Conservation Assessment of *Acacia beadleana* R.H.Jones & J.J.Bruhl (Fabaceae)

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NSW Threatened Species Scientific Committee

***Acacia beadleana* R.H.Jones & J.J.Bruhl (Fabaceae)**
Distribution: Endemic to NSW
Current EPBC Act Status: Not listed
Current NSW BC Act Status: Not listed
Proposed listing on NSW BC Act: Endangered

LHS: Image KD Mackay; RHS image JJ Bruhl

Summary of Conservation Assessment

Acacia beadleana was found to be eligible for listing as Endangered under IUCN Criterion B1ab(iii,v) + B2ab(iii,v).

The main reasons for this species being eligible are: (i) a very highly restricted geographic distribution, extent of occurrence (EOO) and area of occurrence (AOO) are both 28 km^2; (ii) It most likely occurs in two threat defined locations; and (iii) Continuing decline has been inferred in habitat quality and the number of mature individuals due to frequent fire impacting recruitment, while the number of mature individuals is projected to decline due to ongoing adverse fire regimes and drought.

Description and Taxonomy

Acacia beadleana (Fabaceae) is described by Jones and Bruhl (2006) as:
"Single to multi-stemmed, lignotuberous, erect to spreading evergreen shrub, 0.4–2.5 m high. Stems woody, terete, roughened by phyllode scars. Branchlets terete with persistent, densely pilose indumentum; trichomes simple, hyaline appearing silver to white, antrorse to retrorse. Stipules subpersistent, narrowly triangular to triangular, 0.4–1 mm long, hairy. Pulvinus 0.5–1 mm long, sparsely hairy or sometimes glabrous. Phyllodes alternate and spiralled, crowded along the branchlets; narrowly elliptic, elliptic, linear to broadly linear, narrowly oblong, or

narrowly oblanceolate 5–12.7 mm long, 0.6–1.4 mm wide, straight or recurved, often irregularly furrowed when dried; cross-section narrowly oblong to oblong; sparsely pilose; the hairs mostly restricted to abaxial margin, divergent, sometimes curved, antrorse to subappressed, hyaline and appearing silver to white; base cuneate; apex acute to short-acuminate and mucronate, mucro straight to oblique or hooked; two main veins (separating at proximal end of phyllode; one more or less central and the other closer to the abaxial edge) observed in cleared and stained phyllodes, nerves obscure in dried material; extrafloral nectary usually only one present, occasionally on the pulvinus or more often less than 2 mm distal to the pulvinus; stomata flush with phyllode surface, sometimes slightly raised. Inflorescence solitary, axillary; peduncles densely pilose, 5.8–15.5 mm long, proximally ebracteate; flower heads globular, bright golden-yellow, 32–46 flowered, 7–10 mm diameter when dried; bracteoles hairy; sepals, more than two thirds united from the base, hairy; petals sparsely hairy. Pods oblong; 20–60 mm long, 7–10.4 mm wide, glabrous, pruinose and purplish red when young, maturing to very dark brown outside and mid-tan inside, coriaceous, straight. Seeds of transverse orientation in pod; obloid or ovoid, 3.8–5 mm long, 2.5–3.5 mm wide; black to very dark brown; areole usually open, sometimes closed; aril extending to more than half the length of seed."

Jones and Bruhl (2006) distinguish *Acacia beadleana* from *A. gordonii* (Tindale) Pedley and *A. brunioides* A.Cunn. ex G.Don subsp. *brunioides* based on morphology and geography. *Acacia gordonii* is restricted to the lower Blue Mountains (Bilpin, Faulconbridge) and the Sydney Hills (Glenorie), more than 450 km south of the Gibraltar Range where *A. beadleana* occurs. *Acacia beadleana* is most readily distinguished from *A. gordonii* by the distribution of phyllode and sepal indumentum and the number of flowers per head. The most similar, geographically proximal species to *A. beadleana* is *A. brunioides* subsp. *brunioides*, found c. 6 km from *A. beadleana* – but they differ in indumentum, flower colour and flower head number (Table 1 in Jones and Bruhl 2006).

In this assessment, the word population is used to refer to the concept of 'subpopulation' in IUCN (2022), in keeping with the terminology used in the NSW BC Act, the Commonwealth EPBC Act and other state/territory environmental legislation and general biological usage.

Distribution and Abundance

Using the map from the Australian Institute of Aboriginal and Torres Strait Islander Studies (Horton 1996), *Acacia beadleana* occurs in the traditional lands of the Gumbaynggirr First Nation's peoples.

Acacia beadleana is currently known from Gibraltar Range National Park, east of Glen Innes, northern NSW (Jones and Bruhl 2006). There it is commonly found across a c. 28 000 Ha area of granite derived communities.

Extent of Occurrence and Area of Occupancy

The geographic distribution of *Acacia beadleana* is very highly restricted. The area of occupancy (AOO) was estimated to be 28 km^2, calculated by overlaying 2 km x 2 km grid cells over validated occurrence records, as recommended by IUCN (2022). The extent of occurrence (EOO) was estimated to be 11.8 km^2 based on a minimum convex polygon enclosing all validated records, as recommended by IUCN (2022). The EOO is reported as equal to AOO at 28 km^2, to ensure consistency with the definition of AOO as an area within EOO, following IUCN Guidelines (2022).

Population size.

Population-based ecological knowledge for the species has been collected since 1997 (Jones and Bruhl 2006) with the most recent and detailed work being undertaken for the Commonwealth DAWE Tranche 2 program by Mackay in 2021 (D. Mackay *in litt.* September 2021) and Sheringham in 2022 and 2023 (Sheringham *in litt*. 2022, 2023).

There are two populations of *Acacia beadleana*, separated by c. 3.2 km. Population 1 is bisected by the Gwydir highway and consisted of both adult plants and seedlings when sampled in March 2021. Population 2 consists of c. three patches separated by 0.7-1.5 km. Sheringham (2023) estimated a total of at least 2362 *A. beadleana* plants from recording the number of plants in various random traverses between 2019 and 2023. Using plot-based sampling at known sites (D. Mackay *in litt.* September 2021) and other expert advice (P. Sheringham *in litt* October 2022, May 2023) there were estimated to be a likely total of 3750-4350 *A. beadleana* individuals of which c. 97% were adults.

Plant abundance will vary in response to fire. There are a number of estimates of plants at sites over time (Jones and Bruhl 2006; Mackay 2021) but it is not possible to compare these as sampling design/intensity and areas sampled varied. Importantly, Mackay (2021) could only find seedlings after the 2019/2020 fires at one of five sampled sites (at that site, 50% of individuals were seedlings (c. 100).

It is likely further populations of *Acacia beadleana* may occur in other areas of similar habitat nearby. Sheringham (*in litt.* August 2022) suggests further searches including areas in Nymboida National Park.

Ecology

Habitat

Acacia beadleana grows in skeletal to deep sandy soils derived from granite and can often be found growing amid granite boulders in fire protected microhabitats. Jones and Bruhl (2006) describe the vegetation as a layered open woodland and heath with *Eucalyptus williamsiana*, *Leptospermum trinervium*, *Allocasuarina rigida*, *Callitris monticola*, *Acacia baeurlenii, Boronia anethifolia*, *Mirbelia speciosa*, *Leucopogon neo-anglica*, *Calytrix tetragona*, *Isopogon petiolaris*, *Lepidosperma gunnii*, *L. viscidum*, *Caustis flexuosa*, *Chaetospora turbinata*, *Conospermum burgessiorum* and *Trachymene incisa*.

Lifespan

The longevity of *Acacia beadleana* individuals is not known, but plants are likely to be long-lived. For example, plants can live for at least 16 years in a fire prone landscape when not burnt and may resprout after fire. Adult plants tagged in 2005 at Population 1 by J Bruhl (University of New England (UNE)) did not burn in a fire in 2014, as they were nestled among boulders, but were burnt by the extreme fire in 2019-2020 (D. Mackay *in litt.* September 2021). The primary juvenile period is not known, nor is the time it takes seedlings/juveniles to grow to a sufficient size to be able to resprout after a fire. Resprouting plants are likely fruit-bearing three years after fire (D. Mackay *in litt*. 1 October 2022), at least under good post-fire environmental conditions. Seed longevity in the soil seed bank is not known but in other species of acacias the hard coated seeds have remained viable with a half-life of 10.7 years in the soil seed bank (Auld 1986).

Pollination and seed ecology and the number of populations

Peak flowering occurs in January to February but can occur throughout the year and the main fruiting period is July to August (Jones and Bruhl 2006, J. Whitehead *in litt*. May 2023). The pollinators and seed dispersers have not been documented for *Acacia beadleana* but for acacias they may include bees, beetles and flies (and possibly birds) for pollen movement (Stone *et al.* 2003) and most likely ants for seed dispersal (O'Dowd and Gill 1986), given the aril type in *A. beadleana* (Jones and Bruhl 2006). Whitehead observed introduced honeybees (*Apis mellifera*) and native hoverflies (*Melangyna* species) on flower heads of *A. beadleana* in March and May 2021 (J. Whitehead *in litt.* May 2023).

Data are not available on potential gene flow distances from pollen and seed dispersal in *Acacia beadleana*. Foraging distances by pollinators is highly context specific but some generalisations can be made. Honeybees usually forage up to c. 1000-1500m for pollen or nectar but can travel over 9km for these resources (Couvillon *et al*. 2015; Beekman and Ratnieks 2000). Native bees can be territorial to small patches (a few m^2) of flowering plants (*Amegilla dawsonii* Alcock 1996; *Trichocolletes* sp. Gross 1996) and social *Tetragonula carbonaria* has homing ranges of c. 300m - 700m (Smith *et al.* 2017). *Xylocopa* sp. has long-distance (c. 9km) foraging capabilities as detected in home range studies (Alcock 1996) but it is not clear if experimental home range studies correlate with foraging distances. Zunburchen *et al.* (2010) found a neighbourhood of nesting and foraging habitat to be within a few hundred metres for native bees. The main means of seed dispersal of acacia seeds is likely to be by ants. The distance seeds are transported by ants is also context dependent (Ness *et al*. 2004) but for acacias can involve average distances of 10-300 cm (Auld 1986), to c. 80m with maximum distances over 400m (Pascov *et al*. 2015). Further work is required to understand the types of pollen and seed dispersers for *A. beadleana*.

Based on the estimates above, a gap of at least 2 km between plant patches would generally isolate them from each other and gene flow between them by pollinators would be infrequent. Thus, for *Acacia beadleana* there is considered to be two

populations separated by c. 3.3km. Population 2 is made up of scattered patches with distances between these patches ranging from 0.7 -1.5 km.

Fire ecology

Acacia beadleana has a lignotuber and plants have been recorded resprouting after drought and fire (Jones and Bruhl 2006). The species also responds to fire through new recruitment from the soil seed bank (D. Mackay *in litt.* 2021) but it is noteworthy that after the 2019-2020 fires there were few seedlings at the time of surveys in November to December 2020 and again in March to May 2021. Seedlings have not been recorded in 2022 field assessments (P. Sheringham *in litt.* August 2023). Other species of acacia have produced seedlings from the 2019-2020 fires in the same habitat as *A. beadleana* (e.g. sympatric resprouter *A. cangaiensis*, D. Mackay *in litt.* 2022).

The primary juvenile period is not known, nor is the time it takes seedlings/juveniles to grow to a sufficient size to be able to resprout after a fire. Resprouting plants are likely fruit-bearing three years after fire (D. Mackay *in litt*. 1 October 2022), at least under good post-fire environmental conditions.

Fire history and impacts

Gibraltar Range National Park has a history of frequent fires (Croft *et al.* 2006) with the most recent fires occurring between 16 September 2019 and 7 January 2020 (NPWS Fire History database, 2021). Short intervals between fires have occurred in the recent past, including intervals of 2 years (1988 to 1990), 3 years (2011 to 2014), 5 years (2014 to 2019) and seven years (2002 to 2009) across parts of the species range. Using the SEED Initiative database and researcher knowledge (https://www.seed.nsw.gov.au/; D. Mackay *in litt.* October 2022), population 1 was burnt in 1964/65, 1989/90 (part of site), 1990/91 (part of site), 2002/03, 2011/12 (part of site), 2014/15 (some adult plants protected by rocks were not burnt in 2014/15) and 2019/20. In population 2 fire burnt the areas in 1964/65, 1988/89 (part of site), 1990/91 (part of site), 2002/03, 2014/15 and 2019/20 (Dandarah Crags Walk) with some patches not being impacted in 2014/15 (Anvil Rock Walk site was burnt in 1964/65, 1988/89, 1990/91, 2002/03 and 2019/20). The populations near Murrumbooee Cascades have also experienced frequent fire. In some fires, the entire distribution of the species can be burnt (although within a site researchers have noted that the granite boulders afford protection to some patches of individuals, i.e., they may remain unburnt (D. Mackay *in litt.* 29 Sept 2022). In other fires, only one population or parts thereof may be burnt.

Based on limited data for other resprouters (some eucalypts and Proteaceae species) (Keith 1996), a fire-free interval of at least 6-15 years may be needed to allow juvenile plants to become fire resistant, whereby they develop a sizable lignotuber and the ability to resprout after the next fire. Resprouting shrubs may tolerate exposure to one or possibly two occurrences of fire within a 15-year period. Longer intervals will also be needed to ensure fire resistance in appreciable numbers of recruits and hence, population persistence. With adverse fire regimes and

drought, new recruits to the population may be killed without contributing to future generations and the population size will decline if recruitment is insufficient to replace deaths of established plants (Keith 1996).

No seedlings were observed after the 2019/20 fires in several sites and many of these sites were burnt in both 2014/15 and 2019/20. Resprouting plants are likely fruit-bearing three years after fire (D. Mackay *in litt*. 1 October 2022) if environmental conditions are favourable. The failure of seedling recruitment after the 2019/20 fires at these sites may have resulted from little replenishment of the soil seed bank after the 2014/15 fire as plants experienced drought conditions, although a co-occurring species, *Acacia cangaiensis*, also a resprouter, had good seedling recovery detected in 3 sites, with 1 plot yielding more seedlings on a subsequent survey (D. Mackay *in litt.* September 2021). These surveys were undertaken at the same time as *Acacia beadleana*, and as *A. beadleana* has had additional surveys it does suggest that the soil seed bank was not replenished after previous fires in most of the plots sampled or some other factor, e.g., drought affected seedling establishment in *A. beadleana*. The impact of drought on *A. beadleana* may be a significant factor on seedling attrition and seedbank replenishment. Moisture stress causing attrition has been documented in other species of *Acacia* (Auld 1987).

There has been limited sampling for the level of adult mortality of *Acacia beadleana* due to fires. Mortality is more likely to occur in fires if they are preceded or followed by drought conditions (e.g. 2019/20 fire). At one sampled site, Mackay (2021; *in litt.* October 2022) found mortality in resprouting plants post-fire of 6% across a five-month period with further survey likely to reveal further declines. Hence some successful seedling recruitment and establishment between fires is essential to avoid population declines.

Threats

Adverse fire regimes

Adverse fire regimes are considered a threat to this species. There has been a recent history of high frequency fire that, in combination with drought, may be disrupting the successful ongoing establishment and growth of seedlings and juvenile plants to replace those adults killed in, or soon after fires. There is evidence of mortality of adult plants and poor seedling recruitment after the 2019/20 fires (Mackay 2021). A continual loss of individuals and depletion of the seed bank to successive fires may threaten the viability of the population if lignotubers weaken and recruitment is insufficient to replace plants that die. A fire free interval of at least 7-15 years (or longer if drought conditions prevail) is needed to allow ongoing population persistence in this species. Under future climate scenarios, the New England region is predicted to have changed rainfall conditions in the near future (2020-2039) with decreased rainfall across the region during summer and winter. Mean temperatures are projected to rise by 0.7ºC by 2030 with the greatest increase during summer and spring. The region will have fewer colder nights under 2°C annually, and more hot days over 35°C annually (AdaptNSW 2023). Severe fire weather is projected to increase across the region by 2070 (AdaptNSW 2023).

'Anthropogenic Climate Change' and 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' are listed as a key threatening processes under the NSW BC Act.

Disease

Jones and Bruhl (2006) recorded plants in Population 1 with sooty mould but disease is not considered to be a threat to this species now as Mackay (*in litt.* September 2021) reported that the population was healthy with no sign of mortality, disease or dieback.

Road works

The subpopulation adjacent to the Gwydir Highway could be at risk from future road works if, for example, the road was widened and plants were destroyed. This issue was first raised by Jones and Bruhl (2006).

Number of Locations

The major threat to *Acacia beadleana* is high frequency fire that is leading to adult mortality and loss of recruits, with all sites experiencing this threat in the recent past. In some fires, the entire distribution of the species can be burnt (although within a site, researchers have noted that the granite boulders afford protection to some patches of individuals, i.e., some individuals may remain unburnt in rocky refugia (D. Mackay *in litt.* 29 Sept 2022)). In other fires, only one population or parts thereof may be burnt. Consequently, there are considered to be a minimum of two locations (as even in large wildfires there will be some unburnt refugial plants in rock outcrops) and a maximum of 3-4 locations, reflecting the patchiness of high fire frequency in the past for this species.

Assessment against IUCN Red List criteria

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

Criterion A Population size reduction

Assessment Outcome: Data Deficient

Justification: Criterion A requires population size reduction to be measured over the longer of 10 years or three generations. There is insufficient data on historic population sizes to assess *Acacia beadleana* under Criterion A.

Criterion B Geographic range

Assessment Outcome: Met for Endangered under Criterion B1ab(iii,v), B2ab(iii,v).

Justification: *Acacia beadleana* meets the threshold for Critically Endangered for EOO and Endangered for AOO. Two of the three subcriteria are met but one is met only at the Endangered level. Hence the overall threat category is Endangered.

The geographic distribution of *A. beadleana* is very highly restricted. The area of occupancy (AOO) was estimated to be 28 km^2, calculated by overlaying 2 km x 2 km

grid cells over validated occurrence records, as recommended by IUCN (2022). The extent of occurrence (EOO) was estimated to be 11.8 km^2. The EOO is reported as equal to AOO, to ensure consistency with IUCN Guidelines (2022).

The Geographic range for extent of occurrence (B1) meets the threshold for Critically Endangered as it is < 100km^2 and the geographic range for area of occupancy (B2) meets the threshold for Endangered as it is >10 km^2 and < 500 km^2.
In addition to these thresholds, at least two of three other conditions must be met.

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: Met for Endangered.

   Justification: The major threat to the species is too frequent fire leading to adult mortality and loss of recruits and all sites have experienced this threat in the recent past. In some fires, the entire distribution of the species can be burnt (although within a site, researchers have noted that the granite boulders afford protection to some patches of individuals, i.e., some individuals may remain unburnt in rocky refugia (D. Mackay *in litt.* 29 Sept 2022)). In other fires, only one population or parts thereof may be burnt. Consequently, there are considered to be a minimum of two locations (as even in large wildfires there will be some unburnt refugial plants in rock outcrops) and a maximum of 3-4 locations, reflecting the patchiness of high fire frequency in the past for this species.

   The species is not thought to be severely fragmented.

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 (iii) and (v).

   Justification: Decline is inferred for (iii) the quality of habitat and (v) the number of mature individuals as repeated fires with short intervals between fires have been experienced across the entire range of the species. Such frequent fires can lead to adult mortality and poor seedling recruitment in the species (Mackay 2021).

c) Extreme fluctuations.

   Assessment Outcome: Not met.

   Justification: Extreme fluctuations are unlikely because mature plants resprout from fire.

Criterion C Small population size and decline

Assessment Outcome: Not met.

Justification: There is a likely estimate of 3650 - 4250 mature plants in the wild. This meets the threshold for Vulnerable for population size (< 10 000 mature individuals). 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: There are no data to quantify decline rates across the distribution of the species.

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

Assessment Outcome: Not met.

Justification: Decline is inferred in mature individuals as repeated fires can lead to adult mortality and loss of recruits. The species responds to fire by resprouting from a basal lignotuber and plants can live to at least 16 years, but a recent severe fire event killed adults and seedlings were not detected at several sites. Without seedling recruitment plants lost in the fire are not replaced and the population may decline.

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: Not met.

Justification: Subpopulation 1 has c. 100 adults and subpopulation 2 has more than 3000 adult plants.

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

Assessment Outcome: Not Met

Justification: Most individuals are in one subpopulation, with estimates of some 98% of mature individuals in subpopulation 2. However, for a Vulnerable assessment, there needs to be 100% of mature individuals in one subpopulation.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Not met.

Justification: Extreme fluctuations are unlikely because mature plants resprout following fire.

Criterion D Very small or restricted population

Assessment Outcome: Not met

Justification: The likely total number of mature individuals is estimated to be 3750-4350.
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 likely total number of mature individuals is c. 3750-4350

D2. Population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming CR or even EX in a very short time period.

Assessment Outcome: Not met.

Justification: While there are <5 threat defined locations there are no threats currently known of that could drive the taxon to CR or EX in a very short time.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient.

Justification: No quantitative analysis has been undertaken at this time.

Conservation and Management Actions

Fire management

- Minimise adverse fire regimes. Ensure prescribed burns in the vicinity of the species provide a sufficient fire-free interval (at least 7-15 years) or longer in drought conditions. This should include fire-free intervals sufficient to allow juvenile plants to become fire resistant (likely to be in the order of 10-15 years). This will allow maturation of individuals, accumulation of plant-stored resources for resprouting and replenishment of the soil seed bank. In addition, it is also important that there is sufficient time between fires to enable seedling recruits to become fire resistant (i.e. be able to develop lignotubers and resprout from root suckering following fire).

Habitat loss, disturbance and modification

- Prevent habitat disturbance (road works) in the vicinity of Population 1 by consultation with relevant road authorities and the installation of signage

advising of significant habitat (sign with contact details for NPWS (see below)). Prevent damage to plants from track maintenance in Population 2.

Ex situ conservation

- Develop a targeted *Acacia beadleana* seed collection program for *ex situ* seed banking.

Stakeholders

- Liaise with managers of Gibraltar Range National Park for conservation management and protection of the species.
- Liaise with authorities with fire management responsibilities to ensure there is effective communication between agencies regarding the requirement of fire-free intervals in habitat of *Acacia beadleana*, particularly along the Gwydir Highway.
- Update the Fire Plan of Management for Gibraltar Range National Park so the area where *A. beadleana* occurs ideally has fire-free intervals sufficient to allow juvenile plants to become fire resistant (this is likely to be in the order of 10-15 years).
- Provide detailed maps of the extent of the population in the Gywdir Highway population to the Roads Authority for incorporation into their planning systems so that the population can be protected during road maintenance activities.

Survey and Monitoring priorities

- Monitor for signs of habitat degradation.
- Regularly monitor the population size, age structure and habitat of *Acacia beadleana*. Tag individuals with fire-proof tags to monitor survival over time.
- Re-survey the population following every fire to check for plant survival, recruitment and for signs of adult and seedling mortality during drought.

Information and Research priorities

Recruitment and seedling survival: Plots have been established by D. Mackay (UNE) at three sites. These plots should be used in an ongoing monitoring program. New seedlings should be carefully tagged with fire-proof tags/labels for annual monitoring. Monitoring labelled plants through time will allow for a Population Viability Analysis to be built in due course that will then allow for modelling of stochastic events on population persistence.

Fire biology: The response to fire has been determined for this species. However, the degree of adult mortality in fire, particularly in relation to drought (pre- or post-fire) needs to be examined. In addition, seed bank assessments are necessary to understand longer term persistence after fires, including rate of replenishment of seed banks after fire; under drought conditions; magnitude of seed banks pre and post fire; seed bank longevity; response of seed to soil heating; etc.

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Expert Communications

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Appendix 1

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

Overall Assessment Outcome: *Acacia beadleana* was found to be Endangered under Clause 4.3(b)(d)(ei,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: Endangered via Clause 4.3(b)(d)(ei,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: Not met.

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: 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.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee