

***Acacia dangarensis* Tindale & Kodala (Fabaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Endangered

Proposed NSW BC Act Status: Critically endangered

Conservation Advice: *Acacia dangarensis*

Summary of Conservation Assessment

Acacia dangarensis is eligible for listing as Critically Endangered under Criterion B1ab (iii, v)+B2ab (iii,v).

The main reasons for the species being eligible for listing in the Critically Endangered category are that i) the species has a highly restricted geographic range with an area of occupancy (AOO) and extent of occurrence (EOO) estimated to be 4-8 km², based on a 2 x 2 km grid as recommended for assessing AOO by IUCN (2016); ii) the species is found at only one location; iii) continuing decline in habitat quality and the number of mature individuals is inferred or projected, based on ongoing presence of *Opuntia stricta*, and the presence of many dead stems of *Acacia dangarensis* combined with the absence of recruitment.

Assessment against IUCN Red List criteria

Criterion A Population Size reduction

Assessment Outcome: Data Deficient

Justification: To be listed as threatened under Criterion A the species must have experienced a population reduction of $\geq 30\%$ over three generations or 10 years (whichever is longer). There is insufficient data to assess *Acacia dangarensis* against this criterion.

Criterion B Geographic range

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

Justification: *Acacia dangarensis* has a highly restricted geographic distribution, with an extent of occurrence (EOO) estimated to be 4-8 km², based on known records for the species, including records from recent detailed surveys by Bell (2013). To be listed as Critically Endangered under Criterion B1 a species must have an EOO of < 100 km². *Acacia dangarensis* meets the EOO threshold for Critically Endangered under Criterion B1. Area of occupancy (AOO) of *Acacia dangarensis* is estimated to be 4-8 km², using a 2 x 2 km grid, as recommended by IUCN (2016). To be listed as Critically Endangered under Criterion B2 a species must have an AOO of < 10 km². *Acacia dangarensis* meets the AOO threshold for listing as Critically Endangered under Criterion B2.

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 number of locations equals 1(CR), ≤ 5 (EN), ≤ 10 (VU).

Assessment Outcome: Criterion met at Critically Endangered threshold.

Justification: *Acacia dangarensis* is found at one location. This assessment of number of locations is based on the potential impact of an inappropriate fire regime and weed invasion, the most serious plausible threats. To be listed as Critically Endangered under B1a+2a, a species must be found in one location. *Acacia dangarensis* meets the number of locations threshold for Critically Endangered B1a+2a. Severe Fragmentation is currently unknown.

- 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: Criterion met for (iii) Continuing decline inferred for quality of habitat and (v) Continuing decline projected for number of mature individuals.

Justification: Two major threats impact on *Acacia dangarensis*, i.e. weeds and an inappropriate fire regime. *Opuntia stricta* is present over a large proportion of the range of *Acacia dangarensis* (Bell 2013). *Opuntia stricta* is a Weed of National Significance, which is a group of the “worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts” (Australian Government 1999). The impact of *Opuntia stricta* on *Acacia dangarensis* is poorly known, but *Opuntia* is likely to be a competitor for space and light. Many weeds compete with resident species resulting in reduced growth and, or mortality (Vila et al. 2011). Weeds may compete for aboveground resources (e.g., taller weeds shading shorter native species or seedlings), or belowground resources (e.g., weeds dominating use of limited soil nutrients, water or rooting space). Effects of weeds can also be indirect, via altering community composition (and diversity), and ecosystem processes, such as nutrient cycling (Vila et al. 2011). It can be reasonably expected that *Opuntia stricta* would alter *Acacia dangarensis* habitat by competing with resident species, and using resources (i.e., soil water and nutrients) and hence limiting both adult survival and the recruitment of new individuals (of the threatened species, and co-occurring species).

For *Acacia dangarensis*, Bell (2013) states “The current population on Mt Dangar is an aging one, with very few young plants present”. Such a population structure may occur in obligate seeders, such as *A. dangarensis*, where there has been a long interval between fire and reflects the risk of decline in number of mature individuals if intervals between fires are too long. Recruitment of *A. dangarensis* is expected after fire, contingent on availability of viable seed (i.e., in a soil seed bank) and fire and post-fire conditions appropriate for seed germination, establishment and survival (e.g. seeds promoted to germinate by the fire, adequate post-fire rainfall and seedlings not outcompeted by weeds or lost to grazers). The likely post-fire dynamics of *Acacia dangarensis* and *Opuntia stricta* are currently unknown. *Opuntia stricta* is fire sensitive, but also has a soil seed bank and is bird dispersed (Foxcroft et al. 2010). *Acacia dangarensis* has viable soil stored seed (Bell 2013). Bell (2013) found varying numbers of dead *Acacia dangarensis* standing stems, from 4% to 58%, with an overall figure of 22% (248 stems surveyed in 0.25 ha). The time since fire on Mt Dangar is unknown, although is thought to be >20 years. Continuing decline is expected unless there is successful recruitment either after a fire or independent of fire.

- c) Extreme fluctuations.

Assessment Outcome: Data Deficient.

Justification: Currently there is no available data to assess the likelihood of extreme fluctuations in *Acacia dangarensis*.

Criterion C Small population size and decline

Assessment Outcome: Least Concern

Justification: Bell (2013) estimated a total population of some 30,000 *Acacia dangarensis*. This estimate was based on the mean density of stems in five 500m² survey areas. If lower and upper recorded stem densities are used to estimate the total population bounds, then population estimates range from 16,000 to 47,000 plants. Some 85-90% of the *Acacia dangarensis* individuals are thought to be mature (S. Bell, pers comm., February 2017). This results in an estimate of mature

individuals of approximately 27,600 (plausible range 13,600-40,000). These population estimates are considerably higher than the estimate of 1750 plants made in the 2005 assessment (NSW Scientific Committee 2005). Bell (pers comm., December 2016) noted that the 2013 estimate may overestimate population size because denser stands were sampled (to accommodate other data that was being collected at the time). Further surveys in sparsely populated areas are proposed for 2017 (Bell et al. 2016). To be listed as threatened under Criterion C a species must have <10,000 mature individuals. *Acacia dangarensis* does not meet the threshold for listing under Criterion C.

Criterion D Very small or restricted population

Assessment Outcome: Vulnerable under Criterion D2

Justification: *Acacia dangarensis* AOO is 4-8 km² and it only occurs at one location.

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

D1. Population size estimated to number ≤50 (CR), ≤ 250 (EN), or ≤1,000 (VU) mature individuals.

Assessment Outcome: Criterion not met.

Justification: *Acacia dangarensis* has more than 1000 mature individuals.

D2. Restricted area of occupancy (typically <20 km²) 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: Criterion met.

Justification: *Acacia dangarensis* meets the threshold for listing under Criterion D2, that is, AOO < 20 km² or number of locations ≤ 5, because its AOO is 4-8 km² and it only occurs at one location. The AOO of *Acacia dangarensis* is 4-8 km², it only occurs at one location and there is a plausible future threat of inappropriate fire regime that could increase the species risk of extinction in a very short time.

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 *Acacia dangarensis*.

Description

The NSW Scientific Committee (2005) state that "*Acacia dangarensis* Tindale & Kodela (family Fabaceae) is described by Kodela and Harden (2002) in Harden, G.J. (ed). *Flora of New South Wales Volume 2*, Revised Edit. p 467, UNSW Press, Sydney, as a "small tree to 10 m high; bark at first smooth and grey, later fissured and blackish at base; branchlets more or less terete with low ridges, glabrous. Leaves with rachis 1.5-6 cm long, more or less glabrous or with very sparse hairs, jugary glands present, interjugary glands absent; pinnae 2-6 pairs, 3-8cm long; pinnules 14-30 pairs, linear, mostly 4-9 mm long, 0.25-0.4 mm wide, glabrous; petiole 0.4-4.5 cm long, with 1 prominent gland. Heads globose, 12-26-flowered, bright yellow, in terminal or axillary panicles; peduncles 1-3 mm long, glabrous. Pods more or less straight, more or less flat, 3-8 cm long, 5-7 mm wide, glabrous; seeds longitudinal; funicle filiform and expanded towards seed. Flowers August to September."

"*A. dangarensis* is distinguished from its closest relative *A. decurrens* by its branchlets being terete with several low longitudinal ridges to c. 0.2 mm high (the branchlets of *A. decurrens* are prominently winged with narrow ridges to 2 mm high), leaves with rachis (1.6-)3-6 cm long, 2-6 pairs of pinnae and a gland often present above each secondary pulvinus, and flower heads 2-4 mm in diameter (Tindale and Kodela 1991)."

Distribution

The NSW Scientific Committee (2005) state that “*Acacia dangarensis* is endemic to NSW and confined to the summit and surrounding slopes of Mount Dangar south of Merriwa, within Goulburn River National Park (Tindale and Kodela 1991).”

Bell (2013) estimated that an area of 42 ha (0.42 km²) is currently occupied by *Acacia dangarensis*, with an estimated total population size of around 30,000. Bell (2013) measured the density of live and dead stems across five 50 m transects. Each transect was composed of five alternating 10 m x 10 m quadrats (500 m²); a total area of 0.25 ha was surveyed. The 0.25 ha survey area constitutes 6% of the total species range (42 ha). Live stem densities along these transects ranged from one stem per 9 m², to one stem per 26 m². Using these densities, the lower and upper population estimates are approximately 16,000 to 47,000. Around 85-90% of these individuals are thought to be mature (Bell pers. comm. February 2017). Bell (pers. comm., December 2016) noted that the 2013 estimate may overestimate population size because denser stands were sampled (to accommodate other data that was being collected at the time, further surveys in more sparsely populated areas are proposed for 2017). Because of this bias, these estimates of population should be treated with caution.

Ecology

The NSW Scientific Committee (2005) state *Acacia dangarensis* “occurs in pure stands or as a co-dominant tree in sclerophyll woodland on the edge of dry rainforest on basalt and basalt colluvium.”

Acacia dangarensis co-occurs with the tree *Eucalyptus moluccana* (Bell 2013). Other co-occurring species include trees (*Brachychiton populneus* and *Callitris glaucophylla*), shrubs (*Notelaea microcarpa*, *Nyssanthe diffusa*, *Solanum* spp., *Abutilon oxycarpum*, *Spartothamnella juncea*, *Senecio linearifolius* subsp. *dangarensis*), grasses, herbs and forbs (e.g. *Microlaena stipoides*, *Poa labillardieri*, *Austrodanthonia* spp., *Austrostipa verticillata*, *Oplismenus imbecillus*) (Bell 2013).

Recent surveys have found that little-to-no recruitment is occurring in the *Acacia dangarensis* population on Mt Dangar (Bell 2013). *Acacia dangarensis* on Mt Dangar flowers and fruits frequently, but seedling recruitment has been extremely limited. Its soil stored seed, at densities of 21 viable seeds/m², germinates when treated with heat (Bell 2013). It is likely that the absence of fire is limiting recruitment (Bell 2013).

Threats

NSW Scientific Committee (2005) state that “The low total number of plants and the highly restricted distribution of *Acacia dangarensis* make it susceptible to demographic and environmental stochasticity, such as frequent or very severe fires, or storms. Weed infestation, particularly from prickly pear, *Opuntia stricta*, may reduce seedling recruitment and threaten the future persistence of *Acacia dangarensis*.”

While goats have been recorded on Mt Dangar in the past, the impact of goats on the species is currently unknown.

Conservation and Management Actions

There is a NSW Saving Our Species site-managed program for *Acacia dangarensis* (NSW OEH, 2016). The following actions are derived from this program:

Habitat loss, disturbance and modification

- Implement and Maintain appropriate fire regime.
 - Ensure that the location is burnt while viable seed is present.
 - Ensure that intervals between future fires are long enough for the seed bank to be replenished.
 - Manage fire (severity, frequency) and post-fire conditions to promote successful *Acacia dangarensis* recruitment by ensuring seed is retained on site (i.e., erosion management), competition to seedlings is minimized (i.e., weed management) and grazing/browsing minimized (i.e., feral herbivore control).
 - Improve understanding of *Acacia dangarensis* response to fire by conducting experimental burn.
 - Confirm that mass germination of *Acacia dangarensis* will be stimulated by burning by applying a fire of sufficient severity to produce enough soil heating.

Invasive species

- Reduce and maintain weed densities at low levels.
 - Continue management actions to control *Opuntia stricta* (i.e., biological control, mechanical removal).
 - Weed control will be particularly important after any fire, to prevent weed impacts on *Acacia dangarensis* recruitment.
- Reduce pest animal species densities and maintain at low levels.
 - Control feral goats – known to browse on *Acacia dangarensis*.

Ex situ conservation

- Develop a targeted seed collection program for ex situ seed banking.
- Establish living collections in botanical gardens.

Stakeholder Management

- Work closely with landholders of private land on which *Acacia dangarensis* exists.
 - Ensure land management is sympathetic to the species (avoid intense grazing, frequent fire and weed invasion) and highlight importance of protecting any recruitment.

Survey and Monitoring priorities

- Regular surveys to determine changes in the *Acacia dangarensis* population.
 - Permanent monitoring plots should be established to monitor
 - tree mortality,
 - indications of tree decline (e.g., canopy dieback)
 - recruitment and plant growth/survival
 - evidence of injury (herbivory, illegal collections)
 - Relate *Acacia dangarensis* population dynamics (above) to:
 - weeds (density of *Opuntia stricta*).
 - grazing (density of feral grazers).

Information and Research priorities

- The following knowledge gaps were identified by Bell (2016):
 - population size (number of plants) - refine existing data
 - occupied habitat – refine mapping of the full extent of occurrence on Mt Dangar
 - occupied habitat – define and extrapolate to other locations elsewhere (predictive)
 - fecundity – proportion of successful flower fertilisation to viable seed
 - fire response – confirm prediction that fire will stimulate mass germination
 - seed dispersal – investigate the impact ant predation may have on viable seed loads
 - herbivory – determine if feral goats or other pests are impacting on young plants
- The optimal fire interval for *Acacia dangarensis* is unknown. Key to determining this is knowing on time to maturity, time to senescence and duration of viable soil seed storage. These latter two characteristics could be investigated by monitoring mortality rates of mature trees and seed burial experiments, respectively.
- As noted above, the response of *Acacia dangarensis* to fire is unknown. From the responses of similar species we would expect mass recruitment. Experimental burns should be carried out on small sections of the population, potentially with different timing and intensity, to assess mortality and recruitment rates, as well as the response of potential competitors (e.g., weeds).

References:

Australian Government (undated) Weeds of National Significance. Online

<http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>

Bell, S. and Elliott, M. (2013) Preliminary results suggest fire is required to maintain *Acacia dangarensis*, a threatened single-population endemic from the Hunter Valley of NSW. Australasian Plant Conservation 22: 9-10.

Bell, S.A.J. (2013) *Ecological studies on Acacia dangarensis: Baseline data to inform management*. Unpublished Report to NSW Office and Environment, Mudgee. October 2013. Eastcoast Flora Survey.

Bell, S., Lamrock, P., Grenadier, L., Crust, D. and Menke, L. (2016) Research plan: ecology and management of threatened flora species at Mt Dangar, Hunter Valley, New South Wales. Draft for review (version 1). Unpublished.

Foxcroft, L. C., Rouget, M., Richardson, D. M. and Mac Fayden, S. (2004) Reconstructing 50 years of *Opuntia stricta* invasion in the Kruger National Park, South Africa: environmental determinants and propagule pressure. Diversity and Distributions 10: 427-437.

IUCN Standards and Petitions Subcommittee (2016) Guidelines for Using the IUCN Red List Categories and Criteria. Version 12. Prepared by the Standards and Petitions Subcommittee.

<http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.

Kodala, P.G. and Harden, G.J. (2002) *Acacia*. Pp 381-476 in Harden, G.J. (ed.) Flora of New South Wales. Volume 2. Revised Edition (New South Wales University Press, Sydney)

NSW Scientific Committee (2005) Final determination to list the small tree *Acacia dangarensis* Tindale & Kodala as an ENDANGERED SPECIES. Accessed 22nd November 2016.

<http://www.environment.nsw.gov.au/determinations/AcaciaDangarensisEndSpListing.htm>

NSW OEH Office of Environment and Heritage (undated) Conservation Projects: Mount Dangar: *Acacia dangarensis*. Accessed 22nd November 2016.

<http://www.environment.nsw.gov.au/savingourspeciesapp/ManagementSite.aspx?SiteID=884>

Tindale M.D. and Kodala P.G. (1991) *Acacia tessellata*, *A. cangaiensis* and *A. dangarensis* (Fabaceae: Mimosoideae), three new species from northern New South Wales, Australia. *Australian Systematic Botany* 4: 579-589.

Vila, M., Espinar, J., Hedja, M., Hulme, P., Jarosik, V., Maron, J., Pergl, J., Schnaffer, U., Sun, Y. and Pysek, P. (2011) Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities and ecosystems. *Ecology Letters* 14: 702-708.

Expert Communications

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