

Evidence on Listing Eligibility and Conservation Actions 2017

Clausena excavata (Burm.f.)

Current EPBC Act status: *Not listed*

Current TPWC Act status: Endangered (D)

Proposed Action: Reassess IUCN category and criteria for listing

Nominated Status: Critically Endangered (B1ab(iii)+2ab(iii); C2a(ii))

Taxonomy

Scientific name:	<i>Clausena excavata</i> (Burm.f.) The taxon is currently listed in the Northern Territory (NT) under the name <i>Clausena</i> sp. Tipperary (G.J.Leach 2152), however this name will be changed to <i>Clausena excavata</i> (Burm.f.) in due course.		
Common name:	none		
Family name:	RUTACEAE	Fauna <input type="checkbox"/>	Flora <input checked="" type="checkbox"/>

Note: *Clausena excavata* is indigenous to the NT, but it was introduced to Christmas Island for purposes other than conservation. The Christmas Island population is excluded from this assessment in accordance with the IUCN Red List Guidelines (IUCN 2017), which state that an assessment can only include wild populations outside the natural range of the species if the intent of the introduction was to reduce the extinction risk of the species. Therefore, the conservation status of the species resulting from this assessment and the protective functions afforded by listing *C. excavata* apply only to the NT distribution.

Species Information

Description

Clausena excavata grows as a slender shrub 1–4 m in height (NT Herbarium 2013). Leaves are compound with approximately 10–30 leaflets. Leaflets ovate, 3-6 cm long, approximately 1.5 cm wide, asymmetrical, finely hairy and aromatic with a distinctive aniseed or sarsaparilla smell. Plants can produce a compound inflorescence of pale green or cream coloured flowers in the leaf axils. Fruit are small, hairy, fleshy and are red at maturity.

Diagnostic Characters: Leaflets alternate to subopposite, mostly 17-25, apex acute; branchlets lacking prickles.

Distribution

Clausena excavata occurs naturally on the Australian mainland with a highly restricted distribution in the NT. The species also occurs on Christmas Island where it is recently derived from plants introduced from Indonesia or Malaysia, is very different in origin to the native NT population and is considered an invasive weed. Outside of Australia, it occurs in Malesia and South East Asia, from the Ganges Delta in eastern India to southern China and Timor (Molino 1994).

Where *C. excavata* occurs in the NT, it is known from a small area located on Tipperary Station, and approximately 4-5 km north-west of Mt. Burrell, in the Daly Basin Bioregion. It has been recorded from only two sites (see Appendix A). The distribution is associated with the margins of dry vine thickets around limestone. The tenure of the property is privately owned perpetual pastoral lease.

The two patches of habitat that this taxon is known from are situated approximately 500 m apart. Based on satellite imagery, the larger of the two patches is approximately 6.25 ha in area and the other is approximately 2 ha. *Clausena excavata* occupies only the margin or fringe of the monsoon vine thicket, and is not found in the interior of this habitat. The maximum area currently known to be occupied by *C. excavata* is very small, much less than 10 ha, given that plants are found only at the periphery of the two limestone vine thickets. The AOO is 4 km², based on 2 km x 2 km grids. A minimum convex polygon around all known individuals has an area of less than 10 ha so, by convention, the EOO is scaled up to match the AOO at 4 km². This is a single subpopulation.

An ex situ population of one plant is in cultivation in Darwin and was the only survivor of two small root suckers taken from the edge of one subpopulation in 2010. The plant was grown on to flowering and fruiting to enable a positive species identification to be made in November 2014. This resulted in upgrading from the informal, essentially local, phrase name *Clausena* sp. Tipperary (G.J. Leach 2152) to the widely accepted name *Clausena excavata* (Burm.f.), as articulated by Molino (1994).

Adequacy of Survey

Monsoonal rainforests (of which vine thickets are a type) have in general been relatively well sampled across the NT (Russell-Smith 1991; Liddle *et al.* 1994). The very few records of *C. excavata* suggest that it is indeed a rare species within its natural Australian distribution. Additional very small patches of vine thicket vegetation on limestone are evident on satellite imagery in the general vicinity of the two known sites. While several habitat patches of 0.5-3 ha close to the known sites were surveyed in 2010 without finding new *C. excavata* records, other potential sites have not yet been surveyed. Even if *C. excavata* was found to occur at these latter very small patches, the total area occupied by the species would still be much less than 1 km². A larger patch of monsoon rainforest to the south at Pawpaw Springs, and also on Tipperary Station, has been subject to survey over a number of years and is confirmed as not supporting the species (Russell-Smith 1991; D. Liddle pers. comm.). Additional potential habitat (vine thicket vegetation on limestone) in the Tipperary area and northern NT is rare.

Relevant Biology/Ecology

In the NT, *Clausena excavata* has been recorded from the exposed edges of two small monsoon vine thicket patches situated on limestone (karst) geology. One site consists of broken, outcropping limestone and the other is the perimeter of a limestone sinkhole. The species has been observed to produce root suckers and may be a basal resprouter. It is likely to rely on the protection from fire afforded by the limestone rock outcrops but may also require the higher light levels available at the thicket edge. In common with several other plants of monsoon vine thickets, this species may be facultatively deciduous during the dry season, to reduce water loss and stress over the long rainless period. Plants in cultivation with limited watering appear to retain leaves until well into the dry season, gradually losing leaves as the dry progresses and would be easily detected in most months except perhaps in September - October. As most survey work to date has been done just before, during and after the wet season, this is unlikely to have affected detectability.

The specificity of habitat favoured by the species and the large distance over sea to other natural populations makes the probability of genetic exchange with other populations, including the introduced population on Christmas Island, minute.

Flowering: November (in cultivation).

Immature fruit: December.

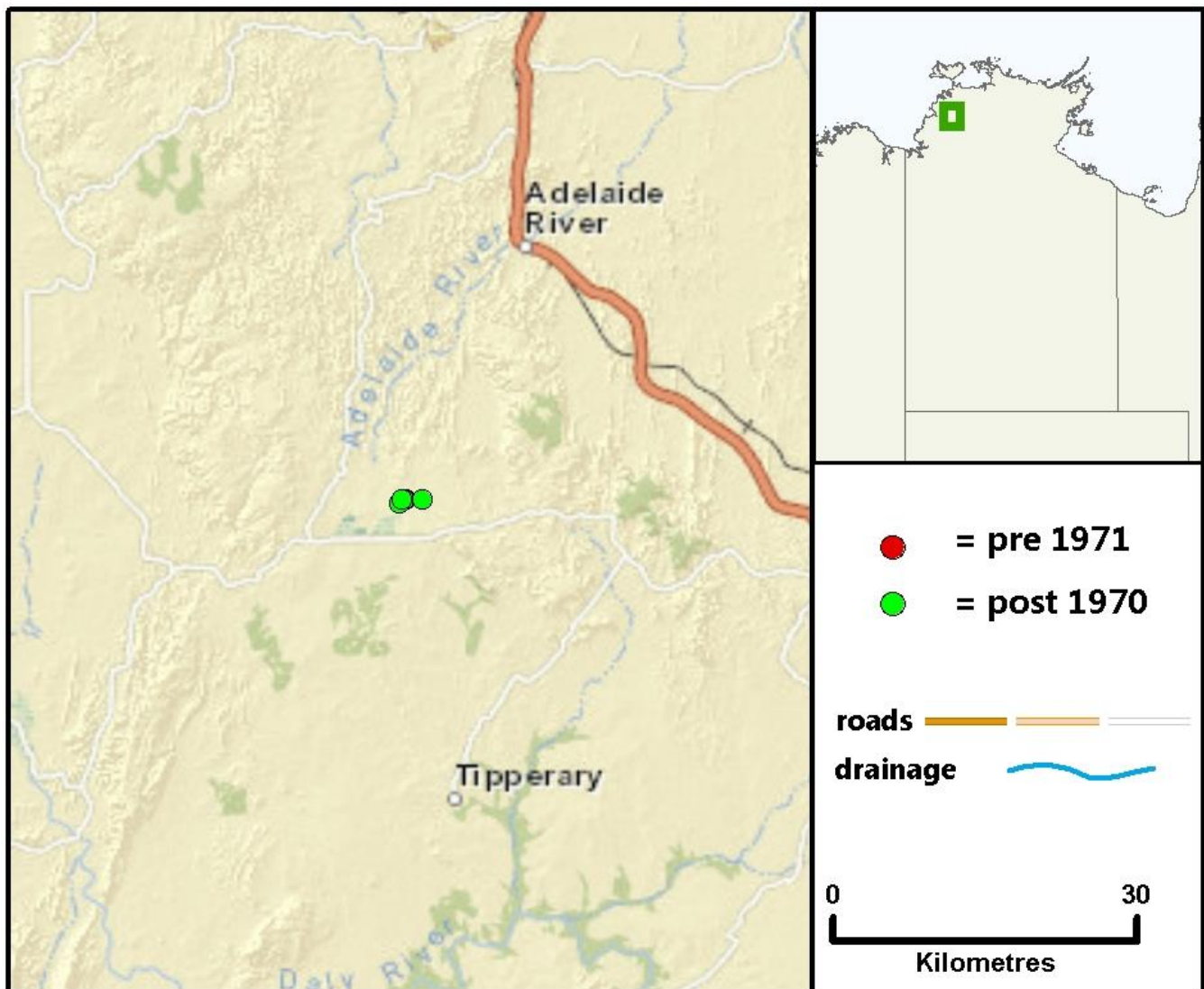
Threats

Threat <i>(describe the threat and how it impacts on the species. Specify if the threat is past, current or potential)</i>	Extent <i>(give details of impact on whole species or specific subpopulations)</i>	Potential Impact <i>(what is the level of threat to the conservation of the species)</i>
<p>The incursion of Gamba Grass (<i>Andropogon gayanus</i>) and Mission Grasses (<i>Cenchrus polystachios</i> and <i>C. pedicellatus</i>) into the species' ecotonal habitat is an immediate major threat to <i>Clausena excavata</i>. All three species, but particularly Gamba Grass, are high-biomass producing, introduced perennial grass species and are now established and common at Tipperary Station. A massive propagule source of Gamba Grass occurs in the large cleared paddocks 1.5 km to the south and satellite populations also occur sporadically in the intervening woodland with the grass well established and common at the main site (in December 2010). Gamba Grass forms taller, denser stands, curing later in the Dry season. This results in substantial changes to savanna fire regimes. It can dramatically increase local fuel loads from the 2–4 tonnes/ha typical for native grasses to 11–15 tonnes/ha or sometimes even 30 tonnes/ha for Gamba Grass resulting in later, more intense fires that can kill or reduce the vigour of tree species (Rossiter <i>et al.</i> 2003; Ferdinands <i>et al.</i> 2006; TSSC undated). Gamba Grass may also out-compete native woody species both by grossly altering the availability of nitrogen to native plant species and by using larger amounts of water than native grasses (Rossiter <i>et al.</i> 2004; Rossiter-Rachor <i>et al.</i> 2009; TSSC undated). The Mission grasses present a similar challenge.</p> <p>Given the close proximity of Gamba grass to known subpopulations of <i>C. excavata</i> in 2010 and that <i>C. excavata</i> occurs on vine thicket margins with lower tree cover likely to be easily colonised by Gamba grass, this grass is considered a serious and imminent or actual threat to <i>C. excavata</i>. Recent mapping of gamba grass (2016) shows it continues to spread, alter fire regimes and threaten areas known to contain <i>C. excavata</i> (TNRM 2017). Efforts to control the spread and establishment of gamba grass on the larger scale have not proved successful in the surrounding area, suggesting the risk posed is very high. Gamba grass control at a smaller scale (e.g. over several kilometres) at Mary River National Park has demonstrated there is potential to limit the threats it poses to natural habitats (S. Dwyer pers. comm.).</p>	<p>An immediate threat and one that is encroaching on all habitats in the Daly Region</p>	<p>High in the near future, Severe in the long-term</p>
<p>Feral pigs (<i>Sus scrofa</i>) occur in the area and can physically damage plants and disturb habitat. (Current and Future)</p>	<p>100 % of the population is exposed to this threat</p>	<p>low</p>
<p>Grazing stock (<i>Bos indicus</i>) move through the area and can physically damage plants and spread weedy grasses (Current and Future)</p>	<p>100 % of the population is exposed to this threat</p>	<p>low</p>

Climate change – little is known of potential impacts, but this species is dependent on small patches of monsoonal rainforest.	100 % of the population is exposed to this threat	unsure
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Summary of IUCN attributes¹

EOO	4 km ² (scaled up to match AOO)	AOO	4 km ² (based on 2 km x 2 km grids)	Generation length	unknown
No. locations	1	Severely fragmented	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown <input type="checkbox"/>		
No. subpopulations	1	No. mature individuals	Less than 150		
Percentage global population within Australia		< 1 % of global species' population			
Percentage population decline over 10 years or 3 generations		Unknown, possibly none			



¹ Refer to [Guidelines for using the IUCN Red List Categories and Criteria](#) for definitions. Basis for calculations of number of locations and number of subpopulations should be given in the Distribution section.

Assessment of available information in relation to the listing Criteria

Criterion A. 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.		
	<i>based on any of the following</i>		
	(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	

Evidence:

The species is estimated at less than 150 mature individuals but there are no quantitative data to infer percentage of past, current or future population reduction and so there is insufficient data to assess the species' eligibility for listing under this criterion.

Criterion B. 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:

Clausena excavata is highly restricted, being known from only two small patches of vine-thicket habitat, comprising a single location. The larger patch is approximately 6.25 ha in area and the other is approximately 2 ha; AOO = 4 km², based on 2 km x 2 km grids.

The species occupies only the margin or fringe of monsoon vine thicket on limestone outcrop, and was not found in the interior of this habitat. The plant is likely to rely on the protection from fire afforded by the limestone rock outcrops and vine thicket habitat but may also require the higher light levels available at the forest edge. The major threat to *C. excavata* is incursion by introduced grassy weeds, Gamba Grass and Mission grasses into its ecotonal habitat. These are high-biomass producing introduced perennial grass species which are now established and common on Tipperary Station. Given the rapid spread of Gamba Grass over the last two decades in landscapes to the south of Darwin, use of Gamba Grass as a fodder

species on pastoral lands and close proximity to the existing sub-populations, the quality of habitat for *C. excavata* is projected to decline markedly over the next decade or so.

Targeted searches for the species (in December 2010) confirmed its presence at both vine thicket patches from which it was previously known (K. Brennan pers. comm.; I.D. Cowie & J.O. Westaway unpublished data). Four other patches of monsoon vine thicket on limestone west of the known site were also searched but *C. excavata* appears to be absent from these patches. Monsoonal rainforests (of which vine thickets are a type) have, in general, been relatively well sampled across the NT (Russell-Smith 1991; Liddle *et al.* 1994), so the few records of *C. excavata* suggest that it is indeed a rare species within its natural Australian distribution. Additional very small patches of limestone vine thicket vegetation are evident on satellite imagery in the general vicinity of the known sites but, other than the four mentioned above, remain to be surveyed. Even if *C. excavata* was found to occur at one or two of these patches, the total area occupied by the species would still be less than 1 km²; AOO is considerably less than the IUCN threshold for Endangered (500 km²) but will exceed the threshold for Critically Endangered (10 km²) if found at two more sites. Potential habitat in the area is otherwise rare.

There is no evidence the species undergoes extreme fluctuations in numbers or range.

On the basis of the evidence above, both the EOO and AOO are smaller than the IUCN thresholds for Critically Endangered (B1+2); the species is known from only a single location, so meets subcriterion (a) for Critically Endangered; and there are serious threats that are likely to degrade, at least, the extent and quality of habitat (b(iii)). Consequently, *C. excavata* is eligible for listing as **Critically Endangered** under this criterion (B1ab(iii)+2ab(iii)).

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

Evidence:

The species in the NT is estimated at less than 150 mature individuals, and is known from only two localities within a single location and subpopulation. There is no evidence the species undergoes extreme fluctuations in numbers. There is no quantitative data to infer past or current population reductions, or the scale of possible future declines

This species has a population size smaller than the threshold for Critically Endangered (C); there are threats from which there is an inferred future decline (C2); and there is only one subpopulation (a(ii)). Consequently, *Clausena excavata* as eligible for listing as **Critically Endangered** under this criterion (C2a(ii)).

Criterion D. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2. <i>Only applies to the VU category</i> Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. Typically: AOO < 20 km ² or number of locations ≤ 5

Evidence:

A targeted search for the species in December 2010 (by I.D.Cowie and J.O.Westaway) confirmed its presence at the main vine thicket patch from which it was originally recorded in 1989. This is a relatively large and substantial limestone vine thicket remnant (6.25 ha) and 15 small stands of *C. excavata* were located on the western, northern and south eastern margins of this patch. A total of 262 resprouting stems in around 85 very loose aggregations or 'clumps' were counted at these stands; an average of three stems per clump. This is therefore thought to represent at least 85 individual plants. An accurate estimate of the number of 'mature individuals' is difficult to determine due to the resprouting or apparent clonal nature of the species and uncertainty about the size a plant needs to attain to be reproductive. Two small root suckers 15-20 cm high dug for ex situ cultivation and conservation showed no development of separate root systems and it was considered that they would be unlikely to survive in the wild if the rhizome attaching them to the parent plant was severed. Thus, they could not be considered separate individuals. The one surviving root sucker first flowered in cultivation at approximately 0.6 m in height, a similar height to many stems seen in the field. However, no fertile plants were found at this site in the field and only one relatively large individual, about 2 m tall, showed evidence of recent flowering and fruiting. Four other small patches of monsoon vine thicket on limestone west of the known site were also searched as part of this survey but *C. excavata* was absent from these patches.

What is now considered to be the other previously known site was also revisited in 2010 and consists of a single stand with an estimate of up to 50–60 stems/plants (K. Brennan pers. comm.). The number of 'mature individuals' is likely to be considerably less than this due to the clonal nature of growth and the apparent immature stage of most stems. Immature fruit occurred on a few plants at this site. Using the average figure of 3 stems per clump above, it is estimated this site supports around 19 clumps. Thus, the total known population across the two vine thicket patches is estimated at 320 stems or 104 clumps, and the latter is taken here to be an estimate of the number of mature individuals.

The two patches of habitat that this taxon is known from are situated approximately 500 m apart. Based on satellite imagery, the large patch is approximately 6.25 ha in area and the other is approximately 2 ha. *Clausena excavata* occupies only the margin or fringe of the monsoon vine thicket, and was not found in the interior of this habitat. The plant is likely to rely on the protection from fire afforded by the limestone rock outcrops but may also require the higher light levels available at the thicket edge. The maximum area currently known to be occupied by *C. excavata* is very small, much less than 10 ha, given that plants are found only at the periphery of the two limestone vine thicket habitat patches. The AOO is 4 km², based on 2 km x 2 km grids.

As monsoonal rainforests (of which vine thickets are a type) have in general been relatively well sampled across the NT (Russell-Smith 1991; Liddle *et al.* 1994), the few records of *Clausena excavata* suggest that it is indeed a rare species within its natural Australian distribution. Additional very small patches of limestone vine thicket vegetation are evident on satellite imagery in the general vicinity of the known sites; some have been surveyed and found to not support *C. excavata* but others remain to be surveyed. The probability of finding more than one or perhaps two additional small subpopulations is considered low. Some of these 'potential' sites are probably poorly drained and there is no evidence *C. excavata* will survive in those conditions. Also, surveys of nearby potential new sites in 2010 concentrated on the five most prospective vine thicket patches of those in the area and only one supported *C. excavata* (Appendix A, Tipperary B). Even if *C. excavata* was found to occur in some of these other patches, the population size and total area occupied by the population would still be very small and exposed to the same threatening processes. Potential habitat in the region is otherwise rare.

As detailed above, the species is subject to continuing and future threats from invasion by weedy grasses, particularly Gamba Grass and to a lesser extent Mission grasses.

Based on the evidence above, this species has a population size smaller than the IUCN threshold for listing as Endangered (D); the AOO is smaller than the threshold for Vulnerable (D2); and there are ongoing threats. Consequently, *C. excavata* is eligible for listing as **Endangered** under this criterion (D).

Criterion E. 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:

No such quantitative analysis has been done for this species and there are insufficient quantitative data available to do so.

Summary

Clausena excavata is eligible for listing as **Critically Endangered** (B1ab(iii)+2ab(iii) + C2a(ii)) and as **Endangered** under criterion D, based on a small population size (estimated to be fewer than 150 mature individuals) and the species is subject to continuing and future threats from invasion by weedy grasses, particularly Gamba Grass and Mission grasses. As monsoonal rainforests (of which vine thickets are a type) have in general been relatively well sampled across the NT (Russell-Smith 1991; Liddle *et al.* 1994), the few records of *C. excavata* suggest that it is indeed a rare species in the Territory and on the Australian mainland. This habitat generally occurs as a network of small patches. Their small size and sensitivity to fire and/or altered fire regimes, increases the risks posed by invasive species like Gamba Grass.

Management and Recovery ²

Is there a Recovery Plan (RP) or Conservation Management Plan operational for the species?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
<p>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).</p> <ul style="list-style-type: none"> Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses (SEWPAC, 2012; http://www.environment.gov.au/biodiversity/threatened/publications/threat-abatement-plan-reduce-impacts-northern-australias-biodiversity-five-listed-grasses) 		
<p>List current management or research actions, if any, that are being undertaken that benefit the conservation of the species.</p> <ul style="list-style-type: none"> A weed management plan (2014) exists for gamba grass in the NT (Weed Management Branch 2014). Gamba Grass mapping (DENR and NESP) will inform threat management. Fire mapping (NAFI) will inform threat management. Gamba Grass and related fire management undertaken by Territory Parks and Wildlife (Department of Tourism and Culture) undertake extensive management actions on NT National Parks. Management lessons learnt from Park management and related plans may inform threats management of this species. An EPBC threat abatement plan that relates to Gamba Grass and Mission Grass spells out management, monitoring and research priorities. General fire and gamba grass management on the property and across the surrounding area is being undertaken by landholders, Bushfires NT, Department of Infrastructure (Vacant Crown Lands). One plant is in cultivation, to assist with taxonomic work and for ex situ conservation. While the plant has flowered several times, no fruit has yet been harvested and the plant is still too small to support the removal of cuttings. 		
<p>List further recommended management or research actions, if any, that would benefit the conservation of the species.</p> <ul style="list-style-type: none"> Survey of nearby limestone vine thicket vegetation for the presence of <i>Clausena excavata</i> to fully define the size, extent and status of the population. Establish a formal monitoring program for this species to investigate the health, status and dynamics of the wild population, including information on the response to fire and introduced animals. Information on growth rates and size of reproductive stems is required to provide an estimate of generation time in the wild. Gamba Grass and other invasive weeds (especially perennial grasses) should be controlled and managed (DSEWPAC, 2012) at the known sites to prevent the development of excessive fuel loads that will inevitably result in high-intensity fires that pose a threat of loss or decline in the <i>C. excavata</i> stands. Fire and weed management on the property to prevent incursions into the limestone vine thicket community and ecotone from adjoining areas. Buffering from land-use activities, such as grazing, in the woodland vegetation adjacent to limestone habitat. Establish additional ex situ plants/populations. Conduct genetic research to ascertain the species' phylogeography in the NT. 		

² There should be at least one action for each identified threat (and vice versa)

Consistency with CAM MOU

Consistent with Schedule 1, item 2.7 (h) and 2.8 of the Common Assessment Method Memorandum of Understanding, it is confirmed that:	
<ul style="list-style-type: none"> 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 <input checked="" type="checkbox"/> No <input type="checkbox"/>
Comments:	
<ul style="list-style-type: none"> surveys of the species were adequate to inform the assessment; 	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
Comments:	See section above under Adequacy of Survey
<ul style="list-style-type: none"> 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 <input checked="" type="checkbox"/> No <input type="checkbox"/>
Comments:	

Nomination prepared by:	
Contact details:	
Date submitted:	22 November 2017
<p><i>If the nomination has been refereed or reviewed by experts, please provide their names and contact details:</i></p> <p>Ian Cowie, Chief Botanist NT Herbarium.</p> <p>The nomination has been reviewed by the NT Threatened Species Expert panel. The recommendation of the Panel is the species be listed as Critically Endangered.</p>	

References cited in the advice

- Department of Land Resource Management (2012). Threatened Species of the Northern Territory: *Clausena* sp. Tipperary (G.J. Leach 2152) (RUTACEAE). [Online]. Darwin: Department of Natural Resources, Environment and the Arts. Available from: http://www.lrm.nt.gov.au/_data/assets/pdf_file/0005/143159/Clausena_Tipperary_VU_FINAL.pdf
- DSEWPAC (2012) Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses. Department of Sustainability, Environment, Water, Population and Communities, Canberra. (<http://www.environment.gov.au/biodiversity/threatened/publications/threat-abatement-plan-reduce-impacts-northern-australias-biodiversity-five-listed-grasses>)
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- Rossiter, N.A., Setterfield, S.A., Douglas, M.M., Hutley, L.B. and Cook, G.D. 2004, 'Exotic grass invasion in the tropical savannas of northern Australia: Ecosystem consequences', in *Proceedings of the 14th Australian Weeds Conference*, Eds. B.M. Sindel and S.B. Johnson. Weeds Society of New South Wales, Sydney, pp. 168–171.
- Rossiter-Rachor, N. A., Setterfield S. A., Douglas, M. M., Hutley, L. B., Cook, G. D. and Schmidt, S. (2009). Invasive *Andropogon gayanus* (gamba grass) is an ecosystem transformer of nitrogen relations in Australian savanna. *Ecological Applications* 19(6): 1546-1560.
- Russell-Smith, J. (1991). Classification, species richness, and environmental relations of monsoon rain forest in northern Australia. *Journal of Vegetation Science* 2, 259-278.
- Territory Natural Resource Management (TNRM)(2017). Video: Gamba grass – A weed that's killing country. <https://www.territorynrm.org.au/single-post/2017/07/05/VIDEO-Gamba-grass---A-weed-thats-killing-country>. (accessed 22/09/2017)
- TSSC (undated). Advice to the Minister for the Environment, Water, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendments to the List of Key Threatening Processes under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) <http://www.environment.gov.au/biodiversity/threatened/key-threatening-processes/ministers-decision-invasion-by-gamba-grass-other-introduced-grasses> (accessed May 2017)

Summary of subpopulation information (detailed information to be provided in the relevant sections of the form)						
Site, Location or subpopulation (include coordinates)	Land tenure	Survey information: Date of survey and No. mature individuals	Area of subpopulation s	Site / habitat Condition	Threats (note if past, present or future)	Specific management actions
Tipperary Station A	Pastoral lease	262 stems in c.85 aggregations, not all 'mature' (December 2010)	6.25 ha	On the fringe of monsoon vine forest patch, associated with outcropping limestone	Major source of Gamba grass 1.5 km away and satellite infestations closer in the eucalypt woodland matrix	General fire and weed management on the property Two 'suckers' taken to establish species ID and for ex-situ conservation. One plant is established and has flowered several times but no fruit have yet been harvested. The plant is in cultivation at Ian Cowie's residence but is not large enough to take cuttings from.
Tipperary Station B	Pastoral lease	50-60 stems but most considered immature (December 2010)	2 ha	On the fringe of monsoon vine forest patch around limestone sinkhole	Major source of Gamba grass 1.1 km away and satellite infestations closer in the eucalypt woodland matrix	General fire and weed management on the property