Tweed – Brunswick Coast population of the Koala (*Phascolarctos cinereus*)

Nomination for listing as an Endangered Population for purposes of the *Threatened Species Conservation Act 1995*

April, 2012

1. NOMINATOR DETAILS

This nomination has been prepared by Tweed Shire Council on the recommendation of the Tweed Coast Koala Advisory Group (TCKAG). Membership of the TCKAG is as follows:

Councilor Dot Holdom (Chair)
Mr. John Turbill, Office of Environment & Heritage
Mr. Steve Jensen, Department of Planning & Infrastructure
Ms. Lorraine Vass, Friends of the Koala Inc.
Mr. Ralph Kraemer, community representative
Ms. Jennifer Hayes, Team Koala Inc.
Ms. Anita Mudge, community representative
Ms. Rhonda James, community representative
Ms Sandy Pimm, Tweed Shire Council
Dr. Mark Kingston, Tweed Shire Council

Nominator contact details:
Tweed Coast Koala Advisory Group
C/- Dr. M. Kingston
Biodiversity Program Leader, Natural Resource Management
Tweed Shire Council
PO Box 816 Murwillumbah NSW 2484.Tel: 02 6670 2593 Fax: 02 6670 2557 e-mail: MKingston@tweed.nsw.gov.au

I declare that the information in this nomination and its attachments is true and correct to the best of my knowledge.

SIGNATURE:

DATE:

2. INTRODUCTION

Koalas are obligate folivores that feed primarily on trees of the genus *Eucalyptus*, their distribution in eastern Australia extending from far north-eastern Queensland to the Eyre Peninsula in South Australia (Strahan and Van Dyck 2008). Throughout the species' geographic range, koalas have been reported as utilising a diverse range of *Eucalyptus* species (Hawkes 1978; Lee and Martin 1988; Hindell and Lee 1990; Phillips 1990; White and Kunst 1990; Melzer and Lamb 1996; Lunney *et al.* 1998; Martin and Handasyde 1999; Lunney *et al*. 2000; Ellis *et al.* 2002). Within a given area however, only a few of the available *Eucalyptus* species will be preferentially browsed, while others, including some non-eucalypts, may be incorporated into the diet as supplementary browse or utilised for other purposes (Hindell and Lee 1987; Lee and Martin 1988; Hindell and Lee 1990; Phillips 1990; Lunney *et al.*. 1998; Phillips *et al.* 2000, Phillips and Callaghan 2000; Moore *et al.* 2004; Moore *et al.* 2005; Callaghan *et al.* 2011).

Female koalas reach sexual maturity between eighteen months and two years of age and can theoretically produce one offspring each year. Data indicates however, that on average most females in wild populations breed every second year over the term of their reproductive lives (McLean and Handasyde 2006). The longevity of individuals in the wild also varies but appears to average 8-10 years for most mainland populations; Phillips (2000a) estimated a generation time for the species of 6.02 ± 1.93 (SD) years.

Studies of free-ranging koalas have established that those in a demographically stable breeding aggregation arrange themselves in a matrix of overlapping home range areas (Hindell and Lee 1988; Lee and Martin 1988; Faulks 1990; Mitchell 1990; White 1999; Hopkins and Phillips 2010). Home range areas vary in size depending upon the quality of the habitat (measurable in terms of the abundance of preferentially utilised food trees) and the sex of the animal (males have larger home range areas than females). Long-term fidelity to the home range area is generally maintained by adult koalas in a stable population (Mitchell 1990; Kavanagh *et al.* 2007).

In New South Wales (NSW) the koala is currently listed as a Vulnerable species in Part 1 of Schedule 2 of the *Threatened Species Conservation Act 1995*. Koalas are not currently listed as an endangered species in Part 1 of Schedule 1, or are they a

critically endangered species in Part 1 of Schedule 1A of the Act and therefore populations of this species are eligible to be listed as endangered subject to satisfying requirements of the *Threatened Species Conservation Regulation 2002.*

A comprehensive and systematic assessment of koala distribution and abundance within the coastal portion of the Tweed Local Government Area (TLGA) was undertaken on behalf of Tweed Shire Council by Phillips *et al.* (2011), while a similar assessment for the coastal portion of the adjoining Byron LGA (BLGA) to the south was also completed (Hopkins and Phillips, 2011). Based on the information contained in these two reports, much of which is reiterated herein, it is proposed that the **Tweed-Brunswick Coast population of the Koala (*Phascolarctos cinereus*)** meets the following criteria for listing as an *endangered population* in accordance with Division 3 of the *Threatened Species Conservation Regulation 2010:*

- the population is now considered to be disjunct (Clause 11(a)) and is also of significant conservation value (Clause 11 (c));
- the population is estimated to have undergone a large reduction in population size within the last three koala generations (Clause 12); and
- the estimated total number of mature individuals remaining in the population is low (Clause 14) to very low (Clause 15), and a continuing decline is predicted.

In response to the work of Phillips *et al.* (2011) Tweed Shire Council is in the process of preparing a Comprehensive Koala Plan of Management for the Tweed Coast population of the koala. Prepared in accord with *State Environmental Planning Policy No. 44 (Koala Habitat Protection)*; it is envisaged that provisions of this plan – to the extent it is possible – will assertively deal with those processes currently working to limit long-term viability of the population.

3. DESCRIPTION OF THE POPULATION

3.1 Population boundaries

The Tweed-Brunswick Coast population of the koala occupies coastal lowlands of the Tweed and Byron Local Government Areas (LGAs) in far northeastern New South Wales (NSW). The coastal portion of the Tweed LGA, hereafter referred to as the Tweed Coast Study Area (TCSA), covers an area of approximately 21,200ha, extending southwards from the NSW – Queensland State border to encompass lands

surrounding the Terranora and Cobaki Broadwaters and thereafter extending along the coast generally east of the Pacific Highway for approximately 37km to the Tweed LGA boundary.

Recent work in the adjoining Byron LGA by Hopkins and Phillips (2011) has established that the extent of the decline reported herein extends a further 6.5km south along the coastline to all remaining habitat areas east of the Pacific Highway but otherwise north of the Brunswick River. This latter area in the Byron LGA is approximately 2,020ha in size.

For the purpose of this nomination the southern boundary of the Tweed-Brunswick Coast population of the koala is defined as the Brunswick River between the Pacific Highway and the coastline. Figure 1 indicates the location and boundary of the nominated population.

Figure 1. Boundary of nominated population

3.2 Current distribution

Within the nominated boundaries evidence of koala activity was widespread in the north but recorded most commonly from sites in the central portion of the TCSA with a small number of outliers in the north and west. There was no evidence of a substantive koala population in that area of the Byron LGA that has been included in this nomination.

For purposes of longer term management Phillips *et al.* (2011) considered that the remaining TCSA koala populations could be divided into two sub-populations, the first located to the north of the Tweed River, the second to the south. The prognosis for the northern sub-population was poor with localised extinction predicted within the next 3 – 5 years, the basis and justification for which is explained elsewhere in this nomination.

South of the Tweed River, population modelling based on koala activity data collected during the field survey resulted in identification of three discrete areas containing resident koala populations. These areas collectively approximate 1,030ha of occupied habitat in the central portion of the TCSA in the general localities of Kings Forest, Round Mountain and Pottsville Wetlands, further details of which are as follows:

(i) Bogangar – Kings Forest – Forest Hill

Located to the north and west of Cudgen Lake in the central portion of the TCSA, this population cell extends from the Depot Road area of Kings Forest to Forest Hill in the south, encompassing lands adjacent to Tweed Coast Road and covering a portion of Cudgen Nature Reserve as well as the southern portion of the Kings Forest locality; the cell is approximately 360ha in size, approximately 70% of which is vegetated.

(ii) Tanglewood – Round Mountain – Koala Beach

Located to the west of Cabarita and generally bordered in the north by Clothiers Creek Road and Koala Beach in the south, this population cell occupies a large proportion of Cudgen Nature Reserve, extending into the outskirts of Cabarita, crossing Clothiers Creek Rd in the north and extending into fragmented vegetation to the south of Tanglewood Village. An area of approximately 580ha is recognised as supporting resident koala populations at this time. This cell potentially has connectivity with the Bogangar – Kings Forest – Forest Hill cell to the north, and to the south across Round Mountain Rd where significant activity extends into the north of forested lands surrounding the Koala Beach estate. Collectively, approximately 80% of the above lands are theoretically capable of supporting koala populations.

(iii) Pottsville Wetlands – Black Rocks – Dunloe Park

Located to the south of the preceding cell but separated from it by a distance of approximately 3km, this cell is almost entirely contained within the Pottsville Wetlands Reserve, but is otherwise bordered in the north by Pottsville Road and to the east by the Black Rocks residential estate. The cell extends to the south to occupy some vegetated areas of the Dunloe Park area. The cell encompasses an area of approximately 320ha.

Elsewhere the presence of a small cell in the Duranbah – Eviron Road locality suggests the possible existence of a small, resident population in the area, potentially extending to the western side of the Pacific Highway. Population boundaries are difficult to define in these areas due to the fragmentation of vegetation and sampling scale, suffice to say that carrying capacity east of the Highway in this particular area is low.

Figure 2. Location of resident koala populations

3.3 Extent and quality of remaining habitat

Over the past 150 years, over 44% of the original vegetation cover within the TLGA has been cleared or heavily modified (Kingston *et al.* 2004). Clearing on the coastal lowlands has been extensive and concentrated on areas of low to moderate slope with higher rainfall and fertile soil leaving only fragmented remnants on the steeper slopes (Kingston *et al.* 2004).

A map of remaining areas of koala habitat based on the tree preference models of Phillips (2000b) and associated habitat definitions outlined in Appendix 3 of the Approved Koala Recovery Plan (DECC 2008) was prepared by Phillips *et al.* (2011) and Hopkins and Phillips (2011). Approximately 4,368 ha of fragmented but otherwise suitable koala habitat remains within the nominated area, the details of which are as follows:

(i) Primary Koala Habitat

Areas of Primary Koala Habitat are now limited to no more than 306ha of mapped vegetation and consist of communities dominated by the preferred koala food trees Swamp Mahogany *Eucalyptus robusta* and/or Forest Red Gum *E. tereticornis* ± Tallowwood *E. microcorys* growing on medium or high nutrient soil landscapes.

(ii) Secondary (Class A) Habitat

Secondary (Class A) Habitat comprises the bulk of remaining koala habitat, encompassing 2,676ha of mapped vegetation communities growing on medium to high nutrient soil landscapes wherein Swamp Mahogany and/or Forest Red Gum ± Tallowwood are sub-dominant elements.

(iii) Secondary (Class B) Habitat

Secondary (Class B) Habitat comprises 1,386ha of mapped vegetation communities containing Tallowwood and/or Grey Gum *E. propinqua*, growing on low nutrient soil landscapes.

(iv) Other Habitat

Approximately 2,948ha of mapped vegetation comprising 12.33% of mapped vegetation within the TCSA does not support preferred koala food trees.

(v) Unknown Habitat

A total of 13,046ha was unable to be classified due to a lack of information regarding floristic composition. The greater proportion of this category (12,436ha) comprised areas classified as “Substantially Cleared of Native Vegetation” by Kingston *et al.* (2004) within Tweed LGA. While this mapping category includes urban areas, roads and beach sand, it also encompasses lands with scattered trees which in some areas contain scattered koala food trees.

The distribution and extent of remaining koala habitat areas within the TCSA and adjoining coastal section of the BLGA is illustrated in Figure 3.

Figure 3. Koala habitat map and resident koala populations

4. CLAUSE 11(a) - DISJUNCT POPULATION

Data arising from the work by Phillips *et al.* (2011) indicated that the Tweed Coast population of the koala was disjunct for purposes of conservation and management. Despite the presence of koala populations in the adjoining Gold Coast LGA to the north, there has been no evidence of recruitment into the northern sub-population of the Tweed Coast koala population over at least the last three koala generations. If recruitment has occurred, it has not been sufficient to reverse the current trend of population decline. Range contraction of the Tweed Coast koala populations was first reported by Phillips (2002), and has subsequently been confirmed by ongoing contractions over the following two koala generations in the range parameter *Extent of Occurrence* (Phillips *et al*. 2011).

The western boundary of the Tweed - Brunswick Coast population of the koala is the Pacific Highway. Some koala mortalities have been recorded along the Pacific Highway in the southwest, attesting to the ongoing barrier effect this motorway represents. Significantly though, regular monitoring of underpasses along the Highway between Chinderah and Yelgun has indicated negligible use by koalas; a single instance of three traverses (considered to be the same animal) being recorded in the vicinity of Eviron Road in 2005, and nothing since (Dr. Mark Fitzgerald *pers. comm*.).

5. CLAUSE 11 (c) – SIGNIFICANT CONSERVATION VALUE

The northern boundary of the Tweed-Brunswick Coast population of the koala is the NSW – Qld border. Earlier work by Fowler *et al.* (2000), most recently updated by that of Lee (2009) and Lee *et al.* (2009) has confirmed genetic affinities of the Tweed-Brunswick Coast population of the koala with other populations generally considered to comprise the Southeastern Queensland (SEQ) koala genome. On this basis and in addition to its current measure of isolation, the Tweed-Brunswick Coast population of the koala is considered to be of significant conservation value because a) remaining populations represent a southeastern outlier of the SEQ koala genome and contains unique alleles not known to occur elsewhere, and b) remaining populations represent those at the extreme northeastern limit of the species' geographic range in NSW

6. CLAUSE 12 - LARGE REDUCTION IN POPULATION SIZE

6.1 Contraction of *Extent of Occurrence*

Based on the analysis of historical koala records for the TLGA, Phillips *et al.* (2011) initially determined that the Tweed Coast population of the koala had undergone an estimated contraction in the range parameter *Extent of Occurrence* of at least 18% over the last three koala generations. Field survey data however, indicated a more greatly reduced *Extent of Occurrence* based on evidence of koalas being recorded from only 17 of the 85 primary field sites that were sampled. This latter result translated to a revised *Extent of Occurrence* approximating 12,631ha for the Tweed-Brunswick Coast population of the koala when all sites returning koala activity were enclosed in a Minimum Convex Polygon (incorporating a buffer of 600m to account for sampling uncertainty), the extent of disparity amounting to an estimated contraction of approximately 50% when compared to that area estimated from the historical records for the last three koala generations alone. This estimate of range contraction is even greater when results from the adjoining component of the BLGA are included (no koala activity recorded in 12 primary field sites).

6.2 Reduction in *Area of Occupancy*

Further analysis of the historical koala records for the TLGA initially indicated that there had not been any statistically significant change in the associated key range parameter *Area of Occupancy* over the last three koala generations. This was again contradicted by field survey data which otherwise indicated a significantly reduced

occupancy rate of 20.00 ± 8.50% (95%CI) of available habitat, the extent of which amounted to a 55% reduction when compared to that calculated from the historical records for the last three koala generations alone. This estimate of reduction is even greater when results from the adjoining BLGA are included.

The decline in occupancy rate estimated by field survey data of Phillips *et al.* (2011) was further supported by independent data collected in areas surrounding the Koala Beach residential estate, which had similarly recorded a decline in koala activity of approximately 50% over the preceding 5 year period (Ms. Tanya Fountain, Tweed Shire Council, *pers. comm*.).

6.3 Reasons for decline

In contemplating the discrepancy between outcomes based on historical records analysis and that obtained by field survey, Phillips *et al.* (2011) considered that there must have been a recent escalation of threatening processes that acted directly upon key range parameters within the timeframe of the most recent and/or immediately preceding koala generation.

The greater proportion of bushland areas surrounding Cudgen Lake in the centre of the TCSA were identified as being subject to wildfire at some stage in the 15 year history of fire reporting available to Phillips *et al.* (2011). Additionally, a large proportion of this area, particularly to the north and west, was identified as having been burnt on more than one occasion, with intervening intervals of as short as three years. Two of the most recent fire events, in 2004 and 2009, were high-intensity and extended over much of the forested area to the north, west and south of Cudgen Lake.

It is these latter two events that were considered primarily responsible for the population attrition (Phillips *et al.* 2011), while a similar fire history in the Billinudgel Nature Reserve has been identified as the major contributing factor to the loss of koala populations in the adjoining area of the BLGA to the south. The effect of fire is, to some extent, illustrated by the juxtaposition of mapped fire events and the current extent and location of remaining population cells comprising the Tweed-Brunswick Coast population of the koala. This influence is visible in the total absence of koala population cells in the Billinudgel Nature Reserve, and the configuration of the northern-most koala activity cell in the TCSA, where it is apparent that the majority of the area affected by the 2009 wildfire as well as a large proportion of the 2004

wildfire area is currently unoccupied by koalas, despite the presence of high quality habitat.

7. CLAUSES 14 & 15 – LOW AND/OR VERY LOW NUMBER OF MATURE INDIVIDUALS IN POPULATION

Using a combination of fixed radius and transect searches, Phillips *et al.* (2011) recorded the presence of four koalas from the 17 primary and 14 supplementary field sites that returned significant koala activity levels, resulting in a density estimate of 0.14 ± 0.12 (95% CI) koalas ha^{-1}. This estimate is generally concordant with that derived by earlier studies in the general area, Phillips (2002) reporting densities of 0.14 and 0.17 koalas ha^{-1} at Old Bogangar and Koala Beach respectively, while Phillips and Pereoglou (2004) determined a koala density of 0.18 ± 0.04 koalas ha^{-1} for the Kings Forest area.

The preceding density estimates, adjusted to account for the available habitat in each cell (Sec 3.2 above refers), result in an estimated population size of 144 koalas for currently occupied areas of habitat within the TCSA (Table 2).

Table 2. Koala population estimates (N) with bounds for currently occupied areas of the TCSA based on the density estimate determined by field survey (Source: Phillips *et al*. 2011).

Locality	Cell size (ha)	Available habitat	Population estimate		
			Lower 95% CI	N	Upper 95% CI
Bogangar – Kings Forest – Forest Hill	358	71%	5	36	66
Tanglewood – Round Mountain – Koala Beach	578	80%	9	64	120
Pottsville Wetlands – Black Rocks	316	79%	10	35	65
Duranbah – Eviron	625	10%	1	9	16
Total			**25**	**144**	**267**

It is not possible to accurately estimate the number of mature individuals remaining in the Tweed-Brunswick Coast population of the koala without having sampled and assessed animals comprising the remaining population(s). However, the upper 95% Confidence Interval for the Tweed-Brunswick Coast population of the koala has been estimated at 267 individuals (Table 2). An unknown proportion of this number will

invariably comprise juveniles and sub-adult koalas, implying that the estimated total number of mature individuals in the population will be less than 250. As noted previously, no koala activity was recorded in 12 primary field sites north of the Brunswick River (Hopkins and Phillips, 2011).

7.1 Likelihood of ongoing decline

The likelihood of ongoing decline in the Tweed-Brunswick Coast population of the koala is considered to be high.

Given the widely-dispersed evidence of koala activity and the absence of any signs of recruitment into the relic sub-population located north of the Tweed River, Phillips *et al.* (2011) predicted a likelihood of localised extinction of this sub-population within the next three to five years. This eventuation will see the current estimated *Extent of Occurrence* for the Tweed-Brunswick Coast population of the koala contract further.

Population Viability Analysis carried out by Phillips *et al.* (2007) on a demographically stable population of approximately 510 koalas in the Coomera – Pimpama area of SEQ demonstrated that as little as a 2-3% increase (as a function of total population size) in mortality rate due to incidental factors such as road mortality and dog attack is sufficient to drive ongoing population decline. In this context and given the already reduced population size, it is considered that the current incidental mortality rate of koalas comprising the Tweed-Brunswick Coast population of the koala due to road mortality alone (see below) can no longer be sustained. It is thus considered that the Tweed-Brunswick Coast population of the koala will continue to decline until the incidental mortality rate can be curtailed, or the population recovered to more sustainable levels.

8. THREATENING PROCESSES

8.1 Short term

(i) Fire

Phillips *et al.* (2011) considered stochastic and poorly-planned and/or managed fire events to represent the single biggest threat to the recovery of the Tweed-Brunswick Coast population of the koala. Wildfire has the potential to exacerbate koala population decline (Starr 1990; Melzer *et al*. 2000; Lunney *et al*. 2007) as each high-intensity or high-frequency fire within areas occupied by resident populations

removes a proportion of the breeding population at a rate faster than the time required for the loss to be replaced by successive koala generations.

(ii) Road strike, dog attack and disease

Phillips (2002) reported vehicle-strike as responsible for 34% of known koala mortalities within the TCSA. While this statistic has decreased to 19% in the intervening decade, Phillips *et al.* (2011) considered this more likely attributable to overall population decline than a lessening of the threat itself.

Clothiers Creek Road is a known koala blackspot in the TCSA, Phillips (2002) reporting that it accounted for 47% of known roadkills between 1991 and 2000. The eastern section of the road passes through portions of the mapped Tanglewood – Round Mountain – Koala Beach population cell referred to previously, and also the major vegetated link between this cell and that of the Bogangar – Kings Forest – Forest Hill cell to the north. Koala road-strike is also recorded from Round Mountain and Pottsville Roads, both of which pass through areas of koala habitat and coincide with breaks in the mapped distribution of the koala population (Fig 2, Sec 3.2 refers).

The record of reported incidence of koala mortality due to dog attack in the TCSA is incomplete, with available records indicating only three mortalities over the last 20 years; the actual number is almost certainly higher. Data from elsewhere however can effectively illustrate the magnitude of this threat, attacks by domestic dogs constituting approximately 15% of all admissions to the Port Macquarie Koala Hospital (Ms. Cheyne Flanagan, pers comm.). Data from Southeastern Queensland indicates around 110 mortalities per year, the threat being ranked as the third most important in this region (DERM 2009) and the fourth in NSW (DECC 2008).

Since 1 July 2007 when Friends of the Koala Inc. commenced licensed activities in Tweed Shire it has dealt with 40 mortalities from the study area. Of these, 20 animals have succumbed to disease (50%), 9 animals have been road strike victims (23%), 3 dog attacks (7%) and 8 animals have died of other or unknown causes (20%; Friends of the Koala President, Lorraine Vass, pers comm.). Although disease is considered to be a secondary threat to koala recovery, its relatively high incidence in the remaining Tweed-Brunswick koala population is cause for concern.

8.2 Medium to long term

(i) Habitat loss to urban development

Vegetation mapping projects in the Tweed LGA indicate that approximately 965ha of bushland was removed between 2000/2001 and 2007 (BRS 2008). A disproportionate amount of this loss has occurred within the TCSA wherein approximately 100ha of koala habitat has been lost over that 6 to 7 year period. The extent of clearing and development within coastal vegetation communities within the TCSA has reduced the occurrence of Primary Koala Habitat to a number (n = 84) of small patches totaling only 200ha, the bulk of which is now mostly embedded in or adjoining the expanding urban landscape.

Within the TCSA there are a number of development proposals in varying stages of progress, each of which have the potential to further contribute to loss and further fragmentation of habitat for the Tweed-Brunswick Coast population of the koala. Such proposals have the potential to further impede dispersal and recruitment processes between remaining population cells, elevate the threats of domestic dog attack, stress-related disease and motor vehicle strike.

Submitted for consideration.

END OF NOMINATION

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Note: Unpublished reports (indicated by asterisk) are provided separately on CD.

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Figure 1. Boundary of nominated population (red line)

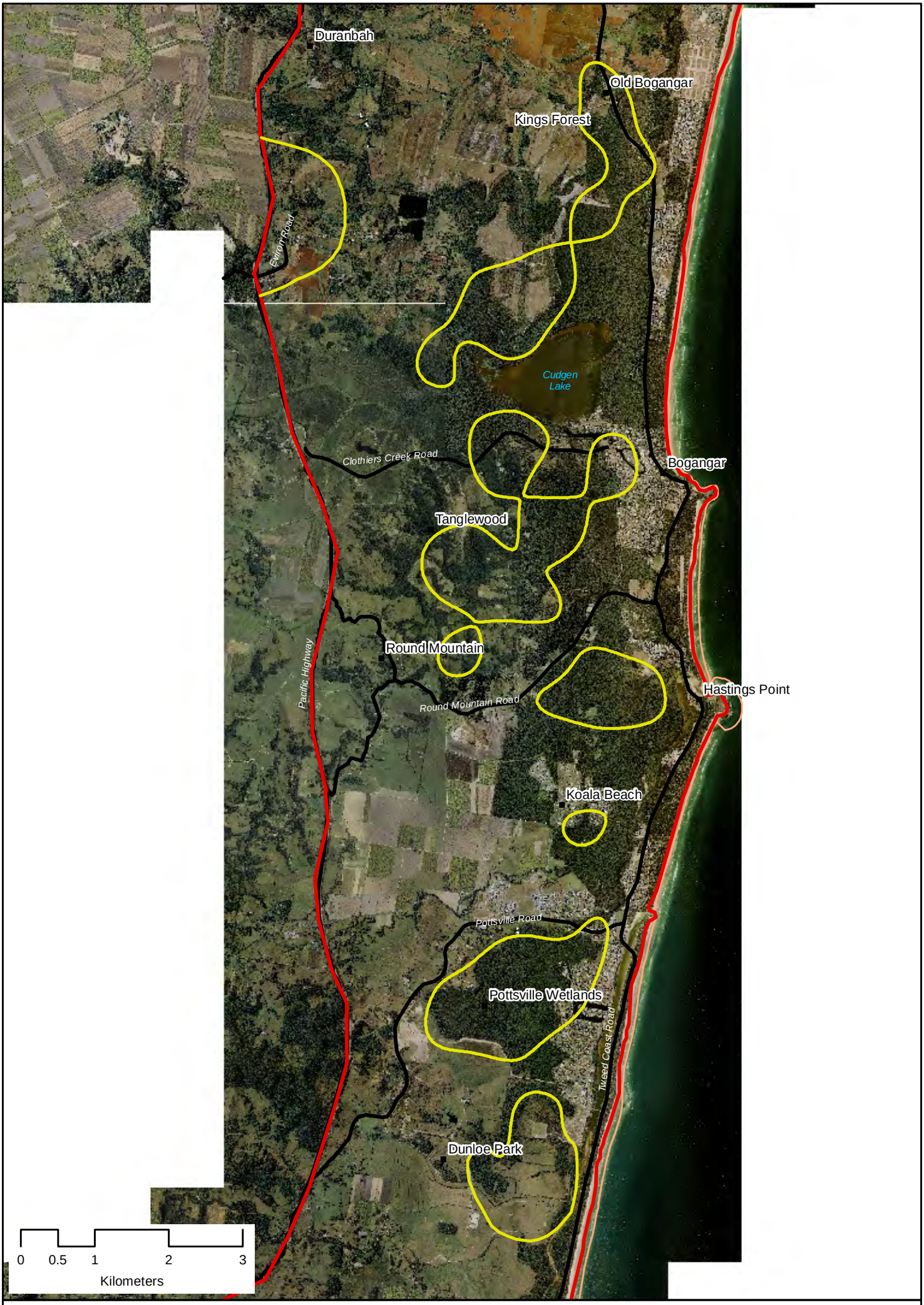

Figure 2. Location of resident koala populations (yellow lines)

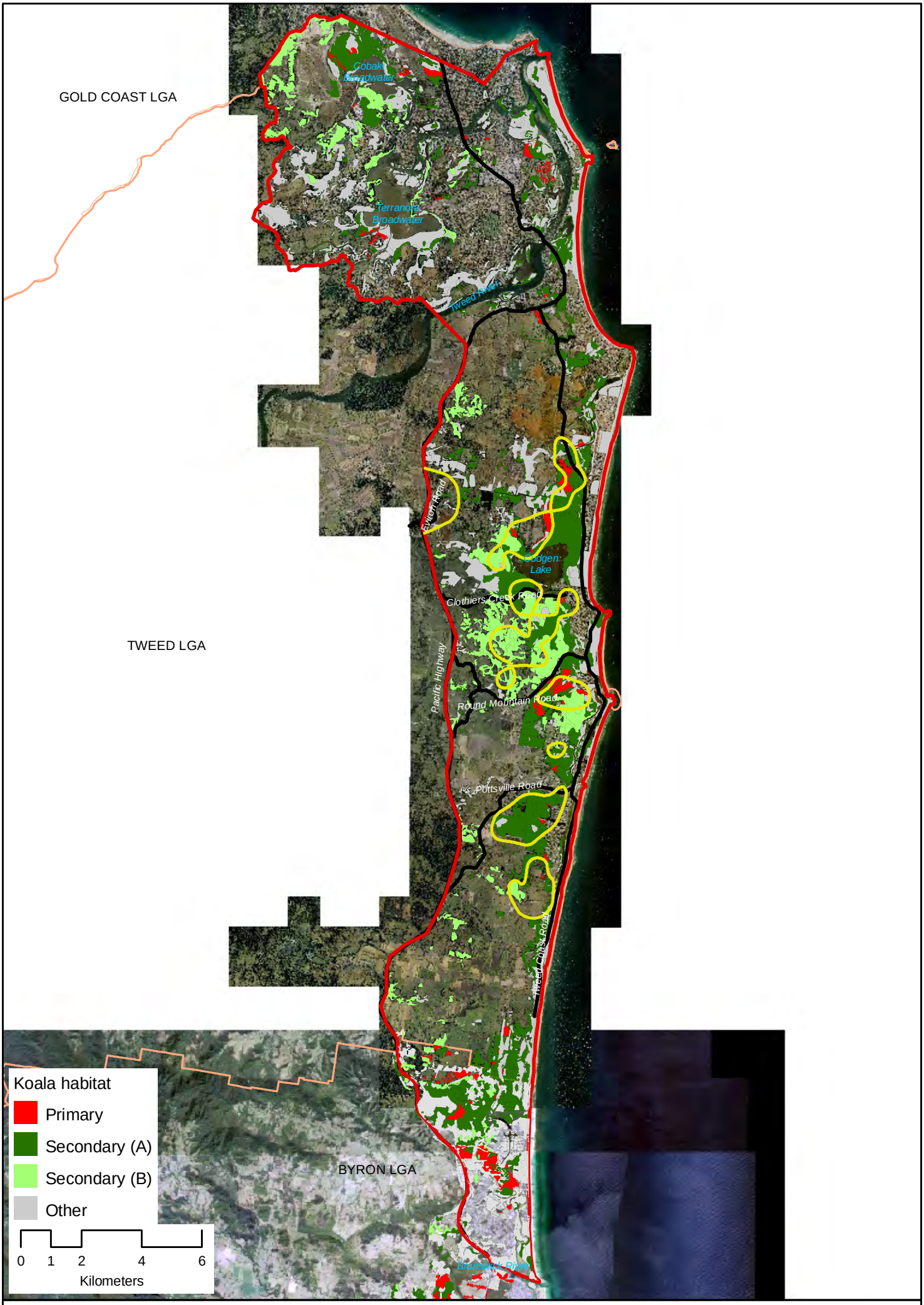

Figure 3. Koala habitat map and resident koala populations