Tree species preferences of the Koala *Phascolarctos cinereus* as a basis for the delineation of management areas for recovery planning in New South Wales.

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Executive Summary

Koalas are obligate folivores which feed primarily on the genus *Eucalyptus*. Throughout their range in New South Wales, koalas have been recorded as using a wide variety of *Eucalyptus* spp. However, there is confusion at all levels of interest (lay people, koala carers and researchers) as to which tree species are most important to koalas in a given area. This inability to clearly distinguish preferred food tree species, coupled with the lack of quantitative criteria by which such trees may categorised and grouped, has arguably hindered the further advancement of meaningful conservation measures for free-ranging koala populations.

Using genetic data, recent studies have concluded that the koala populations of eastern Australia represent a single Evolutionarily Significant Unit comprised of smaller Management Units. Because of their focus on contemporary population structure, allele frequencies and short-term management issues, the need to identify such management units becomes a necessary precursor to effective recovery planning. Indeed, without the effective conservation and management of these units in the first instance, the broader goal of effectively conserving koala biodiversity throughout the remaining range of the species in New South Wales cannot be realised.

Based on a review of published literature relevant to tree species use by koalas in New South Wales, and given a familiarity with data sets maintained by organisations such as the Australian Koala Foundation, the South East Forests Conservation Council and others, this report attempts to remove some of the uncertainty and to identify the tree

species most preferred by koalas throughout their remaining geographic range in New South Wales. In order for this to be accomplished however, it has been necessary to re-evaluate tree use by koalas in terms of recently established criteria and to renounce several assumptions which underpin the current understanding of tree use by koalas. Based on a revised understanding of food tree preferences of koalas throughout many parts of their remaining range in New South Wales, and assisted by data contained in the National Eucalyptus Data Project, preferences are regionalised by natural aggregation in order to delineate a minimum of seven management areas for koalas in NSW. The management areas are based on an assumption of functional independence (in terms of tree species preferences) between populations in each of the nominated areas. The notion of functional independence is also supported to some extent by a similarity matrix which reveals a mean overlap of approximately 15% between each of the nominated areas. However, the extent to which the recommended boundaries capture the significant haplotype differentiation reported by recent genetic studies remains to be determined. The process of regionalisation has also highlighted significant gaps in the knowledge of tree species preferences in some areas, notably the Northern and Southern Tablelands of NSW, where field work is required to validate and/or refine the models that have been proposed.

The use of ecological criteria to define management area boundaries, while soundly based, results in the creation of divisions across existing administrative boundaries, most notably those of Local Government. This result creates problems for koala management, moreso given the precedent established by *State Environmental Planning Policy No. 44*

(Koala Habitat Protection) which is primarily based on LGA boundaries. Thus boundaries based on ecological criteria alone would require some local government administrations and regional recovery teams to be working with two habitat models. The boundaries of the Koala Management Areas proposed for adoption by this report have consequently been subjected to minor realignments in some instances in order to conform with existing LGA boundaries.

The consultancy

This report was undertaken as a consultancy for the NSW National Parks and Wildlife Service. Relevant aspects of the study brief are detailed below:

Background

The NSW Koala Recovery Plan was initiated in April 1998 and a Koala Recovery Team was established in September 1998. One of the main challenges facing the Recovery Team is how to manage a species with a distribution that extends throughout eastern and central NSW, and which has varying habitat requirements, threats and status throughout its range. The recent meetings of the three working groups of the Koala Recovery Team (the Threats, Population and Habitat Management Groups) identified the need to divide the current extent of koala distribution in NSW into a number of meaningful management areas.

Effective long-term conservation management of free-ranging wildlife populations benefits from a detailed understanding of species habitat requirements. There is a considerable amount of knowledge about the tree species preferences of koalas. Although they have been observed in a large number of eucalypt and non-eucalypt species, in any one area koalas will feed almost exclusively on a small number of preferred species. Because koalas rely on a different suite of tree species in different regions, it is proposed that Koala Management Areas be defined according to the distribution of habitat trees.

Tasks

1. Literature Review

Review literature on tree species preferences of koalas in NSW, with reference to studies in other Australian States as appropriate. Useful data sets on tree species use by koalas have been compiled by the Australian Koala Foundation, the South-east Forests Conservation Council, the NPWS and others. Collectively, and when properly interpreted, this data has the potential to identify broad trends in tree species preferences. In addition to ongoing Koala Habitat Atlas work by the AKF, recent work by Lunney *et al.* (1998) and Phillips *et al.* (2000) further demonstrates how such data can be effectively used to create broad-scale koala habitat maps. This and other information/data of relevance will enable tentative regional lists of food tree species to be compiled.

2. Tree Species Distribution

Analyse the geographical distribution of the tree species identified in Task 1 and group into natural aggregations or suites based on data from the National Eucalyptus Project Database (NEPD). The Eastern Bushlands Database and M305 and CRA mapping held by the NPWS may also provide a useful resource.

3. Identification of Regions based on Habitat

Identify key food tree species upon which Koala Management Area (KMA) boundaries can potentially be based using the NEPD and list other food tree species contained within each area

4. Identification of Options for Management Areas

Analyse the juxtaposition of the above KMA boundaries established in Task 3 with Local Government Areas and/or other administrative models (*eg.* NPWS, NVC Act Regional Vegetation Committees), and broad-scale vegetation mapping where appropriate (such as the Eastern Bushlands Database, M305, NPWS CRA mapping). Options for Koala Management Areas will be developed and a preferred model will be identified.

5. Consultation

Throughout the process the consultant will consult with appropriate members of the Koala Recovery Team, as specified by the Project Manager, about the tasks and outcomes of the project.

6. Reporting

A Draft Report and a Final Report will be prepared. An electronic and hard copy version of the Draft and Final Report in Microsoft Word 6.0 (or compatible format) is to be provided. The report will include:

- Details of the methods and resources used to identify important koala food tree species in NSW.

- Regional lists of key koala food trees and an outline of methods used to identify the differences in regional distribution of these species

- Maps of proposed Koala Management Areas and discussion of the rationale used to identify potential Koala Management Area boundaries

- Some consideration of the potential shortcomings in the use of tree species to define management boundaries arising from the above work

- Details of all of the published literature and unpublished reports and information reviewed

Outcomes

The successful completion of this project will result in the definition of a number of Koala Management Areas in NSW. This will facilitate the creation of regional management teams and will enable a regional approach to koala management. In the future, issues of relevance for each Koala Management Area will be highlighted so that the most appropriate management measures can be implemented where they will be most effective.

This approach will also allow regional lists of tree species to be prepared for the purposes of Schedule 2 of SEPP 44. It will also enable the identification of key koala food tree species in each of the Regional Vegetation Management Planning regions, which will provide Regional Vegetation Committees with a greater capacity to protect koala habitat. Consequently, the approach provides an important step forward in addressing the

complex issue of koala recovery and the future management of free-ranging koala populations throughout NSW.

Introduction

The widespread distribution of the koala in New South Wales (NSW) presents a number of problems for recovery planning, one of which is how best to manage/conserve a species which has increasingly disjunct populations occuring across a variety of habitat types from coastal wetlands and the forests of the Great Dividing Range, to open woodlands and riparian communities of the western slopes and plains.

A fundamental requirement of effective *in situ* wildlife conservation is an adequate working knowledge of the species concerned. From the koala's perspective, there are a number of elements to be considered. The first requires an understanding of what behavioural and/or social mechanisms (eg the structure and function of male dominance hierarchies, juvenile dispersal and site fidelity) underpin the population dynamics of breeding aggregations, including the need to recognise necessary habitat components such as home range and/or shelter trees. Of fundamental importance however, is the presence of an adequate food resource. This requires knowledge of which tree species are important for long-term survival of a given population and those which are not. Indeed, an understanding of this basic aspect of the koala's ecology is fundamental to effective conservation and management of remaining populations. The need for a better understanding of habitat use becomes more pronounced given the time lag associated with contemporary koala population declines (Phillips in press), the consequences of which dictate that both short and long-term management strategies are required for koala recovery; short-term to identify those areas currently supporting viable, socially stable populations with a view to securing both the population and its habitat to the maximum

extent possible; long-term to ensure that suitable areas of appropriate habitat are available for future recolonisation and population expansion. Each of these elements are necessary in terms of meeting the requirements of effective *in situ* conservation as defined by the United Nations Convention on Biological Diversity

The concept of defining 'units' for conservation management is relatively new. Historically, the primary unit of conservation has been the species (Rojas 1992; Caughley and Gunn 1996). A more refined, genetically based synonym - the 'Evolutionarily Significant Unit' (ESU) - has been increasingly favoured by conservation biologists, the term being generally defined as a set of populations with a distinct, long term evolutionary history. In order to associate greater rigour with the identification of ESUs, Moritz (1994a) proposed that they should be both reciprocally monophyletic for mtDNA alleles and show significant divergence of allele frequencies at nuclear locii. While this approach injects a greater element of certainty in terms of identifying units for conservation at the macro-scale (see Eldridge *et al.* 1997; Firestone 1999), the need to include information on ecological attributes in the analysis (of ESUs) has also been recognised, because local adaptations to specific habitats may be manifest even if no fixed genetic differences are detectable (Vogler and Desalle 1994).

As a subset of the ESU, the term 'Management Unit' (MU) has been coined to categorise populations with significant divergence of allele frequencies at nuclear or mitochondrial loci, regardless of the phylogenetic distinctiveness of the alleles (Moritz 1994a). In more

general terms, the MU refers to a set of populations that exchange substantial (?) numbers of individuals but which are functionally separate from other such sets (Moritz 1994b).

The distinction between ESUs and MUs in modern day conservation biology parlance is important – ESUs are primarily concerned with historical population structure, mtDNA phylogeny and long-term conservation needs; whereas MUs address current population structure, allele frequencies and short term management issues (Moritz 1994b). It is the latter unit that serves the immediate purpose of koala recovery, for without the effective conservation and management of MUs in the first instance, the broader goal of effectively conserving koala biodiversity throughout New South Wales cannot be realised. Thus, for the purposes of this report, the concept of Koala Management Areas as detailed in the consultancy brief is regarded as synonomous with the notion of MUs for recovery planning.

Genetic data supports a conclusion that the koala populations of eastern Australia are a single ESU comprised of multiple MUs (Houlden *et al*. 1999). The problem that immediately mainfests itself is how best might MUs be defined for the koala within the context of recovery planning in NSW. Houlden *et al.* (1999) concluded that the appropriate short term management unit for koalas is the "local population". Logistically, this is the correct approach simply because of its ability to focus community effort. However, in the absence of defined boundaries by which 'local' populations can be identified, it is unlikely that such an approach conforms to that required for recognition as a MU on genetic grounds, more so given the need for such units to be further defined by

some measure of functional and/or demographic independence. The purpose of this report is to investigate the application of knowledge regarding food tree use by koalas to facilitate the subdivision of NSW into a number of discrete management areas which are internally defined by use of a common food resource. The approach assumes that regional differences in tree species preferences across the species range in NSW will – for the most part – equate to a measure of functional independence. However, the extent to which this approach may assist in meeting current criteria for the designation of Management Units *sensu stricta* remains to be determined and will ultimately require directed inquiry.

Tree species preferences of koalas in NSW

Koalas are obligate folivores which feed primarily on the Genus *Eucalyptus*. In NSW, koalas have been reported as using a variety of eucalypt and non-eucalypt species (Hawkes 1978; Robbins and Russell 1978; Wicks 1978; Gall 1980; Koala Preservation Society 1987; Hindell and Lee 1990; Phillips 1990; Reed *et al.* 1990; Smith 1992; Lunney *et al.* 1996; Jurskis and Potter 1997; Lunney *et al.* 1997; 1998; Phillips *et al.* 2000; Phillips and Callaghan in press). From these studies information on the perceived importance to koalas of a total of 66 *Eucalyptus* spp. and 7 species of non-eucalypt can be ascertained (Table 1). However, two significant issues arise during the process of compiling this data. Firstly, and with the arguable exception of species such as *E. punctata*, *E. tereticornis*, *E. camaldulensis* and *E. viminalis*, there is little agreement on the importance of the majority of tree species used by koalas. Secondly, the terms which have been used to describe the importance of a given tree species lack any definition, *ie*

the difference (if any) between "commonly" used tree species, "staple" tree species and "preferred" tree species has not been specified. Similarly, "occasional" and "low to moderate" palatability ratings remain to be defined. Given the need for greater certainty regarding tree species use by koalas generally, the absence of clearly defined criteria by which food trees can be identified and categorised clearly contributes to confusion about feeding preferences.

The notion that tree occupancy could be used as an indication of feeding preference was first promoted by Eberhard (1978). Concurrently, Robbins and Russell (1978) reported on the movements and feeding patterns of four koalas in a semi-natural environment in the Muogamarra Nature Reserve near Sydney. In common with the conclusions of Eberhard (1978), Robbins and Russell (1978) also considered that occupancy of trees by koalas was likely to be a reasonable index of feeding preferences, a statement qualified within the body of their paper as follows: *"Thus one daily record of position, or even two records at sunset and sunrise, will not necessarily give a good indication of tree usage, or of feeding...*" and that "*More frequent sampling during the day would provide a better index; if more accurate information is required, it would be necessary to sample during the night.*"

In a subsequent study, Hindell *et al.* (1985) also concluded that daytime occupancy of trees reliably predicted the food tree preferences of free-ranging koalas. Based on the results of their work, Hindell and his co-workers then used proportional use (relative exploitation) data in conjunction with abundance indices to develop a formula for

KOALA FOOD TREES IN NEW SOUTH WALES

Species	Status as food resource
A. Eucalypts	
E. acmenoides	occasional [2]; staple [10]
E. agglomerata	preferred [13]
E. albens	occasional [2]; preferred [11]
E. amplifolia	occasional [3]; preferred [5]; staple [10]
E. andrewsii	preferred [5]
E. bancroftii	occasional [2]
E. banksii	preferred [5]
E. bicostata	occasional [2]
E. blakelyi	primary species [2]; occasional [3]; preferred [5]; important [11]
E. botryoides	occasional [3, 7]; staple [10]
E. bridgesiana	preferred [5]
E. caliginosa	preferred [5]
E. camaldulensis	good browse [1], primary species [2]; commonly used [3]; important [9]; staple [10]
E. camphora	occasional [2, 3]
E. cinerea	occasional [3]; staple [10]
E. conica	preferred [5]
E. consideniana	preferred [4]
E. crebra	primary species [2], occasional [3 11]
E. cypellocarpa	occasional [2]; preferred [4,5]
E. dalrympleana	occasional [2, 3]; preferred [5]
E. dealbata	occasional [2]; important [11]
E. delegatensis	occasional [2]
E. dives	occasional [2]
E. elata	staple [10]
E. eugeniodes	occasional [2]
E. globoidea	low palatability [1]; occasional [2]
E. globulus	moderately palatable [1], primary species [2]; commonly used [3]; staple [10]
E. goniocalyx	primary species [2]; commonly used [3]
E. grandis	occasional [2, 3]; staple [10]
E. haemastoma	not suitable for sustained feeding alone [1]; occasional [3]; preferred [7]; staple [10]
E. largiflorens	occasional [3]
E. longifolia	preferred [4]
E. macrorhyncha	primary species [2]; occasional [3]
E. maidenii	preferred [4]
E. melliodora	occasional [2, 3]; staple [10]
E. michaeliana	preferred [5]
E. microcarpa	occasional [2 11]
E. microcorys	moderately palatable [1]; primary species [2]; occasional [3]; important [9]; staple [10]
E. moluccana	occasional [2]; preferred [5]
E. nichollii	occasional [3]; staple [10]
E. nova-anglica	preferred [5]
E. obliqua	moderate palatability [1]; occasional [2, 3]; staple [10]
E. ovata	primary species [2]; commonly used [3]; staple [10]

E. pauciflora	occasional [2]; preferred [5]
E. paniculata	occasional [2, 7]
E. parramattensis	reported as browse [1]; primary food tree [8]
E. pilularis	primary species [2]; occasional [3]; staple [10]
E. piperita	occasional [2]; preferred [6]
E. polyanthemos	occasional [2]
E. populnea	primary species [2]; occasional [3]; preferred [11]
E. propinqua	primary species [2]; occasional [3]; staple [10]
E. punctata	staple browse [1, 10]; primary species [2]; commonly used [3]; preferred [6, 7, 13]; important [9]
E. racemosa	not suitable for sustained feeding alone [1]; preferred [6]; occasional [7]
E. radiata	moderate palatability [1]; occasional [2]
E. regnans	occasional [2]
E. resinifera	reported as browse [1]; staple [10]
E. robusta	primary species [2, 8]; occasional [3]; preferred [7]; staple [10]
E. rubida	primary species [2]; occasional [3]
E. saligna	good palatability [1]; primary species [2]; staple [10]
E. seeana	occasional [2]
E. scoparia	staple [10]
E. sideroxylon	occasional [2]; staple [10]
E. signata	occasional [2]
E. tereticornis	staple browse [1, 10]; primary species [2]; commonly used [3]; important [9] principal[12]
E. viminalis	staple browse [1, 10]; primary species [2]; commonly used [3]; preferred [5]; important [9]
E. youmanii	occasional[2]
B. Non – eucalypts	
Callitris glauca	preferred 'habitat tree' [11]
Callistemon saligna	important[10]
C. citrinus	favoured[11]
Corymbia citriodora	occasional [2,3]; staple [10]
C. intermedia	occasional [2]
C. maculata	occasional [2,3]; staple [10]
Melaleuca quinquenervia	important[10]

Table 1: Koala food trees in NSW (1 = Hawkes 1978; 2 = Pahl *et al.* 1990; 3 = Lee and Martin 1988; 4 = Jurskis *et al.* 1997; 5 = Pahl and Hume 1990; 6 = Robbins and Russell 1978; 7 = Smith and Smith 1990; 8 = Phillips *et al.* 2000; 9 = Reed *et al.* 1990; 10 = Koala Preservation Society 1987; 11 = Smith 1992; 12 = Gall 1980; 13 = Phillips and Callaghan (in press).

determining tree species preferences, the validity of which required four assumptions to be met as follows:

a) that each tree species was homogeneously distributed,

b) that trees occupied by koalas during the day were food trees,

c) that all trees were equally available to the animal, and

d) that each sighting was an independent event.

Based on the data they had collected, Hindell *et al.* (1985) further concluded that differences in individual feeding preferences amongst koalas was likely, as was seasonal variation, the latter qualified by an acknowledged lack of data to support a confident description of the trends. Nonetheless, support for seasonal variation in the use of food trees was unequivocally stated in a subsequent review (Hindell and Lee 1990). In recognising that koalas possibly entered trees for purposes other than feeding, Hindell and Lee (1990) also argued that the frequency of events not for feeding purposes was unlikely to invalidate the assumption that tree occupancy was a reliable indicator of feeding preferences.

As evidenced by the work of Reed *at al.* (1990), Jurskis *et al.* (1997) and others, the approach described in the preceding paragraphs has remained the primary basis for interpreting tree usage by free-ranging koalas. However, recent work by Phillips (1999) has questioned the assumptions and results obtained from the Hindell approach, especially notions of seasonal variation in the use of key food tree species and that occupancy of a

given tree species equates to its importance as a food tree. Based on a two year radio-tracking study, Phillips' work demonstrated that in heterogeneous forest communities such as those typical of much of eastern Australia, less than 30% of observations related to the occupation of preferentially utilised food tree species (the latter determined on the basis of a replicated goodness-of-fit test comparing proportional utilisation to relative abundance). Such a low index of reliability suggests that a measure of caution is required in accepting the results of studies which have otherwise been reliant on such an assumption. Other recent work (Lunney *et al.* 1998; Phillips *et al.* 2000) has further demonstrated significantly higher levels of use of other (non-food) tree species when they occur in close proximity to a preferred food tree species. This proximity variable further complicates the issue of understanding tree species preferences.

Given the above, there is obviously a need to re-evaluate the issue of tree species use by koalas. While there is no argument that koalas will browse on a variety of tree species, there is a need to distinguish between those tree species that are of fundamental importance to the long-term survival of free-ranging koala populations, and those that are of lesser importance. In order to progress debate beyond the *status quo*, and in the absence of an alternative standard by which koala trees can be categorised, the concept of primary and secondary food trees as proposed by Phillips *et. al* (2000) and Phillips and Callaghan (in press) has been adopted for the purposes of this report. While such an approach may be perceived as nepotistic, at this stage it represents the only quantitative approach to categorisation of tree species use by koalas. More importantly, the approach is supported by a robust database for NSW, the bulk of which is maintained by the

Australian Koala Foundation (currently 29,038 trees from 571 independent sites). Additional data is held by the South-East Forests Conservation Council (3,543 trees from 133 sites). It is a familiarity with these data sets which has allowed much of what follows to be developed.

Figure 1 illustrates the fundamental differences between primary food trees, secondary and/or supplementary* food trees, and other tree species used by koalas as determined by field-based survey. Primary food trees exhibit a level of use that is significantly higher than that of other *Eucalyptus* spp. while also demonstrating a mode of utilisation by koalas that is independent of density as demonstrated by the simplified logit models of Phillips *et al*. (2000). Secondary and/or Supplementary* food trees on the other hand, invariably exhibit (on average) a significantly lower level of use than a primary food tree while also demonstrating evidence of more complex variables associated with their use, generally by being both density and/or size class dependent (see Phillips and Callaghan, in press). While the issue of density dependence is a mathematical artefact of the sampling process, it has allowed confirmation of size class as an important variable in the use of secondary and supplementary food tree species by koalas. Clearly, the relationship between koalas and their food trees is more complex than commonly thought.

* (Note: Supplementary food trees arguably represent a third tier in the koala food resource. In common with secondary food tree species they exhibit a level of utilisation that is also size class/density dependent. However, the levels of utilisation of supplementary food tree species are generally lower that that of a secondary food tree species, and possibly dependent upon the presence of the latter in the first instance.

Interestingly, supplementary food tree species invariably tend to be Stringybarks but with significant variation in the use of some species across their range. For example, blue-leaved stringybark *E. agglomerata* is a preferentially utilised species in the Campbelltown area (Ellis *et al.* 1997; Phillips and Callaghan; in press) yet does not appear to be as important for koalas in the south-east forests where its role is apparently usurped by two other stringybarks *E. globoidea* and *E. muelleriana* (SEFC unpub data). The reasons for this are not known at this stage but may reflect the influence of soil type and/or local feeding preferences.)

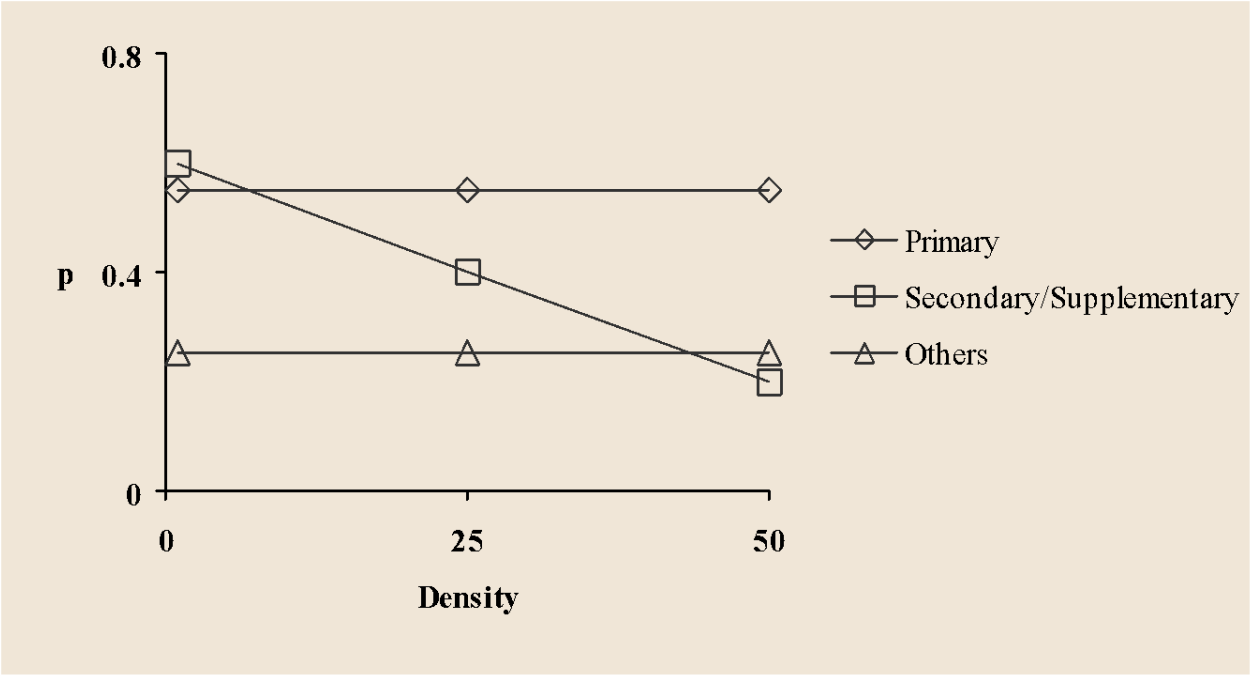

Fig. 1. Diagrammatic model illustrating the fundamental differences between primary food trees, secondary and/or supplementary food trees, and those being the subject of more opportunistic utilisation by free-ranging koalas. Model is loosely based on data values from the north coast of NSW but should be viewed in the context of a sliding scale of y axis values depending on the area and type of habitat being assessed. The Y axis refers to a probability-based estimator (eg the "strike-rate" of Phillips *et al.* 2000) which measures the level of use.

Use of non-eucalypts

Despite the fact that non-eucalypts generally fail to feature significantly in ecologically based studies tree species preferences of koalas (Hindell and Lee 1985, 1990; White and Kunst 1990; Hasegawa 1995; Pahl 1996; Pieters and Woodhall 1996; Melzer and Lamb 1996; Sharp and Phillips 1997; Lunney *et al.* 1998; Phillips *et al*. 2000), their use remains a contentious issue amongst many with an interest in koala conservation. For example, Broad-leaved paperbark *Melaleuca quinquenervia* and *Callistemon* spp. have been promoted as important food trees in some areas (KPS 1987; Smith 1992). Smith (1992) further reported significant use of White Cypress Pine *Callitris glauca* by koalas in the Gunnedah area, a phenomena confirmed by more recent work in the area by the Australian Koala Foundation, which also identified the related Black Cypress Pine *C. endleicheri* and Rough-barked Apple *Angophora floribunda* as receiving significant levels of utilisation (AKF unpub data). Preferential utilisation of Brush Box *Lophostemon confertus* by koalas in an area of the Tweed Shire has also been reported (Phillips 1999).

If it is accepted that the home range areas utilised by koalas in a socially stable population are primarily a reflection of habitat quality (measureable in terms of the relative abundance of preferred food tree species), then it is reasonable to assume that other (non food) tree species within the home range area will be utilised in the course of normal ranging patterns. In addition to providing incidental browse, such trees also provide secure roosting areas or cater to other behavioural needs and thus become

important habitat components. For example, Phillips (1999) was able to demonstrate that significant use of *L. confertus* by koalas over two consecutive years was likely related to its importance as a thermal refuge during the summer months rather than its importance as a food resource. Other workers have noted that even where individual koalas have been observed persistently feeding on species of non-eucalypt, foliage from preferred *Eucalyptus* spp. consistently made up the bulk of the diet (Lithgow 1985; Ough *et al*. 1988; Hindell and Lee 1990; Hasegawa 1995). Thus, whilst it is acknowledged that non-eucalypts will be utilised for a variety of purposes (including food and shelter) by free-ranging koalas, their importance is ancillary to that of the major food tree species which are invariably members of the genus *Eucalyptus*; it is this genus that must become the primary focus for conservation and recovery planning in the first instance.

Tree species preferences – developing a regional perspective

The distribution of koala food trees is not homogeneous throughout the species range in NSW. By way of example, koalas on the north coast of New South Wales are commonly reliant on tree species such as *E. robusta*, *E. tereticornis*, *E. propinqua* and *E. microcorys*. However, none of these tree species occur on the western slopes and plains where species such as *E. dealbata*, *E. blakelyi*, *E. camaldulensis* and *E. populnea* feature prominently in the diet (Smith 1992; Phillips 1999). Conversely, koalas on the south coast of NSW are reliant upon *E. cypellocarpa*, *E. longifolia*, *E. bosistoana* and the stringybarks *E. globoidea* and *E. muelleriana* (SEFC unpublished data). While the extent to which tree species favoured by koalas in one area might prove palatable to koalas in another area is largely unknown, there is some evidence to suggest a measure of

exclusivity. The rejection of *E. microcorys* browse by Victorian koalas is a noteable outcome from the work of Pahl and Hume (1990), as is the apparent failure of free-ranging koalas in the Strezlecki Ranges (VIC) to recognise plantings of *E. tereticornis* and *E. robusta* as a potential food resource (S. Phillips, personal observation). Though modest, such observations imply a measure of support for a notion of independence in the preferential utilisation of at least some food tree species by koalas.

Despite differences in the tree species being preferentially utilised across the range of the koala in NSW, there are also a number of common trends. In western NSW the identification of the "boxes" *E. populnea*, *E. pilligaensis*, *E. melliodora* and *E. conica* as secondary food tree species (Phillips 1999; AKF unpub data) is consistent with results from south-eastern NSW where *E. bosistoana* has been similarly categorised (SEFCC unpub data), as has *E. moluccana* on the north coast of NSW (Lunney *et al.* 1998; AKF unpub data). As alluded to earlier, significant use of "stringybarks" also arises out of the south-east forest data set (SEFCC unpub data), in habitat use by koalas in Campbelltown (Ellis *et al.* 1997, Phillips and Callaghan in press) and on the New England Tablelands (AKF unpub data). Conversely, "ironbarks" collectively fail to figure prominently as a significant food resource in any area using standards adopted for the purposes of this report (see below), nor do the "bloodwoods", various species of "white mahogany", "scribbly gums" and "peppermints" such as *E. pilularis* (Lunney *et al.* 1998; Phillips 1999; Phillips *et al.* 2000; Phillips and Callaghan in press; AKF unpub. data; SEFCC unpub. data).

By accepting such trends as broadly indicative of koala feeding preferences generally, it becomes possible to theorise potential management boundaries based on an understanding of common food resources. This can be achieved in the first instance by examining the distribution of primary and secondary food tree species throughout their range in NSW. The National Eucalyptus Data Project (NEDP) represents the results of a collaborative effort by Australian Herbaria, state-based Conservation agencies and the Environmental Resources Information Network. The NEDP currently holds data on over 163,000 records of locality data of *Eucalyptus*, *Angophora* and *Corymbia* spp. in Australia. Finer resolution on a State by State basis is provided at a scale of 1:100000, along with site details for each record. Models relating to the potential distribution of a given species have also been developed using both a single-rule climatic envelope approach and GARP (Genetic Algorithm for Rule-set Production) modeling. Data associated with the NEDP can be accessed for the purposes of *bona fide* research via the World Wide Web.

In the first instance, each of the *Eucalyptus* spp. listed in Table 1 was categorised as either a primary or secondary food tree on the basis of conformity with the model proposed by Fig. 1. In some instances, the absence of supportive field-based data sets prohibited allocation to a given category with certainty. To this end a precautionary approach was taken, including regard as to whether the tree species was either a "box" (and thus likely to be of some importance) or had taxonomic affiliations with known koala food tree species (eg Red Gums, Grey Gums and Ribbon Gums). From this process a revised food tree list comprised of 66 *Eucalyptus* spp. has resulted (Table 2). A further 29 species of "Stringybark" were also identified as potential food trees.

The geographic distribution of each tree species in Table 2 was then examined using the NEDP data base, with each 1:100000 map sheet being scored for the presence/absence of the selected *Eucalyptus* spp. Where species were represented by small data sets, model distributions were examined to test the potential for occurrence over a wider area. The climatic envelope model proved the most indicative in this regard; however, both were ultimately disregarded in favour of botanical regions (provinces) currently recognised by the National Herbarium (see Harden 1991). This too presents a problem in that the widths of floristic "tension" zones between the respective provinces are unknown. Thus each of the province boundaries are indicative at best, but are useful nonetheless in assisting with the determination of likely KMA boundaries. In order to resolve this issue, where a given map sheet displayed evidence of provincial overlap, individual species records were then examined in order to determine other criteria (primarily altitudinal) upon which to base preliminary boundaries.

It was noted that the use of ecological criteria to define management area boundaries, while soundly based, resulted in the creation of divisions across existing administrative boundaries, most notably those of approximately 27 Local Government Areas (Fig. 2). This result creates problems for koala management, more so given the precedent established by *SEPP No 44 (Koala Habitat Protection)* which is primarily based on LGA boundaries. In order to resolve this issue, some boundary adjustments were deemed necessary. In most instances this resulted in a small (1 – 3 species) increase in the food tree species associated with each of the management areas in order to ensure conformity.

Insert KMAECOS.jpeg

Fig. 2. Proposed Koala Management Area boundaries based solely on ecological criteria (provincial boundaries variously modified - where possible - by NEPD database records). Note configuration with respect to existing administrative (Local Government) boundaries.

The management areas and associated maps as presented herein consequently represent the preferred option for consideration and discussion by the recovery team. A similarity matrix (Table 3) indicates the extent to which food tree species are shared amongst the respective KMAs.

At this point it should be noted that while the majority of koala food trees do not exhibit any significant variation across substrates, field data supports a contention that two of the tree species otherwise categorised as primary food tree species in this report – *E. tereticornis* and *E. viminalis* – exhibit significant substrate-based differences in their use as food trees (AKF unpublished data). Both species clearly conform to the primary food tree criteria when growing on nutrient rich (eg volcanic and/or alluvial) substrates; but do not demonstrate the same patterns of use on low nutrient (eg podzolics and/or upland) substrates. Thus the widespread distribution of these two species in particular does not necessarily equate to suitable koala habitat. However, the potential influence of substrate should not necessarily detract from the overall importance of such species to koalas, especially given that such influences may be quite localised and readily resolved by field-based surveys (see Phillips and Callaghan in press).

The variable use of Stringybarks by koalas also represents a conundrum for recovery planning purposes. Given the diversity of this group in two of the proposed Koala

Management Areas (Northern Tablelands and Central Coast) there is some risk that their recognition as a secondary food tree species may undermine the importance of the other nominated species. Because of this the Stringybarks have been listed in a separate category at this stage.

TABLE 2. KOALA FOOD TREES IN NSW

Species	FTS	1	2	3	4	5	6	7
E. acaciiformis	S				X			
E. albens	S				X	X	X	
E. amplifolia	P	X	X		X			
E. bancrofti	P	X						
E. banksii	S				X			
E. baueriana	S		X	X				
E. bicostata	S				X	X		
E. biturbinata	S	X						
*E. blakelyi**	S				X	X	X	X
*E. bosistoana**	S		X	X				
E. bridgesiana	S			X	X	X	X	
E. caliginosa	S				X			
*E. camaldulensis**	P						X	X
E. camphora	S		X		X	X		
E. canaliculata	S	X						
*E. chloroclada**	S						X	
E. cinerea	S					X		
*E. conica**	S		X		X		X	
*E. consideniana**	S		X	X				
E. coolabah	P						X	X
*E. cypellocarpa**	S		X	X				
E. dalrympleana	S				X	X		
*E. dealbata**	S				X	X	X	
*E. dwyeri**	S		X		X		X	
E. glaucina	S	X	X					
E. goniocalyx	S		X		X	X		
E. interstans	S				X			
E. largeana	S	X	X					
E. largiflorens	S						X	X
*E. longifolia**	S		X	X				
*E. maidenii**	S		X	X		X		
E. malacoxylon	S				X			
*E. mannifera**	S		X	X	X	X		
*E. melliodora**	S				X	X	X	X
E. michaeliana	S		X		X			
*E. microcarpa**	S		X				X	X
*E. microcorys**	P	X	X					

*E. moluccana**	S	X	X		X			
E. nandewarica	S						X	
E. nichollii	S				X			
E. nortonii	S				X	X		
E. notabilis	S	X	X		X			
E. nova-anglica	S				X			
E. ovata	S		X	X				
*E. parramattensis**	P	X	X					
E. pauciflora	S			X	X	X		
*E. pilligaensis**	S						X	
E. polyanthemos	S			X	X	X	X	
*E. populnea**	S						X	X
E. prava	S				X		X	
E. praecox	S		X		X			
*E. propinqua**	S	X						
E. pseudoglobulus	S			X				
*E. punctata**	S		X					
E. quadrangulata	S	X	X		X			
*E. resinifera**	S	X	X					
E. retinens	S				X			
*E. robusta**	P	X	X					
E. rubida	S			X	X			
E. rudderi	S	X	X					
E.rummeryi	S	X						
E. scias	S		X					
*E. seeana**	S	X						
*E. tereticornis**	P	X	X	X	X			
E. vicina	S						X	
*E. viminalis**	P		X	X	X	X		
E. volcanica	S				X		X	
Stringybarks								
*E. agglomerata**		X	X	X				
*E. eugenioides**		X	X	X	X			
*E. globoidea**		X	X	X				
*E. laevopinea**					X			
E. macrorhyncha					X	X	X	X
*E. muelleriana**			X	X		X		
*E. tindaliae**		X						
E. youmanii					X			
E. cannonii			X					
E. stannicola					X			
E. williamsiana					X			
E. subtilior					X			
E. cameronii		X			X			
E. yangoura				X				
E. conjuncta					X			
E. prominula			X					
E. sparsifolia			X					
E. imitans			X					

E. oblonga	X		
E. ralla	X		
E. tenella	X		
E. mckieana			X
E. ligustrina	X		X
E. caliginosa			X
*E. capitellata**	X		
E. camfieldii	X		
E. blaxlandii	X		
E. baxteri		X	
E. bensonii	X		

Table 2. A revised list of koala food trees in NSW and their distribution in terms of the Koala Management Areas proposed by this report (1 = North Coast; 2 = Central Coast; 3 = South Coast; 4 = Northern Tablelands, 5 = Southern Tablelands; 6 = Western Slopes and Plains; 7 = Far West and South West). Species marked "*" are supported by field-based data sets maintained by either the AKF or the SEFCC (FTS = food tree status: P = primary food tree; S = secondary food tree).

	CC	**SC**	**NT**	**ST**	**WSP**	**FWSW**
NC	0.33	0.03	0.11	0.00	0.00	0.00
CC		0.33	0.28	0.14	0.07	0.10
SC			0.17	0.26	0.06	0.00
NT				0.39	0.23	0.05
ST					0.22	0.08
WSP						0.29

Table 3. Similarity matrix indicating the extent of koala food tree overlap between each of the proposed Koala Management Areas. Indices were derived by dividing the number of tree species being 'shared' in any two KMAs, by the total number of food tree species (less those in common) in the two areas.

Koala Management Areas

The definitions below relate to the use of key words in each of the KMA descriptions that follow. Density estimators are arbitrary and should serve as indicative values only.

Signature species - a koala food tree, the geographic distribution of which best defines the boundary of the KMA.

Primary Habitat – areas of forest and/or woodland wherein primary food tree species comprise the dominant (ie. ≥ 50%) overstorey tree species. Capable of supporting high density (≥ 0.75 koala/ha) koala populations.

Secondary Habitat (Class A) – primary food tree species present, usually (but not always) growing in association with one or more secondary food tree species. Capable of supporting medium density (≥ 0.10 koala/ha but < 0.75 koala/ha) koala populations.

Secondary Habitat (Class B) – primary food tree species absent, habitat comprised of secondary and supplementary food tree species only. Capable of supporting viable, low density (< 0.10 koala/ha) populations.

Conservation Status - following the recommendations of Phillips (in press), a conservation status has been tentatively allocated to koala populations in each of the KMAs based on population size criteria for each of the three major conservation categories currently recognised by the IUCN (1994) as follows: Critically Endangered (< 250), Endangered (<2500) and Vulnerable (<10000).

Eucalypt nomenclature, and specifically the use of common names, follows that of Harden (1991).

KOALA MANAGEMENT AREA NO. 1 (NORTH COAST)

Signature Species: Tallowwood *Eucalyptus microcorys.*

KMU description: extending south along the north coast of NSW from the Qld border to the Hunter River; westwards to the headwaters of the Paterson River in the upper reaches of the GDR as approximated by the 800m contour line.

LGA's: Byron, Ballina, Bellingen, Casino, Coffs Harbour, Copmanhurst, Dungog, Gloucester, Grafton, Great Lakes, Greater Taree, Hastings, Kempsey, Kyogle, Lismore, Maclean, Maitland, Nambucca, Nymboida, Port Stephens, Richmond River, Tenterfield, Tweed and Ulmarra.

Primary Food Tree Species: Tallowwood *E. microcorys*; Forest Red Gum *E. tereticornis*; Swamp Mahogany *E. robusta*; Parramatta Red Gum *E. parramattensis*; Orange Gum *E. bancroftii*; Cabbage Gum *E. amplifolia*.

Secondary Food Tree Species: Narrow-leaved Red Gum *E. seeana*, Slaty Red Gum *E. glaucina,* Small-fruited Grey Gum *E. propinqua*, Red Mahogany *E. resinifera,* Mountain Mahogany *E. notabilis,* Grey Box *E. moluccana*, Yellow Box *E. melliodora*, Craven Grey Box *E. largeana*, Grey Gum *E. biturbinata*, Large-fruited Grey Gum *E. canaliculata*, Steel Box *E. rummeryi*, Rudder's Box *E. rudderi,* White-topped Box *E. quadrangulata*.

Stringybarks: Stringybark *E. tindaliae*, Thin-leaved Stringybark *E. eugeniodes*, White Stringybark *E. globoidea*, Blue-leaved Stringybark *E. agglomerata*, Diehard Stringybark *E. cameronii*.

Conservation Status: Vulnerable; mostly comprised of scattered, medium density populations occupying Secondary (Class A) habitat. Some localised areas of Primary habitat support high density populations, the latter usually in association with communities dominated by *E. tereticornis, E. robusta* and/or *E. parramattensis*.

Threatening Processes: Land clearing for agriculture and urban development, particularly along the coastal fringe; timber harvesting (logging of *E. microcorys* and *E. propinqua* in particular), sandmining, fire, motor vehicles, road construction, predation by feral animals.

Insert KMA1.jpeg

NORTH COAST KOALA MANAGEMENT AREA
(Signature species: *E. microcorys*)

KOALA MANAGEMENT AREA NO. 2 (CENTRAL COAST)

Signature Species: Grey Gum *E. punctata*

KMU description: extending along the east coast of NSW from the Hunter River to the Shoalhaven River south of Sydney. Inland from the junction of the Paterson and Hunter Rivers in the north upland to the 500m contour west to the headwaters of the Hunter River; thereafter south on elevated lands between Coolah and Gulgong; then south along the 600m contour to the Shoalhaven.

LGA's: Baulkham Hills, Blacktown, Blue Mountains, Camden, Campbelltown, Gosford, Greater Cessnock, Hawkesbury, Hornsby, Kiama, Ku-ring-gai, Lake Macquarie, Liverpool, Merriwa, Mudgee, Muswellbrook, Newcastle, Penrith, Shell Harbour, Singleton, Sutherland, Warringah, Wollondilly, Wingecarribee, Wollongong and Wyong.

Primary Food Tree Species: Parramatta Red Gum *E. parramattensis***,** Forest Red Gum *E. tereticornis*, Ribbon Gum *E. viminalis*, Swamp Mahogany *E. robusta*, Tallowwood *E. microcorys,* Cabbage Gum *E. amplifolia*.

Secondary Food Tree Species: Broad-leaved Sally *E. camphora*, Fuzzy Box *E. conica*, Yertchuk *E. consideniana*, Dwyer's Red Gum *E. dwyeri*, Slaty Red Gum *E. glaucina*, Bundy *E. goniocalyx*, Craven Grey Box *E. largeana*, Maiden's Gum *E. maidenii*, Brittle Gum *E. michaeliana*, Western Grey Box *E. microcarpa*, Grey Box *E. moluccana*, *E. notabilis*, Swamp Gum *E. ovata*, Brittle Gum *E. praecox*, White-topped Box *E. quadrangulata*, Red Mahogany *E. resinifera*, Rudder's Box *E. rudderi*, Large-fruited Red Mahogany *E. scias*, Grey Gum *E. punctata***,** Monkey Gum *E. cypellocarpa*, Woollybutt *E. longifolia*, Blue Box *E. baueriana*, Coast Grey Box *E. bosistoana*

Stringybarks: Blue-leaved Stringybark *E. agglomerata*, Thin-leaved Stringybark *E. eugenioides*, White Stringybark *E. globoidea*, Yellow Stringybark *E. muelleriana*, Red Stringybark *E. cannonii*, *E. prominula*, Narrow-leaved Stringybark *E. sparsifolia*, *E. imitans*, *E. oblonga*, *E. ralla*, *E. tenella*, Privet-leaved Stringybark *E. ligustrina*, Brown Stringybark *E. capitellata*, Heart-leaved Stringybark *E. camfieldii*, *E. bensonii*, *E. blaxlandii*.

Conservation Status: endangered; populations highly fragmented and disjunct; predominantly low density populations occuping areas of Secondary (class B) habitat.

Insert KMA2.jpeg

CENTRAL COAST KOALA MANAGEMENT AREA
(Signature species: *E. punctata*)

KOALA MANAGEMENT AREA NO. 3 (SOUTH COAST)

Signature Species: none

LGA's: Bega Valley, Eurobodalla and Shoalhaven.

KMU description: extending along the south coast from the Shoalhaven River south of Sydney to the Vic/NSW border. Western boundary defined by the 600 - 800m contour line.

Primary Food Tree Species: Cabbage Gum *E. amplifolia*, Ribbon Gum *E. viminalis*, Forest Red Gum *E. tereticornis*,

Secondary Food Tree Species: Yellow Box *E. melliodora*, Brittle Gum *E. mannifera*, Yertchuk *E. consideniana*, Swamp Gum *E. ovata*; Large-fruited Red Mahogany *E. scias*; Apple-topped Box *E. bridgesiana*, Monkey Gum *E. cypellocarpa*, Woollybutt *E. longifolia*, Maiden's Gum *E. maidenii*, Snow Gum *E. pauciflora*, Red Box *E. polyanthemos*, Coast Grey Box *E. bosistoana*, Blue Box *E. baueriana*, Bastard Eurabbie *E. pseudoglobulus*.

Stringybarks: White Stringybark *E. globoidea*, Yellow Stringybark *E. muelleriana*, Blue-leaved Stringybark *E. agglomerata*, Brown Stringybark *E. capitellata*, Southern White Stringybark *E. yangoura*, *E. baxteri*.

Conservation Status: endangered; highly fragmented and disjunct; mostly comprised of low density populations occuping areas of Secondary (class B) habitat.

Threatening Processes: Timber harvesting (logging of secondary and/or supplementary food tree species), land clearing for agricultural/rural-residential development, fire, road construction.

Insert KMA3.jpeg

SOUTH COAST KOALA MANAGEMENT AREA

KOALA MANAGEMENT AREA NO. 4 (NORTHERN TABLELANDS)

Signature Species: Forest Ribbon Gum *E. nobilis*

LGA's: Armidale, Barraba, Bingara, Dumeresq, Glen Innes, Guyra, Inverell, Manilla, Murrurundi, Nundle, Parry, Scone, Severn, Tamworth, Tenterfield, Uralla and Walcha.

KMU description: eastern boundary extending south from the Qld/NSW border along the 600 - 800m contour line to the headwaters of the Paterson River; thereafter westwards to the vicinity of Coolah and then returning north to the border along a boundary approximated by the 500m contour line.

Primary Food Tree Species: Ribbon Gum *E. viminalis*, Forest Red Gum *E. tereticornis*, Cabbage Gum *E. amplifolia*.

Secondary Food Tree Species: Forest Ribbon Gum *E. nobilis*, Candlebark *E. rubida*, Eurabbie *E. bicostata*, Yellow Box *E. melliodora*, Monkey Gum *E. cypellocarpa*, Fuzzy Box *E. conica*, White Box *E. albens*, Red Box *E. polyanthemos*, *E. interstans*, Moonbi Apple Box *E. malacoxylon*, Brittle Gum *E. michaeliana*, Brittle Gum *E. praecox*, Orange Gum *E. prava*, White-topped Box *E. quadrangulata*, Grey Box *E. moluccana*, Narrow-leaved Black Peppermint *E. nicholii*, Large-flowered Bundy *E. nortonii*, Mountain Mahogany *E. notabilis*, New England Peppermint *E. nova-anglica*, Snow Gum *E. pauciflora*, Broad-leaved Sally *E. camphora*, Bundy *E. goniocalyx*, Apple-topped Box *E. bridgesiana*, Wattle-leaved Peppermint *E. acaciiformis*, Tenterfield Woolybutt *E. banksii*, Dwyer's Red Gum *E. dwyeri*, Blakely's Red Gum *E. blakelyi*, Mountain Gum *E. dalrympleana*, Tumbledown Gum *E. dealbata*, Brittle Gum *E. mannifera*, *E. retinens*, *E. volcanica*.

Stringybarks: Silver-topped Stringybark *E. laevopinea*, Yellow Stringybark *E. muelleriana*, Red Stringybark *E. macrorhyncha*, Youman's Stringybark *E. youmanii*, *E. stannicola*, *E. williamsiana*, *E. subtilior*, Diehard Stringybark *E. cameronii*, *E. conjuncta*, McKie's Stringybark *E. mckieana*, Privet-leaved Stringybark *E. ligustrina*, Broad-leaved Stringybark *E. caliginosa*.

Conservation Status: unknown; populations assumed to be fragmented and disjunct; mostly comprised of low density populations occuping areas of secondary habitat.

Threatening Processes: Timber harvesting (logging of secondary and/or supplementary food tree species), dieback, land clearing for agricultural/rural-residential development, fire, road construction.

Insert KMA4.jpeg

NORTHERN TABLELANDS KOALA MANAGEMENT AREA
(Signature species: *E. nobilis*)

KOALA MANAGEMENT AREA NO. 5 (CENTRAL & SOUTHERN TABLELANDS)

Signature species: Candlebark *E. rubida*

LGA's: Bathurst, Blayney, Bombala, Boorawa, Cabonne, Cooma-Monaro, Cowra, Crookwell, Evans, Goulburn, Greater Lithgow, Gunning, Holbrook, Mudgee, Mulwaree, Oberon, Orange, Queanbeyan, Rylstone, Snowy River, Tallaganda, Tumut, Tumbarumba, Yass and Yarrowlumla.

KMU description: in the north, loosely defined as all land above the 600-800m contour line in the vicinty of Mt. Monundilla and Mt. Nullo north of Kandos, south on both sides of the Great Dividing Range to the Victorian/NSW border. **Sub unit/s:** for management purposes, it may be convenient to split the central tableands from this KMU.

Primary Food Tree Species: Ribbon Gum *E. viminalis,* River Red Gum *E. camaldulensis.*

Secondary Food Tree Species: Candlebark *E. rubida*, Eurabbie *E. bicostata*, Broad-leaved Sally *E. camphora*, Argyle Apple *E. cinerea*, Maiden's Gum *E. maidenii*, Swamp Gum *E. ovata*, Bundy *E. goniocalyx,* Blakely's Red Gum *E. blakelyi*, Apple-topped Box *E. bridgesiana*, White Box *E. albens*, Yellow Box *E. melliodora,* Western Grey Box *E. microcarpa*, Red Box *E. polyanthemos*, Large-flowered Bundy *E. nortonii*, Snow Gum *E. pauciflora*, Tumbledown Gum *E. dealbata,* Brittle Gum *E. mannifera*, Mountain Gum *E. dalrympleana*.

Stringybarks: Red Stringybark *E. macrorhyncha*, Yellow Stringybark *E. muelleriana*.

Conservation Status: unknown; populations assumed to be fragmented and disjunct, mostly comprised of low density populations occuping areas of Secondary (Class B) habitat.

Threatening Processes: timber harvesting (logging of secondary and/or supplementary food tree species), land clearing for agricultural/rural-residential development, fire, predation by feral animals.

Insert KMA5.jpeg

CENTRAL & SOUTHERN TABLELANDS KOALA MANAGEMENT AREA
(Signature species: *E. rubida*)

KOALA MANAGEMENT AREA NO. 6 (WESTERN SLOPES AND PLAINS)

Signature Species: Bimble Box, Poplar Box *E. populnea*

LGA's: Bland, Bogan, Bourke, Brewarrina, Carathool, Cobar, Coolah, Coolamon, Coonabarabran, Coonamble, Cootamundra, Dubbo, Forbes, Gilgandra, Gundagai, Gunnedah, Griffith, Harden, Junee, Lachlan, Leeton, Moree Plains, Narrabri, Narrandera, Narromine, Parkes, Quirindi, Temora, Wagga Wagga, Walgett, Warren, Weddin, Wellington, Yallaroi and Young.

KMU description: Extending south of the NSW/Qld border from between the Warrego River in the west and the upper reaches of the Dumeresq River to the 500m contour line in the east, thereafter south to the Murrumbidgee River; the western boundary defined by the Warrego River to its junction with the Darling River near Wilcannia and then south-east to Hay along a convex line approximated by the Cobb Highway. **Sub unit/s:** The option exists to subdivide the Western Slopes and Plains KMU into two separate units which essentially represent the Lachlan and Darling River catchments respectively.

Primary Food Tree Species: River Red Gum *E. camaldulensis*, Coolabah *E. coolabah*

Secondary Food Tree Species: Dirty Gum *E. chloroclada,* Bimble Box *E. populnea*, Pilliga Box *E. pilligaensis*, Fuzzy Box *E. conica*, Western Grey Box *E. microcarpa*, Yellow Box *E. melliodora*, White Box *E. albens*, Dwyer's Red Gum *E. dwyeri*, Tumbledown Gum *E. dealbata*, Blakely's Red Gum *E. blakelyi*, Apple-topped Box *E. bridgesiana*, Black Box *E. largiflorens*, Mallee Red Gum *E. nandewarica*, *E. vicina*, *E. volcanica*, Red Box *E. polyanthemos*, Orange Gum *E. prava*.

Stringybarks: Red Stringybark *E. macrorhyncha*, Narrow-leaved Stringybark *E. sparsifolia*.

Conservation Status: vulnerable; populations disjunct, a significant population stronghold occuring in the Pilliga Scrub and around Gunnedah. Represented by low, medium and high density populations, the latter two occuring in conjunction with box woodlands and riparian *E. camaldulensis* and/or *E. coolabah* communities.

Threatening Processes: land clearing for agricultural purposes, fire, timber harvesting along with some silvicultural practices, predation by feral animals.

Insert KMA6.jpeg

WESTERN SLOPES & PLAINS KOALA MANAGEMENT AREA
(Signature species: *E. populnea*)

KOALA MANAGEMENT AREA NO. 7 (FAR WEST & SOUTH WEST)

Signature Species: none

KMU description: northern, western and south-western boundaries defined by the Queensland, South Australian and Victorian borders respectively. Eastern boundary defined by the Warrego River to its junction with the Darling River near Wilcannia and thereafter by a concavity approximated by the Cobb Highway south to Hay and eastwards along the Murrumbidgee River to the vicinity of Lake Burrunjuck.

LGA's: Albury, Balranald, Berrigan, Central Darling, Conargo, Corowa, Culcairn, Deniliquin, Hay, Hume, Jerilderie, Lockhart, Murray, Urana, Wakool, Wentworth and Windouran.

Primary Food Tree Species: River Red Gum *E. camaldulensis*; Coolabah *E. coolabah*.

Secondary Food Tree Species: Bimble Box *E. populnea*, Western Grey Box *E. microcarpa*, Yellow Box *E. melliodora*, Tumbledown Gum *E. dealbata*, Blakley's Red Gum *E. blakelyi*, Black Box *E. largiflorens*,.

Stringybarks: Red Stringybark *E. macrorhyncha*

Conservation Status: unknown; populations assumed to be extra-limital; possibility of some scattered populations along the eastern reaches of the Murray River.

Threatening Processes: land clearing for agricultural purposes, timber harvesting, predation by feral animals.

Insert KMA7.jpeg

FAR WEST & SOUTH WEST KOALA MANAGEMENT AREA

Concluding comments

This report proposes the recognition of seven key management areas for koala conservation and recovery planning in New South Wales. While the combined list of some 95 primary, secondary and supplementary tree species may appear excessive, it should be recognised that the approach which has been taken by this report is without precedent and thus represents – for the first time – a categorisation of tree species preferences for koalas throughout their remaining range in NSW. In reality however, each of the nominated KMAs contains a lesser number of tree species which, in turn, become even fewer when approached at the level of a localised koala population.

Notwithstanding the reliance of the proposed habitat models upon a significant amount of largely unpublished data, there remain significant gaps in our knowledge. These gaps are most apparent in the Northern, Central and Southern Tableland areas of New South Wales where there is virtually no data available on tree species preferences. Validation and/or refinement of the models proposed by this report is thus seen as an urgent priority, as is the initiation of investigations to determine the relative abundance and conservation status of free-ranging koala populations in these areas. Additional recommendations for future work include:

a) the need to standardise field survey techniques such that tree species preferences in each of the above can be determined with a high level of confidence;
b) potential refinement of the habitat models proposed herein to provide an effective and meaningful working relationship with SEPP 14;

c) research into the assumed substrate-based volatility of *E. tereticornis* and *E. viminalis* in order to further understand the relationship between the presence of the these two tree species and their importance to free-randing koala populations.

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