerable to drought stress and hydraulic failure (Allen et al. 2010, Choat et al. 2012). There are no experimental or modelled responses for <i>Corokia whiteana</i> to altered rainfall patterns, though it may exhibit some drought tolerance, similar to a related species, <i>C. buddleioides</i> from New Zealand (Wyse et al. 2013). Distributional or ecotone shifts in vegetation as a result of climate change may further isolate subpopulations of <i>Corokia whiteana</i> , putting the species at greater risk of subpopulation loss.		
Increasing fire frequency and intensity	 Timing: current/future Confidence: suspected Consequence: moderate Trend: increasing Extent: across part of its range 	There are no data on how <i>Corokia whiteana</i> responds to different intensity fires. Wet sclerophyll forests in northern NSW can carry high fuel loads (up to 50t/ha), which, because of moisture levels, do not usually carry low-intensity fires but will support very high-intensity fires after a period of drought (Kingston et al. 2004). The 2019-20 bushfires overlapped with eight percent of the modelled range for <i>Corokia whiteana</i> . Three percent overlapped with high severity fire areas and 0.1 percent at very high severity fire areas (Gallagher et al. 2021). Whilst no post-fire surveys have been conducted specifically for the species, observations of post-fire regrowth from undamaged stems or from rootstock has been observed after light to medium fires (Robert Kooyman and Andrew Benwell 2021. pers comm 28 July), though <i>Corokia whiteana</i> is killed in hot fires (Kooyman & Mallee 2020). Climate change is predicted to increase both the frequency and intensity of bushfires (projected increase in the average number of fire weather and severe fire weather days in summer and spring) for northern New South Wales (NSW Government 2014a). Decreased rainfall during hot periods may result in more severe fires than wet sclerophyll communities are adapted to, including Corokia.		
Invasive species				
Invasive weeds	Timing: currentConfidence: suspectedConsequence: moderate	<i>Corokia whiteana</i> is a shrub that grows to a maximum of four meters and thus, it may be shaded out by taller weeds or those which can smother or blanket the available light from seedlings or adult <i>Corokia whiteana</i> . Serious environmental weeds in		

Threat factor	Threat status and severity a	Evidence base
	 Trend: unknown Extent: across part of its range 	the Tweed region are: camphor laurel (<i>Cinnamomum camphora</i>); large-leaved privet (<i>Ligustrum lucidum</i>); small-leaved privet (<i>Ligustrum sinense</i>); groundsel (<i>Baccharis halimifolia</i>); lantana (<i>Lantana camara</i>); mist flower / creeping crofton weed (<i>Ageratina riparia</i>); crofton weed (<i>Ageratina adenophora</i>); kudzu vine (<i>Pueraria lobata</i>); Madeira vine (<i>Anredera cordifolia</i>); morning glory (<i>Ipomoea purpurea</i>); cats claw creeper (<i>Dolichandra unguis- cati</i>); blue trumpet vine (<i>Thunbergia grandiflora</i>); bitou bush (<i>Chrysanthemoides monilifera subsp. rotundata</i>) (Kingston et al. 2004; NSW 2010b). At the time of writing, there were no published reports or observations of weeds interacting with <i>Corokia whiteana</i> .
Habitat loss, degradat	tion, or fragmentation	
Small, fragmented subpopulations	 Timing: current Confidence: inferred Consequence: moderate Trend: unknown Extent: across the entire range 	Corokia whiteana does not occur in stands and individuals are sparsely distributed (Justin Mallee 2021. pers comm. 27 July) and are in low abundance (<12, Quinn et al. 1995). Corokia whiteana subpopulations are isolated by distance, and often separated by unsuitable landscapes (valleys and rivers or agriculture and urban environments). Small, fragmented subpopulations of Corokia whiteana are less likely to recover or recruit post- disturbance, as fecundity is very low (few fruit with seeds available) and germination conditions are very specific (Graeme Errington 2021. pers comm 2 Aug). For example, coastal populations are geographically isolated and considered atypical subpopulations. The connectivity between these and higher altitude populations is probably very low or non-existent. The low fruit set, and high moisture requirements of seedlings may limit recruitment in the area so that a significant disturbance would result in the loss of
Land clearing (from urban, residential and agricultural land development and change) causing habitat fragmentation	 Timing: current Confidence: observed Consequence: minor Trend: increasing Extent: across part of its range 	the founder subpopulation. Land use within the distribution of <i>Corokia</i> <i>whiteana</i> has undergone much change between 1849 (when cedar-getters began altering habitats around the Brunswick River) and the present (ALA 2021; NSW Government 2020). <i>Corokia whiteana</i> currently persists mostly in protected areas separated by unsuitable and altered habitats (urban, peri-urban and agricultural lands), with older records (e.g., 1894) suggesting that it occurred more broadly, and in more connected patches in the past (ALA 2021). The northern coast region of NSW is the fastest growing population in the state (NSW Government 2010) placing continual pressure to clear non-protected lands for agriculture or infrastructure. The <i>Corokia whiteana</i> populations which occur on private lands are at a much higher risk from either intentional or accidental clearance (Quinn et al. 1995). In 1995 it was noted that the population at Yelgun (a coastal population) may be threatened by future urban development (Quinn et al. 1995) and as there are no records of <i>Corokia</i> <i>whiteana</i> in the Yelgun/Billinudgel areas since 1996 (GBIF / NSW BioNET data) this subpopulation may have since been lost.

Threat factor	Threat status and severity ^a	Evidence base
		<i>Corokia whiteana</i> distribution is not easily described as occurring in a single vegetation or soil type. Further, it is a somewhat cryptic species within a rainforest community and is an easily overlooked species. Biodiversity and environmental impact assessments which are overly prescriptive in defining impact from a core population distribution (e.g. Nightcap Range) or a specific habitat type (e.g. rainforest) may be unintentionally overlooking important subpopulations of the species, resulting in unreported subpopulation losses.

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.

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 changes in rainfall patterns Increasing fire frequency and intensity	Very high risk	Very high risk
Possible	Low risk	Moderate risk Land clearing causing habitat fragmentation	High risk Small, fragmented subpopulations Invasive weeds	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

wind – individuals are adversely affected but no effect at population le

Moderate – population recovery stalls or reduces

Major – population decreases

Catastrophic - population extinction/extirpation

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 maintain a watching brief.

Conservation and recovery actions

Primary conservation objective

Key knowledge gaps about pollination ecology and response to fire are filled and *Corokia whiteana* is secure in multiple viable subpopulations with threats mitigated.

Conservation and management priorities

Habitat loss, disturbance and modifications

- Identify if and where habitat disturbance and modifications (e.g., track maintenance, fire) are occurring on the various tenures and protected areas where *Corokia whiteana* subpopulations are found. Mitigate future damage to individuals.
- Investigate formal conservation arrangements, management agreements and covenants on private land, and for subpopulations on crown and private land, investigate inclusion in reserve tenure if possible.

Invasive species (including threats from grazing, trampling, predation)

- Identify weed species that could negatively affect *Corokia whiteana* and implement appropriate weed removal methods.
- Manage sites to prevent the introduction of invasive weeds.
- Ensure that chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the species.

Fire

- Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of *Corokia whiteana*, that they support rather than degrade the habitat necessary to the species, that they do not promote invasion of exotic species, and that they do not increase impacts of grazing/weed infestation.
- Physical damage to the habitat and individuals of *Corokia whiteana* must be avoided during and after fire operations
- Fire management authorities and land management agencies should use suitable maps and install field markers to avoid damage to the species during fire suppression operations.
- Undertake active weed control after fires and along roadsides.

Ex situ recovery actions

• Continue to collect and manage seed from extant subpopulations to store within the Australian Seedbank Partnership. Adhere to best practice seed storage guidelines and procedures to maximise seed viability and germinability.

- Investigate options and suitable locations for translocation to establish additional subpopulations which can provide additional security for the species persistence against threats such as climate change, clearing and fire. 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.
- Continue to collate knowledge from ongoing seed germination, viability, and survival trials to determine limitations and dormancy properties. Integrate new knowledge it into future management plans for the species.

Climate change

• Identify current and future habitats likely to remain or become suitable habitats due to climate change. Consider immediate translocation of the species to future suitable habitats.

Stakeholder engagement/community engagement

- Share identification guides and ex situ recovery protocols for *Corokia whiteana* and develop protection and recovery actions with non-government stakeholders (e.g., Landcare and bush regeneration groups, landowners, and managers) as well as with Local and State government environmental field and extension officers.
- Engage, co-develop and support monitoring and management actions with Traditional Owners in culturally significant areas where *Corokia whiteana* are present.
- Co-develop and implement a citizen science methodology to collect relevant population data (e.g. presence/absence and abundance of the species) with interested stakeholder groups. Ensure method enables quality-assured data for integration with species distribution mapping.
- Alert landowners of the species occurrence on their property and provide guidance on how to protect standing plants and mitigate site-specific threats.

Survey and monitoring priorities

- Undertake a broadscale survey to confirm all subpopulations are extant and include areas of suitable habitat where *Corokia whiteana* may exist.
- Design, support, and implement a long-term monitoring program for all subpopulations, including any new translocated populations, integrating new knowledge on the biology and ecology of the species as it becomes available.

Information and research priorities

- Develop an adequate biological and ecological understanding of the species to determine key attributes for management and recovery and enable the identification of important populations and habitats critical to survival.
 - Key attributes should include (but are not limited to): population structure, size, demographics, habitat parameters relevant to species distribution mapping, germination biology and requirements.
 - Genetic diversity of sub-populations and relatedness to understand past/present genetic exchange

- Key processes should include (but are not limited to): response to disturbance of different intensities (land clearing, land maintenance, grazing (if relevant), weeds, fire, drought), standing plant longevity, shade tolerance, soil seed bank ecology, pollination ecology, breeding system, fruit and seed dispersal agent(s), gene flow and subpopulation connectivity.
- Ex situ optimisation to ensure seed dormancy is fully understood; seed banks manage seed appropriately; long-term living custodial collections are able to be developed as insurance against loss of the species in the wild.
- Undertake surveys in suitable habitats to locate additional subpopulations.

Recovery plan decision

No recovery plan is in place for *Corokia whiteana*. This consultation document will elicit the additional information needed to inform the requirement of a Recovery Plan for the species.

Links to relevant implementation documents

Department of Environment, Climate change and Water NSW (2010) Border Ranges rainforest biodiversity management plan – NSW and Queensland.

<u>NSW Government. Parks and Reserves of the Tweed Caldera Plan of Management. Incorporating</u> <u>National Parks: Mt Warning, Border Ranges, Mebbin, Nightcap, Mt Jerusalem, Goonengerry and</u> <u>Nature Reserves: Limpinwood, Numinbah and Snows Gully.</u>

<u>NSW Government. Saving our species – Corokia whiteana Profile and Keep-watch Management</u> <u>Stream.</u>

NSW Government. Coastal Integrated forestry operations approvals.

NSW Government. A strategic approach to managing fire in parks and reserves

NSW Government. Duroby Nature Reserve plan of management.

<u>NSW Government. Nightcap National Park, Whian Whian State Conservation Area and Snows</u> <u>Gully Nature Reserve Fire Management Strategy</u>

Northern Rivers Regional Biodiversity Management Plan

<u>NSW Government. Northern Rivers regional biodiversity management plan. A national recovery plan for the Northern Rivers Region.</u>

Conservation Advice and Listing Assessment references

Allen CD, Macalady AK, Chenchouni H, Bachelet D, McDowell N, Vennetier M et al. (2010) A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. *Forest Ecology and Management* 259, 660–684.

Atlas of Living Australia (ALA) (2021) *Corokia whiteana* occurrence records. Viewed: 20 September 2021. Available at: https://biocache.ala.org.au/occurrences/search?q=lsid%3Ahttps%3A%2F%2Fid.biodiv ersity.org.au%2Fnode%2Fapni%2F2889568.

Australian National University (2009) Implications of climate change for Australia's World

Heritage properties. A preliminary assessment. ANU, Canberra.

- Bachman S, Moat J, Hill AW, de la Torre J, Scott B (2011) *Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool*. Data from Global Biodiversity Information Facility (GBIF).
- Big Scrub Landcare (2020) *The voice of the rainforest*. Viewed: 17 September 2021. Available at: https://www.bigscrubrainforest.org
- Bundjalung of Byron Bay Aboriginal Corporation (2011) *Arakwal people of Byron Bay*. Viewed:12 November 2020 Available at:http://arakwal.com.au
- Choat B, Jansen S, Brodribb TJ, Cochard H, Delzon S, Bhaskar R et al. (2012) Global convergence in the vulnerability of forests to drought. *Nature* 491, 752–755.
- Compton SG (2002) Sailing with the wind: dispersal by small flying insects. *Dispersal Ecology: the 42nd Symposium of the British Ecological Society* 133, 113–133.
- DEWHA (2008) *Approved conservation advice for Corokia whiteana*. Australian Government, Canberra.
- Gallagher RV (2020) Final national prioritisation of Australian plants affected by the 2019–2020 bushfire season. Report to the Commonwealth Department of Agriculture, Water and the Environment, Canberra.
- Gallagher R V., Allen S, Mackenzie BDE, Yates CJ, Gosper CR, Keith DA et al. (2021) High fire frequency and the impact of the 2019–2020 megafires on Australian plant diversity. *Diversity and Distributions* 27, 1166–1179.
- IUCN Standards and Petitions Committee (2019) Guidelines for using the IUCN red list categories and criteria. Version 14. Viewed: 5 July 2021. Available at: http://intranet.iucn.org/webfiles/doc/ssc/redlist/redlistguidelines.pdf

Kingston M, Turnbull J, Hall P (2004) Tweed Vegetation Management Strategy. Murwillumbah.

- Kooyman R, Mallee J (2020) *Results of surveys and assessment of threatened rainforest species in the Nightcap Range including fire impacts on Peach Myrtle (Uromyrtus australis), and plotbased monitoring of Nightcap Oak (Eidothea hardeniana). Report prepared for SoS* North Coast Branch, NSW Government, Sydney.
- Laidlaw MJ, McDonald WJF, Hunter RJ, Putland DA, Kitching RL (2011) The potential impacts of climate change on Australian subtropical rainforest. *Australian Journal of Botany* 59, 440–449.
- NSW Government (2004) NSW Government. Parks and Reserves of the Tweed Caldera Plan of Management. Incorporating National Parks: Mt Warning, Border Ranges, Mebbin, Nightcap, Mt Jerusalem, Goonengerry and Nature Reserves: Limpinwood, Numinbah and Snows Gully. Viewed:15 July 2021. Available at: http://www.environment.nsw.gov.au/parkmanagement/borderrangesnpmgmtplan.htm
- NSW Government (2005) *Vegetation Map for the Northern Rivers CMA VIS_ID 524.* Department of Planning, Industry and Environment, Sydney. Viewed:15 July 2021. Available at: https://datasets.seed.nsw.gov.au/dataset/vegetation-map-for-the-northern-rivers-cma-vis_id-524fdb07
- NSW Government (2010) NSW climate impact profile. The impacts of climate change on the biophysical environment of New South Wales. Sydney.

- NSW Government (2010b) *Duroby Nature Reserve plan of management*. Department of Environment, Climate Change & Water, NSW.
- NSW Government (2012) Australian Soil Classification (ASC) soil type map of NSW, Sydney, NSW.
- NSW Government (2014a) *New South Wales Climate change snapshot*. Viewed:5 July 2021. Available at: http://climatechange.environment.nsw.gov.au/climate-projections-fornsw/climate-projections-for-your-region/nsw-climate-change-downloads
- NSW Government (2014b) North Coast Climate change snapshot Overview of North Coast Region climate change. Sydney. Viewed:5 July 2021. Available at: https://climatechange.environment.nsw.gov.au/climate-projections-for-nsw/climateprojections-for-your-region/nsw-climate-change-downloads
- NSW Government (2018a) *NSW State of the Environment. Native Vegetation.* Viewed: 21 July 2021 Available at: https://www.soe.epa.nsw.gov.au/all-themes/land/native-vegetation
- NSW Government (2018b) *Coastal Integrated Forestry Operations Approvals.* Viewed: 5 July= 2021 Available at: https://www.epa.nsw.gov.au/your-environment/native-forestry/integrated-forestry-operations-approvals/coastal-ifoa
- NSW Government (2020) *Tyagarah Nature Reserve plan of management*. NSW National Parks and Wildlife Service, Byron Bay.
- PlantNET (1992) New South Wales Flora Online. Corokia whiteana L.S.Sm. Viewed: 7 July 2021 Available at: https://plantnet.rbgsyd.nsw.gov.au/cgibin/nswfl.pl?page=nswfl&lvl=sp&name=corokia~whiteana
- Quinn FC, Williams JB, Gross CL, Bruhl J (1995) *Report on rare and threatened plants of northeastern New South Wales.* Armidale, NSW.
- Te Rūnanga o Ngāi Tahu (2016) *Te Karaka. He Aitaka a Tane Korokio. As tough as wire-netting.* Viewed: 13 July 2021 Available at: https://ngaitahu.iwi.nz/our_stories/tk72-he-aitaka-atane/
- Smith LS (1958) Corokia A. Cunn. An addition to the Australian genera of Saxifragaceae. *Proceedings of the Royal Society of Queensland* 69, 53.
- Smith JP, Heard TA, Beekman M, Gloag R (2017) Flight range of the Australian stingless bee *Tetragonula carbonaria* (Hymenoptera: Apidae). *Austral Entomology* 56, 50–53.
- Sommerville KD, Errington G, Newby Z-J, Lyanage GS & Offord CA (2021) Assessing the storage potential of Australian rainforest seeds: a decision-making key to aid rapid conservation. *Biology and Conservation* 30, 11, 3185–3218.
- State Library NSW (2014) *Rediscovering Indigenous Languages*. Sydney. Viewed: 12 November 2020 Available at: https://www.sl.nsw.gov.au/about-library/services/indigenous-services/rediscovering-indigenous-languages-project
- Webb CJ (1994) Pollination, self-incompatibility, and fruit production in *Corokia cotoneaster* (escalloniaceae). *New Zealand Journal of Botany* 32, 385–392.
- Wyse S V., Macinnis-Ng CMO, Burns BR, Clearwater MJ, Schwendenmann L (2013) Species assemblage patterns around a dominant emergent tree are associated with drought resistance. *Tree Physiology* 33, 1269–1283.

Other references:

Justin Mallee (2021) Field ecologist, Saving our Species, NSW Government. Personal communication - phone conversation 27 July 2021.

Andrew Benwell (2021) Plant ecologist, personal communication - phone conversation 28 July 2021.

Robert Kooyman (2021) Plant ecologist, National Herbarium of NSW and Macquarie University phone conversation 28 July 2021 and unpublished data provided by email 9 August 2021.

Graeme Errington (2021) Seedbank Curator, Royal Botanic Gardens Australian PlantBank. Personal communications via email 2-4 August 2021.

Sally Cooper (2021) Environmental scientist, Tweed Council, personal communications – email and phone conversation 2 Aug 2021.

THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the Environment Protection and Biodiversity Conservation Act 1999

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

Attachment A: Listing Assessment for Corokia whiteana

Reason for assessment

The *Corokia whiteana* was listed as Vulnerable under the *Endangered Species Protection Act 1992* and transferred to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) when it commenced in July 2000. This assessment follows the prioritisation of a nomination from TSSC.

Assessment of eligibility for listing

This assessment uses the criteria set out in the <u>EPBC Regulations</u>. The thresholds used to correspond with those in the <u>IUCN Red List criteria</u> 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.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	<1000	624	<1000	Field surveys of 192 plots over ~40 years in the Nightcap Range report that 56 plots had Corokia, either as single individuals or in low density stands. It was not possible to estimate total numbers based on this data, though expert knowledge of the species allowed an estimate of fewer than 1000 individuals to be made (Robert Kooyman 2021. pers comm 9 Aug). Occurrence sightings reported in Global Biodiversity Information Facility (GBIF) (Bachman et al. 2011) were sorted to retain direct personal observations in the field by NSW government agencies and limited to the last 20 years (2000-2020). Including the 23 records from Quinn et al. (1995) there were a total of 101 records. Assuming each sighting represented eight individuals (mean number of <i>Corokia whiteana</i> observed at a site (Quinn et al. 1995) and assuming no net increase or decline in numbers, an estimate of 808 mature plants was made (with very low confidence).

Table 4 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Declining			The 2019-20 bushfires overlapped with eight percent of the modelled range for Corokia. Three percent overlapped with high severity fire areas and 0.1 percent at very high severity fire areas (Gallagher et al. 2021). <i>Corokia whiteana</i> exposed to hot fires do not survive (Kooyman & Mallee 2020), and as a result some decline is expected, and given fire frequency is predicted to increase (NSW Government 2014a), this decline is predicted to continue into the future.
Generation time (years)	29	15	Unknown	Generation time is difficult to estimate for Corokia. Individuals are very slow-growing and resprout, so age structure is also difficult to determine in the field. Individuals are rarely observed with more than ten fruits, and their seedlings are rarely (if ever) observed in the field (Justin Mallee, Robert Kooyman, Andrew Benwell 2021. pers comm 27–28 July). There are no data on time to maturity or longevity for the species, although long-term survey plots repeated measurements of stems of the same individuals in Nightcap Range for 34 years (between 1986-2020) (Robert Kooyman 2021. pers comm 9 Aug). Using the IUCN generation calculator, survival was set to thirty percent for the first ten years (five years half-life in the seed bank, pre germination) and 80 percent after that. Fecundity was estimated at five individuals per year (a success rate of 50 percent for the ten possible seedlings per year was considered generous for the species considering seedlings are so rarely observed and germination requirements are very specific (Graeme Errington 2021. pers comm 2 Aug). When the onset of maturity (OM) was set to ten years post germination, generation time was 15 years; when OM was set to 20 years, generation time was 25 years and 29 years when estimates were adjusted to include five years half-life in the seedbank (seed bank half-lives commonly range between <1 and 10 years; IUCN 2019). An onset of maturity of 20+ years is feasible for a slow-growing, rainforest / wet sclerophyll understorey species (Andrew Benwell 2021. pers comms 28 July), so the 29 years generation time was used in the assessment.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Extent of occurrence	860 km ²	410 km ²	5798 km²	The minimum plausible value is based on the mapping of point records from a 20 year period (2000-2020) obtained from DAWE and is 410 km ² using IUCN methodology (IUCN Standards and Petitions Committee 2019). The maximum plausible value uses the same methodology, though due to the longevity (more than 40 years) of the species, it includes data points from the last 40 years (1980–2020) and is 5798 km ² . The estimates used in the assessment uses data points from a 30 year period of sightings (1990–2020) and is 860 km ² .
Trend	Contracting			The high rate of development in northern NSW has likely resulted in a loss of <i>Corokia</i> <i>whiteana</i> populations outside of National Parks. Previously <i>Corokia whiteana</i> was thought to occur only in Nightcap Range (PlantNET 1992), and more recently as a "rainforest species", so it would not have been (and is possibly still not) identified as a species at risk from development, forestry or agriculture. The EOO has likely undergone a historical contraction due to land-use change. Climate change is predicted to shift ecotones due to altered weather and fire patterns. As <i>Corokia whiteana</i> is a light and moisture-sensitive species, which is killed by fire, the trend in EOO is predicted to contract in the future.
Area of Occupancy	152 km ²	80 km ²	164 km ²	The minimum plausible value is based on the mapping of point records from a 20 year period (2000-2020) obtained from DAWE and is 80 km ² using IUCN methodology (IUCN Standards and Petitions Committee 2019). The maximum plausible value uses the same methodology, though due to the long (more than 40 year) longevity of the species, includes data points from the last 40 years (1980–2020) and is 164 km ² . The estimated used in the assessment uses data points from a 30-year period of sightings (1990–2020) and is 152 km ² .

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Contracting			The high rate of development in northern NSW has probably resulted in a loss of <i>Corokia whiteana</i> outside of National Parks. Previously <i>Corokia whiteana</i> was thought to occur only in Nightcap Range (PlantNET 1992), and more recently as a "rainforest species", so would not have been (and is possibly still not) identified as a species at risk from development, forestry or land-use change. The AOO has likely undergone a historical contraction due to land-use change. Climate change is predicted to shift ecotones due to altered weather and fire patterns. As <i>Corokia whiteana</i> is a light and moisture-sensitive species, which is killed by fire the trend in AOO is predicted to contract in the future.
Number of subpopulations	6	6	10	The minimum plausible value was estimated by visualising sightings data in GoogleEarth and estimating physical distance and visualising altitudinal variations and changes in vegetative cover or land use. The upper estimate of 10 subpopulations assumes that sightings isolated by more than 4km distance or separated by agricultural or urban areas are genetically isolated.
Trend	Contracting			Climate change is predicted to altered precipitation patterns and increase fire weather and the number of hot days. <i>Corokia whiteana</i> is a rainforest/wet sclerophyll species with specific ecological requirements, there are very low numbers in some of the subpopulations (<6 individuals) and as recruitment has not been observed, seedlings are rare and fecundity is very low, the number of subpopulations are predicted to decline.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification	
Basis of assessment of subpopulation number	Sightings are ge subpopulations) each other by ap subpopulations continuous thro 4km and a valley other by 4km an are a number of the Nightcap / V agricultural land <i>Corokia whitean</i> (<i>Tetragonula ca</i> though butterfli birds may consu set (<10 fruit/pl probably not att conducted on th isolated populat The proposed su 2-Yelgun (coasta Creek and Koon, Whian, and 6-Th	ographically isola ographically isola oproximately 7 kn are most abunda ughout. The Nigh y to Koonyum Ra ad another valley other isolated re Vhian Whian sub ls, is the subpopu <i>a</i> are likely pollin <i>rbonaria</i>) has a n es and other flyir ume the fleshy fru lant – Justin Malle ract a large numl is species to dete ions of Corokia. ubpopulations ar al), 3-Brunswick yum Range (Mt Ju-	ted, with Upper Duroby (24 km north from the inland aswick Heads populations (both coastal) are separated from a and areas of urban and agricultural development). Inland the nightcap and Whian Whian areas and seem acap/Whian Whian subpopulation is separated by at least age and near Upper Wilson's Creek (separated from each . On the same range as the Upper Wilson's Creek sightings, cords, each more than 4 km from another sighting. South of population, and isolated by more than 6.5 km of various lation near The Channon. ated by a range of insects and native bees. The native bee aximum foraging distance of 712 m (Smith et al. 2017) g insects may travel much further (Compton 2002). Bats or it and distribute the seed as well, though due to the low fruit e 2021. pers comm. 27 July), <i>Corokia whiteana</i> would er of frugivorous dispersers. No genetic research has been mine the actual connectivity between geographically : 1-Upper Duroby (Duroby Nature Reserve/Hogan's Scrub), leads (coastal), 4-Clarrie Hall Dam area, Upper Wilson's rusalem National Park and surrounds), 5-Nightcap/Whian		
No. locations	1	1	6	The minimum plausible value uses climate change predictions resulting in heat waves and drought and of shifting temperature envelope and floristic shifts. These impacts are predicted to occur by 2050-2100 (Laidlaw et al. 2011), which is feasibly within one generation of this slow- growing, long-lived species. Further research is needed to determine if subpopulations are more drought protected than others. However, assuming a separate heatwave or drought season would impact each subpopulation separately then the maximum plausible value is six.	
Trend	Static Increased threat of decline via climate change and slow recovery and low recruitment potential for <i>Corokia whiteana</i> are likely to maintain a location of one.				
Basis of assessment of location number	Climate change will alter precipitation patterns, increase annual mean temperatures and hence evapotranspiration and soil processes. The predicted rising cloud cap will affect rainforest habitats (ANU 2009). The slow-growing <i>Corokia whiteana</i> with extremely low recruitment and complex recruitment requirements will not adjust and respond to the predicted shifts in altitude that temperate rainforest communities are predicted to undergo (Laidlaw et al. 2011). This, in combination with a rising cloud base and increased frequency and severity of maximum temperatures and bushfires are predicted to severely impact all <i>Corokia whiteana</i> within one generation (a low confidence estimate of generation is more than 29 years). Thus, a location of one was assigned.				
Fragmentation	Some subpopulations are separated by unsuitable habitats (areas of agricultural or urban landscapes) and are between four and 24 km apart. Others are separated by altitudinal changes accompanied by vegetative shifts in dominant habitat types. Whilst birds can traverse these territories it is unlikely that the insect pollinators do. Localised pollination patterns may have isolated these geographically distant subpopulations. Genetic research is required to confirm this hypothesis.				

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Fluctuations	<i>Corokia whiteana</i> is a long-lived resprouting species with low fecundity and low recruitment. It is not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals			

Criterion 1 Population size reduction

Redu	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	Enda Seve	ngered re reduction		Vulnerable Substantial reduction
A1		≥ 90%	≥ 70%	6		≥ 50%
A2, A	3, A4	≥ 80%	≥ 50%	6		≥ 30%
A1 A2 A3 A4	Population reduction observed, estimat past and the causes of the reduction are understood AND ceased. Population reduction observed, estimat past where the causes of the reduction be understood OR may not be reversibl Population reduction, projected or susp to a maximum of 100 years) [(<i>a</i>) cannot An observed, estimated, inferred, proje reduction where the time period must i future (up to a max. of 100 years in futu reduction may not have ceased OR may be reversible.	red, inferred or suspected in e clearly reversible AND red, inferred or suspected in may not have ceased OR ma e. bected to be met in the futur t be used for A3] cted or suspected populatio nclude both the past and th ure), and where the causes of not be understood OR may	n the ny not re (up n e of not	Based on any of the following	(a) (b) (c) (d) (e)	direct observation [except A3] an index of abundance appropriate to the taxon a decline in area of occupancy, extent of occurrence and/or quality of habitat actual or potential levels of exploitation the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites

Criterion 1 evidence

Insufficient data to determine eligibility

Population decline is less than 30 percent

The 2019-2020 bushfires overlapped with eight percent of the modelled range of Corokia. Three percent overlapped with high severity fire areas and 0.1 percent with very high severity fire areas (Gallagher et al. 2021). No post-fire surveys have been conducted specifically for the species. Observations of post-fire regrowth from undamaged stems or from rootstock has been observed after light to medium fires (Robert Kooyman and Andrew Benwell 2021. pers comm 28 July), though *Corokia whiteana* is killed in hot fires (Kooyman & Mallee 2020). From these observations we can anticipate a decline of 3–4 percent in the total population due to bushfires. There are no survey data to suggest either a historical or recent decline of over 30 percent has occurred due to any other threatening process.

Conclusion

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

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

		Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited	
B1.	Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²	
B2.	Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²	
AND	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)	(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,iv,v)+2ab(i,ii,iii,iv,v) for listing as Endangered

Geographic distribution and generation length

Corokia whiteana has an extent of occurrence (EOO) of 860 km² and an area of occupancy (AOO) of 152 km² though as the shrub is sparse and fairly inconspicuous, the AOO is likely an underestimate.

Severely fragmented

Corokia whiteana is considered severely fragmented as all mature individuals occur in small (~ eight individuals) subpopulations, isolated both ecologically and geographically from each other. *Corokia whiteana* has extremely low fecundity (<10 fruit per reproductive year, and each fruit with only one seed each). Seedling trials at the Australian PlantBank suggest that conditions for successful germination are very specific (Graeme Errington 2021. pers comm 2 Aug). There have been no observations of seedlings occurring near mature *Corokia whiteana* in the field (Justin

Mallee, Robert Kooyman, Andrew Benwell 2021. pers comm 27–28 July) and so replacement of adult plants via recruitment is predicted to be very low. The distance and pattern of dispersal by birds would depend on fruit seasonality, seed passage time and foraging behaviour of the particular bird species. The small number of fruits produced on a *Corokia whiteana* would not attract a large number of birds to create connectivity between fruiting areas. Consumption of *Corokia whiteana* fruit is assumed to be opportunistic and by locally foraging frugivores. *Corokia whiteana* are rarely clumped and are often dispersed as a low cover species throughout wet sclerophyll forests (Kooyman 2021. unpublished data, 9 Aug).

The proposed subpopulations are:

- 1. Upper Duroby (Duroby Nature Reserve/Hogan's Scrub),
- 2. Yelgun (coastal),
- 3. Brunswick Heads (coastal),
- 4. Clarrie Hall Dam area, Upper Wilson's Creek and Koonyum Range (Mt Jerusalem National Park and surrounds),
- 5. Nightcap National Park and Whian Whian Conservation Area
- 6. The Channon.

All are separated by distances >4 km. The current distribution could be a result of either a historical retraction of *Corokia whiteana* to current remnant vegetation or expansion by founding events (possibly facilitated by bird dispersal). The occurrence in atypical locations such as Yelgun and Brunswick Heads suggests the latter, though perhaps both are true.

Each of the subpopulations is separated by unsuitable habitat (typically areas of agricultural or urban landscapes). Some are separated by altitudinal changes and vegetative shifts in dominant habitat types. Whilst birds can traverse these territories; it's unlikely that the insect pollinators do. The pollinators of *Corokia whiteana* are unknown, though a related species, *Corokia cotoneaster*, is self-compatible and pollinated by a wide range of insects (Webb 1994). Localised pollination patterns may continue to isolate the geographically distant subpopulations. Each subpopulation is likely at risk from extirpation as many of them are small, consisting of a low number of individuals (e.g. only six at Yelgun). Should one of these subpopulations fail, recolonisation is unlikely.

The most abundant subpopulations are those at Nightcap Range/ Whian Whian Conservation Area and Mt Jerusalem National Park. Even in these areas, *Corokia whiteana* is still considered "rare" and "low cover" (Kooyman 2021. pers comm, unpublished data 9 Aug). Four of the six subpopulations (Upper Duroby, Yelgun, Brunswick Heads and The Channon) are in small and isolated patches, separated from each other by unsuitable habitats. The long-term viability of these subpopulations is questionable and in the event of a disturbance, the recolonisation of these locations is unlikely. Therefore, *Corokia whiteana* is considered severely fragmented.

Number of locations - bushfire

Each of the six subpopulations would have variable susceptibility to various threatening processes. Five subpopulations are on protected tenures (Nature Reserves, National Park, Conservation Areas), The Channon subpopulation is not on a protected tenure, and the sites

surrounding the Clarrie Hall dam are predominantly on Tweed Council managed lands. Four of the six subpopulations are predicted to contain less than ten individuals (Upper Duroby, Yelgun, Brunswick Heads & the Channon), and thus are not likely to be viable long term, these sites would be particularly vulnerable to a single severe fire and would result in the complete loss of the relevant subpopulation. The remaining two subpopulations (Clarrie Hall Dam area, Upper Wilson's Creek and Koonyum Range, and Nightcap National Park and Whian Whian) are more spread out over an area of approximately 225km²; an area that is connected by vegetation and may be impacted by a single fire season. Using bushfire season as the threatening process, the number of locations is five.

Number of locations – climate change impacts on geographically fragmented and ecologically isolated subpopulations

Climate change is predicted to increase annual mean and maximum temperatures in northern NSW (an increase of 0.4–1.0°C by 2039 and 1.5–2.4°C in the distant future 2060–2079). The number of hot days (maximum temperature greater than 35°C) will increase and the number of cold nights (minimum temperature less than 2°C) will decrease. Average fire weather and severe fire weather days will increase in summer and spring as rainfall decreases in winter, though increases in autumn and spring (NSW Government 2014b). Subtropical rainforests are predicted to be susceptible to these changes, and are predicted to experience floristic turnover and altitudinal shifts (Laidlaw et al. 2011). Corokia whiteana is geographically fragmented and ecologically isolated (see severely fragmented section above). These changing climate conditions presumably also impact pollinators and dispersers, though further research is required to determine the effect on *Corokia whiteana*'s population structure and survival. *Corokia whiteana* appears to require a specific set of environmental attributes characterised by the ecotone between two habitat types (wet sclerophyll and open rainforest). Moisture, light and soil types are likely be key predictors of suitable habitat. As Corokia whiteana are often found on the edge of wet sclerophyll forests, any shift in habitat will impact the species, as the biological traits mentioned above will not enable it to "keep up" with surrounding vegetation changes.

The predicted climate changes (NSW Government 2014b) and rising cloud base (ANU 2009), combined with increased frequency and severity of bushfires are predicted to severely impact all *Corokia whiteana* within one generation (a low confidence estimate of generation is more than 29 years); thus the number of locations is estimated to be one.

Continuing decline in the extent of occurrence; area of occupancy; area, extent and/or quality of habitat; the number of subpopulations; the number of mature individuals

The 2019-2020 bushfires were preceded by several years of drought and extreme weather conditions. The bushfires were unprecedented as the extent and intensity exceeded any event in recorded history for the Nightcap range (Kooyman & Mallee 2020) and will likely have changed some habitats permanently. As the climate conditions which create these fires are predicted to increase in frequency and intensity into the future (see Number of Locations above, NSW Government 2014b), it can be inferred that a resulting decline in *Corokia whiteana* EOO, AOO, quality of habitat, number of subpopulations and number of mature individuals will also occur within the next one to three generations.

The distribution is extremely patchy, and the slow growth and poor fecundity will result in reduced recruitment and the slow recovery of the species. As threatening processes increase, the loss of *Corokia whiteana* will exceed the ability to replace individuals, resulting in a decline in EOO, AOO, the number of subpopulations and the number of mature individuals.

Conclusion

The Committee considers that the species' Extent Of Occurrence (EOO) and Area Of Occupancy (AOO) is restricted, and the number of locations is restricted and continuing decline is estimated for the extent of occurrence, area of occupancy, the area, extent and or quality of habitat, the number of locations or subpopulations and as a result, the number of mature individuals. Therefore, the species meets the relevant elements of Criterion 2 to make it eligible for listing as Endangered.

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

Criterion 3 Population size and decline

	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(i) Number of mature individuals in each 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

Insufficient data to determine eligibility

Population size < 2,500

The total population is estimated to be less than 1000 individuals (Robert Kooyman 2021. pers comm 9 Aug) This expert opinion is based on decades of field surveys of species densities in the Nightcap Range. This is within the range estimated using the number of sightings (78) multiplied by mean observed *Corokia whiteana* densities (eight per site).

Projected declines

There are insufficient data to determine generation length with certainty, and similarly, there are insufficient data to project a rate of decline for this species.

Number of individuals in each subpopulation

The percentage of mature individuals in each of the proposed subpopulations are based on visual estimates of sightings records and abundance records in Quinn et al. (1995):

- 1. Upper Duroby, 0.6 percent, observed
- 2. Yelgun, 0.6 percent, observed

- 3. Brunswick Heads, 0.8 percent, estimated
- 4. Clarrie Hall Dam area, five percent, estimated
- 5. Upper Wilson's Creek and Koonyum Range, 20 percent, estimated
- 6. Nightcap National Park and Whian Whian Conservation Area, 70 percent, estimated
- 7. The Channon, two percent, estimated

The majority (70% and approximately 700 individuals) occurs in one identified subpopulation (Night Cap Range and Whian Whian Conservation Area).

Conclusion

The total number of mature individuals is less than 1000, which is low. However, there are insufficient data available to suggest whether the numbers have declined or will continue to decline at a high rate. Therefore, the species has not met this required element of this criterion.

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

Criterion 4 Number of mature individuals

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

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

Criterion 4 evidence

Eligible under Criterion 4 D1 for listing as Vulnerable

Population size < 1000

The total population is estimated to be less than 1000 individuals (Robert Kooyman 2021. pers comm 9 Aug). This expert opinion is based on decades of field surveys of species densities in the

Nightcap Range. This is within the range estimated using the number of sightings (78) multiplied by mean observed *Corokia whiteana* densities (eight per site).

Conclusion

The Committee considers that the total number of mature individuals is less than 1000, which is low. Therefore, the species has met the relevant elements of Criterion 4 to make it eligible for listing as D Vulnerable

However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion is based on the acceptance that this species is severely fragmented and 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.

Conclusion

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

Adequacy of survey

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

Listing and Recovery Plan Recommendations

No recovery plan is in place for *Corokia whiteana*. 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.

© Commonwealth of Australia 2021



Ownership of intellectual property rights

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

Creative Commons licence

All material in this publication is licensed under a <u>Creative Commons Attribution 4.0 International Licence</u> except content supplied by third parties, logos and the Commonwealth Coat of Arms.

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

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the

 $(\mathbf{\hat{I}})$

Environment 2021, Conservation Advice for Corokia whiteana, Canberra.

This publication is available at the SPRAT profile for Corokia whiteana.

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

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

Acknowledgements

The following people made significant contributions, which greatly improved our understanding of Corokia, and thus improved this conservation advice. Those people included: Justin Mallee, Andrew Benwell, Robert Kooyman, Sally Cooper and Graeme Errington.

Version history table

Document type	Title	Date [dd mm yyyy]
Conservation Advice	Approved Conservation Advice for Corokia whiteana	01 10 2008
-	_	-