Australian Government
Department of Agriculture, Water and the Environment

Consultation on Species Listing Eligibility and Conservation Actions

Callitris oblonga subsp. *corangensis* (Corang pine)

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

1) the eligibility of *Callitris oblonga* subsp. *corangensis* (Corang pine) for inclusion on the EPBC Act threatened species list in the Critically Endangered category; and

2) the necessary conservation actions for the above species.

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

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

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

Responses are to be provided in writing by email to: species.consultation@awe.gov.au. 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 3 March 2022.

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General background information about listing threatened species

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

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

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

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

Privacy notice

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

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

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

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent,

how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: https://www.awe.gov.au/about/commitment/privacy .

Information about this consultation process

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

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

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

CONSULTATION QUESTIONS FOR CALLITRIS OBLONGA SUBSPECIES CORANGENSIS (CORANG PINE)

SECTION A - GENERAL

1. Is the information used to assess the nationally threatened status of the subspecies robust? Have all the underlying assumptions been made explicit? Please provide justification for your response.

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

3. Have you been involved in previous state, territory or national assessments of this subspecies? If so, in what capacity?

PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT

SECTION B DO YOU HAVE ADDITIONAL INFORMATION ON THE ECOLOGY OR BIOLOGY OF THE SPECIES/SUBSPECIES? (If no, skip to section C)

Biological information

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

5. Do you have any additional information on the ecology or biology of the subspecies not in the current advice?

SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SUBSPECIES? (If no, skip to section D)

Population size

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

7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the subspecies? If not, please provide justification for your response.

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

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

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

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

   Level of your confidence in this estimate:

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

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

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

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

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

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

9. Does the current and predicted rate of decline used in the assessment seem reasonable? Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.

Evidence of total population size change

10. Are you able to provide an estimate of the total population size during the early 1990s or 2000s at or soon after the start of the most recent three generation 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/subspecies numbers, and also choose the level of confidence you have in this estimate.

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

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

    Level of your confidence in this estimate:

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

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

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

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

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

11. Are you able to comment on the extent of decline in the subspecies' total population size over the last approximately 60 years (i.e. three generation period)? Please provide justification for your response.

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

    Decline estimated to be in the range of:

    ☐ 1–30% ☐31–50% ☐51–80% ☐81–100% ☐90–100%

Level of your confidence in this estimated decline:

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

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

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

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

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

12. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

SECTION E ARE YOU AWARE OF INFORMATION ON THE TOTAL RANGE OF THE SUBSPECIES? (If no, skip to section F)

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

13. Does the assessment consider the entire geographic extent and national extent of the subspecies? If not, please provide justification for your response.

14. Has the survey effort for this species/subspecies been adequate to determine its national distribution? If not, please provide justification for your response.

15. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.

16. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate? Please provide justification for your response.

17. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the extent of occurrence and/or area of occupancy.

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

    Current extent of occurrence is estimated to be in the range of:

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

Level of your confidence in this estimated extent of occurrence

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

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

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

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

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

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

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

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

Level of your confidence in this estimated extent of occurrence:

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

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

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

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

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

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

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

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

19. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the former extent of occurrence and/or area of occupancy.

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

    Past extent of occurrence is estimated to be in the range of:

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

    Level of your confidence in this estimated extent of occurrence

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

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

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

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

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

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

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

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

    Level of your confidence in this estimated extent of occurrence:

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

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

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

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

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

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

20. Do you consider that all major threats have been identified and described adequately?

21. To what degree are the identified threats likely to impact on the subspecies in the future?

22. Are the threats impacting on different localities equally, or do the threats vary across different localities?

23. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the subspecies at any stage of its life cycle?

24. Can you provide supporting data/justification or other information for your responses to these questions about threats?

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

25. What planning, management and recovery actions are currently in place supporting protection and recovery of the subspecies? To what extent have they been effective?

26. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the subspecies?

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

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

28. Are you aware of other knowledge (e.g. traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?

29. Are you aware of any cultural or social importance or use that the subspecies has?

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

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

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

    a. Where there is awareness, what are these interests of these individuals/organisations?

    b. Are there populations or areas of habitat that are particularly important to the community?

PART 3 – ANY OTHER INFORMATION

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

Conservation Advice for *Callitris oblonga* subsp. *corangensis* (Corang pine)

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

The purpose of this consultation document is to elicit additional information to better understand the status of the species and help inform conservation actions, further planning and a potential recovery plan. The draft assessment below should therefore be considered **tentative** at this stage, as it may change as a result of responses to this consultation process.

Note: Specific consultation questions relating to the below draft assessment and preliminary determination have been included in the consultation cover paper for your consideration.

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

Photos of *Callitris oblonga* subsp*. corangensis* © Copyright, M Fagg (from Australian Plant Image Index)

Conservation status

Callitris oblonga subsp. *corangensis* (Corang pine) is proposed to be transferred from the Vulnerable category to the Critically Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999.* The Corang pine was originally listed at the species level under the *Endangered Species Protection Act 1992* before being transferred to the EPBC Act.

The Committee's assessment is at Attachment A. The Committee's assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: Insufficient data
- Criterion 2: B1ab(iii,v): Critically Endangered
- Criterion 3:C2a(ii) Vulnerable
- Criterion 4: Insufficient data
- Criterion 5: Insufficient data

The main factors that make the species eligible for listing in the Critically Endangered category are a very restricted range, low number of locations, and continuing decline in the quality of habitat 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 Species Profile and Threat Database.

Species information

Taxonomy

Conventionally accepted as *Callitris oblonga* subsp*. corangensis* K.D. HILL (Hill 1998).

The taxon's epithet refers to the only known occurrence of this subspecies, on the Corang River, New South Wales (NSW).

Description

The following description for the Corang pine is adapted from PlantNET (2021), DEE (2008) and Wood (2021). The Corang pine is a small tree or shrub growing to five metres in the Cupressaceae family. The species has dense erect branches and dark green or bluish-green foliage. Leaves are usually four–five millimetres long with leaf scales distinctly keeled. The bark is hard and compacted. The species is onoedious having male and female flowers and fruits (cones) on the same plant. Female cones occur singly, or in dense clusters on stalks, or short fruiting branchlets, and remain until after maturity. Female cones are 14–18 millimetres long and 10–15 millimetres in diameter with thick scales, each tapering above to an apex usually thickened by a short dorsal point. Male cones are oval-shaped and occur singly or in clusters of two-five and are up to two millimetres long.. The scales on male cones alternate and are approximately half as long as the intervening scales. The columella (vegetated stalk) is short and

often tri-angled. Seeds are dark brown and numerous, with two or three wings and are approximately two millimetres wide. Seeds are endospermic (contains an endosperm in the mature seed).

Identifying features of the Corang pine compared to *C. oblonga* subsp. *oblonga* (pygmy cypress pine), are smaller female cones (12–15 millimetres long) and larger alternating scales (alternating scales approximately two-thirds as long as the intervening scales).

Distribution

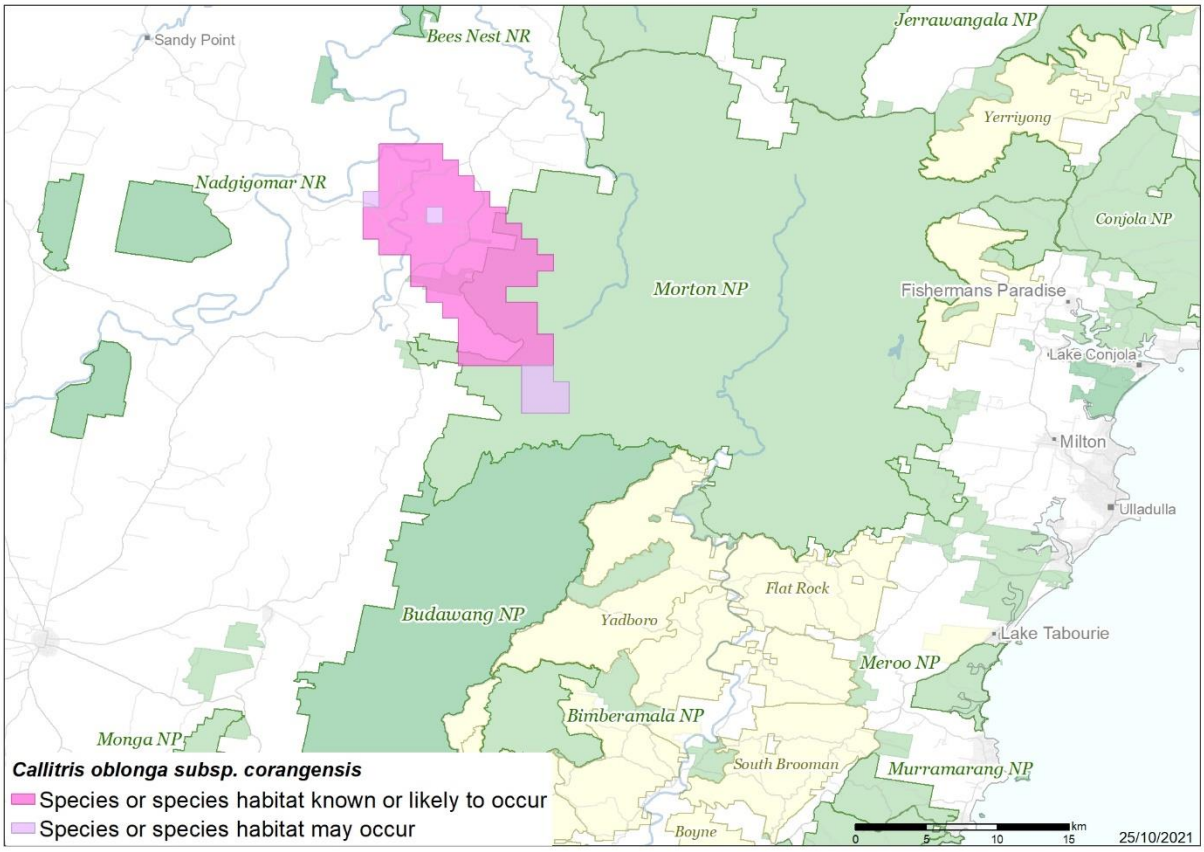
The Corang pine is confined to the Southern Tablelands of NSW and occurs along the floodplains and banks in the mid-reaches of the Corang River, north of Braidwood (NPWS 2001), between the confluence with the Shoalhaven River in the north, and south to just past Smilers Creek (Map 1). The taxon is absent in steep gorge country downstream from Nadgengutta Creek (Appleby & Wright 2021).

The population is considered to be a single subpopulation with numerous locally abundant individuals along an approximately 20 km section of the Corang River (DEE 2008). Some localities have been recorded to reach densities of over 800 trees in an area of less than 0.5 ha (DAWE 2021). However, this density of plants may not be consistent across the area. The total population was estimated to consist of at least 5000 mature individuals; however, a full census of the population had not been carried out prior to the 2019–20 fires (Nadolny & Benson 1993). The population range based on the species' management plan was estimated at 2500 to 10,000 individuals before the 2019–20 fires (NPWS 2001). Surveys indicate that the population does not extend significantly below 500 m in altitude (NPWS 2001).

The majority of the Corang pine population is downstream from the Morton National Park (NPWS 2001) on private land and fewer than 1000 individuals are estimated to be reserved within the National Park prior to the 2019–20 fire (Briggs & Leigh 1996). The population is also found on Crown Lease and Crown Reserve land.

Three individuals of the Corang pine have been reported (in February 2020) along the Mongarlowe River (~20 km southwest from the natural population), grown from seed collected from the Corang River (ALA 2021). There is also a single plant found beside the Nerrriga-Braidwood Road about five km south of Nerriga (DAWE 2021) and an individual in Warri Reserve on the Shoalhaven River, both believed to have been planted (NPWS 2001). Individuals growing outside of the species' natural range do not represent natural subpopulations.

Map 1 Modelled distribution of the Corang Pine



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.

The cultural significance of Corang pine is not well understood. However, Indigenous Australians have had a long and continuous association with country including the south coast more broadly (DECC 2009). Areas where the Corang pine has been recorded are located within the region of the Yuin people, according to the Map of Indigenous Australia (AIATSIS 1996). The Morton land (land within and surrounding Morton National Park) was a place of significant cultural heritage to the Yuin people, containing several hundred Indigenous heritage sites and meaningful areas

in Indigenous mythology (e.g. Didthul and Fitzroy Falls). Surrounding bushland also contains sites of great importance to Indigenous communities, whose occupation of the area dates back over 20,000 years (Shoalhaven Tourism 2021). Further work should determine whether the Corang pine is of significance to Indigenous Australians and seek opportunities for the share of knowledge on this taxon.

Relevant biology and ecology

Habitat

Like most *Callitris* species, the Corang pine is a regional endemic (Sakaguchi et al. 2015) and is confined to a single subpopulation within the Corang River catchment. It grows in sand along watercourses in shrubland and open woodland in granite country, within the eastern side of the Southern Tablelands. The species shows adaption to the riverine environment by its flexible stems, cones located close to the main stem and strong lateral root development (Harris & Kilpatrick 1991a). The population occurs between 520–600 m in altitude (NPWS 2001). Most plant growth has been observed in spring which coincides with high moisture availability (winter-spring), while moisture availability in summer is moderate (AVH 2021).

The Corang pine grows in rocky riverine shrubland dominated by *Leptospermum polygalifolium* (tantoon), *Callistemon paludosus* (river bottlebrush) *Hakea dactyloides* (dogwood hakea), and *Lomatia myrtifolia* (river lomatia). It is absent where the riverine shrubland is taller than two metres (NPWS 2001). On flatter fine grained alluvial sections of river, the Corang pine occurs with emergent *Eucalyptus viminalis* (manna gum), *Lomandra longifolia* (spiny-head mat-rush) and naturalised radiata pine *(Pinus radiata)* (NPWS 2001). It has also been observed to occur with other associated shrubland and/or riparian species such as *Acacia melanoxylon* (Australian blackwood), *Bursaria spinosa* (blackthorn), *Melaleuca parvistaminea* (small-flowered honey-myrtle), and *Allocasuarina* spp. (AVH 2021).

The Corang pine is mostly found growing near the flood debris line (strand line) , rarely more than eight metres above the low flow water height. However, the height of the debris line and associated species varies depending on the rivers cross section (NPWS 2001). For example, in steep gorge sections, the plant may be associated with hillslope species such as *E. pauciflora* (snow gum) and *E. dives* (broad-leaved peppermint) (NPWS 2001). Habitat locations favoured by the species include rocky benches that receive high flows and broad sandy flood plains, especially on outside bends (NPWS 2001). The Corang pine is absent in steep gorge country downstream from the Nadgengutta Creek confluence which is dominated by *Casuarina cunninghamiana* (river she-oak); river she-oak is absent from areas upstream where the Corang pine is found.

Reproductive Ecology

Pygmy cypress pine (at the species level) is an evergreen monoecious conifer. Pollen is released from the small male cones, which occurs in January to March for the South Esk pine from Tasmania (TSS 2016). Female cones produce seeds which mature and enlarge over several seasons before becoming woody and ceasing to grow (TSS 2016). Mature seeds are thus retained in the plant canopy (serotinous) (Merrit et al. 2014), as opposed to male cones which detach from the plant within one year (Harris and Kilpatrick 1991a). All *Callitris* species are wind pollinated; cones are considered advantageous for wind pollinated species because it helps

overcome pollen limitation of seed set (Kelly and Sork 2002). Seed is only released in response to death of the tree or the branches that support it, usually by extreme stressful events (fire or flood) (TSS 2016). Seeds can also be transported downstream by water flow and by wind over very short distances (<5 m; TSS 2016). Corang pine seedlings have been observed growing in piles in flood debris (NPWS 2001).

Laboratory research on seed viability has been undertaken for the taxon to inform ex situ conservation actions (Offord et al. 2004; Merritt et al. 2014). Offord et al. (2004) found that 62 percent of seedbank stored seeds germinated, after being stored at 3.5 degrees Celsius and at 12.3 percent moisture content for 8.4 years. Seeds were treated with dry heat for 15 minutes at 60 degrees Celsius to alleviate dormancy and germination occurred two to three weeks after treatment (Offord et al. 2004). Merritt et al. (2014) found that the seed lifespan of the taxon was in the middle category between the longest-lived and shortest-lived species out of 172 species of diverse Australian flora (when aged at 45˚C and 60 percent relative humidity). Seedlings are shade intolerant and require open ground for establishment (Thomas 2013). However, surveys after the 2019–20 fires counted more seedlings when amongst weeds compared to when weeds were absent (Appleby & Wright 2021). This infers that weeds may provide a benefit to seedling growth from shade and associated increased water retention in the soil (Appleby & Wright 2021). Vegetative reproduction could also be possible but probably not common in the wild (Harris 1989; Harris and Kilpatrick 1991b).

The time to reproductive maturity and generation length are unknown for the Corang pine. However, for the South Esk pine, time to reproductive maturity is considered to be five to 10 years (TSS 2016) and the generation length is estimated to be 15 years (Thomas 2013). The Corang pine is slow growing with post-fire growth measured between one to 12 cm, 12–17 months following fire (Appleby & Wright 2021). Plants become reproductive between one to two metres in height; however, their age at that stage is unknown (McDougall 2021. pers comm 14 September). Mature individuals of *Callitris* species have been aged between 70-170 years, depending on species and region (Pearson et al. 2016). A life expectancy for the South Esk pine is estimated at 70 years (TSS 2016).

Genetics

The populations of the three subspecies (Corang pine, South Esk pine and *C. oblonga* subsp. *parva*) are widely distributed within eastern Australia but highly fragmented. Molecular dating has shown that the subspecies diverged a long time ago (pre- to mid- Pleistocene, 2.66 to 1.08 million years ago) and has persisted in refuges with low fire frequency, remaining separated due to low dispersal (Worth et al. 2018). All subspecies show strong geographic structuring and genetic differentiation (Worth et al. 2018). The Corang pine is the most diverged of the subspecies, based on chloroplast haplotype network analysis (Worth et al. 2018). Four internal transcribed spacer haplotypes are identified for *C. oblonga* (two for *C. oblonga* subsp. *parva*, one for the South Esk pine and one for the Corang pine, Worth et al. 2018).

Fire Ecology

Recent post-fire surveys have shown that the Corang pine is an obligate seeder because mature individuals are killed by fire and the taxon does not resprout via epicormic growth following scorch by fire (Appleby & Wright 2021). This is consistent with the genus with few exceptions. For example, *C. glaucophylla* can resprout following exposure to low fire intensity (Prior &

Bowman 2020). Stochastic events (fire or flood) facilitate regeneration. In the event of fire, large amounts of seed are released and result in recruitment near the parent plant (TSS 2011). Recruitment of burnt individuals is dependent on post-fire rainfall to trigger and promote germination (NPWS, 2001). Successful recruitment has been observed by the production of large numbers of even-aged stands, as has been shown in the South Esk pine (TSS 2016). The number of seeds released can be in the thousands-millions per stand. For example, the South Esk pine has a mean number of viable seeds per cone of 33 and there can be thousands of cones per mature individual (Harris and Kilpatrick 1991a). The number of seeds estimated for the Corang pine are 40 per cone (NPWS 2001). The most suitable fire regime for the species was considered one that is infrequent and small scale (Harris & Kirkpatrick 1991b). However, the most suitable fire regime for the taxon is yet to be confirmed because there are other factors which can limit recruitment, such as concentrated herbivory after small fires. Further, higher severity fires are known to maximise recruitment by increasing the availability of nutrients, light and space. Despite this, the absence of fire is unlikely to pose a significant threat to the species given a long fire-free period previously (see threats section, TSS 2016; DPIE 2021).

Habitat critical to the survival

The Corang pine grows in rocky shrubland and on sandy soils in the flood plains and flood zones of the Corang River. Given the single subpopulation has a very restricted distribution, habitat critical to the survival includes the area of occupancy of the subspecies, areas of similar habitat surrounding the subpopulation that may contain other individuals or be suitable sites for future conservation translocations, and the local catchment for the surface and/or groundwater that maintains the habitat of the taxon.

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.

Considering the discrete distribution of this subspecies, there is sufficient evidence through the taxons' eligibility for listing, to declare all populations/the national population as important populations of this taxon under particular pressure of survival and which therefore require protection to support the recovery of the variety.

Threats

The main threats to Corang pine are fire, herbivory, stochastic events, competition with weeds and disease (Table 1). The taxon is restricted to a single locality, placing the population at risk of cumulative impacts from threatening events.

Table 1 Threats impacting Corang pine

Threat	Status [a]	Evidence
Habitat loss, disturbance and modification		
Inappropriate fire regimes	Timing: current/future Confidence: observed	The local abundance of Corang pine can be severely reduced by a single fire that kills all mature individuals. However, the Corang pine also relies on

Threat	Status [a]	Evidence
	Consequence: catastrophic Trend: unknown Extent: across the entire range	disturbance events, such as fire, to release seeds and regenerate (NPWS 2001). Observations of even-aged stands of recruits of other *Callitris* species provide evidence of the importance of fire for regeneration for some species (Harris & Kilpatrick 1991a). Fire can also facilitate seedling growth in shade intolerant *Callitris* species by increasing sunlight penetration (Harris & Kilpatrick 1991a). However, the exact role of fire for regeneration and seedling growth is still unclear for the Corang pine. The South Esk pine requires at least 5-10 years to reach reproductive maturity (TSS 2016). A fire interval of 11 years (threshold of five–50 years) is deemed suitable for dry sclerophyll forest species in the New England Tableland Bioregion to allow the species time to produce sufficient canopy-stored seed for regeneration (Clarke et al. 2009). Fire-free intervals of five–10 years (TSS 2011) and 11 years (Clarke et al. 2009) have been recommended for the South Esk pine. The most suitable fire-free interval for the Corang pine is yet to be confirmed, however longer fire intervals would reduce the extinction risks for the taxon. If, fire intervals are shorter than the fire-free interval, it could lead to local losses of the taxon. The 2019-2020 bushfires were estimated to have burnt 83–84% of the Corang pines' modelled range at high severity (map 2, Gallagher et al. 2021; Appleby & Wright 2021). Recent post-fire surveys to the area (November 2020–May 2021) have shown that only 69 mature individuals remain in the population, scattered over 18 localities (Appleby & Wright 2021). Post-fire floods have also contributed to this loss by uprooting surviving individuals (Appleby & Wright 2021). Despite a broad pre-fire population estimate between 2500 to 10,000 individuals (NPWS 2001), over 4000 dead mature trees were recorded. Localised, very high intensity burns resulted in zero recruitment for any species (including Corang pine) at some sites 12–17 months post-fire, as the fire burnt through the humic layer in the soil (Appleby & Wright 2021). However, there was widespread recruitment of seedlings at other less intense burnt sites and in excess of 76,000 seedlings were counted in the burnt areas (76,163; Map 2; Appleby & Wright 2021). However, recruitment was patchy; not all burnt adults produced seedlings, and seedlings per tree ranged from five to 50 within the canopy area of individual burnt trees (Map 2; Appleby & Wright 2021). Future climate change predictions for southeast Australia in the temperate forested region, where the taxon occurs, include an increase in the number of days of elevated temperatures and an increase in the Forest Fire Danger Indices (FFDI), which increase

Threat	Status [a]	Evidence
		bushfire risk (Clarke 2015; Dowdy et al. 2019; BOM & CSIRO 2020). This indicates an increased risk from high-fire frequency, high fire intensity and a subsequent decline in the fire-free interval (Enright et al. 2015; Gallagher 2020; Gallagher et al. 2021). The Corang pine habitat has had a long fire-free period before the 2019–20 fires. Fires have not been recorded in the area since at least 1920, according to the NSW fire history register (DPIE 2021). Therefore, Corang pine could be more reliant on flood events to stimulate recruitment, given that flood events have been more common than fire. Frequent fires in succession could prevent individuals from reaching maturity or limit seedbank accumulation. The risks of such events are likely to increase if prescribed burns are added to the background fire frequency and as climate change unfolds (Clarke 2015; Dowdy et al. 2019; BOM & CSIRO 2020). Therefore, high fire frequency could cause further decline to the taxon. Low severity fires also represent a risk if fire frequencies increase and available fuel loads are reduced. Low severity fires are capable of killing standing plants but temperatures can be too low to alleviate seed dormancy (Regan et al. 2003). The impact of low fire severity on recruitment has been shown mainly in geosporous plants (release seed into soil). Therefore serotinous species may be less impacted. Other potential fire-related threats include fire-drought, fire-flood, fire-herbivore, fire-weed and possibly fire-disease interactions (see below).
Grazing of Traveling Stock Reserves	• Timing: current • Confidence: suspected • Consequence: moderate/major • Trend: unknown • Extent: across part of its range	A small part of the range of Corang pine occurs over Corang Traveling Stock Reserve (TSR) (NSW Government 2021). The TSRs are parcels of Crown land that provide corridors for stock routes (ranging from 60 metres to almost two kilometres wide) that connect smaller watering and camping reserves and are managed under a state-wide plan (LLS 2019). The TSRs can also be used by graziers during times of drought, bushfire and flood as supplementary grazing areas or for apiary sites (LLS 2019). Routine agricultural activities are exempt from provisions under state legislation (e.g., NSW *Threatened Species Conservation Act 1995* (TSC Act)) meaning that the land can be subject to grazing. Stock can graze directly on the species as well as damage riparian habitat and contribute to erosion. Nutrient enrichment of soils may also occur where stock congregate, and weeds and plant pathogens, especially soil borne pathogens may be spread (TSS 2016). This threat would exert the greatest impact when seedlings are growing post fire or flood which coincides with the period of

Threat	Status [a]	Evidence
		increased risk because of supplementary grazing in TSRs and on private land.
Land use activities	• Timing: current/future • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across part of its range	A large part of the habitat of Corang pine occurs over private agricultural and residential land. Corang pines that occur on private land adjacent to the riparian zone, are at risk. Land use activities can result in localised disturbance of the river edge by clearing and fragmenting habitat, increasing risk of erosion from tracks, roads and fences, introducing weeds and increasing the risk of pollution (NPWS 2001). Seedlings are most at risk as they could be taken during weed control activities and trampled when erecting fences and other structures (Appleby & Wright 2021). Large piles of post-flood debris along the riverbanks (especially at the river bends) that provide important refugia for seedlings and facilitate regeneration (NPWS 2001), are also at risk during post flood clean-up activities or recreational burning. Small parcels of forestry land also adjoin parts of the riparian zone along the Corang River. There were previous concerns that some of these forestry areas could be subdivided and converted to residential or agricultural land (NPWS 2001), which would have similar impacts to those stated above.
Interactions with native species		
Fruit predation by *Calyptorhynchus banksii* (Red-tailed black-cockatoo)	• Timing: current • Confidence: observed • Consequence: minor • Trend: unknown Extent: across part of its range	Although browsing by native species is a natural ecosystem process, the state of equilibrium in the habitat of the Corang pine has been altered because of human induced threatening processes (such as increased fire frequency). Therefore, browsing by native species of plants with critically low numbers of mature individuals, as is the case for Corang pine, presents a significant threat to population persistence and undermines conservation recovery actions for the species. Red-tailed black-cockatoos are known to heavily browse on seeds post-fire from unburnt or lightly scorched trees, which most likely reduces the number of seeds available for post-fire recruitment (Appleby & Wright 2021). Fruit predation would present the greatest risk when fruiting cones are scarce, such as after severe and wide-scale fires.

Threat	Status [a]	Evidence
Herbivory by *Vombatus ursinus* (wombat)	• Timing: current • Confidence: suspected • Consequence: unknown • Trend: unknown • Extent: across part of its range	Although browsing by native species is a natural ecosystem process, the state of equilibrium in the habitat of the Corang pine has been altered because of human induced threatening processes (such as increased fire frequency). Therefore, browsing by native species of plants with critically low numbers of mature individuals, as is the case for Corang pine, presents a significant threat to population persistence and undermines conservation recovery actions for the species. Wombats are found in the Corang pine habitat and are suspected to feed on seedlings (Appleby & Wright 2021), although it is unknown to what extent this impacts seedling survival or survival of the taxon.
Invasive species		
Competition with weeds	• Timing: current/future • Confidence: observed • Consequence: moderate • Trend: unknown • Extent: across the entire range	Weeds can impact on the success and survival of seedlings through competition with nutrients, light and water and other factors, reducing qualitative and quantitative characteristics. Weeds of particular concern include blackberry (*Rubus fruticosus* species aggregate), English broom (*Cytisus scoparius* subsp. *scoparius*), and radiata pine (NPWS 2001, NSW Government 2021). Blackberry is locally abundant along parts of the Corang River and has the potential to spread (NPWS 2001). Radiata pine is also widespread in parts of the Corang pine habitat. Broom and gorse, although not yet found along the Corang River, have potential to spread from the Shoalhaven River upstream, where it is common (NPWS 2001). Corang pine is absent where blackberry forms a closed canopy and where the riverine shrubland is taller than two metres (NPWS 2001), indicating that weeds could limit habitat availability for the species. Radiata pine could also affect the flood characteristics and recruitment patterns of the Corang pine, particularly as trees mature (NPWS 2001). However, recent post-fire surveys (12–17 months post-fire) have shown weeds to be beneficial to seedling growth. For example, Corang pine seedlings were more abundant where weeds were abundant indicating that they facilitated recruitment, possibly through improving moisture retention and shelter, or it could have been correlated with localised areas of nutrient enrichment (Appleby & Wright 2021). The relationship between weeds and seedling growth requires further research over a longer time period following fire, to see if this beneficial relationship is sustained. Post-fire surveys have recorded additional weeds in Corang pine habitat including *Conyza* spp, spear thistle (*Cirsium vulgare*), medic (*Verbascum* sp., *Medicago* sp.), ribwort (*Plantago lanceolate*), *Verbena*

Threat	Status [a]	Evidence
		bonariensis, *Anthoxanthum odoratum* and cat's-ear (*Hypochaeris radicata*) (Appleby & Wright 2021). Blackberries, gorse and English broom are listed as Weeds of National Significance because of their invasiveness, potential for spread, and economic and environmental impacts (DPI 2021). These weeds are considered high risk and high priority species in the region and are managed under the South East Regional Weed Management Plan (LLSSE 2017). Although the extent of impact of weeds on the taxon is unclear (NPWS 2001), competition with weeds could be a potential threat to the taxon in the future.
Browsing by feral herbivores	• Timing: future • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across part of its range	Browsing by feral herbivores is a potential threat to the Corang pine, particularly by feral goats (*Capra hircus*), rabbits (*Oryctolagus cuniculus*) (TSS 2016) and deer (various species, potentially Sambar deer (*Cervus unicolor*) and/or Rusa deer (*C. timorensis*)). Goats have been observed in the lower part of the population and some browsing of shrubs appears to occur (NPWS 2001). Rabbits occur in low densities in the region (OEH 2013), although evidence of rabbit damage near the Corang River is lacking (NPWS 2001). Deer may also occur with the Corang River catchment, but their population size within the region and impact on Corang pine is unknown (Wright & Appleby 2021. pers comm 20 October). Browsing by deer on other *Callitris* species in north-eastern Victoria was shown to be low because of low herbivore densities (Lunt et al. 2011). In contrast, browsing by Rusa deer in coastal NSW resulted in a high mortality of *C. endlicheri* (black cypress pine) seedlings over a 12 month period, leading to 59 percent reduction in seedling density overall (Mackenzie & Keith 2009). This indicates that deer browsing has the potential to be significant for the taxon. The impacts of feral goats have been listed as a Key Threatening Process under the EPBC Act (DEWHA 2008). Although the amount of grazing and impact on the taxon from feral herbivores is unclear (NPWS 2001), browsing, especially on seedlings, could be a potential threat to the taxon in the future.
Habitat damage by feral pigs	• Timing: future • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across part of its range	Populations of feral pigs are known to occur in Morton National Park (OEH 201). Pigs cause damage by rooting for food which causes erosion and introduces weeds. Feral pigs are listed as a key threatening process (KTP) under the EPBC Act (DEE 2017). Although there is not yet evidence of pig damage near the Corang River (NPWS 2001), pigs could potentially be a threat to the taxon in the future.

Threat	Status [a]	Evidence
Climate Change		
Increased temperatures and change to precipitation patterns	• Timing: future • Confidence: suspected • Consequence: major • Trend: increasing • Extent: across the entire range	Future climate change predictions for southeast Australia in the temperate forested region, where the taxon occurs, include an increase in the number of days of elevated temperatures and an increase in the FFDI, which are useful indicators of drought (Clarke 2015; Dowdy et al. 2019; BOM & CSIRO 2020). In regions projected to become warmer and drier, an emerging phenomenon known as the interval squeeze is predicted to become more apparent (Enright et al. 2015). This phenomenon predicts a reduced population persistence because of demographic and post-fire recruitment shifts (plants produce fewer seeds and have a lower seedling survival), and shorter fire-free periods (Enright et al. 2015). Corang pine grows within or adjacent to the riparian zone indicating its dependence on surface and ground water. Increased drought could make conditions unfavourable and result in the loss of suitable habitat, which can cause population declines in species with highly restricted habitats. For example, persistent drought is thought to be the cause of poor health and local mortality of mature trees in the locality situated north of Oallen bridge, along Oallen road (Appleby & Wright 2021). This site is located approximately two hundred metres from the river, along a dry drainage line and has been subject to persistent drought. Warmer temperatures, heat waves and changes to precipitation patterns may also favour the spread of some weed species (Scott et al. 2014).
Increasing frequency and severity of floods	• Timing: future • Confidence: observed • Consequence: major • Trend: increasing • Extent: across the entire range	Climate projections for south-eastern Australia include increasing severity of flood events (CSIRO & BoM 2015). This is because as the atmosphere warms, its capacity to hold moisture increases, enhancing the potential for extreme rainfall events and increased risk of flooding (CSIRO & BoM 2015). High severity floods have the capacity to cause erosion or scouring along the riverbanks which threatens all riparian habitat of Corang pine, rendering it unsuitable for the species (TSS 2016). Flood events also bring debris which can directly damage mature individuals and re-establishing beds of juvenile plants Flood events that result in the death of mature trees or senescence of a branch with cones, however are important to trigger the release of seed and provide opportunities for regeneration if sufficient time intervals allow for seedlings to reach maturity. The 2019–20 bushfire was followed by two major flood events in the year following the fires (McDougall 2021. pers comm 14 September). Despite the adaptation of the taxon to flood-prone environments, occurrence of a major flood event soon after a high-

Threat	Status [a]	Evidence
		intensity fire, uprooted trees which had survived the fire, and impacted post-fire recruitment in the flood zone by removing seed and soil (Appleby & Wright 2021). Evidence of scouring in the post-fire surveys showed no or very low recruitment at these locations (Appleby & Wright unpublished data). Flood events that occur after fires can result in greater scouring, because water movement (velocity) is increased as riparian vegetation is reduced (Pettit & Naiman 2007).
Threats resulting from small and fragmented populations		
Allee effects and low genetic diversity	• Timing: current/future • Confidence: inferred • Consequence: moderate • Trend: unknown • Extent: across the entire range	Many small, isolated subpopulations are subject to the effects of low genetic diversity (Frankham et al. 2014). There is only one known locality of the Corang pine with an estimated pre-fire population of 2500 to 10,000 individuals (NPWS 2001) and limited information on their genetics or reproductive potential. Therefore, the population could already be approaching the minimum viable population size required to ensure genetic fitness and continuation into the future (Traill et al. 2007; Frankham et al 2014). Although wind pollinated plants are less impacted by low genetic diversity in comparison to fauna pollinated species, the single locality of the taxon is likely to be at risk of the negative consequences associated with low genetic diversity.
Disease		
Dieback caused by *Phytophthora cinnamomi*	• Timing: future • Confidence: suspected • Consequence: unknown • Trend: unknown • Extent: across the entire range	*Phytophthora cinnamomi* is an introduced soil-borne pathogen, which infects a large range of plant species and may contribute to plant death, especially when other stresses are present, such as waterlogging, drought and fire (DEE 2018). *Phytophthora cinnamomi* spreads through water runoff, transportation of infected soil by humans and animals and root-to-root contact spreading both uphill and downhill (Shearer & Tippet 1989). Dieback caused by *P. cinnamomi* is listed as a key threatening process under the EPBC Act (DEE 2018). *Phytophthora cinnamomi* is now widespread in coastal forests in NSW (DPIE 2019) and is recognised as an existing threat in the regions management strategy (OEH 2011). *Phytophthora cinnamomi* is identified as a threat to the pygmy cypress pine in Hastings River (OEH 2021). Some localities have reported mature individuals to be dying in unburnt areas, such as the locality near Oallen bridge. The cause is unknown but could be

Threat	Status [a]	Evidence
		because of drought or infection from *P. cinnamomi* (Wright & Appleby 2021. pers comm 20 October 2021). Although *Callitris* species are not known to be susceptible to the pathogen, other riparian species have shown susceptibility to *P. gregata* which also causes poor health in infected plants (Wan et al. 2020). Although there have been limited studies on the impact of *P. cinnamomi* in *Callitris* species, it is a potential threat to the single population of the Corang pine.

[a]Timing—identify the temporal nature of the threat;
Confidence—identify the extent to which we have confidence about the impact of the threat on the species;
Consequence—identify the severity of the threat;
Trend—identify the extent to which it will continue to operate on the species;
Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life stage they affect; the duration of the impact; 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. Threats with unknown consequences (herbivory by wombats and disease) have not been included in Table 2.

Table 2 The Corang pine risk matrix

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Low risk	Moderate risk	Very high risk	Very high risk **Increased temperatures and change to precipitation patterns**	Very high risk
Likely	Low risk	Moderate risk	High risk **Land use activities** **Herbivory by *Calyptorhynchus banksii* (black cockatoos)** **Competition with weeds**	Very high risk **Increasing frequency and severity of floods** **Increased frequency and severity of bushfire**	Very high risk
Possible	Low risk	Moderate risk	High risk **Browsing by feral herbivores** **Habitat damage by feral pigs** **Allee effects and low genetic diversity**	Very high risk **Grazing of Traveling Stock Reserves**	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk **Dieback caused by *Phytophthora cinnamomi***	High risk	Very high risk

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

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

Conservation and recovery actions

Primary conservation objective

By 2030, the Corang pine population has increased in abundance and is sustained in habitats in which threats are managed effectively. By 2030, a viable ex-situ collection of the Corang pine is maintained to allow for relocation in the event of future threatening events.

Conservation and management priorities

Habitat loss, disturbance and modifications

- Avoid and minimise further loss and fragmentation of habitat.
- To manage the risk of impacts associated with TSRs and when particular localities of the taxon is identified at risk to this threat, reduce the impacts through well-maintained fencing where possible.
- Investigate land acquisition, formal conservation arrangements, management agreements and covenants on private land, and for localities on Crown and private land, investigate inclusion in Protected Areas tenure, if possible.

Climate Change and Fire

- Develop and implement a fire management strategy that optimises the survival of the Corang pine.
    - Avoid planned burns in all habitat until the fire-response of the Corang pine is better understood.
    - Protect unburnt habitat (i.e., maintain firebreaks and no prescribed burns), particularly in the localities near Oallen Road and in National Parks and Wildlife Service reserves in upstream locations.
    - Take the likelihood of increasingly frequent bushfires into account when developing prescribed burning programs, to avoid excessive, frequent burning of any localities.
    - Provide maps of known occurrences to local and State Rural Fire Services and consult with them when planning for prescribed burns is being undertaken.
- Identify current and future habitat likely to remain or become suitable habitat due to climate change and ensure impacts of other threats to their habitats are minimised.
- Establish multiple translocated populations in suitable habitat to spread the risk to the species associated with climate change fire and impact from other stochastic extreme events. .
- Ensure readiness and resourcing for postfire control of feral herbivores in the event that fire occurs (see Invasive species actions below).

Interactions with native species

- Implement browsing management actions, in consultation with land managers and community groups, to reduce the impacts of wombats on young Corang pine and black cockatoos on mature Corang pine, e.g., establish fenced enclosures around young plants and investigate bird deterrent methods as required.

Invasive species

- Implement weed management actions in consultation with land managers and community groups, using appropriate techniques to minimise the effect of herbicide on native vegetation, according to the Australian Weeds Strategy 2017-2027 (IPAC 2016).
- If there is evidence of browsing and/or habitat destruction by feral herbivores (e.g., goats, rabbits and pigs), reduce the impacts of feral herbivory and disturbance through well-maintained fencing (e.g., Mackenzie & Keith 2009), where suitable, and/or through ongoing control programs. Ensure programs are used in combination with weed control programs, to minimise an increased risk of weeds from herbivore control, e.g., blackberry.
- Minimise the impact of rabbits to susceptible populations by implementing actions as described in the *Threat abatement plan for competition and land degradation by rabbits* (DEE 2016).
- If radiate pine is identified as a threat to the taxon, design and implement an eradication and subsequent site restoration strategy to remove radiata pine from habitats likely to support Corang pine.

Climate change, fire and floods

- Identify current and future habitat likely to remain or become suitable habitat due to climate change and ensure impacts of other threats to this habitat are minimised.
- Reduce the risk to the species associated with climate change, fire and extreme events by establishing multiple translocated populations in suitable habitat.

Disease

- If there is evidence of risk to the Corang pine from *P. cinnamomi*, minimise the spread and mitigate it's impact by following the guidance described in the *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi* (DEE 2018).
- Implement a hygiene management plan and risk assessment to protect the known population from introduction of new isolates of *P. cinnamomi* or other plant pathogens. This may include but is not limited to:
    - Ensure contaminated water and/or soil are not introduced into the area for firefighting, track maintenance, infrastructure development or revegetation activities, e.g., ensure all nursery propagation is through disease accredited production facilities.
    - Ensure appropriate phyto-hygiene protocols are adhered to when entering or exiting known localities of Corang pine, such as those outlined in Podger et al. (2001).
- If there is evidence that *P. cinnamomi* is impacting the Corang pine, implement mitigation measures including, but not limited to, the application of a biodegradable, systemic fungicide such as phosphite (or other alternatives); noting the potential deleterious effects as a fertiliser with prolonged usage (Lambers et al 2013).

Ex-situ recovery action

- To manage the risk of losing genetic diversity, collect and store sufficient quantities of seed from all known localities of the population in long-term storage to preserve genetic material, in accordance with the Plant Germplasm Conservation Guidelines (Martyn Yenson et al. 2021). Routinely determine the viability of stored seed.
- Establish plants in cultivation or collect and maintain plant cuttings in appropriate institutions such as Botanic Gardens. Cuttings may be a particularly important ex-situ resource given the suspected small number of individuals and the effect of any seed collection on population viability.
- To mitigate the threat of high fire frequency, undertake conservation translocations of propagated individuals, in suitable habitat with secure land tenure, to increase the population of the Corang pine, in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018).

Stakeholder engagement/community engagement

- Engage with Indigenous Australians to identify Indigenous management responsibilities and cultural connections to the Corang pine. Identify and encourage collaboration opportunities and the two-way sharing of knowledge of this taxon.
- Raise awareness of the location of this species with the Rural Fire Service, other fire and land management agencies, government agencies and the general public, to minimise impact to the taxon.
- Engage with local landowners to:
  - raise awareness of the species and its importance (protection under the state legislation – the Native Vegetation Act),
  - educate them about activities that threaten the taxon, particularly in regard to clearing weeds, burning flood debris, feral herbivores etc., and
  - secure access to the localities on private land, particularly those that haven't been surveyed previously, when conducting research and monitoring activities.
- Support interested local landowners and community groups to carry out conservation activities for the taxon, including revegetating areas with low/no recruitment, and weed and pest control.
- Engage with researchers prior to conducting surveys and develop a monitoring program to obtain the most up-to-date advice on the taxon.

Survey and monitoring priorities

- Establish and maintain a monitoring program to:
  - determine population size and trends, particularly seedling survival,
  - determine habitat conditions, particularly the health of individuals in unburnt habitat,
  - assess threats and their impacts (herbivory, weeds, etc.), including the effect of fire on the life-cycle on the species,
  - document recruitment, longevity, pollination activity and seed production, and
  - monitor the effectiveness of management actions and the need to adapt them, if necessary.

- Previous surveys have identified priority sites for monitoring, including the localities upstream from Nerriga bridge, adjacent to Welcome Reef road and in easily accessible areas in Crown reserves and TSRs adjacent to Nerriga bridge (Wright & Appleby 2021. pers comm 20 October).

Information and research priorities

- Undertake genetic research to:
  - understand the genetic structure, gene flow and relatedness of individuals in respect to seed dispersal,
  - create a resource for understanding the genetic ability for adaptive change, and
  - understand the taxon's genetic diversity, ability to disperse within the river and minimum viable population size.
- Undertake research into the taxon's fire and flood ecology, including seedling recruitment and survival post-fire and flood, and the interval required to allow plants to reach reproductive maturity.
- Investigate the taxon's susceptibility to *P. cinnamomi* or other diseases and its potential impact on population persistence. Investigate appropriate mitigation measures to minimise the impact of the disease, if deemed to be susceptible.
- Investigate the role that weeds have on seedling emergence and establishment. Identify if radiata pine is a threat to the taxon.
- Undertake research into the taxon's reproductive ecology, including reproductive strategies, seedling recruitment, longevity, fecundity, and seed germination requirements. Improve understanding of the impacts of climate change on population viability, including the impacts of increased bushfire frequency and change in rainfall.
- Map critical habitat on Commonwealth land.
- Investigate options for linking or establishing additional subpopulations, including replanting on Crown land and TSRs.
- Investigate the possibility of establishing voluntary conservation agreements (VCAs) through the NSW Biodiversity Conservation Trust on key private properties. Consider actions such as replanting and weed and pest control.
- Investigate the cause of dying mature individuals in unburnt locations, such as those individuals along Oallen road.

Recovery plan decision

A decision about whether there should be a Recovery Plan for this species has not yet been determined. The purpose of this consultation document is to elicit additional information to help inform this decision.

Links to relevant implementation documents

DEE (Department of the Environment and Energy) (2016) *Threat abatement plan for competition and land degradation by rabbits*. Commonwealth of Australia.

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

Attachment A: Listing Assessment for *Callitris oblonga* subsp. *corangensis*

Reason for assessment

The Corang pine 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 prioritisation of a nomination from the TSSC.

Assessment of eligibility for listing

This assessment uses the criteria set out in the EPBC Regulations. The thresholds used correspond with those in the IUCN Red List criteria except where noted in criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing assessments through the Common Assessment Method (CAM).

Key assessment parameters

Table 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

Table 1 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	4457	69	4457	The Corang pine undergoes natural fluctuations in the number of mature individuals, as it is an obligate seeder where mature individuals are killed by fire or flood and germinate post fire and flood (Appleby & Wright 2021 The minimum plausible value is based on post-fire surveys in 2020 and 2021 that identified 69 mature individuals of this species (Appleby & Wright 2021). The maximum plausible value is also based on post-fire surveys in 2020 and 2021 but estimates the pre-fire number of live mature trees based on post-fire numbers of mature trees (live + dead). See the evidence in Criterion 3 to see how this value was calculated. The estimate used in this assessment is based on the maximum plausible value because natural fluctuations are common for obligate seeders.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Declining			Although there is a lack of temporal data on population trends, the population of Corang pine is projected to decline because of threats associated with inappropriate fire regimes and interactions between fire and other ongoing threats, such as herbivory and drought.
Generation time (years)	37.5-40	15	40	The generation length for the Corang pine is unknown. However, the generation length of the South Esk pine (*C. oblonga* subsp. *oblonga*) is estimated at 15 years according to Thomas (2013). However, using the IUCN guidelines for calculating generation length (see evidence under Criterion 1; IUCN 2019) a more appropriate value is between 37.5–40 years. It is likely that a similar generation length can be assumed for the Corang pine and is the estimate used in the assessment. The minimum plausible value represents the lowest generation period for the species, and the maximum value represents the maximum generation period based on IUCN guidelines.
Extent of occurrence	=AOO =48 km^2 (originally 24 km^2)	12 km^2	48 km^2	The minimum plausible value is the value derived from the IUCN assessment for this taxon (Thomas 2013). The maximum plausible value has been calculated using record data from 2000-2021 for extant subpopulations and applying the smallest polygon boundary which can be drawn to encompass these records, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019). As EOO was smaller than AOO, the AOO estimate was also used as the maximum EOO estimate (IUCN 2019). The estimate used in the assessment is based on the maximum plausible value because it includes data from post-fire surveys. All values are within the range of the Critically Endangered category of Criterion 2.
Trend	Unknown			The population trajectory of the species' EOO is unknown due to the lack of pre-fire surveys and a limited understanding of post-fire recovery.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Area of Occupancy	48 km^2	32 km^2	48 km^2	The maximum plausible AOO value has been calculated using record data from 2000 –2021 for extant localities and applying 2 x 2 km grid cells, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019). The minimum plausible value has been calculated using record data from 2021 only for extant localities and applying 2 x 2 km grid cells (IUCN 2019). The estimate used in the assessment is based on the maximum plausible value because it includes data from pre-fire and post-fire surveys. All values are within the range of the Endangered category of Criterion 2.
Trend	Unknown			The population trajectory of the species' AOO is unknown due to the lack of pre-fire surveys and a limited understanding of post-fire recovery.
Number of subpopulations	1	1	1	All individuals in the population are considered to be connected, despite the lack of genetic data to indicate connectivity between individuals. The population is very restricted, and all individuals are within (or adjacent to) the riparian zone along a 20 km section of the Corang River. The high connectivity of the river system is supported by the wide dispersal of seedlings that have emerged post 2019-20 bushfires (Map 2).
Trend	Stable			The population is considered stable, as post-fire surveys (Map 2) and pre-fire herbarium records (Map 1; ALA 2021) appear to occupy the same habitat extent along the Corang River (ALA records data back to 1962). Migration downstream is likely prevented by unsuitable habitat, particularly in steep gorge country and lower elevations. However, the specific habitat requirements for the Corang pine remain to be determined.
Basis of assessment of subpopulation number	The single population occurs within a 20 km section along the mid-reaches of the Corang River with good connectivity within the river system.			

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
No. locations	1	1	1	The Corang pine is found in a very restricted habitat within one river system. The most plausible threats to the taxon are from an increased risk to frequent and intense bushfires and an increased risk of flooding events as a consequence of climate change. A single flood event would impact the whole population. Similarly, a single bushfire event could impact the entire population which occupies less than 48 km^2. While the taxon has seed that will survive and germinate after fire and flood, multiple fires and/or floods in rapid succession, not allowing time for germinated plants to reach reproductive maturity, could cause the population to decline (TSS 2016). Future projections for this region include an increased risk of bushfire, more severe fires (Clarke 2015; Dowdy et al. 2019; BOM & CSIRO 2020) and increasing severity of flood events (CSIRO & BoM 2015). This presents a considerable risk to this taxon due to its possible long life span (which may be 70+ years) and long time to reproductive maturity (5-10 years). Other threats including fire interactions with herbivores, weeds and drought, also contribute to the taxon being considered to have a single location.
Trend	Stable			One location has been used for this assessment. Although, future climate change predictions for this region (elevated risk of fire, flood and drought) could result in population decline, it is unlikely to reduce the number of locations to zero (and result in extinction of the taxon).
Basis of assessment of location number	The Corang pine occurs in a single, restricted location within a single river system and occupies less than 48 km^2. Climate change predictions include an increased risk of frequent and intense bushfires, flood events, and drought. A single bushfire and/or flood event could impact the entire population. Repeated fires and floods in close succession can prevent the plant from reaching maturity and producing seeds, and result in a population decline.			
Fragmentation	The population is not considered severely fragmented due to connection between all individuals within the Corang River.			
Fluctuations	There are no known extreme fluctuations in EOO, AOO, and number of subpopulations or locations.			

Criterion 1 Population size reduction

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

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

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

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

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

Based on any of the following

(a) direct observation [except A3]

(b) an index of abundance appropriate to the taxon

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

(d) actual or potential levels of exploitation

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

Criterion 1 evidence

Insufficient data to determine eligibility

Generation length

The time to reproductive maturity, generation length and longevity are unknown for the Corang pine. However, we can use estimates from other subspecies (South Esk pine) to infer the generation length. The time to reproductive maturity for the South Esk pine is considered to be five to 10 years and the longevity is estimated at 70 years (TSS 2016). Following the IUCN guidelines for calculating generation length and using the estimates based on the South Esk pine, the generation time is in the range of:

$$\text{Generation time} = \text{age of first reproduction} + [0.5 * (\text{length of reproductive period})]$$
$$\text{Generation time} = 5 + [0.5 * (70 - 5)] = 37.5 \text{ years}$$

OR

$$\text{Generation time} = 10 + [0.5 * (70 - 10)] = 40 \text{ years}$$

This gives an estimated three-generation period of approximately 113–120 years.

Population size reduction

Targeted post-fire surveys were carried out between November 2020 to May 2021at 122 locations along a 16 km stretch of the Corang River where the population occurs (Appleby & Wright 2021). Approximately 90 percent of the habitat range for the subspecies was surveyed (Wright & Appleby 2021. pers comm 25 October). Areas not surveyed were inaccessible because they occurred on private property that did not permit access; the riparian zone was accessed at these sites using a kayak. The surveys recorded 69 mature individuals, 76,163 seedlings and 6 juvenile plants.

Pre-fire surveys were not done. However, because the taxon undergoes natural population fluctuation in response to fire and flood, i.e., triggers seeds to germinate, and in the case of flood disperse (Hartley & Barrett 2008; DBCA 2021), the number of dead mature individuals recorded during post-fire surveys can be used to estimate the pre-fire population. There were 4052 dead mature trees recorded after the 2019–20 bushfire (Map 3, Appleby & Wright 2021). However, this number needs to be adjusted to include Corang pine habitat not surveyed due to access issues (10 percent; Wright & Appleby 2021. pers comm 25 October). Therefore, we can calculate the number of mature individuals prior to the 2019–20 fires as:

$$(0.1 * 4052) + 4052 = 4457$$

It is important to note that the number of dead mature trees would be an underestimate of the pre-fire population for two further reasons (Wright & Appleby 2021. pers comm 20 October): 1) some mature trees were so severely scorched that they were unable to be identified as their seeds were also burnt, and 2) dead mature individuals are likely to have been transported further downstream by either of the two major flood events (McDougall 2021. pers comm 14 September) that occurred post the 2019-20 fires and before the surveys were carried out. However, these losses are unable to be quantified.

Although post-fire estimates are available, there is no temporal replication of sites to indicate population trends through time Therefore, there are insufficient data to demonstrate if the taxon is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the varieties status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

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

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

Criterion 2 evidence

Eligible under Criterion 2 B1ab(iii,v) for listing as Critically Endangered

Extent of occurrence (EOO) and area of occupancy (AOO)

The most plausible area of occupancy (AOO) and extent of occurrence (EOO) of the Corang pine are estimated at 48 km² (EOO range is 12 km²–48 km² and AOO range is 32 km²–48 km²). These figures are based on the mapping of point records from 1996–2019, obtained from state governments, museums and CSIRO. The AOO was calculated using a 2 x 2 km grid cell method over each spatial data point (2000 –2021). As EOO was smaller than AOO, the AOO estimate was also used as the EOO estimate in this assessment (see Table 3) (IUCN 2019).

The subspecies' EOO appears to meet the requirements for listing as Critically Endangered under B1 (<100 km²). The species' AOO appears to meet the requirements for listing as Endangered under B2 (<500 km²).

Number of locations

The Corang pine population is considered to be a single subpopulation with numerous locally abundant individuals found only along an approximately 20 km section of the Corang River (DEE 2008).

The most plausible threats to Corang pine are inappropriate fire regimes and flood events, and the interaction between fire and flood, and fire with other threats. Catastrophic bushfires affected an estimated 84 percent of the Corang pines' modelled habitat, at high severity (Gallagher 2020). The only locality not burnt by the recent fires was the area north of Oallen road. Two major flood events occurred in the year following the 2019–20 fire and impacted the entire population. Flood impacts can exacerbate the effect of fire because erosion by flood

waters can be more severe when vegetation is removed by fire. Riparian areas with steeper inclines and located on river bends showed more severe scouring and erosion impacts (Wright & Appleby 2021. pers comm 25 October). Despite the impacts of fire and flood, post-fire surveys revealed that there was sufficient remaining seed because an estimated 76,163 seedlings were counted 12-17 months after the 2019–20 fire and subsequent floods. The Corang pine habitat had a long fire-free period before these fires (>100 years) (DPIE 2021).

However, climate change predictions for the region include an increase in fire weather resulting from an increasing FFDI (Clarke 2015; Dowdy et al. 2019; BOM & CSIRO 2020) and increasing severity of flood events because of atmospheric warming and the potential for extreme rainfall events (CSIRO & BoM 2015). Therefore, if another fire was to occur in the range of the Corang pine within the next 11 years (i.e., within the fire-free interval recommended for other the closely related subspecies, the South Esk pine), then all individuals would be at risk of death or poor recovery and there may not be sufficient seed to replenish the population. Further, if fires are too severe, they can remove the humic layer and prevent the germination of seedlings (Appleby & Wright 2021). Major flood events following fire can also prevent seedlings from germinating because of scouring and associated topsoil removal (Appleby & Wright 2021). Further, if drought conditions follow fire, then recruitment can be prevented because water is required for germination (Appleby & Wright 2021). Other threats that interact with fire can also affect seedling recruitment and survival, such as the interaction with herbivory (black cockatoos & wombats; Appleby & Wright 2021) and weeds (NPWS 2001). Therefore, an intense bushfire and associated flood could be capable of impacting the entire population.

Consequently, only a single threatening event (e.g., fire) would be required within the next 11 years for all individuals to be rapidly affected.

The number of locations used in this assessment is one. The species' number of locations appears to meet the requirement for listing as Critically Endangered under this criterion.

Severe fragmentation

The population is not considered severely fragmented because all individuals occur within a single connected river system. Evidence of the connection between individuals can be seen by the wide dispersal of seedlings following post-fire flood events (Map 2). Therefore, the taxon does not meet the requirements for severe fragmentation.

Continuing decline (quality of habitat and number of mature individuals)

Continuing decline in the number of mature individuals is projected. It is estimated that approximately 4457 mature Corang pine trees were killed in the 2019-20 bushfires, with 84 percent of the taxon's habitat being burnt at high severity. In excess of 76,000 seedlings were counted in the burnt areas following the 2019–20 fire (76,163; Map 2; Appleby & Wright 2021) but recruitment was patchy; not all burnt adults produced seedlings, and seedlings per tree ranged from <5 to >50 within the canopy area of individual burnt trees (Map 2; Appleby & Wright 2021). Regions of the highest recruitment occurred around river bends where seeds and other debris are expected to collect, indicating likely dispersal downstream by the subsequent post-fire flood events (Map 2). However, not all seedlings are expected to survive to reach maturity because of threats from fire, flood, weeds, herbivory, and habitat disturbance (Table 2). Further, climate change is predicted to increase the risk of fire, drought and flood events and the

interactions between these threats, and with other threats (fire-flood, fire-drought, fire-herbivory, fire-weeds), which are likely to have major impacts on seedling survival. The time to maturity for Corang pine is unknown but the South Esk pine requires 5-10 years from germination to reach sexual maturity and any fire occurring in this time would likely result in the loss of mature and juvenile plants. Therefore, although it is not possible to estimate the number of seedlings that will reach maturity as a proxy for population decline, decline in the number of individuals is projected because of the increased risks of threats due to climate change predictions.

Continuing decline is also projected in the quality of Corang pine habitat. Severe fires are capable of removing the humic layer which prevents the growth of vegetation following fire. Areas of severely scorched habitat with no subsequent growth were still evident 12–18 months following the 2019–20 fires. Severe floods also scoured the riparian zone in some sections which removed vegetation and reduced opportunity for seedling recruitment. Persistent drought is also capable of drying drainage lines that feed into the Corang River. Drought is likely to be the cause of the poor health and mortality of several individuals in the locality on Oallen road, near Nerriga bridge. Severe and more frequent fires and floods, and drought are predicted in Corang pine habitat.

Corang pine habitat is also at risk of habitat modification on private agricultural and residential land, and in TSRs, due to land use practises that clear vegetation and fragment the habitat. Corang pine could also be at risk due to the impacts of *P. cinnamomi*, should the area become infected with the pathogen in the future. Browsing by feral herbivores (rabbits, goats, deer and pigs) are also likely to contribute to habitat degradation. This risk of all of these threatening processes also makes the population more vulnerable to decline because of the taxon's limited distribution, and potential low genetic diversity.

Extreme fluctuations

Extreme fluctuations represent changes in the total population (rather than a flux of individuals between different life stages), which exceed one order of magnitude (IUCN 2019). Extreme fluctuations can be diagnosed by interpreting population trajectories which show a recurring pattern of increases and decreases; or by using life history characteristics (IUCN 2019).

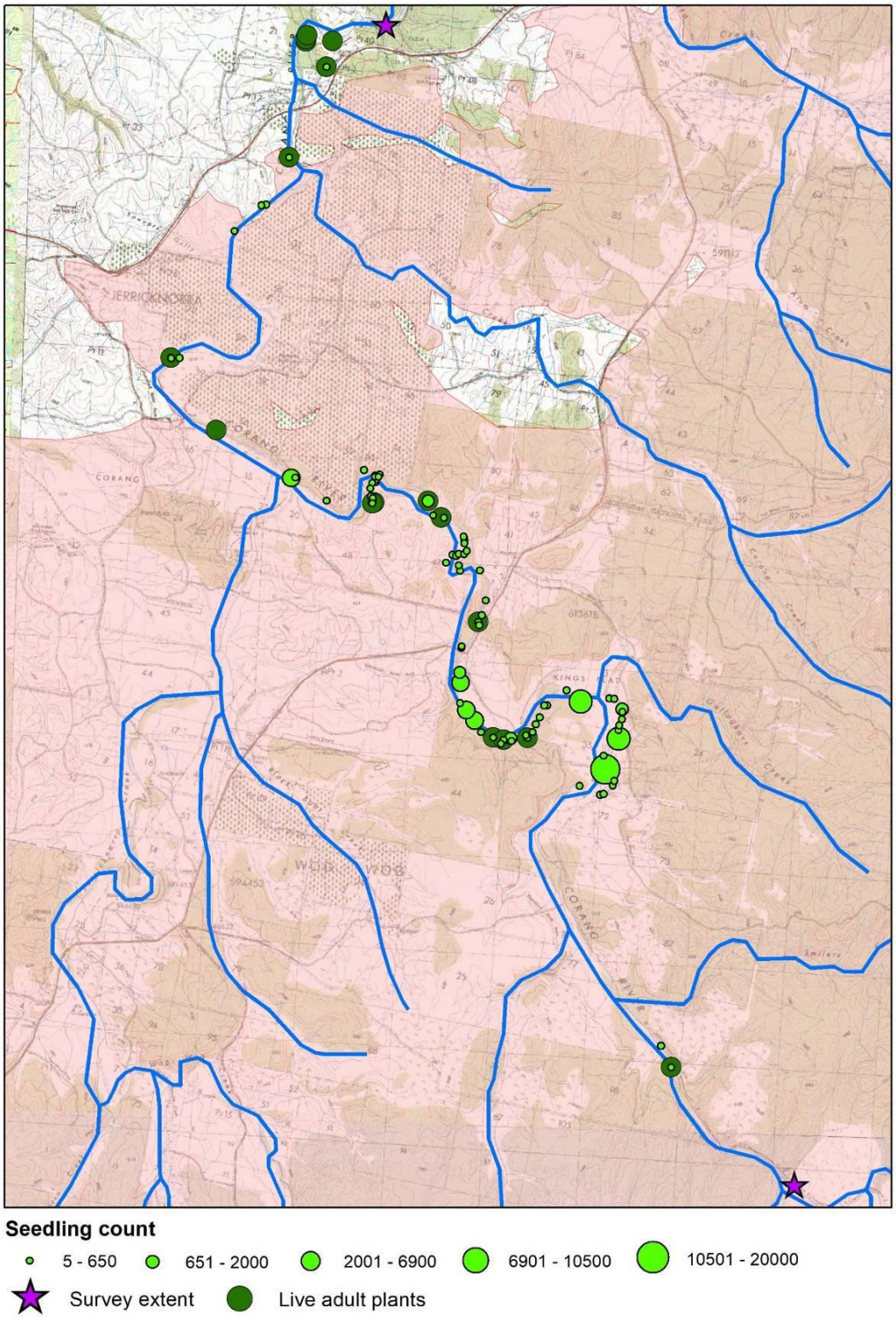
There are no known extreme fluctuations in EOO, AOO, and number of subpopulations, locations or mature individuals.

Conclusion

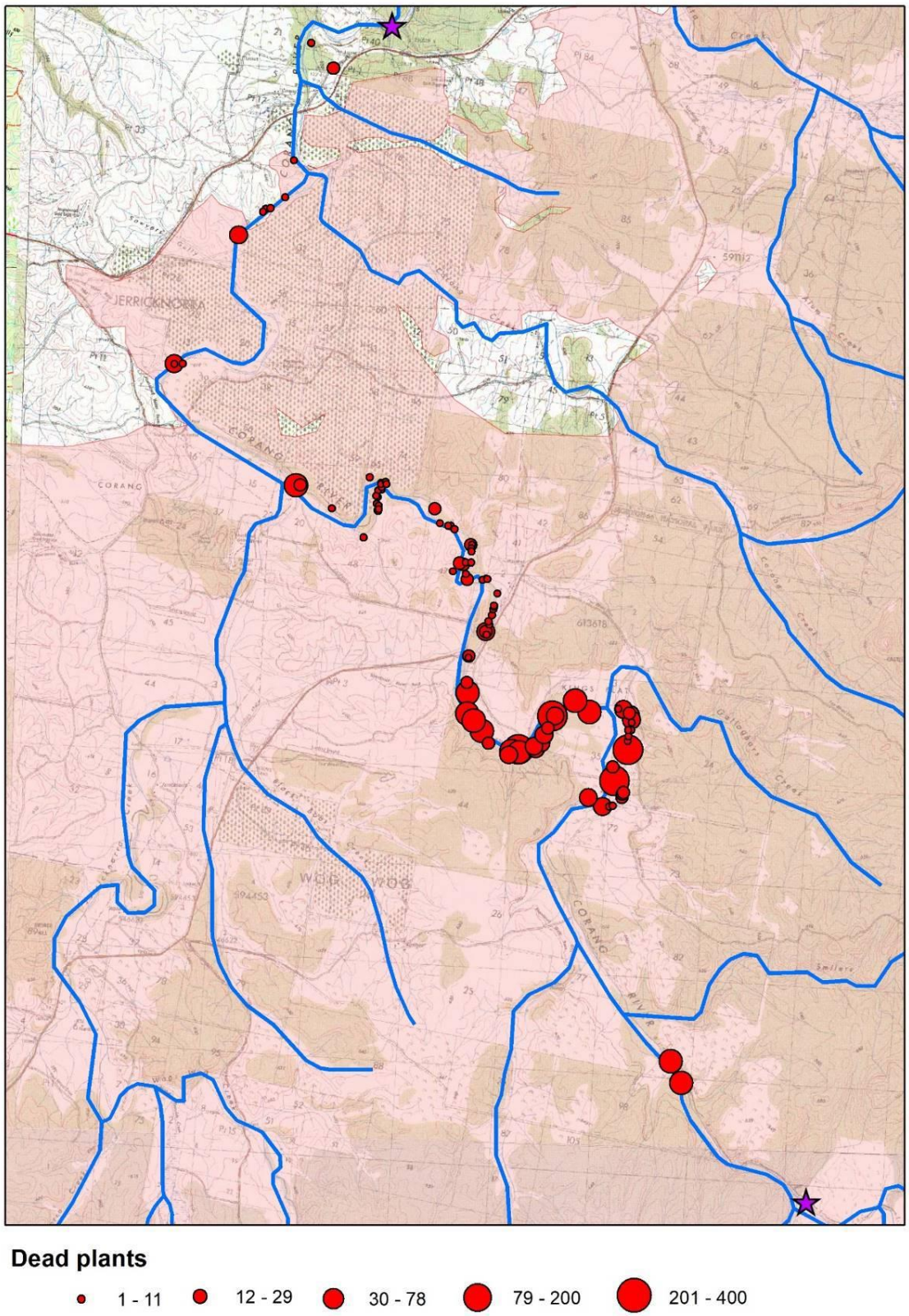
The Committee considers that the species EOO and number of locations are very restricted; and continuing decline is projected in the area, extent and quality of habitat and number of mature individuals due to threats posed by inappropriate fire regimes, disease, browsing, and decreasing precipitation caused by climate change.

The data presented above appear to demonstrate that the species is eligible for listing as Critically Endangered under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the varieties 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.

Map 2 Post-fire survey of Corang pine, mature adult and seedling distribution, showing 2020 fire boundary (Appleby & Wright 2021).



Map 3 Post-fire survey of dead mature Corang pine, showing 2020 fire boundary (Appleby & Wright 2021).



Criterion 3 Population size and decline

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

Criterion 3 evidence

Eligible under Criterion C2a(ii) for listing as Vulnerable

Number of mature individuals

The number of mature individuals is estimated at 4457 (see the evidence under Criterion 1). This value is based on the number of dead mature trees recorded in the post-fire surveys. The value does not take into account the number of dead trees which could have been transported by flood waters downstream or scorched trees without seeds because of post-fire browsing.

Therefore, the number of mature individuals meets the requirement for Vulnerable (<10,000 individuals).

Population decline

As discussed in Criterion 2, the taxon is projected to decline in the number of mature individuals. This is because of the threats due to climate change (increased fire, flood events and drought),

and the interactions between climate related threats (fire-flood, fire-drought), and the interaction of fire with herbivory and weeds.

Percent of individuals in one subpopulation

There is only one subpopulation of the taxon which is restricted to the flood zone along approximately 20 km of the mid-reaches of the Corang River. Therefore, the percent of mature individuals in one subpopulation meets the requirement for Vulnerable (100 percent).

Conclusion

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

Criterion 4 Number of mature individuals

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

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

Criterion 4 evidence

Not eligible

Number of mature individuals

The number of mature individuals is considered to be greater than 1000. The species does not meet the requirements for listing under this criterion.

Species cannot be listed under Criterion D2 (see criterion 4 table [1]). However, the taxon meets the requirements for the Vulnerable category under D2, given the number of locations is one (see Criterion 2).

Conclusion

The data presented above appear to demonstrate that the taxon is not 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 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

Population viability analysis has not been undertaken for this taxon.

Conclusion

There is insufficient information to determine the eligibility of the taxon for listing in any category under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Adequacy of survey

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

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the Environment 2021, *Conservation Advice for Callitris oblonga* subsp. *corangensis* (Corang pine), Canberra. 

This publication is available at the SPRAT profile for *Callitris oblonga* subsp. *corangensis* (Corang pine).

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Version history table

Document type	Title	Date [dd mm yyyy]
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