# NSW SCIENTIFIC COMMITTEE

**Final Determination**

The Scientific Committee, established by the *Threatened Species Conservation Act 1995* (the Act), has made a Final Determination to list a population of the Koala *Phascolarctos cinereus* (Goldfuss, 1817) between the Tweed and Brunswick Rivers east of the Pacific Highway as an ENDANGERED POPULATION in Part 2 of Schedule 1 of the Act. Listing of Endangered populations is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. The Koala *Phascolarctos cinereus* (Goldfuss, 1817) (family Phascolarctidae) is not currently listed as an Endangered species in Part 1 of Schedule 1 nor a Critically Endangered species in Part 1 of Schedule 1A and, as a consequence, populations of this species are eligible to be listed as Endangered populations.

2. The Koala is a medium-sized, stocky marsupial: head-body 674–820 mm (males); 648–730 mm (females); weight 4.2–14.9 kg (males); 4.1–11 kg (females). The tail is vestigial, the limbs are well developed and all paws are equipped with long robust claws. The woolly fur ranges from grey to brown dorsally and is paler ventrally, often with irregular pale patches on the rump. The ears are large, oval and well furred, the nose is prominent, unfurred and black (Menkhorst and Knight 2001; Van Dyck and Strahan 2008; OEH 2013).

3. Koalas are arboreal and obligate folivores feeding predominately on leaves from *Eucalyptus* trees (over 70 species) but in any one area will have a small range of preferred species (Martin and Handasyde 1999; Van Dyck and Strahan 2008; OEH 2013). Some other plants are also occasionally consumed including species of *Acacia*, *Corymbia*, *Angophora*, *Leptospermum* and *Melaleuca* (Martin and Handasyde 1999; CoA 2011). Koalas inhabit a variety of woodlands and forests that are dominated by *Eucalyptus* tree species. Koalas generally occur at low altitudes (< 800 m) and are most common in the foothills of the ranges and coastal plains. In inland areas they often inhabit eucalypt forests along watercourses (Martin and Handasyde 1999; Van Dyck and Strahan 2008).

4. Koalas are largely sedentary and spend up to 20 hours per day resting or sleeping, often in a low fork of a tree. They are most active at night, climbing into the canopy to feed or moving within or between trees. Koalas spend most of their time in trees but will descend and traverse open ground to move between trees (Martin and Handasyde 1999; Van Dyck and Strahan 2008). Koalas are generally solitary and home range size varies from less than 2 ha to over 100 ha depending on habitat quality (Martin and Handasyde 1999; Van Dyck and Strahan 2008). Home ranges may overlap amongst individuals of the same sex in high quality habitat but are usually discreet in drier or less fertile areas. Males have larger home ranges than females and a dominant male's home range overlaps with those of several females and subordinate males (Martin and Handasyde 1999; DECC 2008; Van Dyck and Strahan 2008; OEH 2013). Koalas show a high level of site fidelity (Mitchell 1990; Kavanagh *et al*. 2007). Sexual maturity in female Koalas is reached from eighteen months and in the wild they produce one offspring every one to two years (McLean and Handasyde 2006). Female Koalas live to around 15 years and males to 12 years (CoA 2011). The generation length is estimated to be 6 years (Phillips 2000). At 2–3 years of age, young adult Koalas of both sexes disperse from their natal ranges, typically moving 0.3–11 km, to establish their own home ranges (Mitchell and Martin 1990; Dique *et al*. 2003a; DECC 2008).

5. Koalas are widespread in eastern Australia, being distributed from northeast Queensland to south-east South Australia (CoA 2011). In New South Wales (NSW), the Koala was formerly widely



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distributed throughout the eastern half of the state (DECC 2008). Due to the extensive clearing of forest and woodland for agriculture and urban development, the distribution of the Koala is now highly fragmented (Martin and Handasyde 1999; Van Dyck and Strahan 2008). In NSW, Koala populations are now concentrated on the central and north coast and west of the Great Dividing Range in the north of the state. Smaller isolated populations also occur on the tablelands and the south coast (DECC 2008; OEH 2013). Studies of factors influencing the distribution of Koalas in south-east Queensland indicate that the likelihood of Koala presence declines rapidly as forest cover drops below 60–70% of the landscape (McAlpine *et al*. 2006, 2007). In addition, Koala presence starts to decline when patches of habitat are <150 ha and Koalas are likely be to absent from habitat patches smaller than 50 ha (McAlpine *et al*. 2007).

6. In far north-eastern NSW, records of Koalas between the Tweed and Brunswick Rivers are concentrated in the coastal lowlands. Within the Tweed local government area over 44% of the original vegetation cover has been removed or heavily disturbed over the last 150 years (Kingston *et al*. 2004). Most clearing of native vegetation has occurred on the flatter and more fertile land and has been particularly extensive in the coastal lowlands (Kingston *et al.* 2004). In the adjacent Byron local government area, clearing patterns have been similar and <35% of the lowland and floodplain vegetation communities preferred by Koalas remain (Hopkins and Phillips 2012). Declines in Koala distribution and abundance within Tweed and Byron local government areas have previously been noted and concern for the species' long term persistence have been expressed for some decades (Faulks 1990; Summerville 1990; Phillips and Callaghan 1996; Phillips 2002; Phillips *et al.* 2011; Hopkins and Phillips 2012).

7. A remnant population of Koalas occupies the coastal lowlands between the Tweed and Brunswick Rivers east of the Pacific Highway. To the east the population is bounded by the Pacific Ocean, to the south by the Brunswick River, to the north by the Tweed River and to the west by the Pacific Highway. The population is mostly associated with the largest areas of natural vegetation remaining in the coastal lowlands from north of Bogangar south to the Brunswick River, although the resident population currently only extends to south of Pottsville (Phillips *et al*. 2011; Hopkins and Phillips 2012). Koalas were also consistently recorded historically in the Billinudgel Nature Reserve straddling the Tweed and Byron local government areas north of the Brunswick River. Recent declines and the current paucity of records in this area are likely due to recent high fire frequency (Hopkins and Phillips 2012). Some scattered signs of Koala activity (*e.g*. scats, scratch marks) also occur in the Tweed coastal lowlands west of the Pacific Highway and north of the Tweed River, for example near Tweed Heads South, Cobaki and Bilambil, but these are no longer thought to represent resident populations (Phillips *et al*. 2011) and are not included in this listing.

8. The Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is considered to be disjunct because anthropogenic modification of the landscape has resulted in barriers to movement. The Pacific Highway, a four lane dual carriageway, represents the western boundary of the population. Major roads are considered a significant barrier to the movement of Koalas, functioning both as a substantial habitat gap that resident Koalas are reluctant to cross and as a significant source of mortality (Dique *et al*. 2003a, 2003b; NSW Scientific Committee 2005; Lassau *et al.* 2008; Rhodes *et al.* 2014). Although several fauna under- and over-passes are present along the Pacific Highway, their use by Koalas in the Tweed area has been negligible (Phillips *et al.* 2011; AMBS 2011), although crossing structures have been used by Koalas elsewhere. The Tweed and Brunswick Rivers east of the Pacific Highway are also considered to be wide enough (at least 160 m and 90 m respectively) to constitute a significant barrier to movement. While Koalas will move through habitat that is unsuitable for occupation (Moon 1990; Ramsay 1999), and there are occasional



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observations of individuals swimming across rivers >100 m, rivers >50 m are considered a barrier to demographic connectivity (NSW Scientific Committee 2005).

9. Approximately 3,328 ha of fragmented but otherwise suitable Koala habitat remains between the Tweed and Brunswick Rivers east of the Pacific Highway (S. French *in litt*. May 2015; J. Lofthouse *in litt.* July 2015). Of this, 237 ha is considered to be primary Koala habitat where the preferred food trees Swamp Mahogany *Eucalyptus robusta*, Forest Red Gum *E. tereticornis* and/or Tallowwood *E. microcorys* grow on medium to high nutrient soils (Kingston *et al*. 2004; S. French *in litt*. May 2015; J. Lofthouse *in litt.* July 2015). A further 2,143 ha is considered to be secondary (Class A) Koala habitat where Swamp Mahogany, Forest Red Gum and/or Tallowwood are sub-dominant elements (Kingston *et al*. 2004; S. French *in litt*. May 2015; J. Lofthouse *in litt.* July 2015). An additional 948 ha is considered secondary (Class B) habitat containing Tallowwood and/or Grey Gum *E. propinqua* growing on low nutrient soils (Kingston *et al*. 2004; S. French *in litt*. May 2015; J. Lofthouse *in litt.* July 2015). Between the Tweed and Brunswick Rivers east of the Pacific Highway, a total of 1,120 ha of this preferred Koala habitat currently occurs within conservation reserves (Nature Reserves) (S. French *in litt*. May 2015; J. Lofthouse *in litt.* July 2015).

10. The Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is fragmented into four sub-populations. The Bogangar/Kings Forest/Forest Hill sub-population (inhabiting an area of 358 ha; 71% vegetated); the Tanglewood/Round Mountain/Koala Beach sub-population (inhabiting an area of 578 ha; 80% vegetated); the Pottsville Wetlands/Black Rock/Dunloe Park sub-population (inhabiting an area of 316 ha; 79% vegetated) and the Duranbah/Eviron sub-population (inhabiting an area of 625 ha; 10% vegetated). The extent of connectivity within and amongst these sub-populations remains uncertain (Phillips *et al*. 2011) as roads, cleared agricultural land and/or urban development occur within and amongst them. Although only scattered recent records of koalas exist for the Byron local government area north of the Brunswick River, centred around the Billinudgel Nature Reserve, this area contains suitable koala habitat, historically supported a large koala population and is not clearly disjunct from the extant sub-populations in the Tweed local government area. It therefore could potentially be recolonised (Hopkins and Phillips 2012).

11. The geographic distribution of the Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is highly restricted. The extent of occurrence (EOO) is estimated to be 126–189 km$^2$. The EOO estimate is based on the method of assessment recommended by IUCN (2014). The area of occupancy (AOO) was estimated to be 132–228 km$^2$, based on 33–57 2 x 2 km grid cells, the scale recommended for assessing AOO by the IUCN (2014). The EOO and AOO were estimated using Koala records of variable spatial accuracy compiled by Phillips *et al.* (2011), with additional records from the NSW Wildlife Atlas in the period 2009–2015. The lower estimates were obtained when including only recent records (2000–2015) with high spatial accuracy and the higher estimates were obtained when all records were included.

12. The estimated total number of mature individuals in the Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is considered to be low. Based on density estimates of 0.14 individuals per ha and the area of occupied sites, the total number of individuals in the four sub-populations is estimated to be 144 individuals (9–64 for each sub-population) with an upper 95% confidence interval at 267 individuals (16–120 for each sub-population) (Phillips *et al.* 2011). These estimates include an unknown proportion of juveniles and sub-adults so the number of mature individuals is likely to be less than these estimates.

13. The Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway, like those throughout New South Wales, is subject to a number of ongoing threats including habitat loss



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and degradation, increased mortality due to wildfire, dog attacks and vehicle strike, as well as disease (DECC 2008; Phillips *et al.* 2011). A significant threat to this population is continued habitat loss and fragmentation due to urban development. For example, the Tweed local government area contained almost 83,000 human residents in 2006 but is one of the fastest growing areas in New South Wales and is estimated to exceed 120,000 residents by 2025 (Phillips *et al*. 2011). Almost all of this growth has occurred, and is expected to continue to occur, in the coastal lowlands between Tweed Heads and Pottsville (Phillips *et al*. 2011). Approximately 965 ha of bushland in the Tweed local government area, including approximately 100 ha of Koala habitat, was cleared between 2000 and 2007 (BRS 2008). Development pressures continue in the Tweed and Byron coastal area, with several approved and proposed developments likely to lead to further loss and fragmentation of Koala habitat. Habitat loss and fragmentation also have the potential to further impede dispersal and recruitment between sub-populations and are associated with increased risks of vehicle strike and domestic dog attack (McAlpine *et al.* 2006; Phillips *et al*. 2011). 'Clearing of native vegetation' is listed as a Key Threatening Process under the Act.

14. Inappropriate fire regimes, particularly high intensity or high frequency fires, represent an additional significant threat to the Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway (Phillips *et al*. 2011; Hopkins and Phillips 2012). Fires impact Koalas directly through mortality of animals and habitat fragmentation reduces the ability of animals to subsequently recolonise burnt areas. Increased fire frequency may also reduce quality of Koala habitat and has the potential to exacerbate population decline (Starr 1990; Melzer *et al*. 2000; Lunney *et al*. 2007). The largest area of natural vegetation, and potential Koala habitat, remaining in the Tweed coastal lowlands occurs around Cudgen Lake/Round Mountain (Phillips *et al*. 2011). Much of this area has been burnt multiple times in the last 15 years with time between fires being as short as three years. The 2004 and 2009 fires were of high-intensity and much of the area burnt by these fires is currently unoccupied by Koalas, despite containing areas mapped as high quality Koala habitat (Phillips *et al.* 2011). High frequency fire is also thought to have led to the virtual elimination of the once abundant Billinudgel Nature Reserve koala population in the Byron local government area. This reserve was almost completely burnt in 2004 following two other fires with inter-fire intervals of only three and nine years (Hopkins and Phillips 2012). 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the Act.

15. Mortality in the Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is also exacerbated by vehicle strikes. Phillips (2002) reported that vehicle strike was responsible for 34% of known Koala mortalities on the Tweed coast between 1991 and 2002 and 19% of mortalities since 2002 (Phillips *et al.* 2011). Similarly, of 40 Koala mortalities in the Tweed coastal lowlands since 2007, recorded by Friends of the Koala Inc., nine (23%) were a result of vehicle strike (Phillips *et al*. 2011). Many local roads pass through the population and sections of four major roads (Tweed Coast Road, Clothiers Creek Road, Round Mountain Road, Pottsville Road) have been identified as known Koala 'blackspots' (Phillips 2002; Phillips *et al.* 2011) and additional mortalities are known from the Billinudgel area of the Byron local government area (Hopkins and Phillips 2012). The total number of Koala deaths from vehicle strike is likely to be larger than that reported and the risk of vehicle strike can be expected to increase with increased urbanisation and human population growth. The long-term viability of Koala populations can be particularly sensitive to slight changes in mortality rates. Phillips *et al*. (2007) concluded, on the basis of a Population Viability Analysis, that a slight increase in mortality, due to incidental factors such as road mortality, would be sufficient to drive on-going population decline in an otherwise demographically stable Koala population in south-east Queensland.



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16. Chlamydial disease and the Koala Retrovirus (KoRV) are common in Koala populations in eastern Australia (CoA 2011) and are present in the Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway (Phillips *et al.* 2011; Hopkins and Phillips 2012). Chlamydia can cause blindness, infertility and pneumonia (Polkinghorne *et al*. 2013) while KoRV has been linked to some cancers and suppression of the immune system (Denner and Young 2013). Both diseases impact the general health of populations and can exacerbate the effect of other environmental stressors. Of 40 Koala mortalities recorded from the Tweed coast area since 2007 by Friends of the Koala Inc., 20 (50%) were reported to be from disease (Phillips *et al*. 2011).

17. The Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is also likely to be threatened by mortality due to dog attack (Lunney *et al.* 2007; DECC 2008). The record of dog attacks in this area is not comprehensive, with only three mortalities (7%) attributed to dog attacks over the last 20 years in the Tweed local government area and 17 (4.5%) in the Byron local government area (Phillips *et al*. 2011). The actual incidence of dog attack however is likely to be higher, given the peri-urban/rural nature of much of the area, as well as increased rates of urbanisation and population growth in the area (Phillips *et al*. 2011). On the mid-north coast of NSW, attacks by dogs are the cause of *c.*15% of admissions to the Port Macquarie Koala Hospital (Phillips *et al*. 2011).

18. The population of the Koala *Phascolarctos cinereus* (Goldfuss, 1817) between the Tweed and Brunswick Rivers east of the Pacific Highway is eligible to be listed as an Endangered population 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*:

**Clause 11**

The population is facing a very high risk of extinction in New South Wales in the near future as, in the opinion of the Scientific Committee, it satisfies any one or more of the following paragraphs and also meets the criteria specified in one or more of the following clauses:

(a) it is disjunct or near the limit of its geographic range.

**Clause 13**

The geographic distribution of the population is estimated or inferred to be highly restricted and either:

(a) 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 population, or

(b) the following conditions apply:
    (i) the population or habitat is observed or inferred to be severely fragmented;
    (ii) all or nearly all mature individuals are observed or inferred to occur within a small number of locations.



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**Clause 14**

The estimated total number of mature individuals in the population is low and either:

(a) a projected or continuing decline is observed, estimated or inferred in either of the key indicators:
  (i) an index of abundance appropriate to the taxon, or
  (ii) the geographic distribution, habitat quality or diversity, or genetic diversity of the population, or

(b) the following conditions apply:
  (i) the population or habitat is observed or inferred to be severely fragmented,
  (ii) all or nearly all mature individuals are observed or inferred to occur within a small number of locations.

Dr Mark Eldridge
Chairperson
Scientific Committee

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