Conservation Assessment of *Acacia chrysotricha* Tindale (Fabaceae)

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Figure 1: *Acacia chrysotricha.* Source: Gavin Phillips.

Acacia chrysotricha Tindale (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

Non-genuine change based on improved understanding of threats.

Summary of Conservation Assessment

Acacia chrysotricha was found to be eligible for listing as Critically Endangered under the IUCN Criteria B1ab(iii).

The main reasons for this species being eligible are: 1) *Acacia chrysotricha* has a very highly restricted Extent of Occurrence (EOO) of 28 km^2, 2) *Acacia chrysotricha* is known from a single threat-defined location; and 3) continuing decline has been observed and is expected to continue in the quality of habitat due the combined effects of weed invasion and timber harvesting activities.

Description and Taxonomy

Acacia chrysotricha Tindale (Figure 1; Newry golden wattle, Bellinger River wattle) is a conventionally accepted species (CHAH 2006) in the Fabaceae family. *Acacia chrysotricha* is described in PlantNET (2004) as an "Erect tree usually 6–15 m high; bark finely or deeply fissured, grey to red-brown; branchlets ± terete with low ridges, densely yellowish-hairy at first, later the hairs greyish or fawn. Leaves ± sessile on pulvinus, with petiole to 0.1 cm long above pulvinus; rachis 5–14 cm long, densely hairy, circular jugary glands irregularly present at the lowest 1–3 pairs and/or upper 1–3 pairs of pinnae, interjugary glands absent or rarely an odd one present; pinnae 8–18 pairs, 1–4.7 cm long; pinnules mostly 12–25 pairs (6 or more on basal pinnae), oblong to narrowly oblong, elliptic-oblong or ± lanceolate, recurved when dry, mostly 3–4.5 mm long and 1–1.5 mm wide, with fine white or golden hairs mainly on margins and midvein. Inflorescences in axillary and terminal racemes and panicles; peduncles 3–6 mm long, golden-hairy; heads globose, 15–30-flowered, 4–7 mm diam., bright yellow. Pods straight to slightly curved, ± flat, mostly barely to slightly constricted between seeds, 3–10 cm long, 4–6 mm wide, firmly papery thinly leathery, with long fine hairs; seeds longitudinal; funicle ± encircling the seed. Flowering July-August".

The first collection of *Acacia chrysotricha* was made in 1910. It was first described by Tindale in 1966 based on the following type specimen: "Connell's Creek, on Compt. 24 of Newry SF, just south of Urunga, on a side gully 40 to 50 ft. high, 8 inches in diam. at the base, one tree 70 ft. high, 12 inches in diam., A. Floyd 7.1961 (NSW 34451), located in the National Herbarium of New South Wales, Sydney" (Hunter 2017). The name "Newry golden wattle" refers to the golden hairs on the branchlets (PlantNET 2004). It can be distinguished from similar co-occurring *Acacia* species (*e.g., A. mearnsii* and *A. oshanesii*) by features such as the colour and fissuring of the bark, densely hairy branchlets, shorter petiole length, position of jugary and interjugary glands, typically fewer pairs of pinnae and pinnules and the bright yellow flowers (PlantNET 2004).

Acacia chrysotricha trees are typically described as growing approximately 6 to 20 m tall (PlantNET 2004; Richards 2011), however, a few individuals have been observed with estimated heights as tall as 25–40 m in undisturbed habitats (Smith 2012).

Pedley (2003) proposed the name *Racosperma chrysotrichum* for *Acacia chrysotricha* to resolve taxonomic issues within the *Acacia* genus. However, this change was not accepted and *Acacia chrysotricha* remains the currently accepted name by all relevant authorities (PlantNET 2004; CHAH 2006). *Acacia chrysotricha* is known to hybridise with *Acacia fimbriata* (Kodela and Harden 2002).

Distribution and Abundance

Acacia chrysotricha is endemic to NSW and is currently only known from two sites, each containing a single subpopulation, in the catchment of the Kalang River south of Bellingen on the NSW mid-north coast (Table 1). Both sites are within the NSW North Coast Bioregion (DAWE 2012), and on the traditional lands of the Gumbaynggirr people (Horton 1996) within the Coffs Harbour and Nambucca Local Aboriginal Land Councils.

Table 1: Population breakdown of *Acacia chrysotricha* at all known sites.

Subpopulation	Minimum estimate of all individuals	Minimum estimate of mature individuals	References
Gladstone SF	30	30	NSW Scientific Committee 2000; NSW OEH 1997, 2018
Jaaningga NR/ Newry SF	15,000	2,500	Hunter *et al.* 2020

The largest known site of *Acacia chrysotricha* spans a ridgeline within Newry State Forest (SF), Jaaningga Nature Reserve (NR), and adjacent private property (Richards 2011; Hunter 2017). The Jaaningga NR is one of five closely aligned reserves that comprise the Babadaga Group (NSW NPWS 2012). The name 'Babadaga' is the Gumbaynggirr word meaning 'in a single line', given because they occur one after the other along the long forested ridge-line that separates the Bellinger/Kalang and Nambucca catchments (NSW NPWS 2012). Protection of known subpopulations of *A. chrysotricha* was a key priority in the establishment of Jaaningga NR, which was created in 1999 covering an area of 975 hectares to work towards an improved understanding of the ecology of this species, especially its response to fire (NSW NPWS 2012). Jaaningga NR, Gladstone SF, and Newry SF are included within the proposed Great Koala National Park announced by NSW Government (2025).

Initial assessments of the species found only about 1,200 *Acacia chrysotricha* plants within the Jaaningga NR (NSW Scientific Committee 2000). However, more recent survey efforts since 2012 have found additional mature individuals near old logging dumps within the area, as well as areas of high seedling density following fire (see *Response to fire* below) (Smith 2012; Hunter 2017; Hunter *et al.* 2020). Hunter (2017) estimated that there were approximately 25,000 (+/- 5000) individuals (including juveniles) within the Nature Reserve based on observations within 40 plots distributed across a range of environments and vegetation associations where *A. chrysotricha* is found. A subsequent survey between 2018 and 2020 included an additional 43 plots within Jaaningga NR and Newry SF (Hunter 2020). Demographic profiles for 2017 and 2020 monitoring were broadly similar; however, the number of individuals had reduced, and in 2020 the subpopulation was estimated to be 20,000 (+/- 5000) with approximately 16% of the subpopulation found to be of reproductive age, leading to an estimate of 2,500–4,200 mature individuals in the study area (Hunter 2020).

The second site, approximately 3.4 km to the west of the Jaaningga NR site is a small stand in Gladstone SF. This site occurs within a eucalypt plantation managed for hardwood production and was previously estimated to be approximately 30 individuals (NSW Scientific Committee 2000). Observations in 2018 described locally occasional trees up to 20 m tall, with about 10 mature trees within a 50 x 50m area (G. Phillips *in litt.* January 2024). The trees were between a cleared property on the north and a heavily lantana (*Lantana camara*)-infested stand of *Eucalyptus saligna* to the south, which appeared to have been harvested in the previous decades (G. Phillips *in litt.* January 2024). The trees observed were large and old, and were all producing viable seeds, however, no recruitment was observed. Trees were highly fecund compared to those seen in Newry SF (G. Phillips *in litt.* January 2024). The 30 mature individuals observed in Gladstone SF in 2018 were senescent and in poor health, similar to observations in the area in 1997 that stated nearly all trees were large and old, with some dead or dying back (NSW OEH 1997, 2018).

The *Acacia chrysotricha* population consists of two subpopulations. Jaaningga NR, Newry SF and adjacent private property make up a single subpopulation while the stand in Gladstone SF can be considered a separate subpopulation due to being separated by a distance of greater than 3 km, which is expected to exceed typical pollinator and seed dispersal distances (Auld 1997; Stone *et al.* 2003; Blyth *et al.* 2020). The distance between the closest records of the Gladstone Forest plantation subpopulation and the Jaaningga NR subpopulation is approximately 3.4 km (to a single record in the south) and 3.8 km to the main cluster of records on the northern side of the ridgeline. The entire population spans 9 km from west to east.

Extent of Occurrence and Area of Occupancy

The extent of occurrence (EOO) was estimated to be 12.32 km^2 based on a minimum convex polygon enclosing cleaned mapped occurrences of the species, the method of assessment recommended by IUCN (2022). The area of occupancy (AOO) for *Acacia chrysotricha* was estimated to be 28 km^2 based on 2 x 2 km grid cells, the scale recommended for assessing the area of occupancy by IUCN (2022). Where EOO is less than AOO, the IUCN guidelines recommend that EOO estimates be adjusted to be equal to AOO to ensure consistency with the definition of AOO as an area that fits within EOO (IUCN 2019); as such the EOO for *A. chrysotricha* is also considered to be 28 km^2. Both EOO and AOO were calculated using ArcGIS (ESRI 2015) using a cleaned spatial dataset that excluded records of high spatial uncertainty or where site descriptions did not match the observed locations.

Ecology

Habitat

Acacia chrysotricha is an understorey to mid-storey species that grows in eucalypt forests and on the margins of warm temperate rainforests in steep narrow gullies and along intervening ridges (Kodela and Harden 2002). Soils where this species occurs are described as metamorphosed sediments with substantial amounts of free quartzitic gravel (Kodela and Harden 2002). The species grows between 44 m and

172 m in elevation (Hunter 2020), and the region receives approximately 1,556 mm of rainfall annually (mean calculated over 10 years; 2014–2023) (BOM 2024).

In Jaaningga NR, *Acacia chrysotricha* occurs in at least two vegetation communities in moister gully positions and on drier ridge lines (Hunter 2017). One community is described as a lower slope and gully wet sclerophyll forest, with very tall blackbutt (*Eucalyptus pilularis*), turpentine (*Syncarpia glomulifera*), Sydney blue gum (*Eucalyptus saligna*) and ironbark (*Eucalyptus ancophila* / *Eucalyptus fusiformis*), and a dense understorey of rainforest tree and shrub species. The other vegetation community is described as a slightly drier, mid- to upper slope moist sclerophyll forest with very tall blackbutt, turpentine, Sydney blue gum and white mahogany (*Eucalyptus acmenoides* / *Eucalyptus carnea*), with a mid-dense understorey comprising mainly rainforest tree and shrub species (Richards 2011; Hunter 2017).

The Gladstone SF subpopulation occurs on the edge of a eucalypt plantation. The area is described as open wet sclerophyll forest on an undulating east-facing slope, within a valley with sandy loam soils on sandstone (NSW OEH 2018). The *Acacia chrysotricha* trees are located above a drainage line and below a track where the surrounding area appears to have had previous forestry operations, with mostly early regrowth observed (NSW OEH 2018). Co-occurring plant species in the area included *Eucalyptus saligna*, *Callicoma serratifolia*, *Ozothamnus diosmifolius* and the introduced *Lantana camara* and *Solanum mauritianum* (NSW OEH 2018).

Life History

Life history data and research on *Acacia chrysotricha* are scarce, however, observations from surveys and monitoring have shown that it is a disturbance-responsive species that experiences strong self-thinning throughout its lifetime. The longevity of *A. chrysotricha* is not known, but is estimated to be approximately 30 to 60 years based on related species in similar habitats (Richards 2011). Flowering occurs primarily in July and August, with fruiting in November (PlantNET 2004). While bees and wasps are considered the most important pollinators, other insects such as hoverflies, beetles and butterflies also contribute to the pollination of *Acacia* species to varying extents (Stone *et al.* 2003; Fleming *et al.* 2007). Birds may also assist pollination for some *Acacia* species as they forage for nectar produced by the jugary glands, which are abundant on *A. chrysotricha* (Knox *et al.* 1985; Vanstone and Paton 1988; Fleming *et al.* 2007). Seed dispersal is likely to occur abiotically through soil disturbance and water flow, as well as biotically via possums, birds, ants and other opportunistic fauna species (Armstrong 1979; Gibson *et al.* 2011). Seeds are encircled by a funicle, which is a food source for ants that may assist in secondary dispersal, following seed dropping from the tree (O'Dowd and Gill 1986; Kodela and Harden 2002). While smaller ants may remove the funicle and leave the seed close to the parent plant, larger ants may carry the seed to their nest and deposit them 15 cm deep into the nest where they remain until conditions are right for germination (Auld 1986; Gibson *et al.* 2011). Most *A. chrysotricha* individuals are considered immature at <6 years old and under 2 m in height, while as few as 5% are over 10 m in height (Hunter 2017). Given its response to disturbance, population dynamics can differ across its range due to variations in disturbance regimes, predominantly fire and logging history.

Acacia chrysotricha is an obligate seeder and a disturbance-responsive species with recruitment entirely dependent on the germination of physically dormant soil seed bank. Recruitment events primarily rely on fire, however, other disturbances such as track work, timber harvesting activities, and soil disturbance from tree falls can trigger low levels of germination (Richards 2011). Survey data has shown recruitment in areas close to logging dumps and along snigging tracks, and Smith (2012) speculates that some seeds, such as those in Gladstone SF, may have been transported to new locations in the past in the tyres of logging trucks.

Survey data suggest that natural thinning may be in the order of a 100-fold decrease from a disturbance event to maturity, depending on the size of the original recruitment event (Hunter 2017). Between 2017 and 2020, there was a 33% reduction in individuals across 40 monitoring plots within Jaaningga NR, with the greatest reductions observed for trees <2 m in height (Hunter *et al.* 2020). This supports expectations of a high attrition rate for juvenile plants, with few individuals making it to maturity (Hunter *et al.* 2020). The combination of a long lifespan and significant thinning as stands mature can lead to narrow age class ranges in the least disturbed and most disturbed locations (Hunter 2017). Stands of *Acacia chrysotricha* of various age classes have been found throughout Jaaningga NR, with clustered groups of similar-aged individuals found to be highly dependent on disturbance events (Hunter 2017). The oldest and largest individuals were isolated or in low numbers with a scattered distribution, in relatively undisturbed, protected gullies (Hunter 2017). In these long-undisturbed landscape positions, there is minimal recruitment leading to cohorts of the same age.

For obligate seeders, generation length can be estimated as the sum of the primary juvenile period and the half-life of seeds in the seed bank (IUCN 2022). There has been no specific study to determine the juvenile period of *Acacia chrysotricha*, however, based on similar species and field observations (most individuals >10 m being mature), it is estimated to be between 5–10 years to the age of first reproduction (Richards 2011; NSW Government 2021). Previous studies have estimated the half-life of the seeds of other *Acacia* species to be approximately 10–18 years (Auld 1986; Holmes and Newton 2004), and it is estimated that *Acacia* seeds can remain viable in the soil for 50 to 100 years due to their hard seed coat (Farrell and Ashton 1978; Auld 1987; Gibson *et al.* 2011). Based on this information, the generation length of *A. chrysotricha* is estimated to be approximately 15–28 years.

Response to fire

Individuals at all life stages are highly susceptible to death from fire but exhibit high levels of recruitment even after mild fires (Hunter 2017; M. Smith *in litt*. January 2024). For example, a hazard reduction burn in 2013 resulted in the death of six of the seven sub-adult plants (up to 6 m tall) within one 10 m x 10 m plot, even with very mild fire conditions with flames less than 1 m high (M. Smith *in litt.* January 2024). Approximately 230 juvenile plants had germinated in the same plot 12 months after fire, where there had previously been none (M. Smith *in litt.* January 2024). Hunter (2017) observed that while few mature adults appear to have survived low to moderate fire intensities, high levels of recruitment were observed in Jaaningga NR in areas where hazard reduction burns had taken place. However, after fires, plants will undergo natural thinning after the initial recruitment flush of recruitment, and few of them are likely to survive to maturity.

As obligate seeders, fire frequency plays an important role in the maintenance of a viable *Acacia chrysotricha* population (Smith *et al.* 2014). *Acacia* species in fire-prone landscapes in Australia have hard seeds exhibiting physical dormancy, which is typically broken by heat from fire (Ooi 2012; Ooi *et al.* 2014). This allows for dormancy to be broken after a fire, allowing the entry of water for subsequent germination and emergence during elevated post-fire levels of resources (light, nutrients, water), and time to reach maturity and replenish seed banks before the next fire occurs (Liyanage and Ooi 2017; Pausas and Lamont 2022). Too frequent fire could result in the loss of mature trees and exhaust the soil seed bank, while too infrequent fire may lead to the senescence of trees without replacement levels of recruitment (Pausas and Keeley 2014). In the western part of Jaaningga NR, fires are less likely to occur due to the wet forest habitat, and this is expected to contribute to the accumulation of a very large seed bank. In the eastern end of the range, a prescribed burn that occurred in 2011 has resulted in an abundance of juveniles but fewer mature individuals (Hunter 2017). The total population of *A. chrysotricha* (including juvenile and mature individuals) may naturally be high directly after fire and be followed by a drastic decline (Hunter 2017). These predictable changes in population structure within fire intervals are indicative of transition between life stages (Hunter 2017) and should not be misinterpreted as trends in population size between successive fire intervals (IUCN (2024) guidelines). While more research is required to understand optimal fire regimes, Hunter (2017) suggests a minimum of 50 years between fires may not be detrimental.

Cultural Significance

The *Acacia* genus is diverse and forms an important part of Aboriginal culture with species serving many purposes from food and medicines (Devitt 1992; Akter *et al.* 2016), to utensils such as digging sticks and barbs, weapons, musical instruments, firewood, ceremonial items and seasonal signals (Searle 2023). Knowledge is passed down through generations by word-of-mouth and is incorporated into stories such as the D'harawal story, "Doo'ragai Diday Boo'Kerrikin: The Sisters Boo'kerrikin", which tells a story of three sisters that look alike but can be distinguished by the green of their eyes and represents *Acacia decurrens*, *A. parvipinnula* and *A. parramattensis,* which can be distinguished by the green of their leaves (Bodkin and Bodkin-Andrews 2011).

The name Jaaningga, given to the Nature Reserve where the majority of *Acacia chrysotricha* is found, means 'green wattle' in the Gumbaynggirr Aboriginal language (Morelli 1999). Its use refers to the sweet gum (Jaaning) that seeps from the trunk and is eaten (Morelli 1999).

This assessment is not intended to be comprehensive of the traditional ecological knowledge that exists for *Acacia chrysotricha* or to speak for Aboriginal people. 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.* 2020). Aboriginal peoples have cared for Country for tens of thousands of years (Bowler *et al.* 2003; Clarkson *et al.* 2017). There is traditional ecological knowledge for all plants, animals and fungi connected within the kinship system (Woodward *et al.* 2020). Traditional ecological knowledge referenced in this assessment belongs to the relevant knowledge custodian and has been referenced in line with the principals of the NSW *Indigenous Cultural and Intellectual Property protocol* (ICIP) (Janke and Company 2023).

Threats

Acacia chrysotricha is threatened due to the potential to be affected by adverse fire regimes, weed encroachment and timber harvesting activities. The majority of the population occurs in Jaaningga NR, which offers protection from some threats and disturbances (NSW NPWS 2012). However, parts of the population in Newry SF and Gladstone SF are in areas that are managed for conservation, timber harvesting and recreation, and are more susceptible to threats associated with timber harvesting, trackwork and other disturbances, noting that these activities also provide the opportunity for recruitment. *Acacia chrysotricha* was also affected by vandalism in early 2024 in an incident that caused the loss of 13 mature trees along a 1.2 km span of fire trails within Jaaningga NR (NSW DPE 2024).

Adverse fire regimes

Acacia chrysotricha trees of all age classes are highly susceptible to death by fire, even of low severity (Hunter 2017). Wildfire poses a significant threat to the survival of *A. chrysotricha* as the majority of the population occurs on north-facing slopes in Jaaningga NR and Newry SF that could be impacted by a single fire under the right conditions (*e.g.*, hot and dry weather with high wind speed) (M. Smith *in litt.* January 2024). While recruitment in *A. chrysotricha* is cued to fire, fire frequency plays a critical role in the maintenance of viable populations (Bradstock *et al.* 1996; Pausas and Keeley 2014). However, fire regimes vary across the range of *A. chrysotricha* due to variations in habitat and aspect.

Too frequent fire can lead to declines in mature populations and depletion of the residual seed bank (Ooi *et al.* 2014; Palmer *et al.* 2018). Observations have shown that even low severity fires can kill mature *Acacia chrysotricha*. There are only a few instances where large trees have survived mild fires, and consequently, recruitment following a fire is necessary to replace mature individuals that are lost (Hunter 2017). Depending on the fire severity and sensitivity of the seeds, seeds may suffer mortality in the upper soil layers (Ooi *et al.* 2014). Too frequent fires can kill young trees before they reach maturity and replenish the seed bank, leading to population reductions without replacing adult plants over time (Ooi *et al.* 2014; Duivenvoorden *et al.* 2024).

In wet sclerophyll forest, infrequent fire may lead to stands of larger mature adult *Acacia chrysotricha* trees, and dense understoreys where interspecific competition is relatively high (M. Smith *in litt.* January 2024). In these circumstances, there is little recruitment of *A. chrysotricha* seedlings, but soil-stored seed banks may be accumulating. Here, older trees may senesce over time, however, the ever-growing soil stored seed bank beneath the senescing trees will remain for extended periods (up to 50–100 years) until the next stochastic event (M. Smith *in litt.* January 2024).

In some environments, interactions between weeds and fire regimes can be detrimental to the success of post-fire recovery of native species such as *Acacia chrysotricha*. In high-density forest areas where canopy cover is higher, Lantana has been shown to be more likely to be outcompeted by native understorey species during post-fire recovery (Hotspots Fire Project 2017). Conversely, in highly degraded areas, Lantana can compete successfully with native species (Hotspots Fire Project 2017). Consequently, fire intensity plays a role in the ability of weeds such as Lantana to outcompete native species following fire. Increased growth and survival of Lantana has been observed with higher intensity fires, largely due to increased light availability (Hotspots Fire Project 2017; Duggin and Gentle 1998). Higher intensity fires that open the canopy, therefore, can increase competition from Lantana or other weeds, hindering recruitment.

Increase in fire frequency as a result of human-induced climate change

Higher mean temperatures due to climate change can contribute to increased risks of adverse fire regimes. In eastern Australia, substantial increases in projected mean temperatures are expected with reductions in average winter rainfall (CSIRO 2024). In the North Coast region of NSW annual mean temperatures are projected to increase by 2˚C by 2070, with an average of nine more days exceeding 35˚C per year (AdaptNSW 2024; CSIRO 2024). Rainfall is expected to be more variable with less certainty in projections around coastal regions, however, trends suggest that there is likely to be a decrease in winter rainfall and increased rainfall in other seasons (AdaptNSW 2024; CSIRO 2024). The number of projected high fire danger days will also increase, with the highest dangers predicted in spring (peak prescribed burning season) and summer (peak fire risk season) (AdaptNSW 2024). Fire risk varies across landscapes and bioregions, and is strongly influenced by ignition patterns, climate, fuel moisture, fuel loads and vegetation type (Bradstock *et al.* 2014; Clarke *et al.* 2020). In the North Coast region of NSW, increases in area burned have been observed in the past despite increased rainfall, possibly due to higher ignition instances from lightning or human activity (Bradstock *et al.* 2014). Increased warming with dry periods due to climate change has the potential to increase fire frequency and severity, which may contribute to reductions in the population of *Acacia chrysotricha.*

'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' and 'Anthropogenic climate change' are listed as Key Threatening Processes under the NSW *Biodiversity Conservation Act 2016.* 'Fire regimes that cause declines in biodiversity' is listed as a Key Threatening Process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Weed Invasion

Acacia chrysotricha is threatened by weed encroachment throughout its range. Lantana (*Lantana camara*) is the most problematic weed impacting *A. chrysotricha* and has the potential to hinder recruitment. Surveys have shown that the removal of lantana around mature individuals of *A. chrysotricha* was associated with improved recruitment and survival of *A. chrysotricha* seedlings compared to where it was not removed (NSW NPWS 2012). Lantana has been observed in Gladstone SF, Jaaningga NR and Newry SF. Due to the large area affected by this weed, control activity is generally limited to trackside spraying and mechanical removal (NSW NPWS 2012). While weed control has been incorporated into management programs within parts of Jaaningga NR, it requires ongoing monitoring and removal. Lantana invades disturbed areas such as roadsides, cultivated pastures and fence lines and from there can invade the edges of forests (Department of Natural Resources and Environment Tasmania 2003). The generally suppressive effect of Lantana has been observed on a wide range of species due to factors such as inhibition of germination due to lack of light, smothering, and sequestration of surface-soil nutrients made available by disturbance episodes (Gentle and Duggin 1998; NSW Scientific Committee 2006). Given that *A. chrysotricha* utilises similar areas of disturbance for recruitment, lantana can hinder the establishment and growth of *A. chrysotricha* seedlings in areas of dense infestations (NSW Scientific Committee 2006). Other weeds that have been observed within Jaaningga posing a threat to *A. chrysotricha* through competition and suppressing recruitment include *Paspalum mandiocanum* and *Senna septemtrionalis*, which have been targeted in weed control work (Morison 2017).

'Invasion, establishment and spread of lantana (*Lantana camara* L. *sens. lat*)' is listed as a Key Threatening Process under the NSW *Biodiversity Conservation Act 2016*. 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants' is listed as a Key Threatening Process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Human disturbance from timber harvesting, track building and maintenance

Surveys conducted by Hunter *et al.* (2020) suggested that some *Acacia chrysotricha* appeared to have been damaged or removed during track widening and expansion. While disturbance has been found to trigger recruitment of *A. chrysotricha* along forest/snig tracks and road verges, it is generally sporadic and in lower numbers compared to recruitment events triggered by fire (Richards 2011; Hunter 2017). This is evident from surveys in 2012, where individual mature trees were found near timber stockpiling areas and along property edges (Smith 2012). A survey along one snigging track found approximately 50 immature individuals <10 m in height, with recruitment likely triggered by the most recent timber harvesting event, prior to Jaaningga NR being gazetted, with a few much older individuals to the east and west of the tracks (Smith 2012).

Timber harvesting activities and associated trackwork may contribute to continuing declines in habitat quality as they may facilitate weed infestation (NSW NPWS 2012). Weed infestations have been recorded around trails, with the highest densities occurring in areas that were heavily disturbed in the recent past by timber harvesting operations (NSW NPWS 2012). Yearly monitoring since 2017 has not shown evidence of further harvesting activities in the survey area within Jaaningga NR (NSW Government 2023). There are active hardwood plantation zones in Newry SF and Gladstone SF adjacent to the records of the species (Forestry Corporation 2024), and these locations have likely been affected in the past by clearing for the establishment of plantations and limiting future recruitment (G. Phillips pers. obs. November 2018). Records within Newry SF show several individuals along the southern and western perimeter of the plantation, suggesting that the region offers suitable habitat for the recruitment of *Acacia chrysotricha*.

Number of Locations

Acacia chrysotricha occurs at 1–2 threat-defined locations as per the IUCN definition (IUCN 2022) on the basis of adverse fire regimes being the most serious plausible threat resulting in the lowest number of locations. All records of *A. chrysotricha* within Jaaningga NR and Newry SF occur on a steep northerly facing slope that could be burnt by a single fire on a bad weather day (M. Smith *in litt*. January 2024). The Gladstone SF subpopulation, although only 3–4 km distant, is separated from the Jaaningga subpopulation by cleared agricultural lands and the valley of Spicketts Creek, meaning the fire histories of the sites differ considerably, with no single fire recorded crossing the valley (SEED data), and therefore each site could be considered a separate location. However, rising temperatures and longer dry periods due to climate change are expected to cause higher fire frequency and severity. With projected increases in fire danger weather due to climate change, it is plausible that a single fire could burn both sites under the right conditions. Consequently, a large high-severity fire has the capacity to kill a large portion of the standing plants while also impacting the soil-stored seed, and further reductions in the seed bank may occur if subsequent fires occur too quickly for plants to grow and replenish the seed bank. When taking a precautionary but realistic approach resulting in the lowest number of possible locations, as recommended by the IUCN (2022), *A. chrysotricha* is considered to occur in a single threat-defined location.

Assessment against IUCN Red List criteria

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

Criterion A *Population Size Reduction*

Assessment Outcome: Data Deficient

Justification: Due to a lack of long-term monitoring data across the range of *Acacia chrysotricha*, and a lack of data for trends in mature individuals, it is not possible to estimate population size reductions over three generations (45–84 years).

Criterion B *Geographic range*

Assessment Outcome: Critically Endangered under Criterion B1ab(iii)

Justification: *Acacia chrysotricha* occurs within Jaaningga NR, Newry SF and Gladstone SF near Bellingen in north-eastern NSW. The AOO is highly restricted and has been calculated as 28 km^2, meeting the threshold for Endangered. The EOO is very highly restricted and has been calculated as 12.32 km^2 (adjusted to 28 km^2 to match the AOO in accordance with IUCN guidelines (IUCN 2012), meeting the threshold for Critically Endangered.

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: Critically Endangered due to having one threat-defined location.

Justification: *Acacia chrysotricha* is found at 1–2 threat-defined locations when considering the most serious plausible threat of inappropriate fire regimes. With projected increases in fire danger weather due to climate change, it is plausible that a single fire could burn both sites under the right conditions and therefore, when taking a precautionary but realistic approach, *A. chrysotricha* is considered to occur in a single threat-defined location.

Acacia chrysotricha is not considered severely fragmented as the majority of individuals are found in a large subpopulation that is considered viable.

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: Continuing decline observed and inferred for (iii) quality of habitat.

Justification: *Acacia chrysotricha* has been observed and is inferred to be undergoing a continuing decline in the quality of habitat due to the combined effects of weed invasion (particularly *Lantana camara*) and human disturbance from timber harvesting, track building and maintenance. The adverse effects are particularly evident at the Gladstone SF subpopulation, which is a small stand occurring on the edge of an active Eucalypt plantation managed for hardwood production. Harvest history indicates the area was harvested in June 2000 (FCNSW 2025). Observations in 1997 and 2018 describe the *A. chrysotricha* trees as senescent and in poor health, with no sign of recruitment. This suggests that competition and suppression from the plantation, along with associated heavy infestations of lantana, have contributed to declines in habitat quality and consequent poor health and dieback within the subpopulation, hindering recruitment that relies on a soil seed bank, without which the subpopulation may be lost. While activities such as timber harvesting, track building and maintenance can trigger some recruitment through disturbance, the recruitment from these disturbances is generally sporadic and in low densities compared to fire, which is the primary form of recruitment (Richards 2011). These activities can also lead to plant deaths through physical damage or removal, as was observed during surveys by Hunter *et al.* (2020). Additionally, these disturbances facilitate weed invasion, with lantana the most problematic weed within the range. Lantana invades disturbed areas such as roadsides, cultivated pastures and fence lines, having its greatest density in highly degraded areas (Hotspots Fire Project 2017), including areas heavily disturbed in the recent past by timber harvesting operations (NSW NPWS 2012). High-density Lantana infestations have been observed to suppress recruitment and survival of *A. chrysotricha* seedlings and contribute to ongoing declines in the quality of habitat throughout the species' range.

c) Extreme fluctuations.

Assessment Outcome: Not met

Justification: *Acacia chrysotricha* is a relatively long-lived tree and maintains a long-lived soil seed bank, and as such there is no evidence of extreme fluctuations in the species.

Criterion C Small population size and decline

Assessment Outcome: Data Deficient

Justification: The population size of *Acacia chrysotricha* is estimated to be approximately 2,500–4,200 mature individuals, meeting the threshold for Vulnerable.

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: Data Deficient

Justification: While monitoring surveys within Jaaningga NR and Newry SF between 2017 and 2020 indicated a 33% reduction in overall *Acacia chrysotricha* individuals within the survey area, the vast majority were juveniles, and significant thinning is expected over the lifetime of the species. While there may be continuing decline due to fire, weed invasion and timber harvesting activities, there is insufficient data to estimate the decline in mature individuals over time due to a lack of baseline data.

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

Assessment Outcome: Not met.

Justification: Although continuing decline in the number of mature individuals for *Acacia chrysotricha* may be inferred from declines in habitat quality due to lantana invasion, the relevant subcriteria for C2 are not met.

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

Assessment Outcome: Not met.

Justification: The population of *Acacia chrysotricha* consists of two subpopulations, with the largest containing approximately 2,500–4,200 mature individuals

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

Assessment Outcome: Not met.

Justification: *Acacia chrysotricha* does not contain 100% of individuals in a single subpopulation and therefore does not meet the threshold for VU for this subcriteria.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Not met.

Justification: *Acacia chrysotricha* is a relatively long-lived species and is unlikely to undergo extreme fluctuations.

Criterion D Very small or restricted population

Assessment Outcome: Vulnerable under Criterion D2.

Justification:

The population of *Acacia chrysotricha* is estimated to contain 2,500–4,200 mature individuals and therefore does not meet the threshold for listing under criterion D1. Although the number of mature individuals exceeds 1,000, *A. chrysotricha* is found in only 1–2 threat-defined locations. A plausible future threat could cause the species to become Critically Endangered or even Extinct in a very short time and therefore the species meets the requirement for Vulnerable under criterion D2.

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: Not met.

Justification: The current estimated population for *Acacia chrysotricha* is a minimum of 2,500–4,200 mature individuals.

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: Met.

Justification: *Acacia chrysotricha* occurs at 1–2 threat-defined locations, based on the threat of adverse fire regimes, which may be exacerbated by climate change. A plausible future threat could cause the species to become Critically Endangered or even Extinct in a very short time and therefore the species meets the requirement for Vulnerable under criterion D2.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient

Justification: Currently there is insufficient data to undertake a quantitative analysis to determine the extinction probability of *Acacia chrysotricha*.

Conservation and Management Actions

Acacia chrysotricha is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation strategy has been developed by the NSW Department of Climate Change, Energy, the Environment and Water under the Saving our Species program. The conservation strategy identifies priority locations, critical threats and required management actions to ensure the species is extant in the wild in 100 years. *Acacia chrysotricha* sits within the site-managed species management stream of the SoS program. The conservation strategy can be viewed here: https://savingourspecies.environment.nsw.gov.au/project/330.

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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 chrysotricha was found to be Critically Endangered under Clause 4.3(a)(d)(e iii).

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,	
	(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 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 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: Data Deficient

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: Not met

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: Vulnerable under Clause 4.7

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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