Conservation Assessment of Myall Creek Wattle *Acacia atrox* Kodela (Fabaceae)

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Acacia atrox Kodela (Fabaceae)

Distribution: Endemic to NSW
Current EPBC Act Status: Not Listed
Current NSW BC Act Status: Endangered
Proposed listing on NSW BC Act: Critically Endangered
Reason for change: Conservation assessment completed using IUCN Red List Criteria supports Critically Endangered. This category was not available on NSW *Threatened Species Conservation Act 1995* (repealed) at time of initial assessment in 2001.

Summary of Conservation Assessment

Acacia atrox was found to be eligible for listing as Critically Endangered under Criterion A2(b), B1ab (iii, v) and B2ab (iii, v).

The main reasons for this species being eligible are that; i) a population reduction has been observed that has not ceased within three generations based on population surveys performed between 2000 and 2019; ii) it has a highly restricted geographic range; ii) the population of the species is severely fragmented; iii) there is an observed continuing decline of the species habitat area, extent, and quality; iv) there is an observed decline in the number of mature individuals.

Description and Taxonomy

Acacia atrox, (family Fabaceae) (Kodela 2000; Copeland and Kodela 2012), commonly known as the Myall Creek Wattle, has two subspecies: *Acacia atrox* subsp. *atrox* and *Acacia atrox* subsp. *planitiicola*. *Acacia atrox* subsp. *atrox* was first described from the Inverell region by Kodela (2000) as a "dense, much branched shrub normally 0.5-1.5 (-2) m high, oldest plants to 4 m high; main stem less than 10 cm diam. at breast height, sometimes twisted, spreading by suckering. Bark grey-brown, becoming dark grey and vertically fissured with age". *Acacia atrox* subsp. *planitiicola* was first described by Copeland and Kodela (2012) as a shrub to small tree to 6 m high, spreading by suckering; bark grey-brown, rough, vertically fissured; branchlets terete, pale light green to yellowish green, becoming darker and brownish in colour with age, glabrous, with inconspicuous low rounded longitudinal ridges. Plants are covered in light green to blue spiney phyllodes, 2-4cm long and 1-1.2mm wide (Copeland and Kodela 2012). Phyllodes are sessile, patent to slightly inclined, very narrowly linear, straight, terete to quadrangular in section with a yellow vein at each angle and a less prominent vein in between these (8-veined altogether, less with *A. atrox* subsp. *planiticola*), gradually tapered towards a pungent apex (the fine tip orange-brown, 2-3 mm long). Inflorescences normally paired (often one of the peduncles missing), on a short axis (rudimentary raceme) to 1 mm long in phyllode

axils (often appearing simple); cream coloured to pale yellow. Ovary densely clothed with minute white hair (NSW Threatened Species Scientific Committee 2001).

Differences between the subspecies appear within slight features of the phyllodes and flowers. In *A. atrox* subsp. *planiticola* the phyllodes appear to be less rigid with the longitudinal veins being less pronounced and fewer in number and the flower-heads appear to be smaller (5–7 mm diam.) with fewer flowers (17–25-flowered) than in *A. atrox* subsp. *atrox.* (Copeland and Kodela 2012).

Both *Acacia atrox* subsp. *planitiicola and Acacia atrox* subsp. *atrox* are combined in this assessment.

Distribution and Abundance

Acacia atrox is endemic to northern New South Wales (NSW). It occurs naturally in two subpopulations: one within Kirramingly Nature Reserve, south-west of Gurley (this is the only known population of *A. atrox* subsp. *planiticola;* Copeland and Kodela 2012), and the other on private land near Myall Creek, north-east of Bingara (see Appendix 2. Figure 1). Both locations are within the Nandewar and Darling Riverine Plains Bioregions, the traditional lands of the Kamilaroi First Nations People (Department of Planning and Environment [Map Data] 2022; Moree Plains Shire Council 2022). As part of the NSW Department of Planning and Environment (DPE) Saving our Species (SoS) program, an active translocation site has been established in the Moree Plains Local Government Area (LGA) (Office of Environment and Heritage 2019a) This translocation sites population has not been included in the total population estimates for the assessments. Summarised population abundance of *Acacia atrox* across the 19 years of available records can be found in Appendix 2 Table 1 (Hawes *et al*. 2000; Bell & Hunter 2006; DPIE 2019)).

Acacia atrox has an Extent of Occurrence (EOO) of 22 km^2, calculated as a minimum convex polygon containing all known occurrences, the method of assessment recommended by IUCN (2022). The Area of Occupancy (AOO) is estimated to be 8 km^2 based on the species occupying two, 2 x 2 km grid cells, the scale recommended by IUCN (2022). Both EOO and AOO were calculated using GeoCAT software (Bachman *et al.* 2011), enclosing all recent confirmed survey and herbarium records. Please see GeoCAT EOO and AOO results from cleaned data set in Appendix 3.

The Myall Creek subpopulation of *Acacia atrox* was cleared by the landowner in 1996, and the site was then subjected to additional raking and tilling with earth moving equipment (Bell and Hunter 2006). This stimulated mass root suckering in surviving individuals of the species in the years to follow (Bell and Hunter 2006). When first described as a new species by Kodela (2000) the area occupied by *A. atrox* at this site was identified as approximately 10 hectares (ha) but may have existed more widely across the local landscape prior to clearing (Bell and Hunter 2006). This estimate was then quantified through surveys by Bell and Hunter (2006) who mapped the boundary of the extent of ramets (stems), which showed that *A. atrox* only covered approximately 4 ha (Bell and Hunter 2006).

Hawes *et al*. (2000) estimated the subpopulation of *A. atrox* at Myall Creek to be approximately 50,000–100,000 ramets following the 1996 land clearing event. Bell and Hunter (2006) conducted subsequent surveys, establishing sixteen 5 x 5 m survey plots in random locations in the subpopulation, where ramets were counted within each (Bell and Hunter 2006). From these plots it was estimated that there were approximately 18,000 ramets/hectare, giving an estimated total of 70,000 ramets across the 4-ha occupied by the species.

Ongoing monitoring of the species under the Saving our Species (SoS) program uses ground-based photographic surveillance within the sixteen plots established by Bell and Hunter (2006). Density of ramets <20 cm tall is estimated within a 3 m radius of a fixed point in the plot, combined with a count of ramets over 20 cm tall across the entire plot. Results from this monitoring method at Myall Creek in 2019 estimated a subpopulation of 10,000 ramets occurring as dense, mostly juvenile individuals across the 4ha area occupied (Department Planning, Industry and Environment 2019; T Soderquist *in litt.* May 2022). The 2019 subpopulation of 10,000 ramets is predicted to continue to decline through natural thinning and attrition towards an estimated 500 larger ramets over the next 50 years, based on observations of reduction for this subpopulation over the last two decades (T. Soderquist pers. comm. May 2022). That is, there is an observed decline in the number of ramets of *A. atrox*.

The *Acacia atrox* subpopulation within Kirramingly Nature Reserve occurs in five distinct sites over an area of approximately 5 ha. It has been estimated from the Saving our Species monitoring that there are 250 stems >10cm diameter within these sites, which range in distance from 50 to 200 m apart (DPIE 2019). The subpopulation is made up of mostly mature individuals with young ramets being sparse and since monitoring began under SoS one of these have died bringing this estimate to 249 stems (NSW Gov 2020). Monitoring under SoS at Kirramingly since 2012 indicates that mortality, recruitment, growth, and changes in health are minimal in this subpopulation (T. Soderquist, '*in litt'.* May 2022).

Acacia atrox is thought to have previously been more widely distributed in the woodland and grasslands communities that were once widespread across the Moree Plains and Gwydir LGAs (Copeland and Kodela 2012; National Parks and Wildlife Service 2003). European settlement from the 1800s has significantly modified this landscape through clearing for grazing and intensive cropping of wheat, sorghum, and cotton (National Parks and Wildlife Service 2003). The current geographic isolation of the two remaining subpopulations, which are inferred to have been historically connected, may have contribute to the lack of viable seed production of for *A. atrox* as a potential consequence of genetic isolation (Copeland and Kodela 2012; Department of Planning Industry and Environment 2019). The presence of uniquely shaped, hard galls of an unknown species of Lepidopteran have been found on ramets of *A. atrox* within both subpopulations. Lepidopteran and host plant relationships can take up to 10,000 years to form, and the presence of these identical shaped galls at both subpopulations is further evidence of a long, shared evolutionary history in a less fragmented landscape (T. Soderquist pers. comm. April 2022).

Acacia atrox occurs within the protected area network in Kirramingly Nature Reserve, which is managed by the NSW National Parks and Wildlife Service. The Myall Creek

subpopulation occurs on private land and is currently subject to a five-year conservation management agreement up to 2025 (T. Soderquist pers. comm. May 2022).

Cultural Significance

The *Acacia* genus throughout Australia has commonly been used by Aboriginal peoples. It was highly valued as a source of food, medicine, and for the quality of the timber being used in the production of a range of tools and weapons (Koori History. com 2017). Traditionally Aboriginal people in central Australia use at least 49 species of *Acacia sp.,* of these the majority providing edible seeds (House & Harwood 1991). The gum of many *Acacias* was eaten by some Aboriginal groups (Morrison 2000). Coarse string was made from the inner bark of *Acacia* species (Gott 2008), and this was used to weave into bags and nets. *Acacia melanoxylon* and *A. concurrens* are known species used for these purposes (Morrison 2000). Aromatherapy was common (Plomley 1966 as cited in Gott 2008) with the use of smoke treatment from smouldering branches to treat multiple ailments (Morrison 2000).

This assessment is not intended to be comprehensive of the Traditional Ecological Knowledge that exists for *Acacia atrox*. Aboriginal people have a long history of biocultural knowledge, which comes from observing and being on Country, and evolves as it is tested, validated, and passed through generations (Woodward *et al*. (Eds.) 2020). Aboriginal Peoples have cared for Country for tens of thousands of years (Bowler *et al.* 2003; Clarkson *et al*. 2017). Although no specific information could be collected on *Acacia atrox* it is acknowledged that there is traditional ecological knowledge for all plants, animals and fungi connected within the kinship system (Woodward *et al.* (Eds.) 2020).

Ecology

Habitat

Acacia atrox is found on deep black clay soils derived from basalt and shallow red sandy loams on upper slopes and crests (Office of Environment and Heritage 2019b). The subpopulation at Myall Creek grows on slopes and low hills in modified agricultural areas with a mix of native and exotic grasslands (Kodela 2000). The subpopulation in Kirramingly Nature Reserve occurs in open grassy *Eucalyptus* woodland communities with a scattered understory of *Callitris glaucophylla* and *Notelaea macrocarpa,* and a dense native grassy groundcover (Copeland and Kodela 2012; Clarke *et al* 1998).

Flowering and Clonality

Acacia atrox has creamy to pale yellow flowers which appear in March and June (Hawes *et al*. 2000). Despite substantial survey of the species, there has been no known production of viable seed at any age observed during monitoring (T. Soderquist pers. comm. May 2022; Hawes *et al* 2000). All specimens of *A. atrox* exist as multi-stem clones from only four known genetically unique individuals and the species reproduces solely by vegetative suckering (T. Soderquist pers. comm. May 2022, NSW Gov 2020, NSW Gov 2021; Broadhurst 2020). *Acacia atrox* ramets are stimulated to grow from a disturbed root of a parent stem and reproduces further by

production of suckers from its own establishing root network. Once established, each ramet has the potential to survive and decay independently from the cloned parent, meaning that all stem counts are considered mature individuals under the IUCN Red List guidelines (IUCN 2022).

The current failure of the two subpopulations to set viable seed may reflect both a long history of asexual reproduction and effect of habitat disturbance as seen in closely related *Acacia* species (O'Brien *et al.* 2014). Studies of the threatened shrubs *Acacia carneorum* and *Hakea pulvinifera,* which also have minimal (for *A. carneorum)* to no (*H. pulvinifera*) sexual reproductive success*,* infer that a diversion towards a clonal trait signifies a long history of subpopulations being isolated from each other (O'Brien *et al.* 2014) as observed in these closely related species of *Acacia.*

Life History

It is conceived that some of the older individuals of *Acacia atrox* are at least one hundred years old and considered senescent (Bell and Hunter 2006; Copeland and Kodela 2012). Based on the estimated longevity of 100 years, a generation length of 47 years has been calculated using IUCN (2022) methods. A natural survival rate of 75% for the first several years has been estimated, given that each clonal ramet can be supported by the root system of more establishing ramets. An additional natural attrition of 10% per decade has been predicted to account for loss through disturbance and ongoing natural succession (IUCN 2022).

Threats

Clearing

The current limited geographic extent of *Acacia atrox* is the result of historical clearing for agricultural development (Department of Planning Industry and Environment 2019). Of the remaining two subpopulations, one is protected within Kirramingly Nature Reserve, managed by the NSW National Parks and Wildlife Service NSW (National Parks and Wildlife Service 2003). The subpopulation at Myall Creek is currently managed by the landowner under a five-year management agreement under the Saving our Species program (Department of Planning Industry and Environment 2019). There is potential for future clearing of the species within private lands, particularly at Myall Creek where the majority of the population of *A. atrox* occurs. Clearing of habitat for agriculture and pasture improvement where protection has ceased, or in areas where the species has not been recognised is a potential future threat for the species (Office of Environment and Heritage 2019c). Clearing of native vegetation is a Key Threatening Process under the NSW Biodiversity Conservation Act 2016 (BC Act 2016), and under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999) (Australian Government, Department of Climate Change, Energy, the Environment and Water 2021). Management should seek to secure private land conservation agreements (e.g., covenants or extended voluntary agreements) to ensure the private property population is not lost.

Herbivory and stem damage

The hard, sharp phyllodes of mature foliage (Copeland and Kodela, 2012) might provide some protection from browsing by vertebrate herbivores. However, young regenerating ramets have been observed to be damaged by domestic livestock, and new growth is grazed by kangaroos, feral goats, and rabbits (T. Soderquist *in litt*. May 2022; Copeland and Kodela, 2012)), all of which are present in both subpopulations. Research into *Acacia carneorum,* which has similar ecological characteristics and is closely related to *Acacia atrox,* concluded that grazing animals such as rabbits have impacted on recruitment of suckering juveniles even when present in only small numbers. As a result, the exclusion of rabbits is considered essential for the long-term conservation of *A. carneorum* (Auld 1993). Grazing threats can change over time depending on changing climatic conditions (Auld 1993). During prolonged drought periods grazing pressures from livestock, native and feral species may increase when other forage is unavailable (Williams *et al* 2008). There is currently no active management to exclude grazing animals from *Acacia atrox* subpopulations. The Myall Creek subpopulation is likely to be more susceptible to grazing and damage from livestock as it occurs on private land that is intensively grazed (Department of Planning Industry and Environment 2019).

High Intensity and High Frequency Fire

There is no direct evidence of the fire response of *Acacia atrox.* However, inappropriate fire regimes have been identified as a threat to over 800 Australian native species, including many species of *Acacia* (Department of Agriculture, Water, and the Environment 2022). *Acacia atrox* is only known from two small, fragmented subpopulations and stochastic events such as fire could potentially be catastrophic for the species and its ability to recover (Department of Planning Industry and Environment 2019). High intensity fire is likely to kill mature trees of *A. atrox* (Office of Environment and Heritage 2019b). High frequency fires may affect the species' ability to recruit new individuals as subsequent fires will deplete nutrient stores in remaining roots, limiting their ability to resprout (Department of Planning Industry and Environment 2019). The impacts of fire may worsen in the face of extended severe droughts under future climate change.

Inadequate Recruitment

Lack of recruitment of younger ramets into both subpopulations (as shown by survey work undertaken through the SoS program (DPIE 2019)) could result in rapid population decline if mortality exceeds ongoing recruitment. Recruitment of regenerating ramets at the Myall Creek subpopulation occurred because of soil disturbance after a mass clearing event. Apart from this there has been minimal evidence to support ongoing recruitment. An increase in suckering has been observed at Kirramingly Nature Reserve after kangaroos stimulated growth by digging, possibly to graze on the exposed roots (DPIE 2019). However, there is no evidence that this stimulus of vegetative reproduction is enough to support the population naturally, as little recruitment has been observed at Kirramingly since discovery in 2012 (Office of Environment and Heritage 2019a). Other than anthropogenic soil and root disturbance through tilling and digging, there is a lack of information on other mechanisms to

promote natural clonal reproduction, and the overall population of the species is likely to continue to decline towards an older demographic (T. Soderquist *in litt.* May 2022). This is exacerbated by the fact that the two small, severely fragmented subpopulations remain vulnerable to stochastic events (DPIE 2019).

Long term isolation, habitat modification and climatic changes may also lead to the absence or disruption of environmental cues and interacting ecological relationships needed for the development of seed (National Parks and Wildlife Service 2000; Department of the Environment, Water, Heritage, and the Arts 2008).

Assessment against IUCN Red List criteria

Criterion A Population Size Reduction

Assessment Outcome: Critically Endangered under criterion A2 (b, c)

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

(b) Index of abundance appropriate to the taxon

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

Justification: A population size reduction of 80% for the index of abundance appropriate for the taxon over the past 3 generations of 141 years for *Acacia atrox* has been inferred. *Acacia atrox* at the Myall Creek subpopulation was estimated at 50,000 - 100,000 ramets when first surveyed in 2000 (Hawes *et al.* 2000). Bell and Hunter (2006) established sixteen survey plots at Myall Creek and estimated the total number of ramets to be 70,000. Subsequent photographic monitoring used within these same sixteen plots under the Saving our Species (SoS) program since 2012 estimates 10,000 ramets as of 2019 (Department of Planning Industry and Environment 2019). Using the minimum estimate of 50,000 ramets recorded in 2000, this number reduced to 10,000 by 2019, representing an 80% population reduction for the index of abundance for the species in less than 3 generations. There is also an inferred continuing decline in the area, extent, and quality of habitat of *Acacia atrox.* Decline is a result of the historic and ongoing threats from further clearing for cropping, grazing and damage caused by livestock (particularly at Myall Creek), grazing and browsing by feral herbivores such as goats and rabbits, extended drought, and the potential threat of wildfire (National Parks and Wildlife 2003). These historic and continuing threats have significantly reduced the area and quality of the habitat for this species (Department of Planning Industry and Environment 2019; Moree Shire Council, 2022).

Criterion B Geographic range

Assessment Outcome: Critically Endangered under Criterion B1ab (iii, v) + B2ab (iii, v)

Justification: B1 & B2. *Acacia atrox* has a very highly restricted Extent of Occurrence of 22 km^2 calculated as a minimum convex polygon containing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022). The Area of Occupancy is estimated to be 8 km^2 using 2x2 km grid cells, as per the IUCN guidelines (2022).

In addition to these thresholds, at least two of three other conditions have been met to satisfy criterion B. 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 Outcomes: Sub criterion met – severely fragmented.

Justification: In an extensively cleared landscape, *Acacia atrox* is considered severely fragmented as all the individuals are found in two small and isolated subpopulations separated by 100 km. Since vegetative suckering is the only known mechanism for reproduction, gene flow between the subpopulations is unlikely. At both subpopulations, stochastic events such as fire may result in the local extirpation of one or both subpopulations independently. Therefore, these small subpopulations may go extinct, with minimal to no probability of recolonisation from the remaining fragmented subpopulation.

Acacia atrox is known from only 2 locations: Kirramingly Reserve and Myall Creek. Each subpopulation is exposed to a different threat factor that can impact on the subpopulation independently of the other. At Myall Creek further clearing, grazing, and livestock damage are ongoing threats being on private lands; while Kirramingly being within a managed reserve is faced with a decline in the population due to inadequate recruitment, and the stochastic threat of fire and/or associated drought destroying all the mature individuals. As the two locations could be affected by the same extreme drought, *A. atrox* has only one threat-based location.

b) Continuing decline observed of (i) Extent of Occurrence (ii) Area of Occupancy (iii) area, extent, and quality of habitat (iv) number of locations (v) number of mature individuals.

Assessment Outcome: Sub criterion met for Critically Endangered – continuing decline under (iii) area, extent, and quality of habitat (v) number of mature individuals.

Justification: (iii) There is an inferred continuing decline in the area, extent, and quality of habitat of *Acacia atrox.* Decline is a result of the historic and ongoing threats from further clearing for cropping, grazing and damage caused by livestock (particularly at Myall Creek), grazing and browsing by feral herbivores such as goats and rabbits, extended drought, and the potential threat of wildfire (National Parks and Wildlife 2003). These historic and continuing threats have significantly reduced the area and quality of the habitat for this species (Department of Planning Industry and Environment 2019; Moree Shire Council, 2022).

(v) A continuing decline of mature individuals has been observed. At Myall Creek Hawes *et al* (2000) estimated 50,000 - 100,000 mostly young, shrub-sized ramets, and this number had declined to 70,000 ramets from Bell and Hunter (2006). A further decline to 10,000 ramets has been recorded under the Saving our Species monitoring program (Department of Planning Industry and Environment 2019). The Kirramingly Nature Reserve subpopulation has remained stable at a total of 250 stems within a 5-ha area since discovery in 2012. There has been one mature tree lost during this time, and this subpopulation persists as an older demographic of aging trees and shrubs (Copeland & Kodela 2012; Department of Planning Industry and Environment 2019). The Myall Creek subpopulation is projected to continue declining as it moves towards an older demographic (Department of Planning Industry and Environment 2019).

b) Extreme fluctuations

Assessment outcomes: Criterion not met

Justification: Monitoring over the 22 years since *Acacia atrox* was first described does not indicate that this long-lived species experiences extreme fluctuations.

Criterion C Small population size and decline

Assessment Outcome: Criterion met for Vulnerable

Justification: The total population size of *Acacia atrox* is estimated to be within the range of ~10,000 10,250 mature ramets. When considering the observed rate at which the main subpopulation is declining at the Myall Creek site (Department of Planning Industry and Environment 2019) Criterion C <10,000 under can be justified for *A. atrox* because the estimated population is within a tolerable level of error (use of estimates from plots and extrapolation).

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) (CR); 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: Criterion met for Vulnerable

Justification: The current estimate of 10,000 ramets at the Myall Creek subpopulation is predicted to reduce through natural thinning and attrition towards an estimate of 500 larger ramets over the next 50 years, based on the observations of reduction for this subpopulation over the last two decades of monitoring (T. Soderquist pers. comm. May 2022). The stable mature population at Kirramingly NR has seen one ramet death since monitoring began in 2012, and without further recruitment into this subpopulation there is also an inferred gradual decline predicted over the next three generations.

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

Assessment Outcome: Sub criterion met for Vulnerable

Justification: There has been an observed decline in the number of individuals at the Myall Creek subpopulation. Population estimates have declined from 70,000 in 2006 (Bell and Hunter 2006) to 10,000 in the 2019 monitoring survey (Department of Planning Industry and Environment 2019). The current estimate of 10,000 ramets at the Myall Creek subpopulation is predicted to reduce through natural thinning and attrition towards an estimate of 500 larger ramets over the next 50 years, based on the observations of reduction for this subpopulation over the last two decades of monitoring (T. Soderquist pers. comm. May 2022).

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

a. (i). Number of mature individuals in each subpopulation ≤50 (CR); ≤250 (EN) or ≤1,000 (VU).

Assessment Outcome: Criterion not met.

Justification: The total population size of *A. atrox* is estimated to be 10, 249 across the two subpopulations which is greater than the minimal required threshold of ≤1,000 to meet Vulnerable.

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

Assessment Outcome: Sub criterion met for Endangered

Justification: The Myall Creek subpopulation contains 10,000 mature individuals representing 97.5% of the total population. The Kirramingly subpopulation contains 249 of the total mature individuals representing only 2.5% of the total number of mature individuals for the species. This meets the 95-100% threat criterion for Endangered.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data deficient.

Justification: Monitoring over the past 22 years since *Acacia atrox* was first described does not indicate that this long-lived species experiences extreme fluctuations.

Criterion D Very small or restricted subpopulations

Assessment Outcome: Criterion not met

Justification: The total population size of *Acacia atrox* is estimated to be in the range of ~10,000 - 10, 250 across the two subpopulations. This is greater than the minimal number required to meet Vulnerable of > 1, 000 mature individuals under criterion D.

To be listed as Vulnerable under D, a species must meet at least one of the two following conditions:

D1. Population size estimated to number fewer than 1,000 mature individuals

Assessment Outcome: Sub criterion not met

Justification: *Acacia atrox* is currently estimated to have a population of < 10 000 mature individuals across the two subpopulations.

D2. Restricted area of occupancy (typically <20 km^2) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

Assessment Outcome: Sub criterion not met

Justification: While *Acacia atrox* only occurs at two locations, with an Area of Occupancy of only an 8 km^2, there is no clear future threat to that would contribute to the extinction of the species in a very short time to meet the assessment requirements of Criterion D2.

Criterion E Quantitative Analysis

Assessment Outcome: Data deficient

Justification: Currently there is not enough data to undertake a quantitative analysis to determine the extinction probability of *A. atrox* under Criterion E.

Conservation and Management Actions

This species is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation project has been developed by the NSW Department of Planning and Environment under the Saving our Species program. The conservation project identifies priority locations, critical threats and required management actions to ensure the species is extant in the wild in 100 years. *Acacia atrox* sits within the site-managed species management stream of the SoS program and the conservation project can be viewed at https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10003

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APPENDIX 1

Assessment against *Biodiversity Conservation Regulation 2017* criteria
The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome:
Acacia atrox was found to be Critically Endangered under Clause 4.2 (1) (a) (2)(b) 4.3 (a) (d) (e) (ii) (iii)

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Critically Endangered 4.2 (1)(a) (2) (b)

(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,	
	(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: Critically Endangered under Clause 4.3 (a) (d) (e) (i) (iii)

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 subpopulations 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 subpopulations of the species.

Clause 4.4 - Low numbers of mature individuals of species and other conditions (Equivalent to IUCN criterion C)
Assessment Outcome: Vulnerable under Clause 4.4 (c) (d) (iii)

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,
	(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: **Data deficient**

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: Data deficient

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.

APPENDIX 2

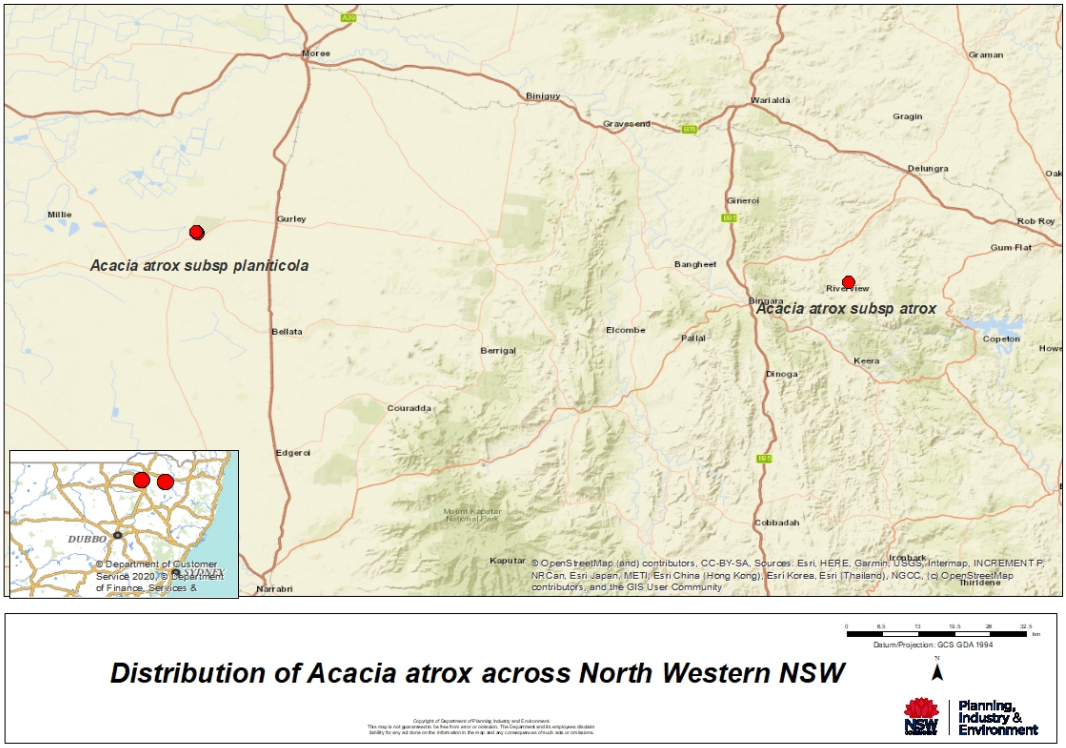

Figure 1. Distribution of *Acacia atrox* across northern NSW on the Moore Plains and Gwydir Local Government areas from cleaned *Acacia atrox* records compiled from Bionet, Atlas of living Australia

Table 1. Summarised population abundance of *Acacia atrox* across the 19 years of available records (Hawes *et al*. 2000; Bell & Hunter 2006; DPIE 2019, NSW Gov 2021)

Sub-population	Demographic	2000	2006	2016	2019	2021
Myall Creek	Mostly young regenerating ramets after soil disturbance stimulated regrowth and mature trees removed	50,000-100,000	70,000	No data	10,000	10,000
Kirramingly	Mostly mature old growth ramets, minimal juvenile recruitment observed	No records	No records	250	250	249
Translocation site	Small population ramets in localised patches 50% survival of total number installed	No data	No data	100	50	50