Abridged Threatened Species Nomination Form

For nominations under the Common Assessment Method (CAM) where supporting information is available, but not in a format suitable for demonstrating compliance with the CAM, and assessment against the IUCN Red List threat status.

Cover Page *(Office use only)*

Species name (scientific and common name)**:**	***Cajanus mareebensis* (S.T Reynolds & Pedley) Maesen**
Nomination for (addition, deletion, change)**:**	**Deletion**
Nominated conservation category and criteria:	**Least Concern**

Scientific committee assessment of eligibility against the criteria:		
This assessment is consistent with the standards set out in Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding.		Yes ☒ No ☐
A.	Population size reduction	Does not meet the criterion. The population is now known to be considerably larger than originally perceived when only four Queensland Herbarium specimens from near Mareeba in 1982. Since 2005, the species has been recorded in many parts of Cape York Peninsula (CYP), where it has been described as 'locally common' at a number of sites, and as far south as Mt. Garnet. The spatial data obtained since 2005, particularly on CYP, have greatly expanded the known extent of occurrence, area of occupancy and population size of the species. A large majority of CYP records were made during one-off surveys and, as a result, there is insufficient data to estimate a trend for the total population. Nevertheless, a reduction in the size of the total population has not been observed since 2005 and there is no basis on which a reduction could be estimated, inferred or suspected in the past or future. Broad-scale clearing of the species' habitat for agricultural expansion in the Mareeba-Dimbulah Irrigation Area, in the southern portion of the range, occurred in the past. Habitat clearing, modification and fragmentation is not considered a current threat anywhere in the species' known range. Other potential threats are considered minimal. Despite the lack of baseline data to estimate a population trend, the data gathered since 2005 demonstrate that the species was originally listed in the EN category in 1992 based on a comparative paucity of data, particularly with respect to this criterion. Given the current data represents a large increase in the species' estimated population size, in addition to its known extent of occurrence and area of occupancy, since 2005, and that the potential causes of past or continuing future decline have ceased or are negligible, it is deduced that the VU thresholds for this criterion have not been met for this species for at least five years (see 5-year rule for transfer between categories outlined in Section 2.2.1 of the IUCN Guidelines (Version 14)), and that the species has effectively recovered.

B.	Geographic range	Does not meet the criterion. Based on 1060 known records EOO is 63,461 km^2 and AOO is 420 km^2 (using Atlas of Living Australia calculator). There have been no observed, estimated, inferred or projected declines in the population (as above) or any events which may suggest extreme fluctuations. The species is not considered to be severely fragmented. The number of locations is two, based on two clearly separated geographic locations – southern Cape York Peninsula and central Einasleigh Uplands bioregions.
C.	Small population size and decline	Does not meet the criterion. Based on the estimated density of mature individuals/ha where the species has been recorded (5-20), the number of mature individuals is estimated to be 210,000 – 840,000 (>10,000). Despite the lack of baseline data to estimate a population trend, the data gathered since 2005 demonstrate that the species was originally listed in the EN category in 1992 based on a comparative paucity of data, particularly with respect to estimating the size of the population or the rate of potential population reduction. Given the current data represents a large increase in the species' estimated population size since 2005, and that the potential causes of past or continuing future decline have ceased or are negligible, it is deduced that the VU thresholds for sub-criterion C1 have not been met for this species for at least five years (see 5-year rule for transfer between categories outlined in Section 2.2.1 of the IUCN Guidelines (Version 14)). There is no evidence of extreme fluctuations or continuing decline at any rate, the number of mature individuals in each of the two subpopulations clearly exceeds 1,000, and neither subpopulation comprises ≥ 90 % of the population. Therefore, the VU thresholds for sub- criterion C2 are not met.
D.	Very small or restricted population	Does not meet the criterion. There is no evidence that the population is very small (>1000 known records). The AOO is >20 km^2 and number of locations, while only two, are large and potential threats to the species are negligible.
E.	Quantitative analysis	Does not meet the criterion. No quantitative analysis into extinction probability has been undertaken. However, there is little doubt that the known abundance of the species is better understood as a result of consistent collections and survey. The 1992 understanding of extent and abundance has changed markedly over a period of over 24 years, as the number of collections and the area of extent has increased. It is highly unlikely to go extinct in the wild in the next 100 years.

Outcome*:*	
Scientific committee Meeting date:	11th August 2016; and again 28th September 2018.
Scientific committee comments:	Extent of Occurrence: Minimum convex hull: 63,461 sq. km. ALA auto-calculation based on 1060 records (Area of Occupancy using 2 km X 2km grid): 420 km^2. Herbarium modelling would suggest a high likelihood of the species occurring in an area of 19,558 km^2. No evidence of population decline or of increasing threats. Appears to be unattractive to domestic stock, is tolerant of regular burning and can withstand regular disturbance. It has a deep tap root, which allows it to recover from disturbances using stored food reserves. When first listed only the Einasleigh Uplands population was known, but now substantial area on Cape York Peninsula is well known. There

	have been significant and comprehensive surveys for this species along the main road corridors in Cape York Peninsula, and it is considered adequately surveyed.		
Recommendation:	"Least concern" under the Nature Conservation Act; "not listed" under the EPBC Act and CAM		
Ministerial approval:	Queensland Minister early in 2017	*Date of Gazettal/ Legislative effect:*	12th May 2017 (NCA)

Nomination summary *(to be completed by nominator)*

Current conservation status				
Scientific name:	***Cajanus mareebensis* (S.T Reynolds & Pedley) Maesen**			
Common name:	None known			
Family name:	Fabaceae		Fauna ☐	Flora ☒
Nomination for:	Listing ☐	Change of status ☐		Delisting ☒
1. *Is the species currently on any conservation list, either in a State or Territory, Australia or Internationally?* 2. *Is it present in an Australian jurisdiction, but not listed?*	*Provide details of the occurrence and listing status for each jurisdiction in the following table*			

Jurisdiction	**State / Territory in which the species occurs**	**Date listed or assessed (or N/A)**	**Listing category i.e. critically endangered or 'none'**	**Listing criteria i.e. B1ab(iii)+2ab(iii)**
International (IUCN Red List)		N/A		
National (EPBC Act)		16th July 2000	Endangered	Unknown
State / Territory	1. Queensland	12th May 2017	Least concern	N/A
	2.			
	3.			

Consistent with Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding, it is confirmed that:	
• this assessment meets the standard of evidence required by the Common Assessment Method to document the eligibility of the species under the IUCN criteria;	Yes ☒ No ☐
Comments:	
• surveys of the species were adequate to inform the assessment;	Yes ☒ No ☐
Comments:	
• the conclusion of the assessment remains current and that any further information that may have become available since the assessment was completed supports or is consistent with the conclusion of the assessment.	Yes ☒ No ☐
Comments:	

Nominated national conservation status: category and criteria			
Presumed extinct (EX) ☐	Critically endangered (CR) ☐	Endangered (EN) ☐	Vulnerable (VU) ☐
None (least concern) ☒	Data Deficient ☐	Conservation Dependent ☐	

What are the IUCN Red List criteria that support the recommended conservation status category?	**None**

Eligibility against the IUCN Red List criteria (A, B, C, D and E)

*Provide justification for the nominated conservation status; is the species eligible or ineligible for listing against the five criteria. For **delisting**, provide details for why the species no longer meets the requirements of the current conservation status.*

A.	Population size reduction (evidence of decline)	• N/A
B.	Geographic range (EOO and AOO, number of locations and evidence of decline)	*Cajanus mareebensis* was originally nominated as endangered in 1992 (under the former Threatened Species Act), based on the species only being known only from limited collections (four Herbarium specimens) in the Mareeba-Dimbulah area. Given the agricultural expansion in the Mareeba-Dimbulah area at that time, the species listing was considered appropriate. In 2005, much larger populations of the species were found to exist on Cape York Peninsula. By 2017, there were 70 Herbarium specimens and an EOO of 63,461 $km^2$and AOO of 420 km^2. There is no evidence of population decline or of increasing threats.
C.	Small population size and decline (population size, distribution and evidence of decline)	• N/A
D.	Very small or restricted population (population size)	• N/A
E.	Quantitative analysis (statistical probability of extinction)	• N/A

Summary of assessment information

EOO	63,461 km^2	AOO	420 km^2 (2 km x2 km grid method).	Generation length	3-6 years

No. locations	2 (southern Cape York, and central Einasleigh Uplands bioregions)	Severely fragmented	Yes ☐ No ☒ Unknown ☐
No. subpopulations	1060 known records from at least 14 subpopulations	No. mature individuals	210,000 – 840,000 individuals (based on density of 5-20 individuals/ ha where it occurs and the AOO of 420 km^2).
Percentage global population within Australia	100%		

Percentage population decline over 10 years or 3 generations	Nil

Threats *(detail how the species is being impacted)*

Threat *(describe the threat and how it impacts on the species. Specify if the threat is past, current or potential)*	Extent *(give details of impact on whole species or specific subpopulations)*	Impact *(what is the level of threat to the conservation of the species)*
Agricultural expansion in the Mareeba Dimbulah Irrigation Area.	Limited agricultural expansion likely with changes to *Vegetation Management Act 1999*	Loss and fragmentation of existing habitat
Potential competition from introduced pasture grasses.	Roadside and disturbed locations	Possible alteration of fire regimes and/or intensity.

Management and Recovery

Is there a Recovery Plan (RP) or Conservation Management Plan operational for the species?	Yes ☐ No

List all relevant recovery or management plans (including draft, in-preparation, out-of-date, national and State/Territory recovery plans, recovery plans for other species or ecological communities, or other management plans that may benefit or be relevant to the nominated species).

- None known

List current management or research actions, if any, that are being undertaken that benefit the conservation of the species.

- The Qld Department of Transport and Main Roads (DTMR) in early July 2016 undertook a *Cajanus mareebensis* translocation trial 5 km south of Coen, to meet its legislative obligations and to better understand the translocation process. At the time of preparing this submission (September 2018), eight of the ten plants re-located remained alive, and six of eight had developed new foliage

List further recommended management or research actions, if any, that would benefit the conservation of the species.

- Some populations in the south of its range to be included in protected areas

Nomination prepared by:	
Contact details:	
Date submitted:	21st October 2019

If the nomination has been refereed or reviewed by experts, please provide their names and contact details:

Nomination to Remove a Threatened Species from the List

For removing a native species from any category in the list of threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The purpose of this form is to provide a nomination to the Threatened Species Scientific Committee (the Committee) for reassessment of a listed species/subspecies to determine if that species should be removed from the list of threatened species under the EPBC Act.

For a species to be found eligible to be removed from the threatened species list evidence must be provided to demonstrate that the species no longer meets any of the five criteria for listing and is therefore not considered threatened. Evidence must also be provided to demonstrate that the removal of conservation management programs for the species as a result of it being removed from the list of threatened species would not result in the species becoming eligible for listing in the foreseeable future.

If there is insufficient information to enable details to be provided because of a lack of scientific data or analysis please include any information that is available or provide a statement next to the relevant question identifying that the data or analysis is not available. Please provide references in your nomination to support information provided.

The Committee recognises that completing a nomination form is demanding as a result of the information required by the Committee to undertake an assessment to determine the eligibility for listing. Nominators are encouraged to seek expert advice where appropriate to assist in the completion of the nomination form.

Note – Further detail to help you complete this form is provided at Attachment A.
If using this form in Microsoft Word, you can jump to this information by Ctrl+clicking the hyperlinks (in blue text).

Important notes for completing this form

- Please complete the form as comprehensively as possible – it is important for the Threatened Species Scientific Committee to have as much information as possible to judge a species' eligibility against the EPBC Act criteria for listing.
- Reference all information and facts, both in the text and in a reference list at the end of the form.
- The opinions of appropriate scientific experts may be cited as personal communications, with their approval, in support of your nomination. Please provide the name of the experts, their qualifications and contact details in the reference list at the end of the form.
- If the species is considered to be affected (benefitted) by climate change and you are referring to this as a reason for delisting please refer to the Guidelines for assessing climate change as a threat to native species (Attachment B; Part G).
- Identify any confidential material and explain the sensitivity.
- Figures, tables and maps can be included at the end of the form or prepared as separate electronic or hardcopy documents (referred to as appendices or attachments in your nomination).
- Cross-reference relevant areas of the nomination form where needed.

Details of the nominated Species or Subspecies

NAME OF NOMINATED SPECIES (OR SUBSPECIES)

Scientific name: *Cajanus mareebensis* (S.T Reynolds & Pedley) Maesen
Common name(s): None known

CURRENT LISTING CATEGORY

What category is the species currently listed in under the EPBC Act?

☐ Extinct	☐ Extinct in the wild	☐ Critically Endangered
X Endangered	☐ Vulnerable	☐ Conservation dependent

REASON FOR THE NOMINATION TO REMOVE FROM THE LIST

What is the reason for the nomination?

X Genuine change of status	X New Knowledge	☐ Mistake	☐ Other
Taxonomic change – ☐ 'split'	☐ newly described	☐ 'lumped'	☐ no longer valid

TAXONOMY

Provide any relevant detail on the species' taxonomy (e.g. authors of taxon or naming authority, year and reference; synonyms; Family and Order)

Accepted name: Fabaceae *Cajanus mareebensis* (S.T Reynolds & Pedley) Maesen (Agric. Univ. Wageningen Pap. 85(4): 149. 1986 [1985 publ. 1986])
Basionym: Leguminosae *Atylosia mareebensis* S.T.Reynolds & Pedley Austrobaileya 1(4): 422 (1981).

INITIAL LISTING

Describe the reasons for the species' initial listing and if available the criteria under which it was formerly considered eligible.

Cajanus mareebensis was originally nominated as endangered in 1992 (under the former Threatened Species Act), based on the species only being known only from limited collections in the Mareeba-Dimbulah area. Given the agricultural expansion in the Mareeba-Dimbulah area at that time, the species listing was considered appropriate. In 2005, much larger populations of the species were found to exist on Cape York Peninsula.

CHANGES IN SITUATION

How have circumstances changed since the species was listed that now makes it eligible for removal from the list?

Since 1992 the species has been recorded in many parts of Cape York Peninsula, particularly between Laura and the Archer River north of Coen, east to Lakefield National Park and just west of Cooktown. In these areas it is often described as 'locally common'. Populations have also been located as far south as Mt. Garnet. These collections have significantly expanded the species population. There are now 87 Atlas of Living Australia (ALA) records and an additional 18 records have recently been lodged with BRI and ATH (Cairns). These recent collections (Biotropica Australia May 2016) have further extended the species range (refer Maps 2 & 3). Collection of fertile material is often problematic on Cape York where the seasonal monsoon restricts access.

Herbarium collections tend to suggest there are two 'loose populations', a southern population located between Mareeba and Mt. Garnet (Einasleigh Uplands Bioregion) and a northern population found between Cooktown and the Archer River (Cape York Peninsula Bioregion).

Whilst the southern area of occupancy has undergone some agricultural expansion, the species is present within areas of intact habitat which is not undergoing any habitat modification. On Cape York Peninsula, the species habitat is not undergoing any modification or fragmentation, nor is there any broad-scale clearing occurring within the species known Cape York range.

Threats

IDENTIFICATION OF KNOWN THREATS AND IMPACT OF THE THREATS

Identify in the tables below any **KNOWN** threats to the species, under the provided headings indicate if the threat is **past, current or future** and whether the threats are **actual or potential.**
NB – CLIMATE CHANGE AS A THREAT. If climate change is an **important** threat to the nominated species it is important that you provide **referenced** information on **exactly how** climate change might significantly increase the nominated species' vulnerability to extinction. For guidance refer to the Guidelines for assessing climate change as a threat to native species (Attachment B; Part G).

Past threats	**Impact of threat**
Agricultural expansion in the Mareeba Dimbulah Irrigation Area.	Loss and fragmentation of existing habitat
Current threats	**Impact of threat**
Potential competition from introduced pasture grasses.	Possible alteration of fire regimes and/or intensity.
Actual future threats	**Impact of threat**
None known	
Potential future threats	**Impact of threat**
None known	

CRITERION 1

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 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

Please identify whether the species meets A1, A2, A3 or A4. Include an explanation, supported by data and information, on how the species meets the criterion (A1 – A4). You must provide a response. If there is no evidence to demonstrate a population size reduction this must be stated

The known population has expanded considerably since 1992 with the lodgement of additional specimens since 2005, from

the Cape York Peninsula bioregion. There does not appear to have been any contraction in the Mareeba area, nor from the nearby Mt. Garnet area where Biotropica personnel made recent collections of fertile material.

CRITERION 2:

Criterion 2. Geographic distribution is precarious 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; (number of mature individuals			

Please refer to the 'Guidelines for Using the IUCN Red List Categories and Criteria' http://jr.iucnredlist.org/documents/RedListGuidelines.pdf for interpreting the criterion particularly in relation to calculating area of occupancy and extent of occurrence.

Please identify whether the species meets B1 or B2. Include an explanation, supported by data and information, on how the species meets 2 of (a) (b) or (c).

You must provide a response. If there is no evidence to demonstrate that the geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy this must be stated.

QLD Herbarium modelling suggests the species has a highly likely range of just below 20,000 kms^2. Based on 1060 known records EOO is 63,461 kms^2 and AOO is 420 kms^2 (ALA calculator). There have been no observed declines in the population or any events which may suggest either fluctuations in numbers of individuals or the area of occupancy.

CRITERION 3

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

Please identify the estimated total number of mature individuals and either an answer to C1 or C2. Include an explanation, supported by data and information, on how the species meets the criteria. Note: If the estimated total number of mature individuals is unknown but presumed to be likely to be >10 000 you are not required to provide evidence in support of C1 or C2 just state that the number is likely to be >10 000.

You must provide a response. If there is no evidence to demonstrate small population size and decline this must be stated.

It is not possible to calculate the total number of individual *Cajanus mareebensis* that may be present. Recent and historical surveys concentrated on this species suggest an average density of 5-20 plants/ha where the species occurs. Recent

translocation works with *C. mareebensis* in the area south of Coen also suggest an average of 10 plants/ha. In a roadside traverse of sections of the Peninsula Development Road, at least 127 and 69 individuals were recorded in a 1 km and a 1.2 km long stretch respectively.

A review of BRI records was undertaken for this submission, examining all records where the collector has provided some indication of plant density, and dividing collections into the northern and southern populations. There were 18 records for each population (total 36) where density was provided. Within the Cape York area, 13 of 18 records noted the plant was common / occasional, and 5 records indicated rare/scarce density. Within the Einasleigh Uplands population, 6 of 18 records suggest a locally common density, and the 12 remaining records indicated density was rare / uncommon. This suggests that more than 50% of sites recorded density as common, with records of the southern population indicating a lower density, wherever density was recorded. Appendix 2 details ALA records where the collector has indicated plant density.

Given that QLD Herbarium and Biotropica modelling suggests the species has a high likelihood to occur over an area of 19,558 sq.kms the total population size may be substantial (refer Maps 2 & 3). There are 1060 known location records, of which significant proportions are records of several individuals per location.

CRITERION 4:

Criterion 4. Very small population			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Please identify the estimated total number of mature individuals and evidence on how the figure derived

You must provide a response. If there is no evidence to demonstrate very small population size and decline this must be stated.

There is no evidence that the population is very small (see above).

CRITERION 5

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**

Please identify the probability of extinction and evidence as to have the analysis was undertaken.

You must provide a response. If there has been no quantitative analysis undertaken must be stated.

No quantitative analysis into extinction probability has been undertaken. However, there is little doubt that the known abundance of the species is better understood as a result of consistent collections and survey. The 1992 understanding of extent and abundance have changed markedly over a period of over 24 years, as the number of collections and the area of occurrence has increased.

Conservation Management Actions

CONSERVATION MANAGEMENT ACTIONS

Provide details of current conservation management actions for the species. Include details of recovery plans, threat abatement actions, state government programs, work being undertaken by conservation groups, protected areas for the species, rebuilding or restocking programs etc.

The Qld Department of Transport and Main Roads (DTMR) has recently (early July 2016) undertaken a *Cajanus mareebensis* translocation trial 5 km south of Coen, to meet its legislative obligations and to better understand the translocation process. At the time of preparing this submission, eight of the ten plants re-located remained alive, and six of eight had developed new foliage. The translocation exercise showed that plants growing on sand soils are more problematic to re-locate because of the lack of soil cohesion; however, individuals on substrates with higher clay content are more amenable to this form of conservation action. During translocation it was found that the plant has a 'pencil-like' tuber up to 300 mm in length which it is assumed is a storage organ facilitating post-disturbance recovery. This was previously unknown. DTMR have also taken steps to ensure that plants growing beside the Peninsula

Development Road are signed/marked to ensure that road maintenance/construction works do not accidentally disturb existing plants. There are no other conservation related actions being undertaken in relation to this species.

REDUCTION OR CESSATION OF CONSERVATION MANAGEMENT ACTIONS

If the management actions referred to in Question 14 were to be reduced or cease as a result of the species being removed from the list, would this result in the decline of the species at such a rate that it would again become eligible for listing in the foreseeable future? Please ensure that you provide evidence and appropriate references to support your response.

Given that the species has maintained its population in the absence of any dedicated conservation actions, it seems unlikely that any downgrading of current listing would affect the species' status.

SURVEYS

Provide information on survey effort to date, and any ongoing/proposed monitoring programs.

As part of this report, Biotropica botanists undertook surveys for the species between Mt. Garnet and the Archer River aiming to confirm and/or extend the species known distribution. This survey suggested plant density was around 5-20 plants/ha and records from that survey are shown on Map 1.

To meet its legislative obligations DTMR have also undertaken pre-construction surveys in areas where the species is likely to occur. These surveys have occurred between Laura and the Archer River. Similar densities have been recorded during these targeted surveys.

Monitoring of ten individual plants recently translocated is ongoing and monitoring of survival and growth will continue for a period of two years.

No other targeted surveys or monitoring programs are currently underway.

Species Information

DISTRIBUTION

Provide a succinct overview of the species' known or estimated current and past distribution, including international/national distribution. Provide a map if available.

Is the species protected within the reserve system (e.g. national parks, Indigenous Protected Areas, or other conservation estates, private land covenants, etc.)? If so, which populations? Which reserves are actively managed for this species? Give details.

Map 1 shows the location of records from QLD Herbarium, ALA, DTMR and in-house (Biotropica) surveys. The species occurs in the following Protected Areas: Oyala Thumotang NP (CYPAL), Olkola NP (CYPAL), Olkola (Kurrumbila) RP 1 and Rinyirru (Lakefield) RP. There are also records from road reserves within Rinyirru (Lakefield) NP. The species has also been recorded within Artemis Antbed Nature Refuge and Yarraden Nature Refuge.

The species does not occur within any community listed under the EPBC Act.

As noted above, between 1962 (the earliest collection record) and 2005, it was thought that the species was restricted to the Mareeba-Dimbulah area, and endangered status was granted in 1992 on the basis of this presumed distribution. In 2005 the species was recorded on Cape York and there have been multiple collections on Cape York since that time.

BIOLOGY/ECOLOGY

Provide a summary of biological and ecological information.

Cajanus mareebensis (S.T Reynolds and Pedley) Maesen is a prostrate trailing (not twining) herb/vine (family Fabaceae) which may be annual or perennial. The plant produces roots at nodules and trailing stems may be up to 4 m in length, more commonly 2-3 m. Leaves have three leaflets that are narrowly ovate, erect or 'finger-like', to 11 mm in width and from 60-90 mm in length. Leaflets are typically lighter and hairless above, with the darker under-surface and stems hairy. Pea flowers are held in long racemes, with the standard and wings yellow, keel green, with a reddish-green calyx. Pods (generally 20 mm x 10 mm) are flattened, clothed in longer white hairs than seen on stems and leaflets, and are (characteristically) mottled purple/brown and green in colour. Pods contain 2-4 darkly flecked seeds. The plant has been recorded in the Einasleigh Uplands and Cape York Peninsula Bioregions.

The species is typically encountered on sandy substrates mostly derived from granitic parent material. Whilst absent from water-logged sites, it may however be encountered near riparian zones in woodland settings, and in the southern-most portion of its range (e.g., near Mareeba) such riparian areas may also support vine forest communities. Herbarium

records suggest the species typically occurs on well-drained rises, on sandy alluvial plains. Records provide no indication that the species favours any particular aspect. Field experience also confirms that aspect is not a distinctive feature of the species habitat.

As *Cajanus mareebensis* is generally found on sand soils derived from granite, the most prevalent soil group associations are the Clark, Dixie and Kimba groups. It is also found on metamorphic substrates south of Coen.

The area of occurrence is subject to a monsoonal climate featuring a typical dry season from May to October, and a wet season (and occasional tropical cyclones) from November to April. The species known distribution is within a broad climate zone which extends beyond the species currently understood distribution.

A number of Regional Ecosystems are known to support the species, some of which have an extensive area of occurrence. These are typically open woodland ecosystems dominated by a variety of species from the Eucalyptus/Corymbia genera including; *Eucalyptus tetrodonta, E, leptophleba, Corymbia tessellaris, C. stockeri, C. clarksoniana, C. dallachyana* and *C. nesophila*. *Erythrophleum chlorostachys* is often present, along with a shrub and grass layer typical of monsoon woodlands. Observations suggest the species is less likely to occur in association with ironbark species (e.g., *E. cullenii* in the north and *E. crebra* in the south). There are no species that may be described as associated with *C. mareebensis*. All of the Regional Ecosystems in which the species is found display floristics and structure that is typical of monsoon woodlands, including Regional Ecosystem 3.11.11 where the species is most common.

The plant's mode of dispersal is unknown. The species appears to have a clumped distribution. Where it occurs there is generally more than one individual, and frequently a number of plants. There is often a distance between one 'clump' and the next 'clump', suggesting that a group of plants are derived from a parent in close proximity. There is no indication that the plant is dispersed by animals or birds. It is likely that the species has significant seed bank longevity (Ailsa Holland pers comm July 18th. 2016)

INDIGENOUS CULTURAL SIGNIFICANCE

Is the species known to have cultural significance for Indigenous groups within Australia? If so, to which groups? Provide information on the nature of this significance if publicly available.

The species has no known cultural significance.

ADDITIONAL COMMENTS/INFORMATION

Please include any additional comments or information on the species such as survey or monitoring information, maps that would assist with the consideration of the nomination.

See Maps 1-3

Reviewers and Referencing

REVIEWER(S)

Has this nomination been peer-reviewed? Have relevant experts been consulted on this nomination? If so, please include their names, current professional positions and contact details.

A number of experts on the flora of Cape York were contacted for their views on the status of *C. mareebensis*. The following presents a summary of information gleaned during these interviews:

Keith McDonald - independent collector (formerly Qld Parks and Wildlife), member Threatened Species Technical Committee (Qld).
Species is most common on sand soils where vegetation is dominated by *Eucalyptus tetrodonta*. Grazing, light grading and fire are tolerated, and a degree of disturbance appears to favour the plant. Cattle ignore the plant and its leafless form during the dry season would limit any value as a feed source. Collections over the past few years have significantly increased its known distribution, and it is known to exist over a wide area between Mt. Garnet and the Archer River, north of Coen.

Dr. Ailsa Holland - Fabaceae curator Queensland Herbarium
Downgrading of current status is supported, although the species does not occur in any protected areas in the southern part of its range.

The plant responds to both fire and anthropogenic disturbance. Both factors are probably important in breaking seed dormancy. It is likely that the seed is very long--lived and able to persist until disturbance occurs. Introduced pasture grasses probably constitute the main threat to the species.

Dr. Bruce Wannan Principal Biodiversity Planning Officer DEHP/Cape York botany specialist

The plant is most common on sand ridges on Cape York Peninsula/Land Zone 5. It is mostly associated with deeply weathered granite substrates. Downgrading of current status is supported. The plant is no longer worthy of endangered or vulnerable status given its prevalence on Cape York and the absence of any threats to the current population.

REFERENCE LIST

Please list key references/documentation you have referred to in your nomination.

Nominator's Details

Note: Your details are subject to the provisions of the *Privacy Act 1988* and will not be divulged to third parties if advice regarding the nomination is sought from such parties. If there are multiple nominators please include details below for all nominators.

TITLE (e.g. Mr/Mrs/Dr/Professor/etc.)

FULL NAME

ORGANISATION OR COMPANY NAME (IF APPLICABLE)

CONTACT DETAILS

DECLARATION

I declare that, to the best of my knowledge, the information in this nomination and its attachments is true and correct.

Signed:

Date: August 2nd, 2016

Lodging your nomination

How to lodge your nomination

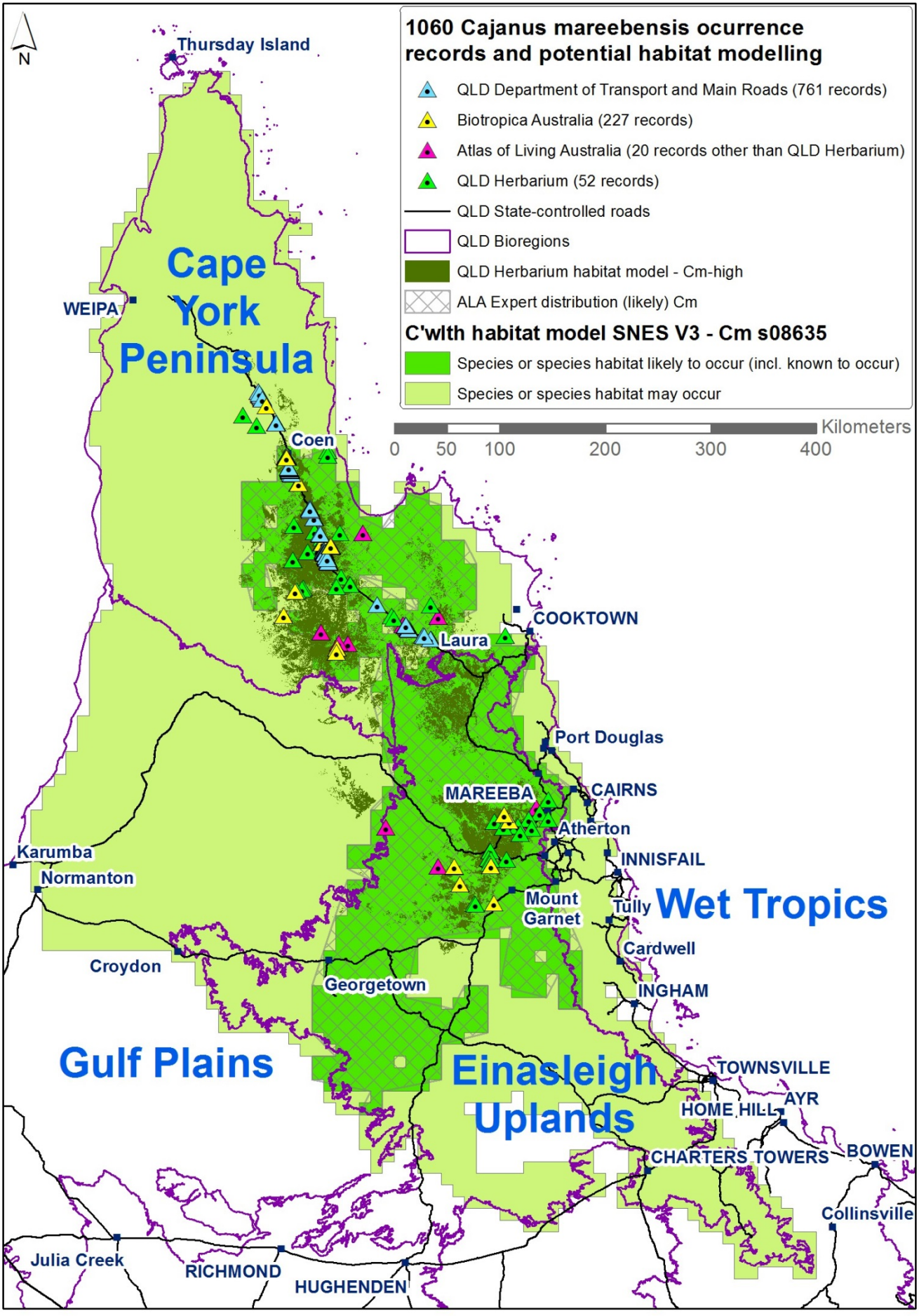
Completed nominations may be lodged either:

1. by email in word format to: epbc.nominations@environment.gov.au, **or**
2. by mail to: The Nomination Officer
   Species Information and Policy Section
   Department of the Environment
   GPO Box 787
   Canberra ACT 2601

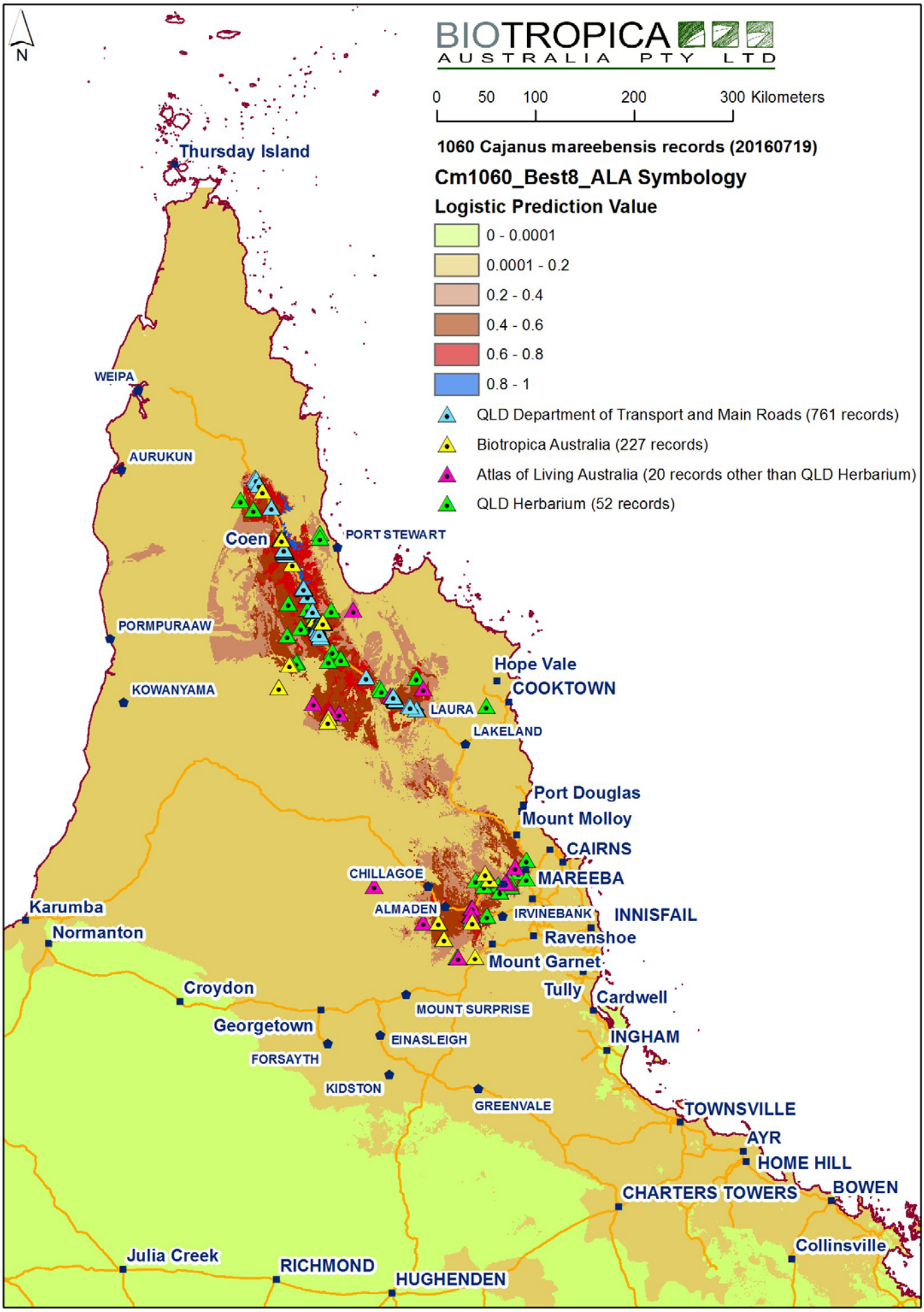
**** If submitting by mail, you must include an electronic copy on a memory stick.***

APPENDIX 1

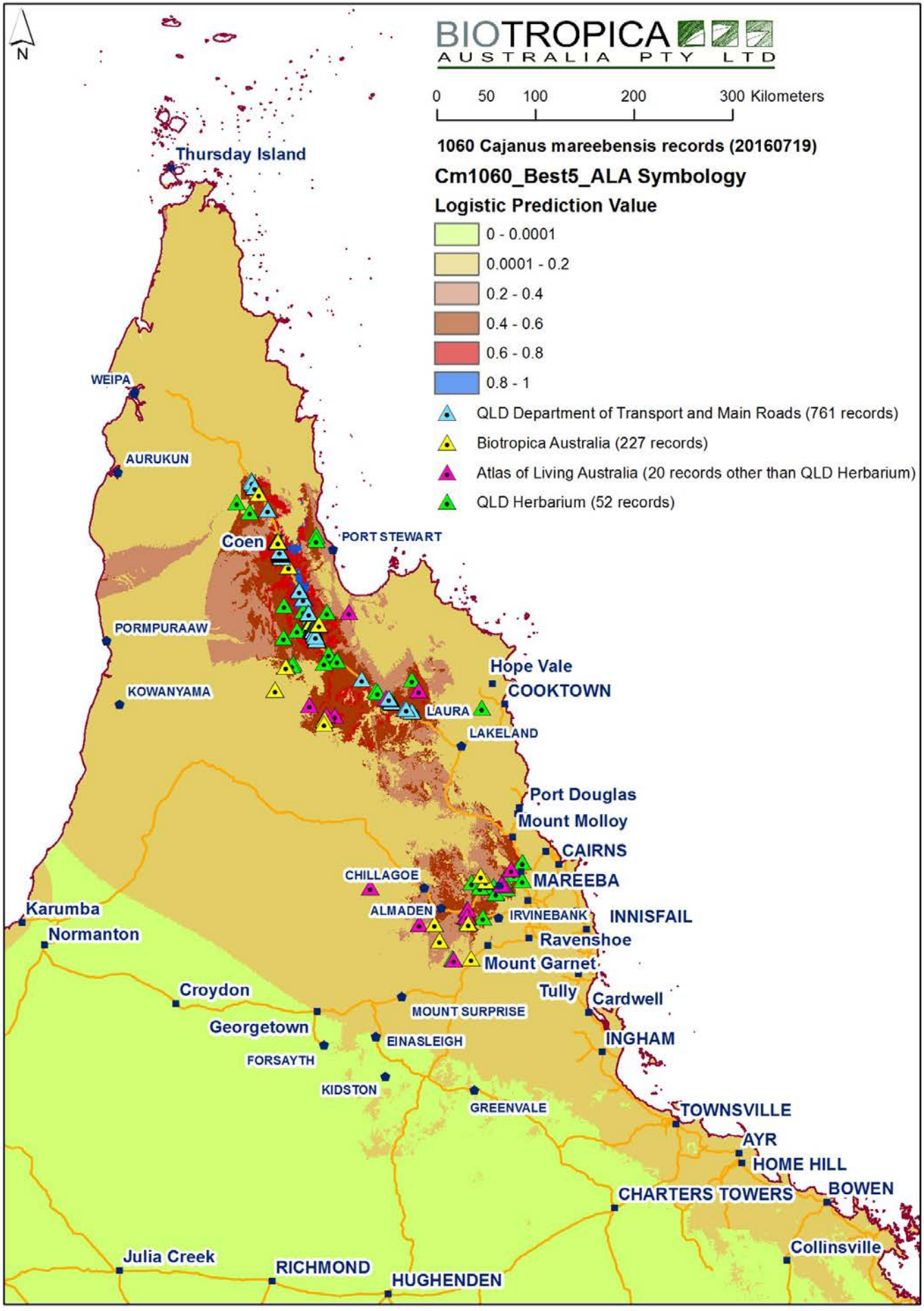
Map 1



Map 2


BIOTROPICA
AUSTRALIA PTY LTD
N
0 50 100 200 300 Kilometers
1060 Cajanus mareebensis records (20160719)
Cm1060_Best8_ALA Symbology
Logistic Prediction Value
0 - 0.0001
0.0001 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
QLD Department of Transport and Main Roads (761 records)
Biotropica Australia (227 records)
Atlas of Living Australia (20 records other than QLD Herbarium)
QLD Herbarium (52 records)
Thursday Island
WEIPA
AURUKUN
Coen
PORT STEWART
PORMPURAAW
KOWANYAMA
Hope Vale
COOKTOWN
LAURA
LAKELAND
Port Douglas
Mount Molloy
CAIRNS
CHILLAGOE
MAREEBA
Karumba
ALMADEN
IRVINEBANK
INNISFAIL
Normanton
Ravenshoe
Mount Garnet
Croydon
Tully
Cardwell
MOUNT SURPRISE
Georgetown
EINASLEIGH
INGHAM
FORSAYTH
KIDSTON
GREENVALE
TOWNSVILLE
AYR
HOME HILL
CHARTERS TOWERS
BOWEN
Collinsville
Julia Creek
RICHMOND
HUGHENDEN

Map 3


N
BIOTROPICA
AUSTRALIA PTY LTD
0 50 100 200 300 Kilometers
1060 Cajanus mareebensis records (20160719)
Cm1060_Best5_ALA Symbology
Logistic Prediction Value
0 - 0.0001
0.0001 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1
QLD Department of Transport and Main Roads (761 records)
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ALMADEN
IRVINEBANK
INNISFAIL
Normanton
Ravenshoe
Mount Garnet
Croydon
Tully
Cardwell
MOUNT SURPRISE
Georgetown
EINASLEIGH
INGHAM
FORSAYTH
KIDSTON
GREENVALE
TOWNSVILLE
AYR
HOME HILL
CHARTERS TOWERS
BOWEN
Collinsville
Julia Creek
RICHMOND
HUGHENDEN

Cajanus mareebensis **Species Distribution Modelling - Technical Background**

Cm1060_20160719: 232 parameters/layers (3 most responsive highlighted)

Methodology

1) Confirm validity of selected modelling strategy with modelling expert Dr.Kristen Williams (CSIRO Canberra)
2) Upload 1060 unique *Cajanus mareebensis* records to the Atlas of Living Australia (ALA).
3) Run MaxEnt (ALA predict tool) with all 232 selected, relevant, environmental and contextual parameters/layers including a 'Jacknife' analysis for quantifying the responsiveness of each parameter/layer. Note that for the initial iteration parameters/layers were sectioned/grouped for better processing efficacy.
4) Iteratively select parameters/layers with a regularised training gain (i.e. with a high responsiveness):
   - above 1.0 in the first two iterations and
   - above 1.2 in the last two iterations.
5) Graphically display the logistic prediction values of the last two model results (best 8 and best 5) together with the 1060 records.

Initial Iteration of 232 parameters/layers resulted in 36 most responsive parameters:

Iteration 2:

Climate1 >1

x Evaporation - annual mean (el747)
x Humidity - annual mean relative (el728)
x Humidity - annual mean relative 3pm (el746)
x Humidity - month max relative (el743)
x Humidity - month min relative (el749)
x Humidity - month min relative 3pm (el744)
x Vapour pressure deficit - annual mean (el738)
x Vapour pressure deficit - annual mean 9am (el757)
x Vapour pressure deficit - month max (el733)
x Vapour pressure deficit - month max 9am (el732)
x Vapour pressure deficit - month min (el724)

Climate2 >1

Aridity index - annual mean (el715)
Aridity index - month max (el719)
Precipitation - annual seasonality (el772)
Precipitation - annual seasonality ratio (el745)
x Precipitation - warmest quarter (Bio18) (el878)
Precipitation - wettest month (el711)
Precipitation - wettest period (Bio13) (el866)
x Precipitation deficit - annual mean (el740)
Precipitation deficit - month min (el763)

Climate3 >1

x Radiation - annual mean (Bio20) (el881)
x Radiation - mean annual precipitation modified (el775)
x Radiation - warmest quarter (Bio26) (el894)

Climate4 (>1)

Temperature - annual range (el725)
Temperature - min difference in min (el716)
x Temperature - min difference in max (el753)
WorldClim; Temperature - seasonality (el783)
WorldClim; Temperature - annual range (el787)

Climate5 (no>1)

Wind

Misc1 (no>1)
Distance-Remoteness-Fire-Drainage

Substrate 2 (>1)
Crop factor - annual mean (el755)
Moisture Index - annual mean (Bio28) (el891)
Moisture Index - warmest quarter mean (Bio34) (el868)
Moisture Index - seasonality (Bio31) (el885)
Water potential - annual mean (el717)
Water stress index - annual mean (el721)

Substrate 1, 3(no>1)
Geology-Soil Chemistry
Soil Structure

Topography (>1)
Physiographic Provinces of Australia (cl2022)
Physiographic Regions 2011 (cl2021)

Vegetation (no>1)

Iteration 3:

Cm1060_Biotropica_Best29

Evaporation - annual mean (el747)
Humidity - annual mean relative (el728)
Humidity - annual mean relative 3pm (el746)
Humidity - month max relative (el743)
Vapour pressure deficit - annual mean (el738)
Vapour pressure deficit - month max (el733)
Vapour pressure deficit - month max 9am (el732)
Aridity index - annual mean (el715)
Aridity index - month max (el719)
Precipitation - annual seasonality (el772)
Precipitation - annual seasonality ratio (el745)
Precipitation - warmest quarter (Bio18) (el878)
Precipitation - wettest period (Bio13) (el866)
Precipitation deficit - annual mean (el740)
Precipitation deficit - month min (el763)
Radiation - annual mean (Bio20) (el881)
Radiation - mean annual precipitation modified (el775)
Radiation - warmest quarter (Bio26) (el894)
Temperature - annual range (el725)
Temperature - min difference in max (el753)
Temperature - min difference in min (el716)
Substrate - Crop factor - annual mean (el755)
Substrate - Moisture Index - annual mean (Bio28) (el891)
Substrate - Moisture Index - seasonality (Bio31) (el885)
Substrate - Moisture Index - warmest quarter mean (Bio34) (el868)
Substrate - Water potential - annual mean (el717)
Substrate - Water stress index - annual mean (el721)
Physiographic Provinces of Australia (cl2022)
Physiographic Regions 2011 (cl2021)

Iteration 4:

Cm1060_Biotropica_Best8

- Precipitation - warmest quarter (Bio18) (el878) [Units: mm]
- Precipitation deficit - annual mean (el740)
  [Units: mm - The monthly difference between precipitation and potential evaporation (pan, free-water surface), without accounting for soil buffering capacity on water availability (after Harmsen et al. (2009), adapted from De Pauw (2002)). Also known as water deficit or hydrological deficit. Values are negative when evaporation demand is greater than rainfall.]
- Temperature - min difference in max (el753)
  [Units: degrees C/day - The monthly average daily difference in maximum temperatures between successive months (i.e., January values minus December values, February values minus January values, etc), representing increments of change in the seasonal progression of daytime temperatures.]
- Radiation - mean annual precipitation modified (el775) [Units: MJ/m2/day]
- Substrate - Crop factor - annual mean (el755)
  [Units:dimensionless - The monthly ratio of actual evapotranspiration to potential (pan, free-water surface) evaporation. Adapted from the index by Specht and Jones (1971). Actual evapotranspiration is an output of a water balance model, and potential evaporation is an input. This ratio represents a water stress index and has been termed the “crop factor” (Doorenbos and Pruitt 1975)]
- Substrate - Moisture Index - annual mean (Bio28) (el891) [Units:dimensionless]
- Substrate - Water stress index - annual mean (el721)
  [Units:dimensionless - The monthly water stress is the percentage of actual to potential evapotranspiration. Adapted from the index by (Hackett 1988). Actual evapotranspiration is an output of a water balance model, and potential evapotranspiration is the pan evaporation (free-water surface) adjusted by the coefficient of potential evapotranspiration (PETCF). A constant PETCF value of 0.9 was used for all months which assumes constant leaf area index.]
- Physiographic Regions 2011 (cl2021) [Units:dimensionless]

FINAL RESULT

Cm1060_Biotropica_Best5

- Water stress index - annual mean (el721)
- Precipitation deficit - annual mean (el740)
- Temperature - min difference in max (el753)
- Substrate - Crop factor - annual mean (el755)
- Precipitation - warmest quarter (Bio18) (el878)

Maxent model for All Species – 1060 records Biotropica Best 5

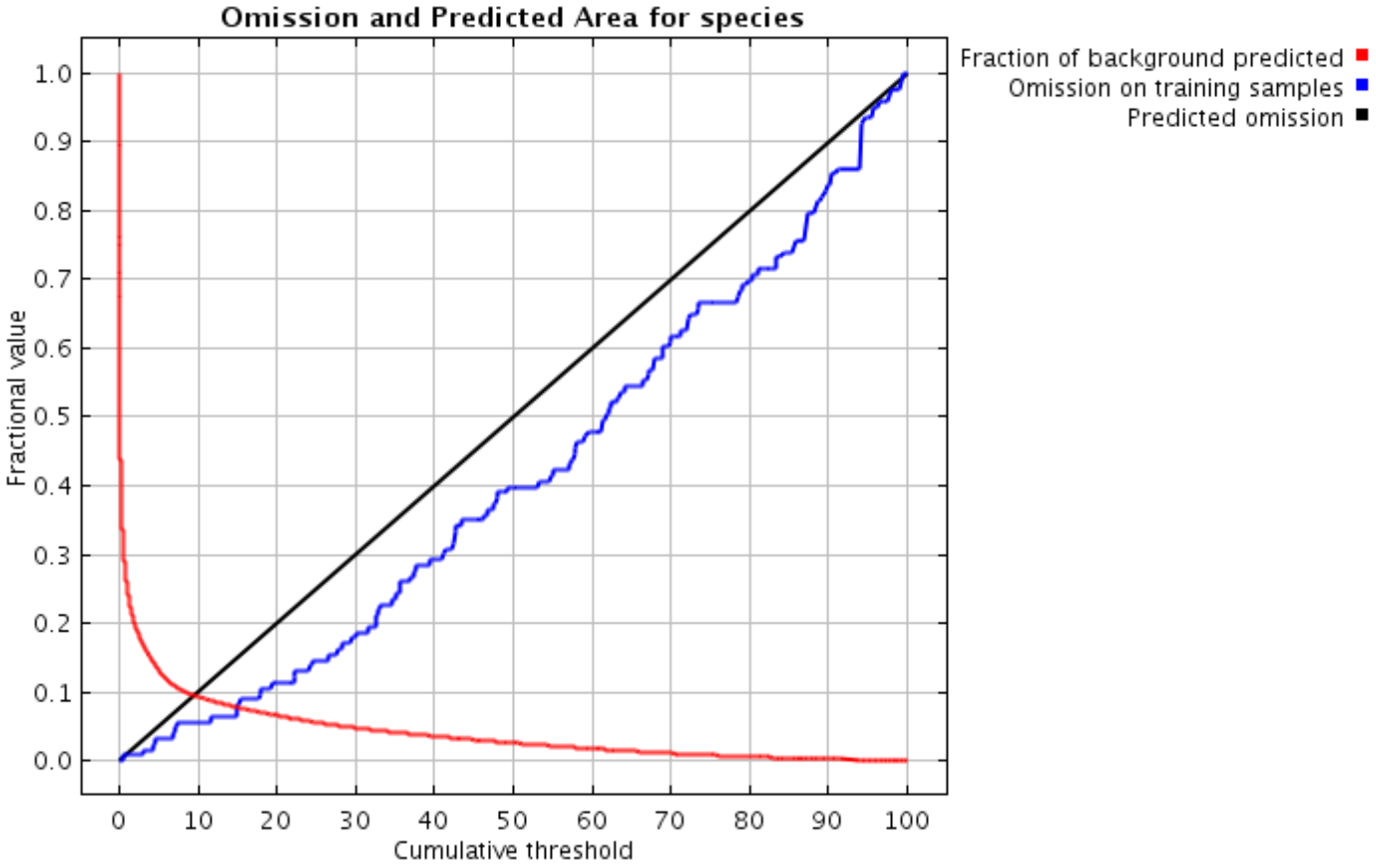
This Maxent v3.3.3e predictive model for All species was created Wed Jul 20 11:50:54 AEST 2016 using Maxent version 3.3.3k. Links at the bottom of this page to the raw data may be used for further analysis.

Model reference number: 1468979425153
Species: All species
Layers:

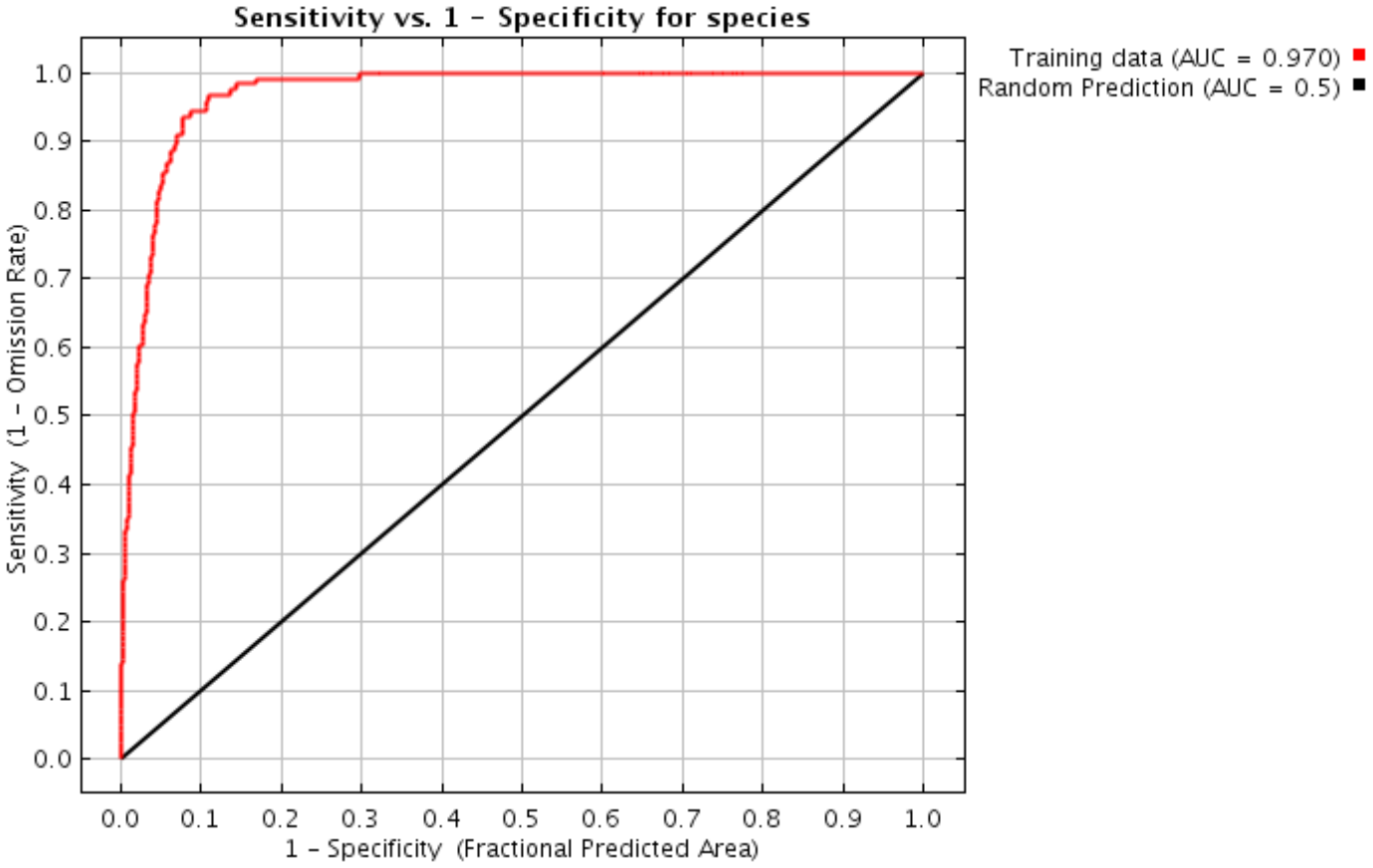
- Water stress index - annual mean (el721)
- Precipitation deficit - annual mean (el740)
- Temperature - min difference in max (el753)
- Crop factor - annual mean (el755)
- Precipitation - warmest quarter (Bio18) (el878)

Analysis of omission/commission

The following picture shows the omission rate and predicted area as a function of the cumulative threshold. The omission rate is calculated both on the training presence records, and (if test data are used) on the test records. The omission rate should be close to the predicted omission, because of the definition of the cumulative threshold.



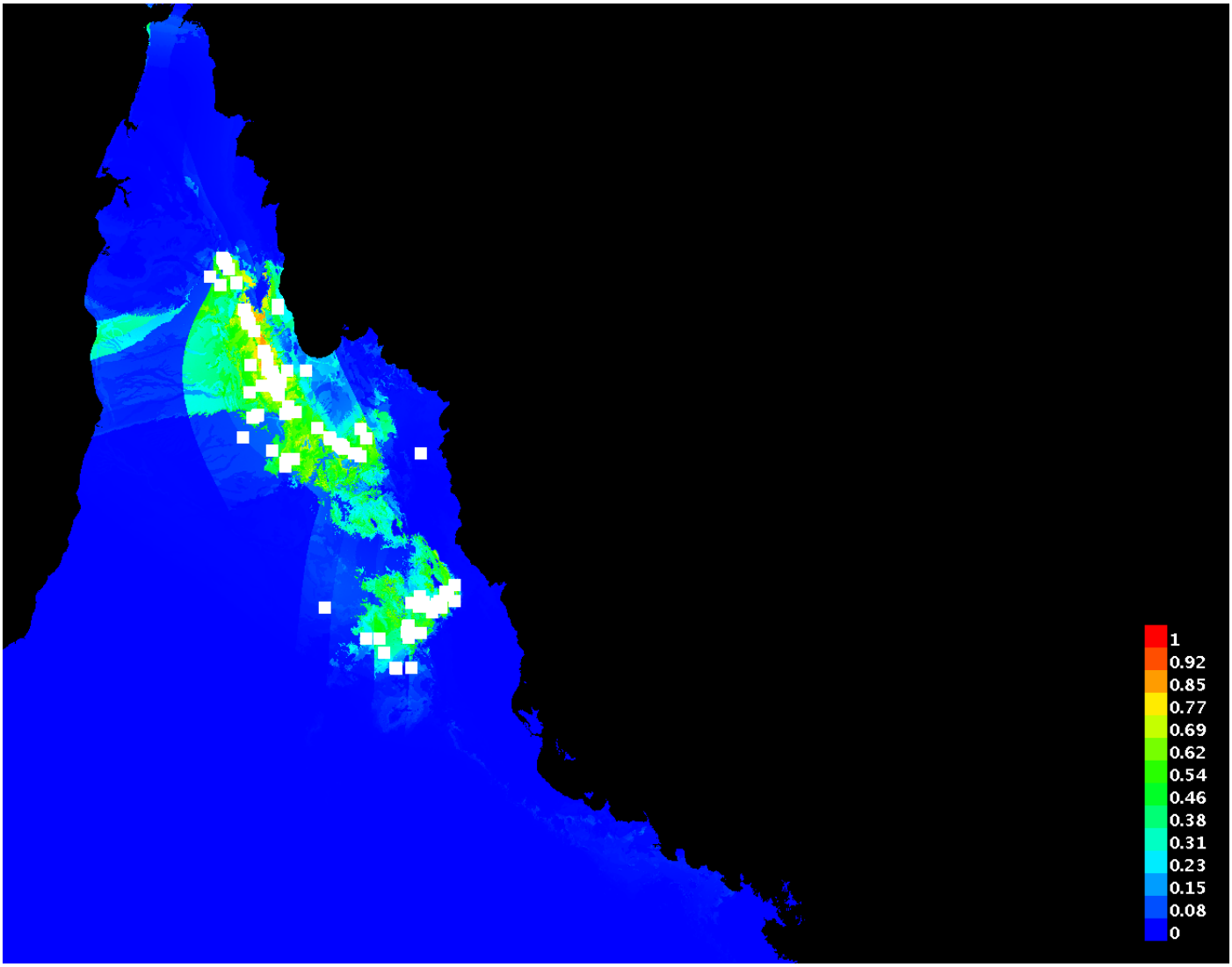
The next picture is the receiver operating characteristic (ROC) curve for the same data. Note that the specificity is defined using predicted area, rather than true commission (see the paper by Phillips, Anderson and Schapire cited on the help page for discussion of what this means). This implies that the maximum achievable AUC is less than 1. If test data is drawn from the Maxent distribution itself, then the maximum possible test AUC would be 0.958 rather than 1; in practice the test AUC may exceed this bound.



Some common thresholds and corresponding omission rates are as follows. If test data are available, binomial probabilities are calculated exactly if the number of test samples is at most 25, otherwise using a normal approximation to the binomial. These are 1-sided p-values for the null hypothesis that test points are predicted no better than by a random prediction with the same fractional predicted area. The "Balance" threshold minimizes 6 * training omission rate + .04 * cumulative threshold + 1.6 * fractional predicted area.

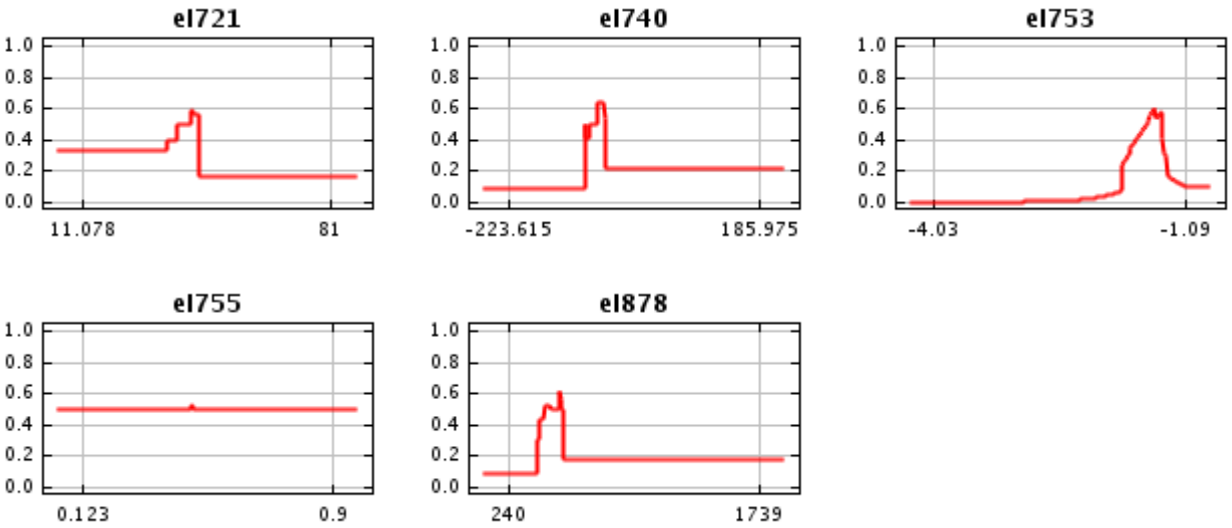
Cumulative threshold	Logistic threshold	Description	Fractional predicted area	Training omission rate
1.000	0.014	Fixed cumulative value 1	0.245	0.008
5.000	0.066	Fixed cumulative value 5	0.131	0.033
10.000	0.228	Fixed cumulative value 10	0.093	0.057
0.509	0.007	Minimum training presence	0.297	0.000
17.894	0.317	10 percentile training presence	0.071	0.098
14.817	0.286	Equal training sensitivity and specificity	0.078	0.081
6.750	0.108	Maximum training sensitivity plus specificity	0.110	0.033
2.738	0.041	Balance training omission, predicted area and threshold value	0.174	0.008
7.035	0.124	Equate entropy of thresholded and original distributions	0.108	0.041

This is a representation of the Maxent model for All species. Warmer colors show areas with better predicted conditions. White dots show the presence locations used for training, while violet dots show test locations.

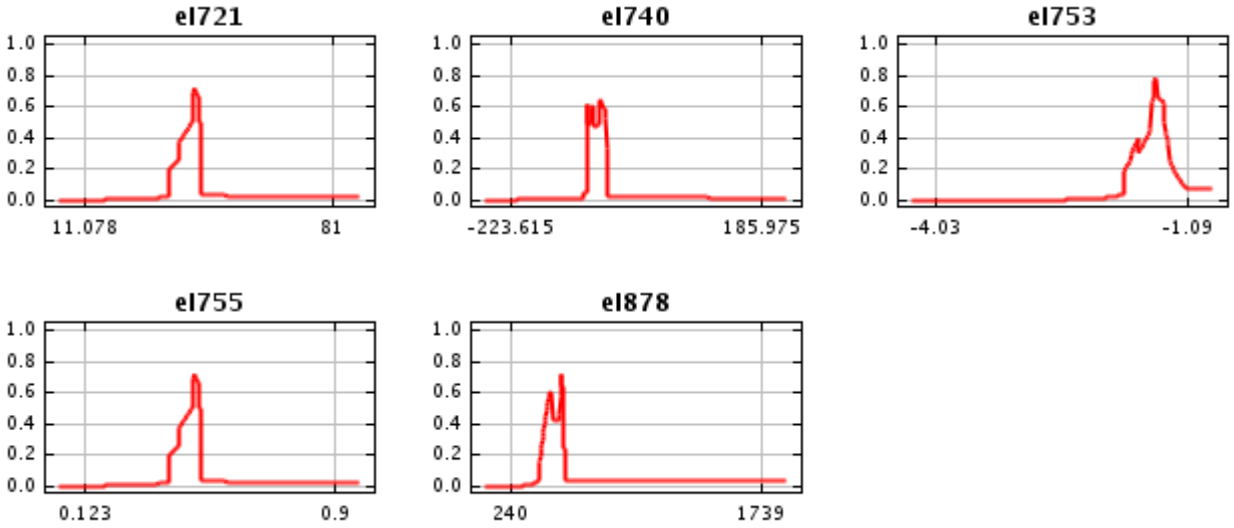


RESPONSE CURVES

These curves show how each environmental variable affects the Maxent prediction. The curves show how the logistic prediction changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together.



In contrast to the above marginal response curves, each of the following curves represents a different model, namely, a Maxent model created using only the corresponding variable. These plots reflect the dependence of predicted suitability both on the selected variable and on dependencies induced by correlations between the selected variable and other variables. They may be easier to interpret if there are strong correlations between variables.



Analysis of variable contributions

The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution when the predictor variables are correlated.

Variable	Percent contribution	Permutation importance
Temperature - min difference in max (el753)	38.7	66.6
Precipitation - warmest quarter (Bio18) (el878)	26.2	13.4
Precipitation deficit - annual mean (el740)	25.1	16
Water stress index - annual mean (el721)	10	3.9
Crop factor - annual mean (el755)	0	0.1

The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is el878, which therefore appears to have the most useful information by itself. The environmental variable that decreases the gain the most when it is omitted is el753, which therefore appears to have the most information that isn't present in the other variables.

Raw data outputs and control parameters

The data used in the above analysis is contained in the next links. Please see the Help button for more information on these.

The model applied to the training environmental layers

The coefficients of the model

The omission and predicted area for varying cumulative and raw thresholds

The prediction strength at the training and (optionally) test presence sites

Results for all species modeled in the same Maxent run, with summary statistics and (optionally) jackknife results

Regularized training gain is 2.226, training AUC is 0.970, unregularized training gain is 2.528.
Algorithm converged after 380 iterations (11 seconds).

The follow settings were used during the run:
123 presence records used for training.
10116 points used to determine the Maxent distribution (background points and presence points).
Environmental layers used (all continuous): Water stress index - annual mean (el721) Precipitation deficit - annual mean (el740) Temperature - min difference in max (el753) Crop factor - annual mean (el755) Precipitation - warmest quarter (Bio18) (el878)
Regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500
Feature types used: product linear quadratic hinge threshold
responsecurves: true
jackknife: true
outputdirectory:
samplesfile: species_points.csv
environmentallayers: /data/ala/data/alaspatial/layers/1468979432509/
warnings: false
tooltips: false
autorun: true
visible: false
threads: 8

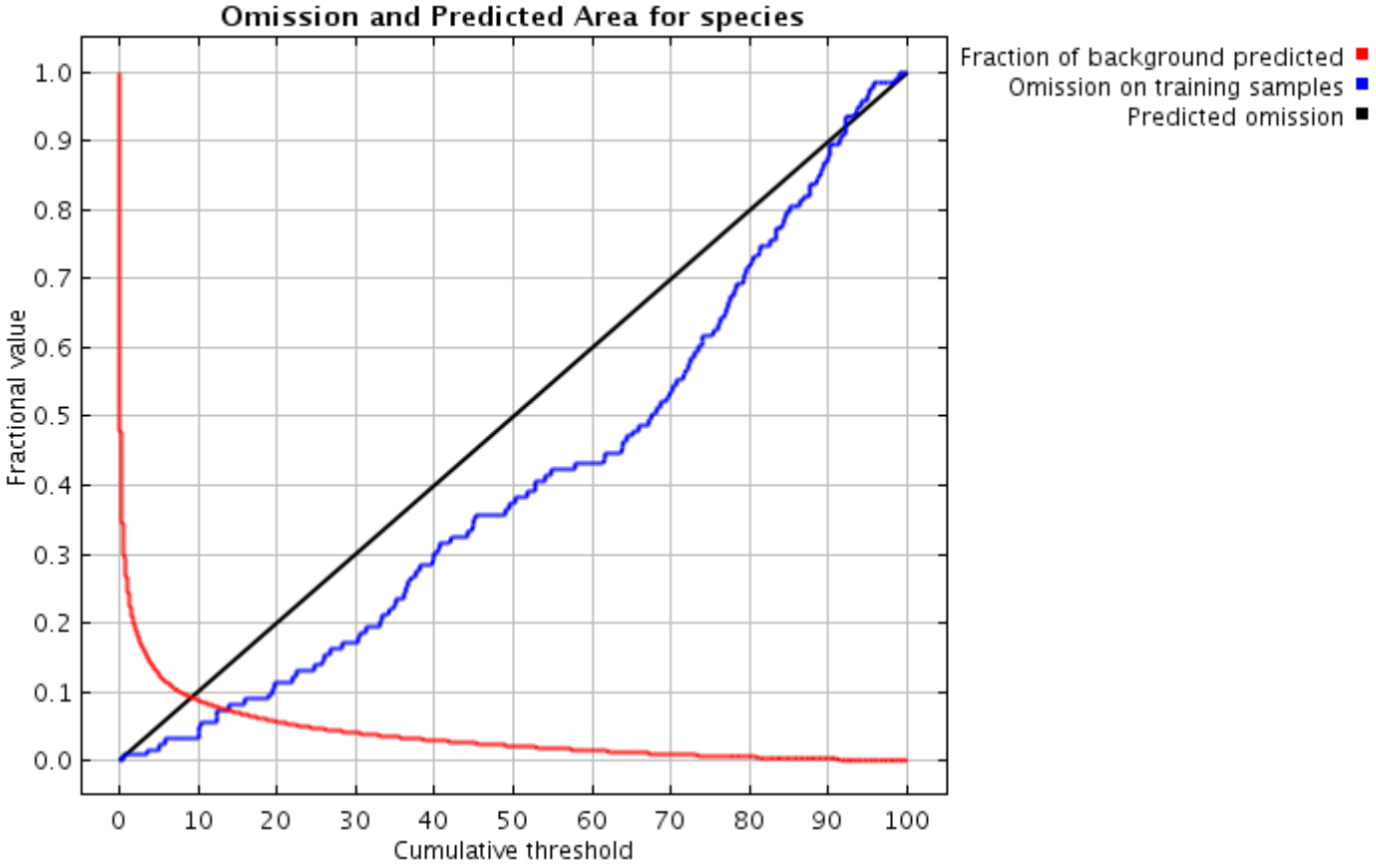
Maxent model for All Species – 1060 records Biotropica Best 8

This Maxent v3.3.3e predictive model for All species was created Wed Jul 20 10:50:20 AEST 2016 using Maxent version 3.3.3k. Links at the bottom of this page to the raw data may be used for further analysis.
Model reference number: 1468975785451
Species: All species
Layers:

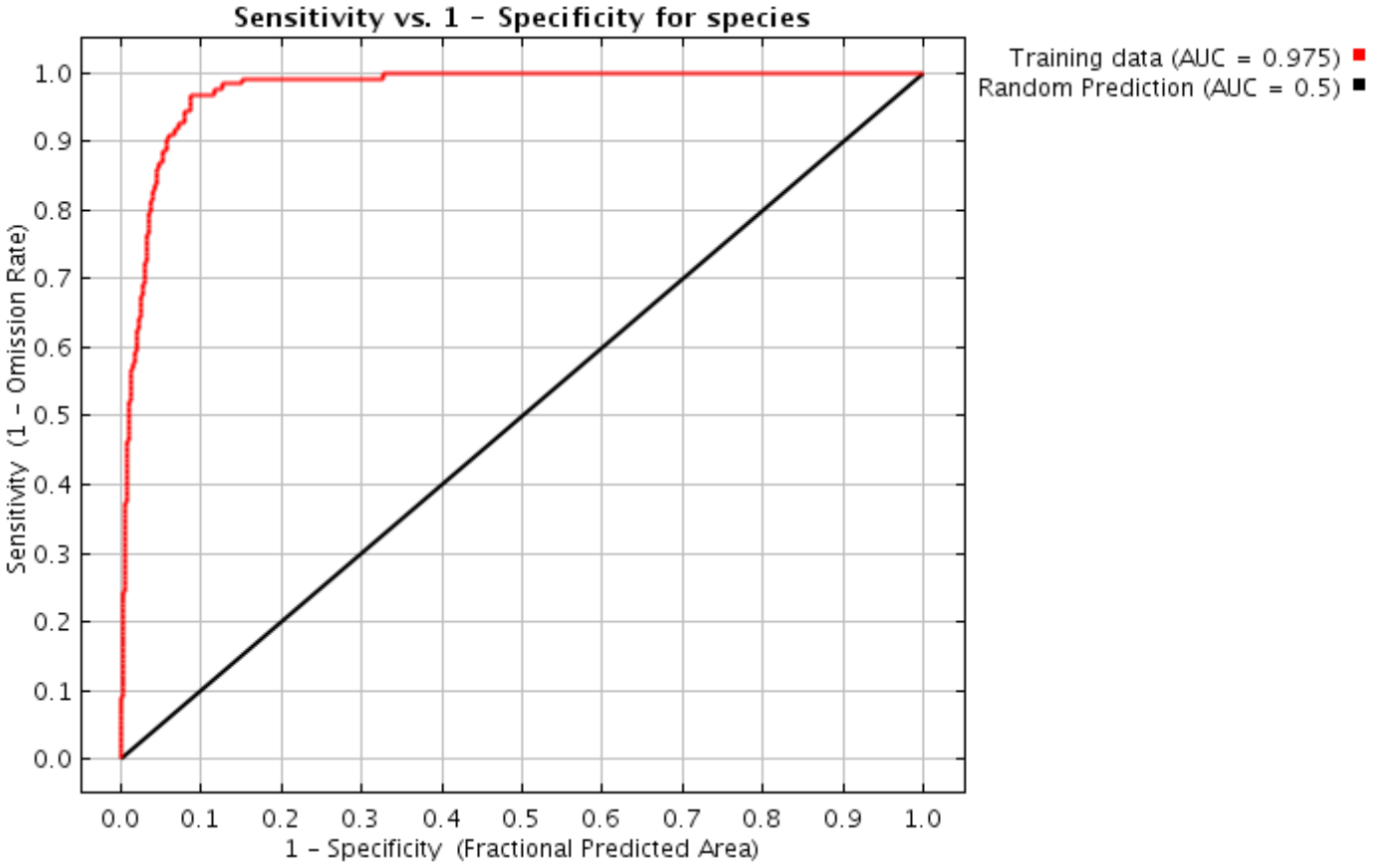
Precipitation - warmest quarter (Bio18) (el878)
Precipitation deficit - annual mean (el740)
Temperature - min difference in max (el753)
Crop factor - annual mean (el755)
Moisture Index - annual mean (Bio28) (el891)
Water stress index - annual mean (el721)
Physiographic Regions 2011 (cl2021)
Radiation - mean annual precipitation modified (el775)

Analysis of omission / commission

The following picture shows the omission rate and predicted area as a function of the cumulative threshold. The omission rate is calculated both on the training presence records, and (if test data are used) on the test records. The omission rate should be close to the predicted omission, because of the definition of the cumulative threshold.



The next picture is the receiver operating characteristic (ROC) curve for the same data. Note that the specificity is defined using predicted area, rather than true commission (see the paper by Phillips, Anderson and Schapire cited on the help page for discussion of what this means). This implies that the maximum achievable AUC is less than 1. If test data is drawn from the Maxent distribution itself, then the maximum possible test AUC would be 0.962 rather than 1; in practice the test AUC may exceed this bound.

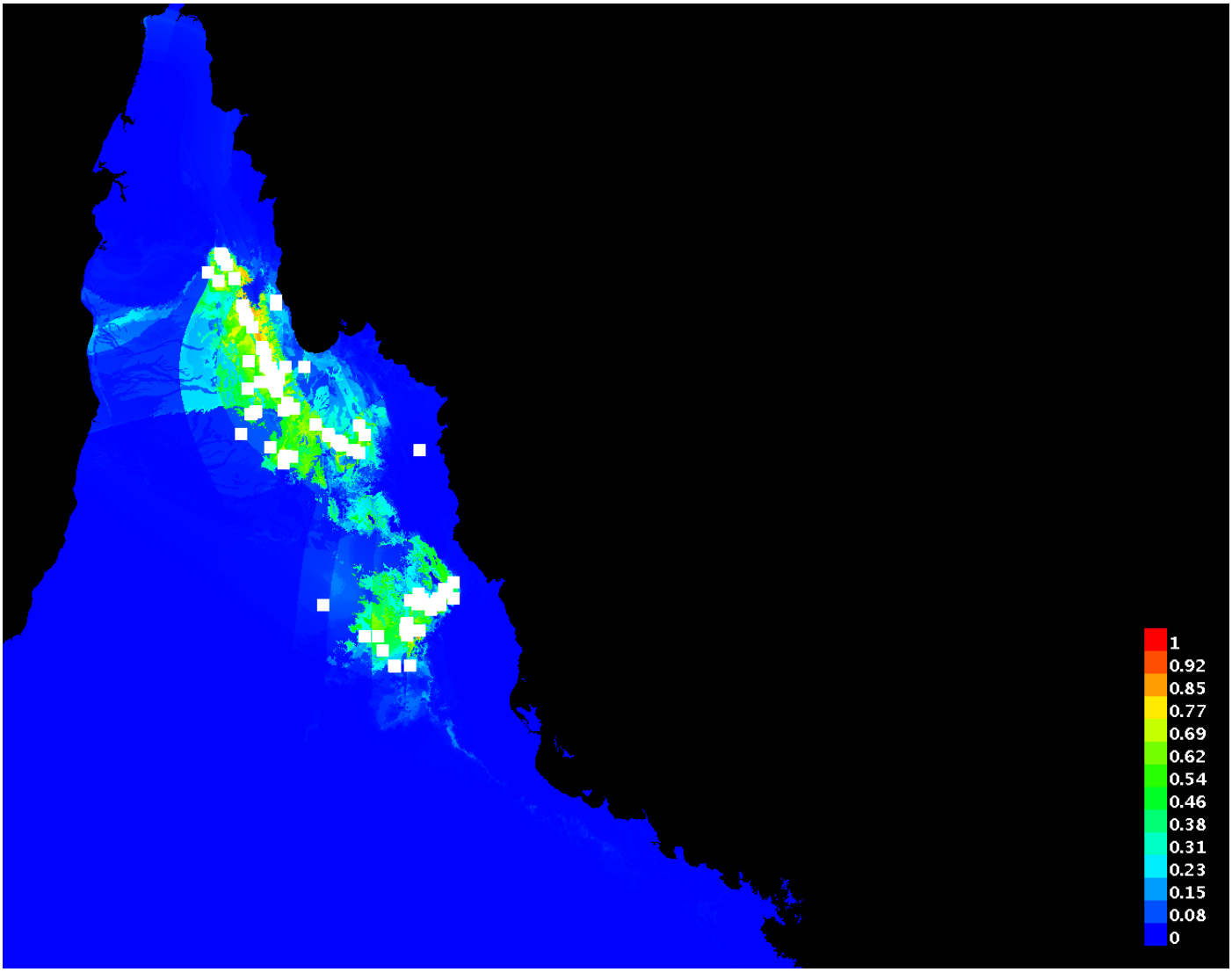


Some common thresholds and corresponding omission rates are as follows. If test data are available, binomial probabilities are calculated exactly if the number of test samples is at most 25, otherwise using a normal approximation to the binomial. These are 1-sided p-values for the null hypothesis that test points are predicted no better than by a random prediction with the same fractional predicted area. The "Balance" threshold minimizes 6 * training omission rate + .04 * cumulative threshold + 1.6 * fractional predicted area.

Cumulative threshold	Logistic threshold	Description	Fractional predicted area	Training omission rate
1.000	0.011	Fixed cumulative value 1	0.248	0.008
5.000	0.068	Fixed cumulative value 5	0.125	0.024
10.000	0.181	Fixed cumulative value 10	0.088	0.033
0.393	0.005	Minimum training presence	0.328	0.000
19.290	0.294	10 percentile training presence	0.058	0.098
13.820	0.229	Equal training sensitivity and specificity	0.073	0.073
10.028	0.181	Maximum training sensitivity plus specificity	0.087	0.033
2.797	0.037	Balance training omission, predicted area and threshold value	0.166	0.008
8.184	0.146	Equate entropy of thresholded and original distributions	0.097	0.033

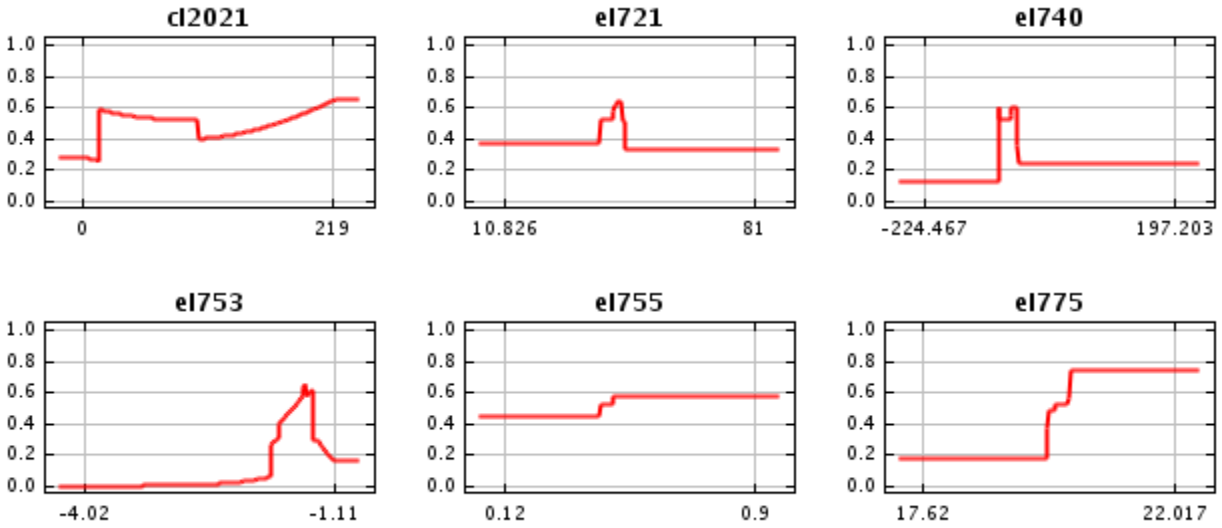
Pictures of the model

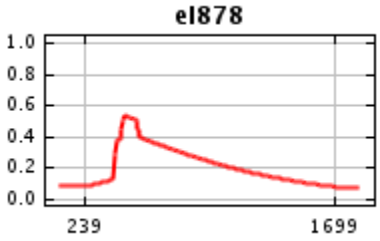
This is a representation of the Maxent model for All species. Warmer colors show areas with better predicted conditions. White dots show the presence locations used for training, while violet dots show test locations.

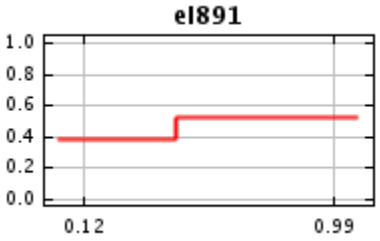


Response Curves

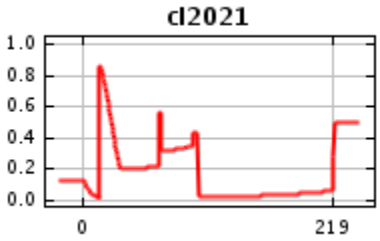
These curves show how each environmental variable affects the Maxent prediction. The curves show how the logistic prediction changes as each environmental variable is varied, keeping all other environmental variables at their average sample value. Click on a response curve to see a larger version. Note that the curves can be hard to interpret if you have strongly correlated variables, as the model may depend on the correlations in ways that are not evident in the curves. In other words, the curves show the marginal effect of changing exactly one variable, whereas the model may take advantage of sets of variables changing together.

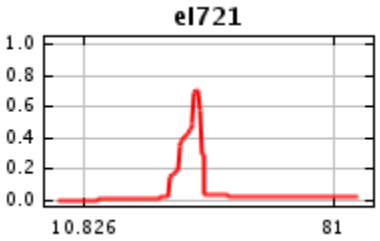


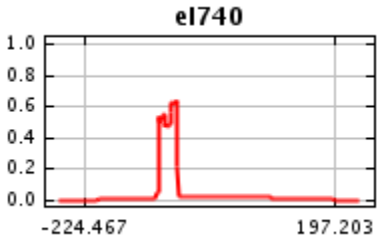


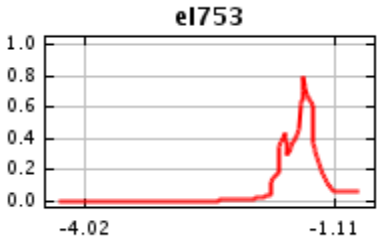


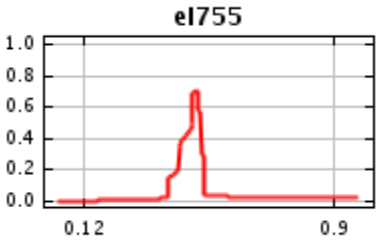
In contrast to the above marginal response curves, each of the following curves represents a different model, namely, a Maxent model created using only the corresponding variable. These plots reflect the dependence of predicted suitability both on the selected variable and on dependencies induced by correlations between the selected variable and other variables. They may be easier to interpret if there are strong correlations between variables.

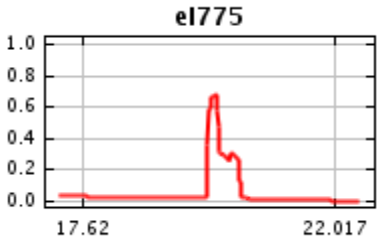


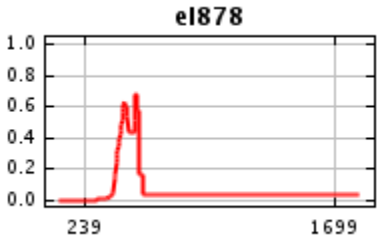


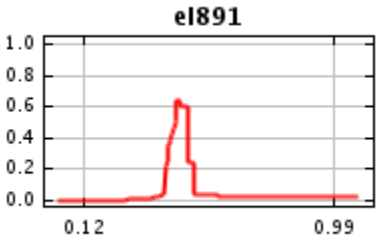










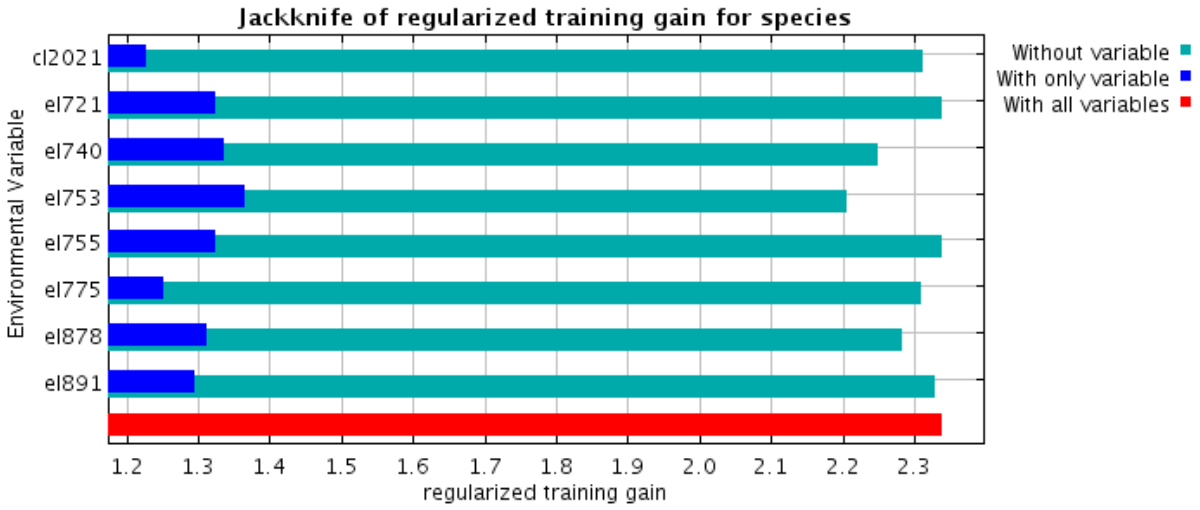


Analysis of variable contributions

The following table gives estimates of relative contributions of the environmental variables to the Maxent model. To determine the first estimate, in each iteration of the training algorithm, the increase in regularized gain is added to the contribution of the corresponding variable, or subtracted from it if the change to the absolute value of lambda is negative. For the second estimate, for each environmental variable in turn, the values of that variable on training presence and background data are randomly permuted. The model is reevaluated on the permuted data, and the resulting drop in training AUC is shown in the table, normalized to percentages. As with the variable jackknife, variable contributions should be interpreted with caution when the predictor variables are correlated.

Variable	Percent contribution	Permutation importance
Temperature - min difference in max (el753)	37.2	67.1
Precipitation deficit - annual mean (el740)	20	10.1
Precipitation - warmest quarter (Bio18) (el878)	18.5	8.3
Water stress index - annual mean (el721)	10.3	1.6
Radiation - mean annual precipitation modified (el775)	10.2	9
Physiographic Regions 2011 (cl2021)	2	2.8
Moisture Index - annual mean (Bio28) (el891)	1.4	0.7
Crop factor - annual mean (el755)	0.4	0.3

The following picture shows the results of the jackknife test of variable importance. The environmental variable with highest gain when used in isolation is el753, which therefore appears to have the most useful information by itself. The environmental variable that decreases the gain the most when it is omitted is el753, which therefore appears to have the most information that isn't present in the other variables.



Raw data outputs and control parameters

The data used in the above analysis is contained in the next links. Please see the Help button for more information on these.

The model applied to the training environmental layers

The coefficients of the model

The omission and predicted area for varying cumulative and raw thresholds

The prediction strength at the training and (optionally) test presence sites

Results for all species modeled in the same Maxent run, with summary statistics and (optionally) jackknife results

Regularized training gain is 2.340, training AUC is 0.975, unregularized training gain is 2.705.
Algorithm terminated after 500 iterations (18 seconds).

The follow settings were used during the run:
123 presence records used for training.
10116 points used to determine the Maxent distribution (background points and presence points).
Environmental layers used (all continuous): Physiographic Regions 2011 (cl2021) Water stress index - annual mean (el721) Precipitation deficit - annual mean (el740) Temperature - min difference in max (el753) Crop factor - annual mean (el755) Radiation - mean annual precipitation modified (el775) Precipitation - warmest quarter (Bio18) (el878) Moisture Index - annual mean (Bio28) (el891)
Regularization values: linear/quadratic/product: 0.050, categorical: 0.250, threshold: 1.000, hinge: 0.500
Feature types used: product linear quadratic hinge threshold
responsecurves: true

jackknife: true
outputdirectory:
samplesfile: species_points.csv
environmentallayers: /data/ala/data/alaspatial/layers/1468975786386/
warnings: false
tooltips: false
autorun: true
visible: false
threads: 8

Spatial Modelling Results Summary

Physiographic Region

region id	region name	Cm records/region	Percentage	region description	region regolith
10204	Coleman Plateau	651	61	Rolling sandy granitic plateau with low ridges of metamorphic rocks, includes Great Escarpment in the east.	Residual sand (> 50%), highly weathered bedrock (20 - 50%) , soil on bedrock (< 20%)
10205	Laura Plain	243	23	Soft sedimentary rock lowlands, alluvial plains and coastal plain.	Residual sand (> 50%), alluvial sediments (20 - 50%) , residual
10203	Wenlock Uplands	79	8	Complex of tablelands and low plateaus with north-south lowlands, including the Great Escarpment, and coastal hills in the east.	Highly weathered bedrock (> 50%), moderately weathered bedrock (< 20%) , residual sand (< 20%)
10208	Garnet Uplands	69	7	Hilly uplands with dissected greywacke and volcanics in north and undulating country on granite and metamorphic rocks in the south.	Soil on bedrock (> 50%), moderately weathered bedrock (20 - 50%)
20103	Holroyd Plains	8	>1	Slightly dissected sandy plains, partly ferruginised.	Residual sand (> 50%), moderately weathered bedrock
10207	Palmerville Hills	4	>1	Granitic hills and plateaus and sandstone mesas with intervening plains.	Highly weathered bedrock (> 50%), moderately weathered bedrock (20 - 50%) , residual sand
10209	Cairns Ranges	4	>1	High ranges east of an interior lowland, consisting of coastal ranges, lowland corridors and bedrock islands.	Soil on bedrock (> 50%), alluvial sediments (20 - 50%) , highly weathered bedrock (< 20%)
10206	Cooktown Ranges	1	>1	Deeply dissected sandstone plateaus with mountain ranges of granite and metamorphic rocks to east, small bedrock islands.	Moderately weathered bedrock (> 50%), soil on bedrock (< 20%) , alluvial sediments (< 20%)
20102	Merluna Plain	1	>1	Undulating clay plains with ferruginous rises.	Residual sand (> 50%), moderately weathered bedrock

Dominant Attributes

Dominant	Type	Detail (sq km)
Landform	Rises	
Regolith	Residual Sand	
Rock Type	Colluvium & Granitoid	
Rock Unit	TQr-QLD Tertiary-Quate	Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)
Soil	Clark, Dixie, Kimba	
RE	Non-remnant	376.5
RE	9.12.7a	318.4
RE	3.5.12	184.0
RE	3.12.19b	116.8
RE	3.11.15a/3.11.11	104.1
RE	3.3.49b	86.4
RE	3.5.7a	54.7

Note: RE extents (sq km) indicative only as selection is based on dominant RE only

Methodology:

1) Spatially intersect 1060 unique Cajanus mareebensis records with the following parameters selected for analysis: Landform, Regolith, Geology, Soil and Regional Ecosystem

2) Identify most frequent polygons by respective attributes

3) Remove duplicate polygons

4) Summarise results, export to spreadsheet and highlight most prevalent/dominant attributes

Table 1: BRI Occurrence Records with Notes on Density

Locality	Collectors Notes on Density
Northern (Cape York Peninsula) Population n=18	
WNW Cooktown	Locally common
Mary Valley Stn	Several observed
PDR 30km north of Coen	Good density
Musgrave	occasional
Dixie Homestead	common
Hann River Roadhouse	scattered
Musgrave	Occasional
Musgrave	Occasional at site
Musgrave/GDR	Occasional
North of Silver Plains	Common on low rise
West of Sliver Plains	Common on low rise
Oyala Thurmontang	Locally common
Lakefield	Occasional
Mary Valley Stn	Uncommon
PDR Moorehead River	Uncommon
Mary Valley Stn turnoff	Uncommon
Mungkan Kandju	Scarce
Pompuraaw Rd	2 plants on quarry
Southern (Einasleigh Uplands) Population n=18	
Lappa Mt Garnet Road	Locally common
Lappa Mt Garnet Road	Locally common
Lappa Mt Garnet Rd	Locally common
SW Mt Garnet	Common at site, but not located within 5km
SW Mt Garnet	Common at site, but not located within 5km
Almaden Mt Garnet Rd	Disturbed roadside, about 10 plants
Mt Garnet	Uncommon
Wolfram Camp Rd	A few plants seen, rare in the area
Dimbulah Wolfram Road	Rare in the area
Almaden Mt Garnet Road	About 10 plants
Dimbulah Wolfram Rd	Rare in the area
Dimbulah Wolfram Rd	Rare in the area
Almaden Mt Garnet Rd	About 10 plants
West of Petford	Scarce in the area
Irvinebank Petford Rd	10 plants in 0.5ha
Dimbulah Wolfram Rd	Rare in the area, a few plants seen
Dimbulah Wolfram Rd	Rare in the area
Dimbulah Wolfram Rd	Rare in the area