

NSW Threatened Species Scientific Committee

Conservation Assessment of *Diospyros mabacea* (F.Muell.) F.Muell. (Ebenaceae)

Kris French, Patricia Nagle and Judy Scott, 15 July 2021
NSW Threatened Species Scientific Committee

Background

The following assessment of *Diospyros mabacea* was conducted as a part of the review of schedules. *Diospyros mabacea* is currently listed on both the NSW BC Act and the EPBC Act as an endangered species. This current assessment was limited to determining if the threat status was likely to change and was largely based on data from McKinley (2006), as there was little detailed recent data available. Any future assessments should require a survey of the species over its entire range, noting the abundance of the species at each site, along with the threats impacting the species.

Diospyros mabacea is a site-managed species under the NSW Saving our Species (SoS) program (DPIE 2021).

***Diospyros mabacea* (F.Muell.) F.Muell. (Ebenaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Endangered

Current NSW BC Act Status: Endangered

Proposed listing on NSW BC Act and EPBC Act: no change, remain as Endangered.

Conservation Advice: *Diospyros mabacea*

Summary of Conservation Assessment

Diospyros mabacea was found to be eligible for listing as Endangered under IUCN Red List Criteria B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v), C2a(i) and D. The main reasons for this species being eligible are its highly restricted geographic range, severe fragmentation, very small population of <250 mature individuals and ongoing threats of weed invasion and grazing pressure.

Description and Taxonomy

Diospyros mabacea was described by Ferdinand von Mueller (1883) under the basionym of *Cargillia mabacea* arising from a review of his own (1866) naming of *Maba quadridentata* F.Muell. Revisions of the family, and descriptions of the genus, were later completed by many authors (APNI 2021).

Jessup (2014) revised *Diospyros* and endorsed the taxonomy of *D. mabacea*. This was subsequently supported by the Australian Plant Census (2016). A detailed description of *D. mabacea* (and comparative anatomy with its closest kin *D. australis*) can be found in Jessup (2014) and Floyd (1982).

PlantNET (2021) describes *Diospyros mabacea* as a "Small tree. Leaves elliptic to oblong or oblanceolate, 6–13 cm long, 2–5 cm wide, soft to firm, apex shortly acuminate, blunt or notched, upper surface dull or slightly glossy, lower surface pale green and moderately glossy, midvein impressed above, midvein and secondary veins raised and hairy below; leaves drying blackish; petiole 2–7 mm long. Flowers 4-

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merous. Calyx lobes 4. Fruit globose, 20–30 mm diam., scarlet, glabrous; calyx not greatly enlarged, lobes obtuse, recurved, glabrous; fruits summer.”

The distinguishing fruit colour of brilliant scarlet (*D. australis* has jet-black fruit) informs the common name “Red-fruited Ebony” (Jessup 2014). Floyd (1982, 1989) describes seeds of *D. mabacea* as “brownish-black, spindle-shaped and triangular in cross-section with one rounded side, finely roughened”. Flowering is in spring and fruit has been recorded in October (Jessup 2014) but more commonly over summer (Floyd 1982, 1989; Harden 1990; PlantNET 2021).

Distribution and Abundance

Diospyros mabacea is endemic to New South Wales and restricted to the area encompassing the Tweed, Brunswick & Oxley Rivers and their headwaters in north-east NSW. There are a number of very early collections of the species: Baeuerlen in 1895-7 (Mullumbimby), Campbell in 1900 (Murwillumbah), and Rummery in 1917 (Tweed) (DPIE May 2020). Atlas of Living Australia (ALA) records were mapped and sorted. A number of records were identified as erroneous: six pertain to planting sites within the Coffs Harbour Botanic Gardens; one (Guymer & Jessup 1981) had an incorrect grid reference.

The extent of occurrence and the area of occupancy for *Diospyros mabacea* were estimated with GeoCAT (Bachman *et al.* 2011) using the occurrence data available from ALA records (accessed June 2020) after removing those erroneous records noted above. However, it is uncertain if many of the older records still reflect extant subpopulations.

Extent of Occurrence (EOO): The EOO was estimated to be 1042 km² based on a minimum convex polygon enclosing all reliably mapped occurrences of the species, the method of assessment recommended by IUCN (2019). To be listed as Endangered under Criterion B1 a species must have an EOO of <5000 km². *Diospyros mabacea* meets the EOO threshold for Endangered under Criterion B1.

Area of Occupancy (AOO): The AOO was estimated to be 112 km². This calculation was based on the species occupying 28 (2 km x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2019). To be listed as Endangered under Criterion B2 a species must have an AOO of <500 km². *Diospyros mabacea* meets the AOO threshold for Endangered under Criterion B2.

A review of *Diospyros mabacea* in 2006 (McKinley 2006) identified 15 sites for the species. Of the 15 sites, 4 are identified by SoS (DPIE 2021) as priority management sites. McKinley (2006) tallied 247 ‘mixed-age class individuals’. Eleven sites that were formally surveyed by McKinley (2006), gave a total of 17 mature individuals, 18 immature and 10 seedlings. There was a lack of detailed site data for the two largest sites in Limpinwood Nature Reserve with 140+ individuals (site 2 in McKinley 2006) and at Tyalgum with 56 individuals of mixed size (site 1 in McKinley 2006)) so the percentage of individuals that were mature in those subpopulations is unknown. McKinley (2006) observed 8 sites with only a single individual present, and a further 4 sites with less than 5 individuals present. Since 2006 some of these individuals have died, while an additional site was found (at Terranora) that added c.10 individuals (L. Weber pers. comm. 2020; S. Ruming pers. comm. 2020; DPIE 2021). DPIE (2021) note that over the past 50 years there has been a loss of 15 individuals at Brays scrub,

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near Murwillumbah. There has not been a more recent comprehensive survey to estimate the overall population size for the species.

Based on McKinley (2006), approximately 50% of all individuals were immature (excluding seedlings) at the very small sites. It is likely that a percentage of the larger sites (comprising 140+ and 56 plants) also comprise a percentage of immature individuals. For the overall abundance, a lower bound of approximately 118 mature individuals and an upper bound of 247 is currently considered a reasonable estimate.

Of particular interest are the subpopulations in the Limpinwood area as these seem to be the key stands and have areas of habitat large enough to support a viable population. Many of the remnants in the cleared landscape further east are probably not viable subpopulations. If isolated trees are lost, they are unlikely to be replaced as the habitat is too small and disturbed. A detailed look at the loss of habitat in the past (a time span covering the last 3 generations of the species) would enable an assessment under Criterion A. This was beyond the scope of this latest assessment due to time and resource constraints.

Ecology

Jessup (2014) described the habitat of *Diospyros mabacea* as “lowland complex notophyll vine forest”, and PlantNET (2021) described it as “lowland subtropical rainforest” where *D. mabacea* grows as an understorey tree, often close to rivers. Soils are generally basalt-derived alluvium. The Border Ranges Rainforest Biodiversity Management Plan (DECCW 2010) describes the landscape where *D. mabacea* occurs as ‘lowland to midland’, and the habitat as ‘moist rainforest’.

The ecology of *Diospyros mabacea* is poorly understood. Seed dispersal is presumably by birds as fruit are deep red berries. There are observations of seedless fruit production in a number of subpopulations (McKinley 2006) but no knowledge of seed viability. Young plants were identified at many sites suggesting some regeneration potential although there was acknowledgement that these small plants may be the result of suckering (McKinley 2006). The species response to fire is unknown, although *Diospyros australis* can resprout after fire (NSW OEH 2014). *Diospyros virginiana*, a species from the USA, is also known to readily sprout from roots following fire (Hodgkins 1958; Halls undated).

Threats

The main threats to *Diospyros mabacea* are outlined in the SOS program’s recovery profile (DPIE 2021) and are summarised below. They include direct and indirect impacts from land management practices that threaten the species.

Loss and degradation of habitat through clearing for agriculture or development. Conservation on private land is uncertain. Cooperation and positive liaison with landholders and land managers is critical for the success of recovery plan priority actions. Changes in land ownership may impact directly on grazing pressures, clearing rates, habitat fragmentation, or adverse hydrological changes.

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Browsing and trampling by domestic stock. Where *Diospyros mabacea* grows on grazed private property the browsing and trampling by domestic and feral stock (cattle, horses, deer, goats) can inhibit seedling recruitment and add unwanted nutrients to soils that can lead to weed growth.

Invasion and competition from various woody and herbaceous weed species. Woody and herbaceous weed species compete for nutrients, water, light and space where they grow alongside *Diospyros mabacea*. Weeds modify the habitat for *D. mabacea*, inhibit recruitment and inhibit saplings from reaching maturity. Vines may grow on *D. mabacea* causing structural damage to the tree by branch breakages and inhibiting fruit production. Known weeds in the habitat of *D. mabacea* include *Lantana camara* (Lantana), *Aristolochia elegans* (Dutchman's pipe), *Ricinus communis* (castor oil plant), *Anredera cordifolia* (Madeira vine), *Dolichandra unguis-cati* (cat's claw creeper), *Ligustrum sinense* (small-leaf privet), and *Cinnamomum camphora* (camphor laurel).

Fire may affect the margins of rainforest habitat. It is unlikely that any sites were burnt in the 2019/2020 fires.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Diospyros mabacea* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Criterion A *Population Size reduction*

Assessment Outcome: Data Deficient.

Justification: There are no data to quantify a reduction in *Diospyros mabacea*.

Diospyros mabacea is a long-lived tree so three generations may date pre-1750. If land clearing has led to >80% habitat reduction, then a Critically Endangered status would need to be considered under A2 and A4 criteria. At this stage the subpopulation and habitat in Limpinwood NR is protected from clearing. Further analysis is needed to estimate past loss.

Criteria B *Geographic range*

Assessment Outcome: Endangered under B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v).

Justification: The Extent of Occurrence (EOO) was estimated to be 1042 km² and the Area of Occupancy (AOO) was estimated to be 112 km². *Diospyros mabacea* meets the Endangered threshold for both EOO (<5,000 km²) and AOO (<500 km²). Even with updated information on the current distribution of the species the EOO and AOO are not likely to meet the thresholds for CR.

In addition to these thresholds, at least two of three other conditions must be met. These conditions are:

- a) The population or habitat is observed or inferred to be severely fragmented or there is 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

Assessment Outcome: Endangered

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Justification: *Diospyros mabacea* may be considered as severely fragmented. The largest habitat areas for the species appear to be in the western part of its distribution in Limpinwood NR. Past clearing has left single trees or fragments of habitat throughout much of the rest of its distribution. There is evidence that most of the AOO is in habitat patches that are smaller than would be required for a viable population. Many contain just one tree. While it is possible seed dispersal by vertebrates may potentially occur over the distribution of the species (by birds for example), successful recruitment is unlikely in many of the patches as they are degraded riverside remnants surrounded by cleared grazing land (i.e. the areas have no future as a habitat for the species). Consequently, these small patches may go extinct as they have little likelihood of recolonization (IUCN 2012).

There are likely to be 10 or more threat-based locations, with threats at each viable site acting independently of others. Resurveying the species and the extent of the threats across its surviving distribution would enable a more informed estimate for the number of locations.

- 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.

Assessment Outcome: Met for (ii, iii, iv and v).

Justification: As there is evidence of ongoing tree death (McKinley 2006), and a lack of recruitment due to the threats of weeds and grazing at many sites, continuing decline in the quality of habitat and in the number of mature individuals is inferred.

- c) Extreme fluctuations.

Assessment Outcome: Not met.

Justification: It is a long-lived tree and extreme fluctuations are unlikely.

Criteria C Small population size and decline

Assessment Outcome: Endangered under C2a(i).

Justification: There is an estimate of <250 mature individuals which meets the threshold for Critically Endangered. However, the one subcriterion that is required to be met is only met at the Endangered threshold, hence the overall outcome is Endangered.

At least one of two additional conditions must be met. These are:

- C1. An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generation (whichever is longer) (CE); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Data Deficient.

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Justification: There is insufficient data to quantitatively assess decline in the population of *Diospyros mabacea*.

C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Endangered

Justification: As there is evidence of ongoing tree death (McKinley 2006), and a lack of recruitment due to the threats of weeds and grazing at many sites, continuing decline in the number of mature individuals is inferred.

In addition, at least 1 of the following 3 conditions:

a (i). Number of mature individuals in each subpopulation ≤ 50 (CR); ≤ 250 (EN) or ≤ 1000 (VU).

Assessment Outcome: Endangered

Justification: The largest known subpopulation is in Limpinwood Nature Reserve which has 140+ individuals. As it is unknown how many of these individuals are mature, it is assumed that there are more than 50.

a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: not met

Justification: Whilst one subpopulation contains 56% of the plants (site 2 in McKinley 2006 Table 1), it does not meet the requirement for Endangered of 95 - 100% (EN) or Vulnerable of 100% (VU) of individuals in the one subpopulation.

b. Extreme fluctuations in the number of mature individuals.

Assessment Outcome: Data Deficient.

Justification: It is unlikely for a long-lived tree like *Diospyros mabacea* to have extreme fluctuations.

Criterion D *Very small or restricted population*

Assessment Outcome: Endangered

Justification: The number of mature individuals is estimated to be < 250 . A lower bound of approximately 118 plants and an upper bound of 247 may be a reasonable estimate for the number of mature individuals (based on McKinley, 2006). There is uncertainty in this estimate as there has not been a recent comprehensive survey.

Criterion E *Quantitative Analysis*

Assessment Outcome: Data Deficient

Justification: There are insufficient data to quantify the extinction risk for this species.

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Conservation and Management Actions.

Diospyros mabacea is a site managed species under the NSW Saving our Species project. For the most recent management projects see the Saving our Species database.

(<https://www.environment.nsw.gov.au/savingourspeciesapp/SearchResults.aspx>)

For future assessments, a survey of the species over its range, noting the abundance and threats of the species at each site, would be useful.

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APPENDIX 1

Assessment against Biodiversity Conservation Act criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Endangered under Clause 4.3 (b)(d e i ii iii iv), Clause 4.4 (a)(e i ii A(II)) and Clause 4.5 of the Biodiversity Conservation Regulation (2017).

Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

Assessment Outcome: Data Deficient

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	

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	(d)	the actual or potential levels of exploitation of the species,
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

Clause 4.3 - Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)

Assessment Outcome: Endangered under Clause 4.3 (b) (d,e,i,ii,iii, iv)

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species,
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

Clause 4.4 - Low numbers of mature individuals of species and other conditions

(Equivalent to IUCN criterion C)

Assessment Outcome: Endangered under Clause 4.4 (a)(e i ii A(II)).

The number of mature individuals is very low, which meets the threshold for Critically Endangered. However, subcriterion (e)(ii)(A)(II) is only met for Endangered (i.e. the number of individuals in each population of the species is very low), hence the overall outcome is Endangered.

The estimated total number of mature individuals of the species is:				
	(a)	for critically endangered species	very low, or	
	(b)	for endangered species	low, or	
	(c)	for vulnerable species	moderately low,	
and either of the following 2 conditions apply:				
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):		
		(i)	for critically endangered species	very large, or
		(ii)	for endangered species	large, or
		(iii)	for vulnerable species	moderate,

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	(e)	both of the following apply:		
	(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and		
	(ii)	at least one of the following applies:		
		(A)	the number of individuals in each population of the species is:	
		(I)	for critically endangered species	extremely low, or
		(II)	for endangered species	very low, or
		(III)	for vulnerable species	low,
		(B)	all or nearly all mature individuals of the species occur within one population,	
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.	

Clause 4.5 - Low total numbers of mature individuals of species

(Equivalent to IUCN criterion D)

Assessment Outcome: Endangered

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 - Quantitative analysis of extinction probability

(Equivalent to IUCN criterion E)

Assessment Outcome: Data Deficient

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 - Very highly restricted geographic distribution of species—vulnerable species

(Equivalent to IUCN criterion D2)

Assessment Outcome: not met

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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