



Consultation Document on Listing Eligibility and Conservation Actions

Antrophyum austroqueenslandicum (Border Ranges Lined Fern/Lamington Tongue Fern)

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

- 1) the eligibility of *Antrophyum austroqueenslandicum* (Border Ranges Lined Fern/Lamington Ox Tongue Fern) for inclusion on the EPBC Act threatened species list in the Critically Endangered category and;
- 2) the necessary conservation actions for the above species.

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 and Energy.

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

or by mail to:

The Director
Terrestrial Species Conservation Section
Wildlife, Heritage and Marine Division
Department of the Environment and Energy
PO Box 787
Canberra ACT 2601

Responses are required to be submitted by 1st May 2020.

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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: <http://www.environment.gov.au/biodiversity/threatened/index.html>.

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: <http://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2018.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: <http://www.environment.gov.au/biodiversity/threatened/nominations.html>.

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: <http://www.environment.gov.au/biodiversity/threatened/recovery.html>.

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](#)'. 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: <http://environment.gov.au/privacy-policy> .

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.

Antrophyum austroqueenslandicum

Border Ranges Lined Fern

Taxonomy

Conventionally accepted as *Antrophyum austroqueenslandicum* D.L Jones

Species Information

Description

The Border Ranges Lined Fern is characterised by fronds with a prominent very narrowly winged strip of 2 to 7 cm in length. The blade of the leaf is narrowly elliptic to lanceolate being 4–8 cm long and 5–9 mm wide. The blade is tapered at each end, semi erect to pendent slightly sickle-shaped, leathery, dark green and shiny above, paler beneath; margins slightly irregular; apex broadly obtuse in sterile fronds, gradually tapering to a point and sub-obtuse in fertile fronds; venation obscure, with long narrow areoles. Spores are sparse and spreading for a short distance along the main veins being absent from the central band (Figure 1).



Figure 1. The Border Ranges Lined Fern. Living plant in situ (HSI, 2016).

The oblanceolate shape of the Border Ranges Lined Fern fronds, lacking lobes, and the arrangement of spore into discrete lines along the netted venation on the underside of fertile adult plants are distinctive and are unlikely to be readily confused with any other fern by an experienced observer who has seen a photograph or specimen of this plant (P. Bostock pers. comm. 2015, L. Weber pers. comm. 2015).

Distribution

The Border Ranges Lined Fern is known from a very narrow range near Tyalgum (in the Border Ranges NSW) and the Nightcap Range National Park (NSW) (Department of the Environment 2012).

The Border Ranges Lined Fern represents the most southern and only sub-tropical member of the genus *Antrophyum* in Australia with *A. callifolium* being the next most southerly, occurring south to the tropical Mackay region (HSI 2016).

The species has only been recorded within lowland subtropical rainforest within the Critically Endangered 'Lowland Rainforest of Subtropical Australia' EPBC listed ecological community and NSW listed 'Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion' Endangered ecological community (NSW *Threatened Species Conservation Act 1995*) (Silcock 2019).

In 1983 a small population of an unnamed fern was discovered in Lamington National Park, Queensland, by Col Harman. The plants were growing on rocks and trees beside a pool. There were less than 5 plants. The plant was assigned the phrase name *Antrophyum* sp. Blue Pool or *A. sp. Q1*. One of these plants was collected as the holotype specimen for the naming of the species, *Antrophyum austroqueenslandicum* by David L. Jones. This specimen is lodged in the Queensland Herbarium. Other plants from this location were thought to have been collected by enthusiasts and the single remaining plant in situ died (date unknown). Subsequent searches failed to find any other plants (L. Weber pers. comm. 2015). On 11 August 2006 it was listed as Extinct in the Wild under the *Queensland Nature Conservation Act 1992* and the *Nature Conservation (Wildlife) Regulation 2006*.

The species was re-discovered as a single population during a 2015 survey at Tyalgum in the Border Ranges region of New South Wales (NSW). The population was found on a large streamside boulder with 65 individual plants (L. Weber pers. comm. 2015). The plants were of various sizes, some were fertile, with spore found. The Queensland Herbarium visited the site confirming conclusively that the plants were Border Ranges Lined Ferns using microscopic comparison to the holotype. The new location is 8.5 km from the extinct sub-population at Blue Pool in Lamington National Park and is on private property subject to an in perpetuity conservation covenant with the Nature Conservation Trust of NSW (NCT) (HSI 2016).

Following the discovery in 2015 extensive surveys were undertaken in potential habitat revealing another population at Nightcap Range National Park in 2017 (L. Weber, pers. comm. 2019). Due to the habitat specificity of this species it is unlikely additional populations occur in surveyed areas (L. Weber, pers. comm. 2019). However, additional populations may be present in extremely remote habitat, and further survey is warranted here.

Analysis of distribution data estimates the EOO and AOO at 8km² (Silcock & Collingwood, in prep.). Fire mapping in December 2019 found that this species has not been adversely affected by the 2019 - 2020 fires (ERIN 2019). However, in September 2019 fires did occur on the edges of Lamington National Park mainly burning the drier edges of the rainforest habitat. The full extent of the fire impact on the species is not yet known.

Cultural and Community Significance

The cultural and community significance of the species is not known.

Relevant Biology/Ecology

The Border Ranges Lined Fern is a non-flowering plant that reproduces by spore on the underside of the leaves when the plant is mature. Like all ferns the species has two distinct stages in its lifecycle - it has sporophyte and gametophyte generations. When the spores germinate, they grow into small heart-shaped plants known as prothalli (the gametophyte generation). The gametophyte produces both male and female cells. After fertilisation occurs the adult fern (the sporophyte generation) begins to develop. Free water is required to effect fertilisation during the gametophytic stage. It is possible the moss-like (gametophyte) stage can

persist for some time in the wild even if no adult plants are present at a location. (P. Bostock pers.comm. 2015) Dispersal is via spore which, due to their extremely small size, are easily dispersed by wind or rain.

In addition to the above described sexually reproduction, ferns are also known to reproduce asexually including self-fertilisation, apogamy (a sporophyte grows into a gametophyte without fertilisation occurring – particularly when conditions are too dry to permit fertilisation); proliferous frond tips ferns produce small ferns -plantlets on the frond tip and via rhizomes which spread through the soil sprouting new ferns.

The Border Ranges Lined Fern only occurs within restricted microhabitats within lowland subtropical rainforest, specifically as a lithophyte on andesite boulders and as an epiphyte on lower parts of tree trunks (L. Weber, pers. comm. 2019). Other *Antrophyum* species occur in tropical Queensland and South-east Asia as epiphytes on all parts of trees including twigs and as lithophytes on boulders and cliffs.

The lifespan of this fern is unknown. The total population is 76 (Silcock & Collingwood, in prep.). There are 46 plants recorded at the Tyalgum (Border Ranges) subpopulation and 30 at the Nightcap Range subpopulation (Silcock & Collingwood, in prep.).

The ecology of this fern is not well known but it appears to require a highly specific microclimate, with constant high humidity and air movement as both known locations (including the former Lamington National Park location) are along streams where humidity is maintained by proximity to flowing water.

It is likely that the fern is not able to occupy many streamside sites on rocks and logs due to inundation from flooding that damages habitat and washes away plants. It has been observed that many plants have died after flooding (L. Weber, pers. comm 2019). It is thought that the location of the boulder with a small stream at its foot, but close to a larger stream that floods to high levels, is critical for its survival. The boulder, on which the species is found at the Tyalgum site is situated outside the zone of major flooding from the larger stream.

The Border Ranges Lined Fern grows with other ferns including *Asplenium australasicum*, *A. harmanii*, *Psilotum nudum* and *Microsorium scandens*. Other boulders within a few hundred metres nearby to the rediscovered Tyalgum subpopulation were searched thoroughly and no additional individual plants of the Border Ranges Lined Fern were observed (HSI 2016).

Threats

Table 1: Threats impacting the Border Ranges Lined Fern based on available evidence.

Number	Threat factor	Threat type and status	Evidence base
1.0	Habitat loss		
1.1	Historic logging and land clearing of habitat	Past/Known	There has been a reduction in the rainforest habitat for the species due to past logging and land clearing. The habitat conversion due to agriculture has caused changes to hydrology and the introduction and spread of weeds (HSI 2016; Silcock & Collingwood, in prep.).
1.2	Infrastructure maintenance	Current/Known	There is documented evidence that infrastructure maintenance impacts this species. The subpopulation at Tyalgum occurs near a roadside and is vulnerable to road widening and associated maintenance activities. The population located in the Nightcap Range National Park is vulnerable to

			herbicide drift associated with infrastructure maintenance (L. Weber, pers. comm. 2019).
1.3	Natural disturbances such as fire, flood or landslides	Past, Potential and Current/Known	Natural disturbances such as floods and landslides can damage existing habitat and wash away plants. Individuals have been documented to be lost during flood events (L. Weber pers. comm 2019)
2.0	Invasive species		
2.1	Invasion by weeds	Current/Known	The invasion by weeds is a documented threat to this species. <i>Lantana camara</i> (Lantana) and other weeds have colonised the rocks and boulders which provide habitat for this fern. These weeds negatively impact the fern by changing the light environment, competing for available habitat and nutrients, and potentially smothering ferns. The invasion of Lantana into the habitat of the Border Ranges Lined fern has altered fuel loads and increased the likelihood of fire (L. Weber, pers. comm 2019). There is ongoing weed management and monitoring by the landholders at the Tyalgum population (L. Weber, pers. comm. 2019).
3.0	Allee effects		
3.1	Small population size	Potential and future/known	As the total known global population of this species is approximately 76 plants, inbreeding and lack of sexual reproduction, reducing the genetic diversity of the species is a threat.
4.0	Illegal collection		
4.1	Collection by fern enthusiasts	Past; suspected/potential	<p>Fern enthusiasts collect epiphytic and lithophytic ferns such as <i>Antrophyum species</i>, reducing the population size and potentially causing extinction of the population (HSI 2016).</p> <p>Illegal collection is thought to be responsible for the extinction of the population at Blue Pool Lamington National Park (HSI 2016).</p> <p>Although the known population of the Border Ranges Lined Fern is within a conservation area covenanted in perpetuity with the Nature Conservation Trust of NSW and within the Nightcap Range National Park, illegal collection remains a potential threat (HSI 2016).</p>
5.0	Climate change		

5.1	Reduced rainfall and drought	Known/Future	Given the species highly specific microclimate (constant high humidity and air movement with proximity to flowing water) climate change is a potential threat to the Border Ranges Lined Fern where it results in a reduction in annual average rainfall and longer and more extreme drought conditions as well as increased risk of fire (Silcock & Collingwood, in prep.).
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Assessment of available information in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)			
Population reduction (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	<i>based on any of the following</i> <ul style="list-style-type: none"> (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 		
A2			
A3			
A4			

Evidence:

As ferns can reproduce both sexually and asexually so it is difficult to determine the exact life span of the species. There has been an observed continuing decline in the number of subpopulations since the 1980s. The species is now known from two subpopulations – the Tyalgum subpopulation with 46 plants and the Nightcap Range subpopulation with 30 plants (Silcock & Collingwood, in prep.). Although there are two fragmented subpopulations the same threats are acting at both. The total population is vulnerable to threats including loss of habitat, weed invasion, allee effects, potential exploitation (illegal collection) and, due to its small area of occupancy, loss and damage due to natural events such as drought, fire and floods. The subpopulation at Blue Pool in Lamington National Park is presumed extinct. There has been a documented decline in the Tyalgum subpopulation from 55 to 46 plants between the years 2015 to 2018.

Currently there is insufficient evidence of observed, estimated, inferred, suspected or projected population size reduction over the required time period of ten years or three generations. The data presented above appear to be insufficient to demonstrate if the species is eligible for listing under this criterion.

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

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions indicating distribution is precarious for survival:			
(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			

Evidence:

The species is known from two subpopulations – one at a private property at Tyalgum (in the Border Ranges) and one in Nightcap Range National Park. The subpopulation at Tyalgum has a decreasing trend in the number of mature individuals – falling from 55 in 2015 to 46 in 2018. The Nightcap Range subpopulation has a population of 30 plants with an unknown population trend (Silcock & Collingwood, in prep.).

Based on available distribution data the species EOO are estimated to be 8 km² which is considered 'very restricted' (Silcock & Collingwood, in prep.). The EOO was calculated using a minimum convex hull (IUCN 2019). The area of occupancy is also 'very restricted' estimated at 8km² calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2019 (IUCN 2019).

There has been an observed continuing decline in the number of subpopulations since the 1980s with one of the two known subpopulations with <5 plants becoming extinct – Blue Pool in Lamington National Park. This is proposed to be partly due to collection for horticulture and natural attrition. A single juvenile plant and two detached sterile leaves of an *Antrophyum*, identified in 2002 as "possibly *A. queenslandicum*", was collected at Mt Ballow, SE Qld in 1953, and included in the Kew Herbarium collection. The specimen label indicated there was a plant in the living collection in Royal Botanic Gardens, Kew, however it is suspected that it is no longer present there (P. Bostock pers. comm. 2015). The exact collection location at Mt Ballow is unknown and there are no other records of the species' presence there; however no targeted surveys have been conducted in that area. The Mt Ballow population, if it was the Border Ranges Lined Fern, may have also been possibly driven to extinction through plant collection (HSI 2016).

The Tyalgum and Nightcap Range subpopulations are fragmented with a single event such as flood or fire having the potential to affect all individuals of the population and potentially place this species at risk of extinction from a single event. This is in line with the IUCN guidelines which state "The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present" (IUCN 2019).

Fire mapping in the Border Ranges and the Nightcap Range National Park (ERIN 2019) found that this species has not currently been adversely affected by the 2019 - 2020 fires however due to this continuing threat this will need to be reassessed in the future. The impact of the September 2019 fires which burnt areas of Lamington National Park is not yet known.

The extent and quality of lowland sub-tropical rainforest habitat in Queensland and NSW has been reduced through previous clearance by agriculture and urban settlement. The fragmented remnants

are threatened by ongoing habitat loss for urban expansion, weeds, hydrological changes, recreation and myrtle rust. These cumulative impacts are causing incremental declines of species in this habitat (Silcock & Fensham 2018).

Due to the species' highly restricted distribution, very low population size, 'one' location and declines in potential habitat, the data presented above appear to demonstrate that the species is **eligible for listing as Critically Endangered under Criterion B1(a,b)(i-v) and Criterion B2(a,b)(i-v).**

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

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

Evidence:

The total number of mature individuals is considered 'very low'. There are two known subpopulations consists of 76 plants including juveniles. This represents 100% of known living mature individuals of the Border Ranges Lined Fern.

There has been an observed decline through loss of the population of <5 plants in Lamington National Park, QLD during the 1980s. The species area of habitat occupied by the species is estimated to have declined from 200m² in 1983 to 100 m² in 2016. The number of plants at the Tyalgum subpopulation has a decreasing trend dropping from 55 in 2015 to 46 in 2018. The Nightcap Range subpopulation was estimated at 30 in 2019 with an unknown population trend. Each subpopulation has less than 50 mature individuals (Silcock and Collingwood, in prep).

The number of mature individuals in the two known living sub populations is less than 80 plants with an observed decline of mature individuals in each subpopulation.

The data presented above appear to demonstrate that the species is **eligible for listing as Critically Endangered under C2 subcriterion (a)(i).**

However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore 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
Number of mature individuals	< 50	< 250	< 1,000

Evidence:

The total number of mature individual plants occurring within the two known living subpopulations of the Border Ranges Lined Fern is less than 100 plants including juveniles. This represents 100% of known living mature individuals of this species.

The Border Ranges Lined Fern is a fern that reproduces by spore and requires specialised habitat conditions for reproduction and survival of mature plants. In addition, as the species occurs in a highly restricted locations, a stochastic event such as a flood, landslide or fire could cause most or all the small population to be lost (L. Weber pers. comm. 2015).

The data presented above appear to demonstrate that the species is **eligible for listing as Endangered** under criterion 4 due to the ‘very low’ number of mature individuals.

However, the purpose of this consultation document is to elicit additional information to better understand the species’ status. This conclusion should therefore 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

Evidence:

As population viability analysis has not been undertaken, there are insufficient data to demonstrate if the species is eligible for listing under this criterion.

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

Conservation Actions

Recovery Plan

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.

Primary Conservation Actions

- Ensure the maintenance and protection of the extant populations.
- No loss in known or potential habitat.
- Implement ex-situ conservation measures via translocation into suitable habitat.
- Conduct surveys in remote areas to try and locate new populations.

Conservation Actions

Conservation and Management priorities

- Habitat loss, disturbance and modifications
 - Protect and prevent further habitat loss by supporting and maintaining the conservation covenant at the Tyalgum subpopulation.
 - Negotiate with land managers to maintain and improve the management of potential habitat.
 - Ensure retention and appropriate management of critical and potential habitat.
- Weed invasion
 - Implement weed management actions in known and potential habitat in partnership with the private land holders and local community groups.
 - Continue to support weed management with the landholders for the Tyalgum subpopulation.
 - Ensure weed management is undertaken in the vicinity of the Nightcap Range National Park subpopulation.
 - Remove weeds using minimal disturbance methods, for example, by using hand weeding near the Border Ranges Lined Fern plants.
- Breeding, seed collection, propagation and other ex situ recovery actions
 - Undertake spore germination and/or vegetative propagation trials to determine the requirements for successful establishment.
 - Establish best practice spore storage guidelines and procedures should be adhered to, in order to maximise spore viability and ability to germinate.
 - If spore germination and vegetative propagation is successful, establish and maintain ex-situ populations in Botanic Gardens.
 - Propagate enough individuals to augment extant populations and undertake translocations.
 - Plan and implement translocation program to re-establish population at Blue Pool in Lamington National Park, and other suitable habitat within the species' range. Translocations should follow the 'Guidelines for the translocation of threatened plants in Australia' (Commander et al. 2018).
 - Establish and maintain plant nurseries to provide reliable sources of high quality, genetically diverse seed for use in restoration efforts, and eliminate the need to harvest seed from wild populations.
- Illegal collection
 - Develop and implement a suitable management strategy to prevent illegal collection of plants and spores from both subpopulations.
- Changes to hydrology
 - Using distribution modelling and potentially climate change predictive future modelling map existing habitat patches and identify new future habitat.
 - Understand and ameliorate the effects of climate change on the species.

Stakeholder Engagement

- Establish a coordinating body to oversee development and continue implementation of management activities, including tracking progress towards recovery and adaptive management.
- Engage community groups in the conservation of this species
- Review the effectiveness of management actions on a regular basis.
- Liaison between all jurisdictions and landholders is required. All landholders, interest groups and the public should be kept informed of the conservation status of the species, key threats, recovery progress and achievements.
- Continue collaborations between universities, CSIRO, botanic gardens and other research institutions to undertake required research.
- Engage with the community and non-government organisations to develop a conservation strategy and assist with on-ground conservation actions including fern experts and enthusiast groups.
- Maintain the confidentiality of known population locations to prevent illegal collection of plants.
- Foster the participation of local land owners/land managers who have potential suitable translocation sites.
- Raise awareness of the species with relevant stakeholders in an attempt to find more populations.
- Maintain engagement with private landholders where the species occurs to ensure management activities are appropriate for the species.

Survey and Monitoring priorities

- Undertake targeted surveys within suitable habitat to locate additional populations.
- Design, establish, implement and/or continue programs to monitor all known sites, including regular monitoring of the species' abundance, extent and condition of populations and the extent and severity of threats.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Survey all populations annually to detect any new or increased threatening processes.

Information and Research priorities

- Undertake research to determine the specific habitat requirements of the species to inform management of extant populations and guide future translocation efforts.
- Undertake research to determine propagation and germination requirements to establish an ex-situ conservation collection and spore storage in preparation for future translocations.
- More precisely assess population size, distribution, and ecological requirements of the species.
- Determine conditions that promote recruitment success and improve the understanding of population dynamics.
- Undertake spore germination and planting trials to determine protocols for the most successful and least costly ex situ and in situ propagation.

References cited in the advice

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- Silcock, J.L & Fensham, R.L (2018) Using evidence of decline and extinction risk to identify priority regions, habitats and threats for plant conservation in Australia. *Australian Journal of Botany* 66:541-555.
- Silcock, J., and Collingwood, T. *Antrophyum austroqueenslandicum* profile in the Action Plan for Australia's most Imperilled Plants, in prep.

Other sources cited in the advice

- P. Bostock (2015) *Personal communication*. Nomination for the Border Ranges Fern for listing under the Environment Protection and Biodiversity Conservation Act 1999. Humane Society International 2016
- L. Weber (2015) *Personal communication*. Nomination for the Border Ranges Fern for listing under the Environment Protection and Biodiversity Conservation Act 1999. Humane Society International 2016
- L. Weber (2019) *Personal communication*. Red Hot List profile for *Antrophyum austroqueenslandicum* D.L.Jones [Pteridaceae] order Ranges lined fern, Lamington ox tongue fern

Collective list of questions – your views

SECTION A GENERAL

1. Is the information used to assess the nationally threatened status of the species robust? Have all the underlying assumptions been made explicit? Please provide justification for your response.
2. Can you provide additional data or information relevant to this assessment?
3. Have you been involved in previous state, territory or national assessments of this species/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? (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 in the ecology or biology of the species not in the current advice/plan?

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

Population size

6. Has the survey effort for this taxon been adequate to determine its national adult population size? If not, please provide justification for your response.
7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the species? If not, please provide justification for your response.
8. If not, can you provide a further estimate of the current population size of mature adults of the species (national extent)? Please provide supporting justification or other information.

If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible 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 SPECIES? (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 (*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 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 species/subspecies' total population size over the last approximately 10 years (i.e. three generations)? 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 SPECIES? (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 species/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 km² 100 – 5 000 km² 5 001 – 20 000 km² >20 000 km²

Level of your confidence in this estimated extent of occurrence

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

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

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

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

Level of your confidence in this estimated extent of occurrence:

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

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

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

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

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

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

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

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 km² 100 – 5 000 km² 5 001 – 20 000 km² >20 000 km²

Level of your confidence in this estimated extent of occurrence

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

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

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

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

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

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

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

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

Level of your confidence in this estimated extent of occurrence:

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

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

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

20. Do you consider that all major threats have been identified and described adequately?
21. To what extent is a drying climate and the threat of fires a risk? Do you have information on the impact of the 2017 and 2019 drought had on the species? Do you have information on the impact of the 2019 – 2020 fires had on the species?
22. To what degree are the identified threats likely to impact on the species/subspecies in the future?
23. Are the threats impacting on different populations equally, or do the threats vary across different populations?
24. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the species/subspecies at any stage of its life cycle?
25. Can you provide supporting data/justification or other information for your responses to these questions about threats?

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

26. What planning, management and recovery actions are currently in place supporting protection and recovery of the species/subspecies? To what extent have they been effective?
27. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species/subspecies?
28. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species/subspecies?

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

29. Are you aware of other knowledge (e.g. traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?
30. Are you aware of any cultural or social importance or use that the species has?

31. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species/subspecies?
32. How aware of this species are land managers where the species is found?
33. What level of awareness is there with individuals or organisations around the issues affecting the species/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

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