Eucalyptus largeana* Blakely & Beuzev. (Myrtaceae*)
Distribution: Endemic to NSW
Current EPBC Act Status: Not listed
Current NSW TSC Act Status: Endangered

Proposed change for alignment: List on EPBC Act as Endangered

Conservation Advice: *Eucalyptus largeana*

Summary of Conservation Assessment

Eucalyptus largeana is found to be eligible for listing as Endangered under Criteria A2 and B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v).

The main reasons for the species being eligible for listing in the Endangered category are i) the species has undergone a reduction in extent of occurrence (EOO) of 31-66% and area of occupancy of (AOO) of 31-36% over its past three generations; ii) estimates of EOO and AOO based on confirmed extant records are 4,842 km^2 and 104 km^2, respectively; iii) 12 of the 14 confirmed extant subpopulations are considered small and relatively isolated; and iv) the majority of remaining subpopulations occur on private lands and roadsides (i.e., land that is not principally managed for conservation) where they are threatened by weed invasion, grazing pressure and land clearing.

Assessment against IUCN Red List criteria

Criterion A Population Size reduction
Assessment Outcome: Endangered under Criterion A2.
Justification: To be listed as threatened under Criterion A2 the species must have experienced a population reduction of ≥30% (for Vulnerable) or ≥50% (for Endangered) over three generations or 10 years (whichever is longer), and the causes of reduction may not have ceased OR may not be understood OR may not be readily reversible. Reductions in AOO and EOO can be used as evidence in Criterion A1, A2, A3 and A4 supporting "suspected" population decline (Table 5.1, IUCN 2016). In a report to the Scientific Committee Mackenzie (2011) examined the 97 records of *Eucalyptus largeana* in NSW and classified them as presumed extinct (subpopulations unverified for 50 years), extant, unconfirmed or out of range (both unsubstantiated with voucher specimens). Using these records Mackenzie (2011) estimated that *Eucalyptus largeana* had undergone a decline in EOO of 31-66% and in AOO of 31-36% over three generations. Under a precautionary interpretation, based on estimates of reductions of EOO, *Eucalyptus largeana* meets the threshold for listing as Endangered under Criterion A2. (Based on reductions in AOO, *Eucalyptus largeana* only meets the threshold for listing as Vulnerable under Criterion A2.)

Criterion B Geographic range
Assessment Outcome: Endangered under B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v).
Justification: *Eucalyptus largeana* has a highly restricted geographic range.
Extent of Occurrence: Mackenzie's (2011) report to the Scientific Committee estimated the EOO of *Eucalyptus largeana* was 4,842 km^2, using a convex hull polygon based on confirmed extant records (as recommended by IUCN, 2016), with an upper estimate of 10,318 km^2 if unconfirmed records are included. The Final Determination by the NSW Scientific Committee (2012) used an estimate of EOO of 5,000-10,000 km^2. There have been no known changes to *Eucalyptus largeana* population or range since the assessment in 2012 (A. Fawcett pers comm., December 2016). To be listed as Endangered under Criterion B1 a species must have an EOO of <5,000 km^2. Under a a precautionary interpretation *Eucalyptus largeana* meets the EOO threshold for listing as Endangered under Criterion B1.

Area of Occupancy: Mackenzie's (2011) estimate of AOO, based on confirmed extant records, was 104 km^2 (using a 2 x 2 km grid, as recommended by IUCN, 2016) with an upper estimate of 140 km^2 if unconfirmed records are included. The area of occupancy (AOO) for *Eucalyptus largeana* was estimated to be 120-140 km^2 (NSW Scientific Committee 2012). To be listed as Endangered under Criterion B2 a species must have an AOO of <500 km^2. *Eucalyptus largeana* meets the AOO threshold for listing as 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 the number of locations equals 1, $\leq$ 5, $\leq$ 10.

   Assessment Outcome: Subcriterion met on the basis of severe fragmentation.

   Justification: Mackenzie (2011) found there were at least 11 extant subpopulations, and up to 20 subpopulations if unsubstantiated records are included. Scientific Committee (2012) increased the number of extant subpopulations to 14. Only two subpopulations are not regarded as small and relatively isolated (Copeland Tops State Conservation Area [SCA] and Avon River State Forest [SF] area). This estimate for subpopulation is likely reflective of locations. *Eucalyptus largeana* qualifies as severely fragmented because of its many small and isolated subpopulations which may go extinct, with a low probability of recolonization. *Eucalyptus largeana* meets the severe fragmentation thresholds for Endangered B1a+2a

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: Subcriterion met.

   Justification: The threats of land clearing, inappropriate management, weed invasion and grazing are ongoing, therefore a continuing decline in EOO (i), AOO (ii), area, extent and/or quality of habitat (iii) number of locations and subpopulations (iv), and number of mature individuals (v) is inferred. "Very few populations of *Eucalyptus largeana* are reserved or occur on land managed for conservation.... The majority of remaining populations occur on private lands and roadsides, often as single trees or small clumps interspersed with other tree species. Populations occurring on private land continue to be threatened by clearing and inappropriate management." (NSW Scientific Committee 2012). The threats of land clearing, as well as weed invasion and grazing pressure, are ongoing for the subpopulations on private land. Weed invasion and grazing pressure may each contribute to a lack of recruitment at affected sites (A. Fawcett pers comm. February 2017). The largest subpopulation, at Copeland Tops, is protected from land clearing and livestock grazing in a conservation reserve, but the threats of weed invasion (*Lantana camara*) and inappropriate fire regimes are ongoing.

c) Extreme fluctuations.

   Assessment Outcome: Data Deficient.

   Justification: Currently there is no available data to assess the likelihood of extreme fluctuations in *Eucalyptus largeana.* It is unknown whether the species resprouts after fire; anecdotal observation after low intensity fire suggests no resprouting.

Criterion C Small population size and decline

Assessment Outcome: Least Concern.

Justification: The population size of *Eucalyptus largeana* is not precisely known but is likely to be less than 10,000, but may possibly exceed 10,000 (MacKenzie 2011). The sub population in the Copeland Tops SCA is estimated to exceed 3,400 – 6,700, and the subpopulation in the Avon River SF area is estimated to be more than 120 individuals (assuming all individuals are mature). To be listed as Vulnerable under Criterion C a species must have <10,000 plants. Under a precautionary

interpretation, *Eucalyptus largeana* meets the total population threshold for listing as Vulnerable under Criterion C.

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

C1. An observed, estimated or projected continuing decline of at least 20% in 5 years or 2 generations (up to a max. of 100 years in future).

Assessment Outcome: Data Deficient.

Justification: There was insufficient data to estimate the rate of continuing decline for *Eucalyptus largeana.*

C2. An observed, estimated, projected or inferred continuing decline.

Assessment Outcome: Subcriterion met.

Justification: The threats of land clearing, inappropriate management, weed invasion and grazing are ongoing. "Very few populations of *Eucalyptus largeana* are reserved or occur on land managed for conservation.... The majority of remaining populations occur on private lands and roadsides, often as single trees or small clumps interspersed with other tree species. Populations occurring on private land continue to be threatened by clearing and inappropriate management." (NSW Scientific Committee 2012). The threats of land clearing, as well as weed invasion and grazing pressure, are ongoing for the subpopulations on private land. Weed invasion and grazing pressure may each contribute to a lack of recruitment at affected sites (A. Fawcett pers comm. February 2017). The largest subpopulation, at Copeland Tops, is protected from land clearing and livestock grazing in a conservation reserve, but the threats of weed invasion (*Lantana camara*) and inappropriate fire regimes are ongoing.

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

a (i). Number of mature individuals in each subpopulation ≤50, ≤250 or ≤1000.

Assessment Outcome: Subcriterion not met.

Justification: The subpopulation at Copeland Tops SCA has more than 1000 mature individuals.

a (ii). % of mature individuals in one subpopulation = 100%, 95-100% or 90-100%.

Assessment Outcome: Subcriterion not met.

Justification: There are at least 11 subpopulations, and up to 20 subpopulations. Assuming a total population of 10,000, the largest subpopulation (Copeland Tops) incorporates 34 – 67% of the total population.

b. Extreme fluctuations in the number of mature individuals

Assessment: Data Deficient.

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

Criterion D Very small or restricted population

Assessment Outcome: Least Concern.

Justification: To be listed under Criterion D1 or D2 the population must be <1000. The total number of mature *Eucalyptus largeana* individuals not precisely known but is likely to be less than 10,000, but may possibly exceed 10,000 (MacKenzie 2011). Based on a population estimate of 10,000 *Eucalyptus largeana* is not eligible listing under Criterion D1 or D2.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient.

Justification: Currently there is not enough data to undertake a quantitative analysis to determine the extinction probability of *Eucalyptus largeana.*

Description
The NSW Scientific Committee (2012) state that "*Eucalyptus largeana* Blakely & Beuzev. (family Myrtaceae), also known as Craven Grey Box, is described by Hill (1991) as follows: "Tree to 40 m high; bark persistent on trunk and larger branches, grey with whitish patches, fibrous-flaky ('box'), smooth above, white to grey, shedding in short ribbons. Juvenile leaves disjunct, lanceolate to broad-lanceolate, dull dark green. Adult leaves disjunct, narrow-lanceolate, 12–18 cm long, 1–2 cm wide, dark green, dull, concolorous. Conflorescence compound; umbellasters 7-flowered; peduncle terete or 4-angled, 10–15 mm long; pedicels terete, 2–4 mm long. Buds ovoid, 3–5 mm long, 2–3 mm diam., scar present; calyptra hemispherical or conical, shorter than and as wide as hypanthium. All stamens fertile. Fruit pyriform or ovoid, 3–4 mm long, 2–3 mm diam.; disc depressed; valves enclosed.""

Distribution
The NSW Scientific Committee (2012) state that "*Eucalyptus largeana* is restricted to the NSW North Coast Botanical subdivision (Hill 1991, Royal Botanic Gardens and Domain Trust 1999-2011), within the NSW North Coast Bioregion, *sensu* Thackway and Cresswell (1995). A number of unsubstantiated records exist from outside the currently accepted range, including from the NSW Northern Tablelands Botanical subdivision and Central Western Slopes Botanical subdivision, however these records have not been verified with voucher specimens."

"The geographic distribution of *Eucalyptus largeana* has been reduced as a result of land clearing, particularly on private property between Pokolbin and Dungog. Only a small number of the known sites targeted during recent (2007) field surveys had extant individuals. In the southern part of the species' range individuals could not be located at the majority of previously recorded sites."

"The largest known population of the species is in Copeland Tops State Conservation Area where the estimated population size is likely to be in excess of 3,400-6,700 individuals (Mackenzie 2011). Approximately 50 individuals have been confirmed within Avon River State Forest plus approximately 70 individuals outside this State Forest boundary. A number of scattered individuals have been reported from within Glen Nature Reserve (Eastcoast Flora Survey 2009), however, these records remain unconfirmed. With the exception of these three populations, the known extant populations are small and isolated, comprising individual trees or small clumps of trees with little probability of re-colonization in the event of local extinction, particularly in the southern part of the species' range. Hence, the number of mature individuals in the species is likely to be moderately low and nearly all mature individuals are observed or inferred to occur within a small number of populations or locations."

Ecology
"Restricted and local, in wet forest on sloping sites in subcoastal ranges" (Hill, undated).

Threats
NSW Scientific Committee (2012) state that "Very few populations of *Eucalyptus largeana* are reserved or occur on land managed for conservation... The majority of remaining populations occur on private lands and roadsides, often as single trees or small clumps interspersed with other tree species. … Populations occurring on private land continue to be threatened by clearing and inappropriate management. With the exception of Copeland Tops State Conservation Area, populations of *Eucalyptus largeana* are threatened by demographic and environmental stochasticity due to their small size and restricted distribution. Collectively, these threats are indicative of a continuing decline in population size, geographic distribution, and in area, extent and quality of habitat."

The threats of land clearing, as well as weed invasion and high grazing pressure, are ongoing for the subpopulations on private land. Weed invasion and high grazing pressure may each contribute to a lack of recruitment at affected sites (A. Fawcett pers comm. February 2017). Lantana can have allelopathic effects on some species (Gentle and Duggin 1997), but impacts on eucalypts are unknown, while weeds may smother *Eucalyptus largeana* seedlings. The largest subpopulation, at Copeland Tops, is protected from land clearing and livestock grazing in a conservation reserve, but the threats of weed invasion (*Lantana camara*) and inappropriate fire regimes are ongoing.

Conservation and Management Actions

There is a NSW Saving our Species site managed program for *Eucalyptus largeana* that focusses conservation actions at three sites (NSW OEH 2016).

<u>Habitat loss, disturbance and modification</u>

- Prevent degradation of known habitat.
    - Prevent grazing, browsing of, and bark damage to, *Eucalyptus largeana*. Seedlings will be more vulnerable to mortality than mature trees.
        - Control feral herbivores (e.g. goats, rabbits).
        - Control domestic stock (e.g., sheep cattle).
        - Feral herbivore/stock control may involve:
            - Localized removal
            - Fencing
            - Reduction to, and maintenance at, low densities.
    - Eradicate or control weeds to maintain them at low densities.
        - Control *Lantana camara* and maintain and low densities.
            - Lantana can have allelopathic effects on some species (Gentle and Duggin 1997), but impacts on eucalypts are unknown.
            - Weeds may smother *Eucalyptus largeana* seedlings.
            - Weeds are likely to colonise, and outcompete *Eucalyptus largeana* seedlings, in gaps.
    - Avoid burning large areas of the site until fire response is known.
    - Prevent changes to soil conditions (e.g. increases in nutrients due to fertilisers and stock, compaction).
- Prevent loss of known habitat.
    - Protect habitat on private land from clearing through conservation agreements with land managers.
        - Raise public awareness that *Eucalyptus largeana* is a rare species, and ways to help with its conservation.
        - Communication with landholders.
    - Protect *Eucalyptus largeana* habitat on roadsides.
        - Erect signage.
        - Fence known stands.
- Increase knowledge about distribution of species.
    - Raise awareness of *Eucalyptus largeana* with land managers and ask them to report potential new records.

<u>Invasive species</u>

- Prevent grazing, browsing of, and bark damage to, *Eucalyptus largeana*. Seedlings will be more vulnerable to mortality than mature trees.
    - Control feral herbivores (e.g. goats, rabbits).
    - Control domestic stock (e.g., sheep cattle).

    - Feral herbivore/stock control may involve:
        - Localized removal
        - Fencing
        - Reduction to, and maintenance at, low densities.
- Eradicate or control weeds to maintain them at low densities.
    - Control *Lantana camara* and maintain and low densities.
    - Weeds may smother *Eucalyptus largeana* seedlings.
    - Weeds are likely to colonise, and outcompete *Eucalyptus largeana* seedlings, in gaps.

Ex situ conservation

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

Stakeholder Management

- Inform land owners and managers of sites where there are known populations and consult with these groups regarding options for conservation management and protection of the species.
- Negotiate land management agreements with private landholders.
- Ensure any management by government agencies is sympathetic to the species (i.e., avoid damaging established trees or recruitment).
    - Forestry activities.

Survey and Monitoring priorities

- Undertake surveys to confirm unsubstantiated subpopulations.
- Undertake surveys at known subpopulations to confirm numbers of individuals and extent/boundaries, along with existing threats.
- Increase knowledge about distribution of species.
- Monitor population changes in abundance of different life stages (seedlings, juveniles, adults).
- Monitoring for any increased habitat degradation.

Information and Research priorities

- Assess population structures at key sites to determine population dynamics (e.g., factors controlling recruitment and its magnitude and persistence).
- Determine impacts of fire (impacts on seed production, seed bank, mature trees, resprouting capacity).
- Assess genetic variation across the distribution of the species. What genetic variation exists within the larger and smaller Eucalyptus largeana subpopulations? Are there subpopulations with unusual genotypes? Are any subpopulations affected by, or at risk of, inbreeding?
    - Should particular conservation measures be taken to protect any genetically distinct subpopulations?
    - Should seeds from genetically distinct subpopulations be preferentially seed banked?

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Thackway R., Cresswell, I.D. (1995) An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserve System Cooperative Program. (Version 4.0. ANCA: Canberra.)

NSW SCIENTIFIC COMMITTEE

Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the tree *Eucalyptus largeana* Blakely & Beuzev. as an ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act. Listing of Endangered species is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. *Eucalyptus largeana* Blakely & Beuzev. (family Myrtaceae), also known as Craven Grey Box, is described by Hill (1991) as follows: "Tree to 40 m high; bark persistent on trunk and larger branches, grey with whitish patches, fibrous-flaky (`box'), smooth above, white to grey, shedding in short ribbons. Juvenile leaves disjunct, lanceolate to broad-lanceolate, dull dark green. Adult leaves disjunct, narrow-lanceolate, 12–18 cm long, 1–2 cm wide, dark green, dull, concolorous. Conflorescence compound; umbellasters 7-flowered; peduncle terete or 4-angled, 10–15 mm long; pedicels terete, 2–4 mm long. Buds ovoid, 3–5 mm long, 2–3 mm diam., scar present; calyptra hemispherical or conical, shorter than and as wide as hypanthium. All stamens fertile. Fruit pyriform or ovoid, 3–4 mm long, 2–3 mm diam.; disc depressed; valves enclosed."

2. *Eucalyptus largeana* is restricted to the NSW North Coast Botanical subdivision (Hill 1991, Royal Botanic Gardens and Domain Trust 1999-2011), within the NSW North Coast Bioregion, *sensu* Thackway and Cresswell (1995). A number of unsubstantiated records exist from outside the currently accepted range, including from the NSW Northern Tablelands Botanical subdivision and Central Western Slopes Botanical subdivision, however these records have not been verified with voucher specimens.

3. Fourteen populations represented by voucher specimens collected less than 50 years ago and/or confirmed during targeted field surveys are believed to be extant (Mackenzie 2011, unpubl. data). Ten populations which have not been sighted in more than 50 years are presumed extinct. Four of these populations could not be relocated during recent (2007) targeted field surveys (Fawcett pers comm. 2008). It is possible that the species still persists in these areas in very low numbers. A further 18 populations recorded during vegetation surveys, but unsubstantiated with voucher specimens, remain unconfirmed, including nine populations reported from outside the currently accepted range of the species and best regarded as doubtful until substantiated with voucher specimens (Mackenzie 2011).

4. The extent of occurrence (EOO) is approximately 5,000-10,000 km^2 based on exclusion and inclusion, respectively, of unconfirmed records from within the species' currently accepted range (Mackenzie 2011), and using a minimum convex polygon as recommended by IUCN (2010). The area of occupancy (AOO) is 120-140 km^2 based on exclusion and inclusion, respectively, of unconfirmed records within the species' currently accepted range (Mackenzie 2011), using 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by the IUCN (2010). Hence, the geographic distribution is considered to be highly restricted.

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5. The geographic distribution of *Eucalyptus largeana* has been reduced as a result of land clearing, particularly on private property between Pokolbin and Dungog. Only a small number of the known sites targeted during recent (2007) field surveys had extant individuals. In the southern part of the species' range individuals could not be located at the majority of previously recorded sites. The EOO is estimated to have declined by 31-66% based on the inclusion and exclusion, respectively, of unconfirmed records from within the species' currently accepted range (Mackenzie 2011). The AOO is estimated to have declined by 31-36% based on the inclusion and exclusion, respectively, of unconfirmed records from within the species' currently accepted range (Mackenzie 2011). This is indicative of a moderate to large reduction in population size.

6. The largest known population of the species is in Copeland Tops State Conservation Area where the estimated population size is likely to be in excess of 3,300-6,700 individuals (Mackenzie 2011). Approximately 50 individuals have been confirmed within Avon River State Forest plus approximately 70 individuals outside this State Forest boundary. A number of scattered individuals have been reported from within Glen Nature Reserve (Eastcoast Flora Survey 2009), however, these records remain unconfirmed. With the exception of these three populations, the known extant populations are small and isolated, comprising individual trees or small clumps of trees with little probability of re-colonization in the event of local extinction, particularly in the southern part of the species' range. Hence, the number of mature individuals in the species is likely to be moderately low and nearly all mature individuals are observed or inferred to occur within a small number of populations or locations.

7. Very few populations of *Eucalyptus largeana* are reserved or occur on land managed for conservation. Populations are known from Copeland Tops State Conservation Area and Berrico Nature Reserve, with unconfirmed records from Talawahl and Glen Nature Reserves and Willi Willi National Park. The majority of remaining populations occur on private lands and roadsides, often as single trees or small clumps interspersed with other tree species. Populations occurring on private land continue to be threatened by clearing and inappropriate management. 'Clearing of native vegetation' is listed as a Key Threatening Process under the NSW *Threatened Species Conservation Act* 1995. With the exception of Copeland Tops State Conservation Area, populations of *Eucalyptus largeana* are threatened by demographic and environmental stochasticity due to their small size and restricted distribution. Collectively, these threats are indicative of a continuing decline in population size, geographic distribution, and in area, extent and quality of habitat.

8. *Eucalyptus largeana* is not eligible to be listed as a Critically Endangered species.

9. *Eucalyptus largeana* Blakely & Beuzev. is eligible to be listed as an Endangered species as, in the opinion of the Scientific Committee, it is facing a very high risk of extinction in New South Wales in the near future as determined in accordance with the following criteria as prescribed by the *Threatened Species Conservation Regulation* 2010:

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Clause 7 Restricted geographic distribution and other conditions

The geographic distribution of the species is estimated or inferred to be:
(b) highly restricted,
and:
(d) a projected or continuing decline is observed, estimated or inferred in either of the key indicators:
  (a) an index of abundance appropriate to the taxon, or
  (b) the geographic distribution, habitat quality or diversity, or genetic diversity of the species.

Associate Professor Michelle Leishman
Chairperson
Scientific Committee

References:

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