DISTRIBUTION SURVEYS AND HABITAT ASSESSMENT FOR THE KOALA (*PHASCOLARCTOS CINEREUS*) IN THE MURRABRINE AREA

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CONCLUSIONS AND RECOMMENDATIONS

Koala surveys were concentrated in catchments on the northern and western sides of the Murrabrine Forest where evidence suggested that evidence of koalas were more likely to be located. Within this parameter the survey areas sampled a range of slope positions and floristic assemblages. Creek flats and gully areas were searched in the more undulating foothill areas. Undulating spurs were preferentially sampled in the steeper areas. Basalt areas were also preferentially sampled.

Eight survey areas were searched. No koala faecal pellets were found at any of the sites The results suggest that few if any koalas remainin the Murrabrine area

Anecdotal evidence indicates that a koala population existed in areas in Murrabrine that were cleared for agriculture. This was also the case in similar habitat to the south in the Brogo and Bega valleys. Koalas in these areas were probably part of the same population that experienced the crash in numbers in 1903/5. The population appears to have persisted to the north of the Murrabrine area after this for at least several decades.

The floristic assemblage type 19 is widespread in the lower drainage areas and on sheltered slopes. However this appears to be largely regrowth regenerating after clearing for agriculture, particularly in the more undulating areas. In the Murrabrine area *Eucalyptus viminalis* and *Eucalyptus baueriana* are well represented in this floristic assemblage. The literature suggests that the *Eucalyptus viminalis* could be a primary koala feed tree species in the riparian locations in the study area. However caution is warranted as there are no data on koalas' use of this species in the coastal areas of SENSW. *Eucalyptus baueriana* indicates moderate/high site productivity and is classified as a secondary koala feed tree species.

There are three floristic assemblages with a high proportion of secondary koala feed tree species that are widespread in the Murrabrine Forest. This suggests that much of the study area consists of secondary koala habitat. Patches of basalt also appear to be widespread. Their fertile soils probably enhance habitat quality. However, there is a high proportion of steeper slopes in the Murrabrine forest that may mitigate against its ability to sustain a koala population.

The playing of taped male koala calls should be carefully undertaken in the study area in late spring. This approach is particularly appropriate as the 1997 SFNSW/NPWS study recorded four callback responses in the general area. Thus some baseline data has already been collected using this technique. To repeat the survey in this area may provide useful data on population trends and distribution. Follow-up searches for koala faecal pellets should also be undertaken. This would test whether a combination of survey techniques (using taped calls and searching for koala faecal pellets in and near to areas where a positive response is gained) is more effective than the method used in this survey.

Landholders in the study area should be contacted and informed about the koala recovery program and the potential importance of the fertile valley areas in the study area. They should be given information about the history and socio-ecology of koalas in the region and asked to report any information they have about local koalas.

PROJECT SCOPE

The scope of the project was to assess whether koalas are present in the Murrabrine forest area and assess habitat. Specifically this was to:

- undertake koala faecal pellet searches in the nominated areas
- undertake tree species preference assessment at active sites within the survey areas
- collect predator scats for analysis and assess predator activity
- provide an assessment of koala habitat in the survey area and identify any potential threats to koalas in the areas

THE STUDY AREA

The Murrabrine Forest is located on the escarpment and foothills of the Coastal Range west of Cobargo (Figure 1). The headwaters of four major creek and river systems are located in this forest. The Murrah River drains from the southern and south eastern parts; Naira Creek from the east; Wandella Creek from the north eastern side; and the Yowrie River from the western and northwestern sides. These creek and river systems adjoin each other in the undulating valley areas below which have been largely cleared for agriculture. These areas are to the north of the Bega and Brogo rivers and are part of the same drainage complex feeding the valley areas from the escarpment forests of the Coastal Range.

For the purposes of the Discussion in this report the term “study area” includes the forested areas on private land within these catchments connected to the Murrabrine Forest.

FIGURE 1: THE MURRABRINE STUDY AREA

SURVEY METHODS

Selection of survey areas
SEWFS staff selected survey areas following assessment of topographical and vegetation maps (Keith and Bedward 2000) and discussions with local landholder, Mr Rob Pearson. Koala records from the NPWS Wildlife Atlas, Lunney et al (1996) and the SFNSW/NPWS koala callback project were also consulted. Anecdotal information about koala sightings was also obtained (Jim Collins pers. comm.)

Because the limited survey time available we decided to concentrate survey activity in the Wandella, Trapyard and New England Creek and Yowrie River catchments on the northern and western sides of the Murrabrine Forest. This was because available evidence (see Discussion below) suggested that evidence of koalas were more likely to be located in this area. Within this parameter the survey areas (Figures 2a & 2b) were selected that sampled a range of slope positions and floristic assemblages. Creek flats and gully areas were selected in the more undulating foothill areas and undulating spurs were preferentially sampled in the steeper areas. Fertile areas on undulating topography were also preferentially sampled. These decisions were based on the following information from the scientific literature and data from koala surveys in the nearby Murrah Forest:

- Hindell (1984) found that koalas preferred eucalypts associated with deeper soils associated with watercourses
- Braithwaite et al (1983) have shown that the gradient in foliage nutrient concentration appears to be the major determinant of the density and species richness and diversity of arboreal marsupials in the Eden forests
- Cork and Braithwaite (1993) have shown a direct correlation between nutrient levels in eucalypt foliage and soil fertility levels
- Norton (1989), Lunney et al (1990), and Norton and Neave (1990) all have stated that koala populations occurred primarily on undulating land with fertile soils prior to clearing.
- Norton and Neave (1990) also provided conclusions from unpublished data held by Norton and Nix that 90% of sites they surveyed that were known to support koalas occurred on slopes of >20 degrees.
- Of the active sites located in Murrah Forest (the nearest area to the Murrabrine known to be supporting koalas for which good data exist) 85.5% were located on slopes less than 20 degrees (South East Forests Conservation Council 1998).

Figures 2a &2b shows the location of the survey areas in the Murrabrine Forest

FIGURE 2a: SURVEY AREAS IN MURRABRINE FOREST

FIGURE 2b: SURVEY AREAS IN MURRABRINE FOREST

RESULTS

Eight survey areas were searched. No koala faecal pellets were found in any of the sites Information about each of the survey areas is provided below.

1. TRAPYARD CREEK UPSTREAM FROM MURRABRINE ROAD

Site location	south-western bank of Trapyard creek for about 400m upstream from Murrabrine Road crossing
Soils/geology	granitic; part of survey area on alluvial flats
Topography	small creek flats and lower slope
Altitude	280m
AMG at starting point	55 744950 5972600
Eucalypts present on lower slopes	*Eucalyptus angophoroides* (apple-topped box), *Eucalyptus baueriana* (blue box)*, *Eucalyptus botryoides* (southern mahogany), *Eucalyptus elata* (river peppermint), *Eucalyptus radiata* (narrow-leaved peppermint), *Eucalyptus viminalis*** (manna gum)
Eucalypts present on upper slopes	*Eucalyptus angophoroides* (apple-topped box), *Eucalyptus globoidea* (white stringybark)* *Eucalyptus sieberi* (silvertop ash) *Eucalyptus radiata* (narrow-leaved peppermint
Veg type identified as	Bega Wet Shrub Forest (type 19) along the creek bank, grading into a drier floristic assemblage on the lower slopes, which could not be classified (second species list provided below for lower slopes).
Survey result	No koala faecal pellets found
Other comments	Probably mining or clearing for agriculture has occurred here long ago

2. MURRABRINE ROAD ABOUT 2 KM SOUTH-WEST FROM TRAPYARD CREEK CROSSING

Site location	top of low ridge running west from Murrabrine Road towards New England Creek, between the road and private property boundary (about 200m)
Soils/geology	granitic
Topography	top of low ridge;
Altitude	300m
AMG at starting point	55 744150 5971400
Eucalypts present	*Eucalyptus angophoroides* (apple-topped box), *Eucalyptus cypellocarpa* (monkey gum)*, *Eucalyptus globoidea* (white stringybark)*, *Eucalyptus radiata* (narrow-leaved peppermint)
Veg type identified as	Hinterland Dry Grass Forest (type 31) or Wallagaraugh Dry Grass Forest (type 30)
Survey result	no koala faecal pellets found
Other comments	Old forest. Site near to 1997 SFNSW callback site.

3. NEW ENGLAND CREEK FIRE TRAIL BETWEEN TWO FORDS

Site location	adjacent to New England Creek between two fire trail fords (about 100m)
Soils/geology	granitic with some basalt rocks; no alluvial flats
Topography	creek flat and gully area
Altitude	300m
AMG at starting point	55 74325 5970600

Eucalypts present	*Eucalyptus cypellocarpa* (monkey gum)*, *Eucalyptus elata* (river peppermint), *Eucalyptus viminalis* (manna gum)*
Veg type identified as	Bega Wet Shrub Forest (type 19)
Survey result	no koala faecal pellets found
Other comments	trees widely spaced, not many old trees; extensive windthrow, perhaps flooding, perhaps some clearing in flat area

4. NEW ENGLAND FIRE TRAIL 700M SOUTH OF SECOND FORD

Site location	200m up slope south-east from New England Fire Trail
Soils/geology	granitic; granite outcrops
Topography	undulating ridge
Altitude	330m
AMG at starting point	55 742800 5970000
Eucalypts present on lower slope	*Eucalyptus cypellocarpa* (monkey gum)*, *Eucalyptus globoidea* (white stringybark)*, *Eucalyptus sieberi* (silvertop ash)
Eucalypts present on upper slope	*Eucalyptus cypellocarpa* (monkey gum)*, *Eucalyptus elata* (river peppermint), *Eucalyptus viminalis* (manna gum)*
Veg type identified as	one of *E. sieberi* dominated types (48, 49 or W1)
Survey result	no koala faecal pellets found
Other comments	Site near to 1997 SFNSW callback site. Fire regrowth with nearly all trees about 40 years old or less, grading into a slightly wetter floristic assemblage which could not be categorised downslope. Larger trees downslope

5. UNNAMED TRACK EAST OF NEW ENGLAND/RAZORBACK FIRE TRAIL JUNCTION

Site location	broad ridge top for 200m east of where New England Fire Trail turns south again after meeting Razorback Fire Trail
Soils/geology	Devonian high quartz metasediments; loamy soil
Topography	flat ridge top
Altitude	530m
AMG at starting point	55 742400 5967650
Eucalypts present	*Eucalyptus globoidea* (white stringybark)*, *Eucalyptus sieberi* (silvertop ash); a few *Eucalyptus cypellocarpa* (monkey gum)*,
Veg type identified as	one of *E. sieberi* dominated types (48,49 or W1) but wetter than usual due to high elevation and sheltered site between two ranges.
Survey result	No koala faecal pellets found
Other comments	52 fires regrowth. Good bellowing point

6. ILLAWAMBARA FIRE TRAIL 1.6 KM NORTH EAST OF JUNCTION WITH MURRABRINE FIRE TRAIL

Site location	double spur and gully area draining northwest from Illawambra Fire Trail, 1.6 km north east of junction with Murrabrine Fire Trail
Soils/geology	basalt
Topography	spur and head of drainage system
Altitude	570m
AMG at starting point	55 747600 5966000

Eucalypts present	*Eucalyptus baueriana* (blue box)*, *Eucalyptus cypellocarpa,* (monkey gum)*, *Eucalyptus elata* (river peppermint), *Eucalyptus fastigata* (brown barrel), *Eucalyptus globoidea* (white stringybark)*, *Eucalyptus maidenii* maidens gum)*, *Eucalyptus seiberi (silvertop ash)*
Veg type identified as	Probably type 35, though presence of *E. baueriana* is unusual
Survey result	No koala faecal pellets found
Other comments	Callback response recorded here in 1997. Rich, fertile forest

7. ILLAWAMBARA FIRE TRAIL 3.1 KM NORTH EAST OF JUNCTION WITH MURRABRINE FIRE TRAIL

Site location	long spur northwest from Illawambra Fire Trail, 3.1 km north east of junction with Murrabrine Fire Trail
Soils/geology	granite and basalt
Topography	undulating spur
Altitude	520m
AMG at starting point	55 748300 5967100
Eucalypts present	*Eucalyptus baueriana* (blue box)*, *Eucalyptus bosistoana* (coastal grey box)*, *Eucalyptus cypellocarpa,* (monkey gum)*, *Eucalyptus elata* (river peppermint), *Eucalyptus fastigata* (brown barrel), *Eucalyptus globoidea* (white stringybark)*, *Eucalyptus maidenii* maidens gum)*
Veg type identified as	probably type 35, though presence of *E. baueriana* is unusual
Survey result	No koala faecal pellets found
Other comments	Rich, fertile forest mostly fire regrowth towards northwestern end of survey area

8. NORTH WEST OF JUNCTION OF ILLAWAMBARA AND MURRABRINE FIRE TRAILS

Site location	two spurs and gully northwest from junction of Illawambra and Murrabrine Fire Trails
Soils/geology	basalt and granite
Topography	undulating spurs and gully
Altitude	570m
AMG at starting point	55 746750 5964950
Eucalypts present	*Eucalyptus cypellocarpa,* (monkey gum)*, *Eucalyptus fastigata* (brown barrel)
Veg type identified as	probably type 10
Survey result	No koala faecal pellets found
Other comments	Rich, fertile forest

** primary koala feed tree species as in Phillips (2000)
* secondary koala feed tree species as in Phillips (2000)
E. viminalis is categorised as primary or secondary depending on whether it was primarily on alluvial soils.

Predators
Three fox (*P. peregrines*) scats were collected. No dog (*P. volans*) scats were found. All of the fox scats were collected in survey areas that were at higher altitudes.

DISCUSSION

Anecdotal history and koala records
Elias (1988) provides anecdotal evidence from an early Murrabrine settler that suggests there was an abundant koala population in the 19th Century in the more fertile parts of the study area. This was the case similar habitat to the south in the Brogo and Bega valleys. Koalas in the Murrabrine, Brogo and Bega areas were probably part of the same population that experienced the crash in numbers in 1903/5 (Lunney and Leary 1988).

However it appears that a remnant of this population survived. The authors quote a former forester that in the 1930's there was a large colony between Reedy Creek and Wandella, just to the north of the study area. Anecdotal information suggests that some of the habitat of this population was not cleared for agriculture until recent decades and that some koalas from this area were translocated to the Bermagui forests as the clearing was undertaken (A. Cotterill SFNSW pers. comm.).

Other anecdotal information comes from Jim Collins (pers. comm.), a biology teacher at Bega High School (1952 -1975). He stated that on three occasions in the 1960's and 70's students reported seeing a koala in or near to this area. He considered this important enough to search the areas where each koala was seen. He received no other reports of koalas in the region in the time he taught at the school. This is important particularly because the study area is remote and student numbers from this area would have been comparatively low.

Lunney et al (1996) also provide three pre-1970 koala records from the Murrabrine area, all by local people. A total of 40 records were collected from across the region for this period. No further koala records were collected by those undertaking this community-based study for later decades covered by the survey.

In summary the history of koalas in the Murrabrine area appears to follow the course described by Lunney and Reed (1989) who stated that *the history of koalas with the Woodchip Agreement Area in the Eden region...demonstrates that large koala populations can decline rapidly, persist for many decades in isolated fragments, and face local extinction because of the sequential loss of each isolated population*.

Evidence that a koala population might be persisting in the general area was gathered in the SFNSW/NPWS koala callback survey. This was undertaken in September/ November 1997. Four responses were recorded in the Murrabrine and nearby areas. One of these was in Murrabrine on the Illawambra Fire Trail (site 42). Two others were in Wadbilliga NP (Sites 38 and 51) and one in Brogo NP (54). Because this was a stratified survey covering the whole region and only 15/16 koala responses were recorded this appears to be a highly significant result.

However follow up surveys for koala faecal pellets were undertaken at three of these sites in March 1998 by staff from the South East Forests Koala Research Project. This included the site in the Murrabrine Forest. No evidence of koalas was located.

The current survey also failed to find evidence of koalas. Given that this only sampled a small proportion of the study area no firm conclusions can be drawn from these results. However survey teams consisting of many of the same people using the same technique located koala evidence in the Numerella area in every survey area selected for searching. This suggests that if a breeding association survives in the Murrabrine area it is probably vesmall in numbers andwidely scattered

Koala feed tree species in the Murrabrine area

Eucalyptus viminalis (manna gum) is common in gully areas at lower altitudes in the study area. Phillips (2000) reviewed literature on tree species preferences and found that this species was considered to be "staple browse" (Hawkes 1978, Koala Preservation Society 1987), "primary species" (Pahl et al 1990), "commonly used" (Lee and Martin 1988), "preferred" (Pahl and Hume 1990) and "important" (Reed et al 1990). Using the only available quantitative approach to categorisation of tree species use by koalas Phillips concluded that *Eucalyptus viminalis* should be considered as a primary species, but only when growing on nutrient rich (eg volcanic and/or alluvial) substrates.

Although this information suggests that *E. viminalis* could be a primary koala feed tree species in the riparian locations in the study area, caution is warranted as it is not known what site conditions influence palatability and as yet there are no data on koalas' use of this species in the coastal areas of SENSW.

Eucalypt species commonly found in the study area that are also listed by Phillips (2000) as secondary species are: *Eucalyptus baueriana* (blue box), *Eucalyptus cypellocarpa* (monkey gum), *Eucalyptus globoidea* (white stringybark) and *Eucalyptus maidenii* (maiden's gum).

Of these *Eucalyptus cypellocarpa* and *Eucalyptus globoidea* have robust quantitative data of koala use. These were gathered from nearby coastal and hinterland areas (South East Forests Council 1998).

Data on koala's use of *Eucalyptus maidenii* was gathered from the Tantawangalo area during the same surveys but only from two active sites. Jurskis et al (1994) provided data on tree species preferences gathered using the asterix survey technique in the Tantawangalo/Yurammie area in 1990/91. These suggest that *Eucalyptus maidenii* was amongst the most important species for koalas at the survey sites. Jurskis and Potter (1996) report that asterix surveys for koala faecal pellets undertaken in the Eden area between 1994 and 1996 revealed that the species was preferred but less common (in the survey areas) and therefore less important.

There appears to be no data on koala's use of *Eucalyptus baueriana.* Phillips (2000) includes it as a secondary feed tree species as one of the box species. Costerman (1981) states that it grows on loamy river flats and fairly sheltered lower slopes with moderately deep moist soils. This suggests both that it may be an important feed tree in these areas and be a habitat indicator. Anecdotal information from the Springvale area (Dick Roberts pers. comm.) suggests that in that part of the Bega Valley *Eucalyptus baueriana* was more important than *Eucalyptus teriticornis* before the 1903/5 population crash, at least as a daytime roost tree for koalas.

Distribution of floristic assemblages in the survey area

Keith and Bedward (2000) have classified floristic assemblages in the region and mapped their distribution using a hybrid decision tree expert decision approach based on quantitative relationships between floristic assemblages and spatial variables (land cover pattern, substrate, climatic and terrain variables). Floristic assemblage classification of the survey areas provided in the tables above and in Appendix 1 are derived from this approach.

The Australian Koala Foundation Habitat Atlas is based on the following categories (Phillips pers. comm.) of primary and secondary koala habitat. Primary habitat is defined as *floristic alliances and/or associations wherein primary food tree species for Koalas comprise greater than or equal to 50% of the dominant overstorey tree species.* Secondary habitat is defined as *floristic alliances and or associations wherein secondary food species plus supplementary food species together comprise 30% or greater of the dominant overstorey tree species.*

The floristic data on the frequency of occurrence of individual plant species in their vegetation survey plots in Keith and Bedward (2000) provide a reasonable guide as to their relative abundance in each vegetation typeFrom this we can ascertain which floristic assemblages probably contain sufficient primary and secondary feed tree species to be categorised as primary or secondary koala habitat. This can assist the modelling of koala habitat in the region and is described in more detail in Allen (1999b).

One of the more extensive floristic assemblages predicted to be in the northern part of the Murrabrine area (Figure 3) is type 19 (Keith and Bedward 1999). Although our surveys suggest that its distributionis is overpredicted in that study this type is widespread in the lower drainage areas and on sheltered slopes. The assemblage varies considerably in species composition across its range, possibly in relation to soils (Keith and Bedward 1999). In the Murrabrine area *Eucalyptus viminalis* and *Eucalyptus baueriana* are well represented. The presence of the former suggests that this may be important, though not necessarily primary koala habitat.

Other floristic assemblages that are widespread in the Murrabrine Forest that appear to contain sufficient secondary koala feed tree species are types 13, 31 & 35 (Figure 3). This suggests that much of the study area consists of secondary koala habitat, particularly as basalt areas appear to be widespread where forests are growing on highly fertile soils.

Figure 3 shows widespread floristic assemblages in the study area (types 13, 31 & 35) that appear to contain sufficient secondary koala feed tree species to be categorised as secondary habitat

FIGURE 3. PROBABLE SECONDARY KOALA HABITAT (TYPES 13, 31 & 35) IN THE STUDY AREA

Slope classes

However most of Murrabrine is on relatively steep land. Figure 4 shows the slope classes in the study area. Figure 5 shows a comparison of slope classes with the Murrah Forest, which sustains a known koala population. The literature (Norton 1989, Lunney et al 1990, and Norton and Neave 1990) and evidence from the nearby Murrah Forest (South East Forests Conservation Council 1998) all suggest koalas prefer more undulating habitat. Hence the higher proportion of steeper slopes in the Murrabrine area may mitigate against its ability to sustain a koala population.

Figure 4 shows the distribution of slope classes in the Murrabrine Forest. Figure 5 provides a comparison of slope classes between the Murrabrine and Murrah Forests.

Disturbance

Clearing and grazing

As is case with virtually all of the Bega Valley almost all forest on private land in the study area in undulating areas appears to have been cleared or heavily disturbed. Some of this has regrown in recent decades, presumably because agriculture activity has declined in this more remote part of the region (Figure 6).

Figure 6 shows the age class of forest on private land in the study area.

Logging

Intensive logging has occurred in the Yowrie River area of Murrabrine Forestprobably within the past 15 years. Assessment by the survey team indicated that the areas logged are more extensive than the data (Figure 7) on logged areas supplied by State Forests NSW for the Eden Regional Forest Agreement suggest.

Figure 7 shows the SFNSW and API data on areas logged in the Murrabrine Forest.

Fire

Severe wildfires have occurred in the area apparently both in 1952 and 1968 (Rob Pearson pers. comm.). Patches of forest in survey areas 4 & 7 are regrowth, probably from the 1952 fire.

Large rabbit population

Extensive evidence of rabbits (diggings and dung) was encountered in almost all survey areas.

Predators

Three fox (*P. perigrines*) scats were collected during the survey. All of these were from the upper slopes. Signs by the Pastures Protection Board indicated that predator baiting has been recently undertaken. The low number of scats suggest that this has been effective, particularly at lower altitudes.

FIGURE 4. SLOPE CLASSES IN THE MURRABRINE FOREST

FIGURE 5. SLOPE CLASSES IN MURRABRINE AND MURRAH FORESTS

FIGURE 6. FOREST AGE CLASS ON PRIVATE LAND IN THE STUDY AREA

FIGURE 7. SFNSW DATA ON AREAS LOGGED IN MURRABRINE FOREST

CONCLUSIONS AND RECOMMENDATIONS

Further surveys

Reasons for undertaking further surveys

Assessing whether koalas survive in the study area is probably one of the more important tasks of the survey component of the recovery program. This is for the following reasons:

- A relatively large remnant of the koala population occupying the fertile valley areas of the region appears to have persisted there longer than other areas around the edge of the Bega Valley and may still be surviving;
- The general area has relatively extensive remnant patches of lowland eucalypt vegetation, much of it in riparian zones. Although this is mainly regrowth, some of it is quite advanced and would probably provide suitable habitat for koalas should koala numbers start to recover;
- There are few or no data on the eucalypt species likely to be important for koalas in this area, particularly for *E. baueriana*, *E. maidenii* and *E. viminalis*. To locate active sites where these species are being used and collect data on browse preferences would be a major contribution to increasing our knowledge of koala habitat use in the region.

Suggested survey method

Because the survey technique used in this study failed to find evidence of koalas there is a case to augment this approach by undertaking taped calls in the study area. This would be particularly appropriate as the 1997 study recorded four callback responses in the general area. Thus some baseline data has already been collected using this technique. To repeat the survey in this area after a three year interval may provide useful data on population trends and distribution.

We also recommend that follow-up searches for koala faecal pellets are immediately undertaken in areas where positive responses occur. This may help to gain important data on feeding and habitat preferences and establish whether the response came from a lone male or a member of a breeding association. It may also provide a test whether this combination of survey techniques (using taped calls and searching for koala faecal pellets in and near to areas where a positive response is gained) is more effective than the method used in this study.

There are concerns about the impact that taped koala calls might have on a small and vulnerable population; that it might disrupt social interaction by frightening off young males, cause dominant males to chase phantoms and attract females who might therefore miss a breeding event.

Probably the impact on males would not be significant; possibly less than that of several human “predators” searching for their faecal pellets. However the impact on potential breeding females may be important. A breeding female may be disorientated by a taped call and could miss a breeding encounter. This may be particularly the case with low density populations such as the one(s) that survive(s) in this region where koalas have widely spaced home ranges and may travel long distances for breeding. One way to reduce the risk of this occurring would be to undertake taped calls towards the end of the breeding season.

Because of the concerns about the use of this method it would be preferable that an officer from the Threatened Species Unit was present when the calls are played and a careful assessment made of its use at the end of the project.

In view of the above we therefore recommend that the taped koala calls are played in the late spring of 2000 at those locations where they were played in 1997. A larger number of people should be at each taped call location than was the case in 1997 (two only) who should be spread over a wider area. An officer from the Threatened Species Unit should be present. Intensive follow-up surveys for koala faecal pellets should be undertaken wherever a positive response is gained.

Contacting landholders
Landholders in the study area should be contacted and informed about the koala recovery program and the potential importance of the population in the study area. They should be given information about the socio-ecology of koalas and asked to report any information they have about koalas in the area.

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APPENDIX 1

FLORISTIC DATA FOR MURRABRINE SURVEY AREAS

The following tables provide floristic data for transects which were searched for koala scats in the former Murrabrine State Forest, now part of Wadbilliga National Park. Sites 1-5 were at the northern end of the Park, accessed via Murrabrine Road and New England Fire Trail. Sites 6-8 were on the north eastern side, accessed via the Illawambra Fire Trail.

Plant species lists for each transect are not exhaustive, but do include all the most common species in the vicinity. They were required principally to determine the forest type (as defined by Keith and Bedward 1999) at each location. In some cases the vegetation fell readily into one of the Keith & Bedward types, and in others appeared to be intermediate between one or more types.

Note:
In the following tables abundance score indicates relative abundance of each species where it occurred, not for the entire transect (i.e. for most species distribution was patchy within each transect).
Cover Abundance Scale (modified Braun-Blanquet):

1 few individuals < 5%
2 many individuals and < 5%
3 5 - <20% cover
4 20 - <50% cover
5 50 - < 75% cover
6 75 - 100% cover
* indicates an introduced species

1. TRAPYARD CREEK UPSTREAM FROM MURRABRINE ROAD

Site location: south-western bank of Trapyard creek for about 400m upstream from Murrabrine Road crossing.
Floristic assemblage identified as: Bega Wet Shrub Forest (type 19) along the creek bank, grading into a drier floristic assemblage on the lower slopes, which could not be classified (second species list provided below for lower slopes).

Species	**Abundance****
Trees	
Acacia mearnsii (black wattle)	3
Eucalyptus angophoroides (apple-topped box))	3
Eucalyptus baueriana(blue box)	1
Eucalyptus botryoides (southern mahogany)	1
Eucalyptus elata (river peppermint)	3
Eucalyptus radiata (narrow-leaved peppermint)	3
Eucalyptus viminalis (manna gum)	3
Shrubs	
Bursaria lasiophylla	1
Cassinia trinerva	1
Coprosma quadrifida	1
Exocarpos strictus	1

Hibbertia aspera	1
Hymenanthera dentata	1
Leucopogon juniperinus	1
Leucopogon lanceolatus	1
Notelaea venosa	1
Ozothamnus diosmifolius	1
Prostanthera lasianthos	1
Grasses	
Entolasia marginata	1
Imperata cylindrica	1
Microlaena stipoides	2
Oplismenus imbecillis	2
Poa meionectes	3
Graminoids	
Carex appressa	1
Lomandra longifolia	2
Ferns	
Adiantum aethiopicum	1
Asplenium flabellifolium	1
Doodia aspera	3
Pellaea falcata	3
Pteridium esculentum (bracken)	2
Climbers	
Billardiera scandens	1
Clematis glycinoides	2
Eustrephus latifolius	1
Geitonoplesium cymosum	1
Glycine clandestina	2
Rubus parvifolius	2
Forbs	
Acaena novae-zelandiae	1
Ajuga australis	1
Arthropodium milleflorum	1
Austrocynoglossum latifolium	1
Brachycome angustifolia	1
Cymbonotus sp.	1
Cynoglossum australe	1
Daucus glochidiatus	1
Desmodium gunnii	2
Dianella tasmanica	2
Dichondra repens	1
Euchiton gymnocephalus	2
Galium binifolium	1
Galium propinquum	1
Geranium sp.	2
Glycine clandestina	2
Hydrocotyle laxiflora	2
Hypericum gramineum	1
**Hypochaeris radicata*	1
Lagenifera stipitata	1

Plantago debilis	1
Pratia purpurascens	2
Ranunculus sp.	2
Senecio linearifolius	4
Solanum pungetium	1
Stellaria flaccida	2
Stellaria pungens	1
Urtica incisa	1
Veronica calycina	2
Viola betonicifolia	1
Viola hederacea	2
Wahlenbergia gracilis	1

Lower slopes, drier floristic assemblage:

Species	**Abundance****
Trees	
Allocasuarina littoralis (black sheoak)	4
Eucalyptus angophoroides (apple-topped box))	3
Eucalyptus globoidea(white stringybark)	1
Eucalyptus radiata (narrow-leaved peppermint)	3
Eucalyptus sieberi (silvertop ash)	1
Shrubs	
Bursaria lasiophylla	1
Exocarpos strictus	1
Hibbertia aspera	2
Hibbertia diffusa	1
Leucopogon juniperinus	1
Leucopogon lanceolatus	2
Notelaea venosa	1
Persoonia linearis	1
Grasses	
Austrostipa rudis	3
Entolasia stricta	2
Microlaena stipoides	2
Graminoids	
Lomandra longifolia	2
Ferns	
Pteridium esculentum (bracken)	2
Climbers	
Billardiera scandens	1
Marsdenia rostrata	1
Forbs	
Desmodium gunnii	1
Dianella caerulea	1
Dianella tasmanica	2
Gonocarpus tetragynus	2
Lagenifera stipitata	2
Opercularia aspera	1

2. MURRABRINE ROAD ABOUT 2 KM SOUTH-WEST FROM TRAPYARD CREEK CROSSING

Site location: top of low ridge running west from Murrabrine Road towards New England Creek, between the road and private property boundary (about 200m)
Floristic assemblage identified as:

Species	**Abundance****
Trees	
Acacia mearnsii (black wattle)	4
Angophora floribunda (rough-barked apple)	1
Brachychiton populneus (kurrajong)	1
Eucalyptus angophoroides (apple-topped box))	3
Eucalyptus cypellocarpa (monkey gum)	1
Eucalyptus globoidea (white stringybark)	3
Eucalyptus radiata (narrow-leaved peppermint)	
Exocarpos cupressiformis (native cherry)	3
Shrubs	
Breynia oblongifolia	2
Bursaria lasiophylla	1
Cassinia trinerva	1
Coprosma quadrifida	1
Elaeocarpus reticulatus	1
Hibbertia aspera	3
Hibbertia diffusa	1
Hymenanthera dentata	1
Leucopogon lanceolatus	1
Notelaea venosa	2
Ozothamnus diosmifolius	1
Persoonia linearis	1
Pittosporum revolutum	
Pittosporum undulatum	1
Santalum obtusifolium	1
Zieria smithii	1
Grasses	
Austrostipa rudis	3
Microlaena stipoides	3
Oplismenus imbecillis	2
Poa meionectes	3
Graminoids	
Lomandra longifolia	1
Lomandra multiflora	1
Ferns	
Blechnum cartilagineum	1
Doodia aspera	1
Climbers	
Glycine clandestina	1
Marsdenia rostrata	1
Forbs	
Brachycome angustifolia	1
Desmodium gunnii	2
Dianella tasmanica	1

Dichondra repens	1
Hydrocotyle laxiflora	2
Lagenifera stipitata	2
Pratia purpurascens	2
Schelhammera undulata	1
Viola hederacea	2

3. NEW ENGLAND CREEK FIRE TRAIL BETWEEN TWO FORDS

Site location: adjacent to New England Creek between two fire trail fords (about 100m)
Floristic assemblage identified as: Bega Wet Shrub Forest (type 19)

Species	**Abundance****
Trees	
Acacia mearnsii (black wattle)	4
Eucalyptus cypellocarpa (monkey gum)	1
Eucalyptus elata (river peppermint)	4
Eucalyptus viminalis (manna gum)	1
Rapanea howittiana (muttonwood)	1
Shrubs	
Breynia oblongifolia	3
Hedycarya angustifolia	1
Hymenanthera dentata	1
Phyllanthus gunnii	1
Pomaderris aspera	1
Prostanthera lasianthos	1
Grasses	
Entolasia marginata	1
Oplismenus imbecillis	1
Poa ensiformis	1
Graminoids	
Carex appressa	1
Lomandra longifolia	1
Ferns	
Adiantum aethiopicum	1
Dennstaedtia davalloides	1
Doodia aspera	2
Hypolepis glandulifera	1
Pellaea falcata	4
Polystichum proliferum	2
Pteridium esculentum (bracken)	1
Climbers	
Glycine clandestina	2
Rubus parvifolius	1
Tylophora barbata	1
Forbs	
Austrocynoglossum latifolium	3
Desmodium gunnii	1
Dichondra repens	1
Geranium sp.	2

Hydrocotyle laxiflora	2
Ranunculus sp.	1
Rubus rosifolius	3
Senecio linearifolius	1
Solanum pungetium	2
Stellaria flaccida	3
Stellaria pungens	1
Urtica incisa	1

4. NEW ENGLAND FIRE TRAIL 700M SOUTH OF SECOND FORD

Site location: 200m up slope south-east from New England Fire Trail

Floristic assemblage identified as: one of *E. sieberi* dominated types (48, 49 or W1), fire regrowth with nearly all trees about 40 years old or less, grading into a slightly wetter floristic assemblage which could not be categorised downslope (the latter presented as a separate list).

Drier *E. sieberi* floristic assemblage:

Species	**Abundance****
Trees	
Allocasuarina littoralis (black sheoak)	1
Angophora floribunda (rough-barked apple)	1
Eucalyptus sieberi (silvertop ash)	4
Shrubs	
Acacia obtusifolia	2
Bossiaea buxifolia	1
Correa reflexa	1
Hibbertia aspera	3
Hibbertia diffusa	2
Indigofera australis	1
Leucopogon lanceolatus	2
Lomatia ilicifolia	2
Oxylobium ilicifolium	2
Persoonia linearis	1
Tetratheca thymifolia	1
Grasses	
Entolasia stricta	1
Microlaena stipoides	2
Poa meionectes	3
Graminoids	
Lepidosperma laterale	1
Lomandra longifolia	1
Ferns	
Pteridium esculentum (bracken)	3
Climbers	
Glycine clandestina	1
Kennedia rubicunda	2
Forbs	
Corybas aconitiflorus	1
Dianella caerulea	2
Pratia purpurascens	1

Scaevola ramosissima	1
Schelhammera undulata	2
Stylidium graminifolium	2
Viola betonicifolia	1

Wetter forest type downslope:

Species	**Abundance****
Trees	
Acacia mearnsii (black wattle)	3
Allocasuarina littoralis (black sheoak)	1
Angophora floribunda (rough-barked apple)	3
Eucalyptus cypellocarpa (monkey gum)	1
Eucalyptus globoidea (white stringybark)	3
Eucalyptus sieberi (silvertop ash)	1
Shrubs	
Bedfordia arborescens	1
Bursaria lasiophylla	1
Elaeocarpus reticulatus	1
Hibbertia aspera	3
Hibbertia diffusa	2
Leucopogon lanceolatus	2
Persoonia linearis	1
Grasses	
Microlaena stipoides	3
Oplismenus imbecillis	1
Poa meionectes	3
Graminoids	
Lomandra longifolia	1
Lomandra multiflora	1
Ferns	
Pteridium esculentum (bracken)	1
Climbers	
Glycine clandestina	1
Forbs	
Ajuga australis	1
Desmodium gunnii	2
Gonocarpus teucrioides	2
Helichrysum elatum	1
Hydrocotyle laxiflora	1
Lagenifera stipitata	1
Pratia purpurascens	1
Schelhammera undulata	2
Viola betonicifolia	2
Viola hederacea	1

5. UNNAMED TRACK EAST OF NEW ENGLAND/RAZORBACK FIRE TRAIL JUNCTION

Site location: broad ridge top for 200m east of where New England Fire Trail turns south again after meeting Razorback Fire Trail

Floristic assemblage identified as: one of *E. sieberi* dominated types (48,49 or W1) but wetter than usual due to high elevation and sheltered site between two ranges.

Species	**Abundance****
Trees	
Eucalyptus globoidea (white stringybark)	1
Eucalyptus sieberi (silvertop ash)	4
Shrubs	
Acacia obtusifolia	2
Bursaria lasiophylla	1
Elaeocarpus reticulatus	1
Hibbertia aspera	3
Leucopogon lanceolatus	2
Lomatia ilicifolia	1
Grasses	
Microlaena stipoides	1
Poa meionectes	1
Graminoids	
Lomandra confertifolia ssp similis	2
Xanthorrhoea concava	1
Ferns	
Blechnum cartilagineum	1
Pteridium esculentum (bracken)	4
Climbers	
Hibbertia dentata	2
Kennedia rubicunda	2
Smilax australis	1
Tylophora barbata	1
Forbs	
Desmodium gunnii	1
Dianella caerulea	2
Dianella tasmanica	1
Goodenia ovata	1
Opercularia aspera	1
Schelhammera undulata	2
Viola hederacea	1

SITE 6. ILLAWAMBARA FIRE TRAIL 1.6 KM NORTH EAST OF MURRABRINE FIRE TRAIL.

Site location: double spur and gully area draining northwest from Illawambra Fire Trail, 1.6 km north east of junction with Murrabrine Fire Trail
Floristic assemblage identified as: probably type 35, though presence of *E. baueriana* is unusual

Trees	
Acacia falciformis	2-3
Acacia mearnsii	3
Eucalyptus baueriana	1
Eucalyptus cypellocarpa	1
Eucalyptus elata	1
Eucalyptus fastigata	2
Eucalyptus globoidea	3
Eucalyptus maidenii	3
Eucalyptus seiberi	1
Shrubs	
Bursaria spinosa	
Bedfordia arborescens	
Correa reflexa	
Hakea erianthia	
Indigophora australis	
Olearia argophylla	
Oxylobium ilicifolium	
Persoonia linearis	
Pimelea axiflora	
Pittosporom revolutum	
Pomaderris aspera	
Grasses	
Poa meionectes	
Graminoids	
Lomandra longifolia	
Ferns	
Adiantum formosum	
Blechnum nudum	
Calochlaena dubia	
Cyathea australis	
Pellaea falcatta	
Pteridium esculentum	
Climbers	
Smilax australis	
Eustrephus latifolius	
Forbs	
Billardiera scandens	
Brachycome sp.	
Desmodium varians	
Dichondra repens	
Geranium potentilloides	

Geitonoplesium cymosum	
Gahnia seiberiana	
Glycine clandestina	
Goodenia ovata	
Helichrysum bracteatum	
Helichrysum white form	
Hydrocotyle laxiflora	
Lepidosperma sp	
Menthe sp	
Oxalis sp..	
Plantago sp.	
Platysace lanceolota	
Rubus parvifolius	
Solanum sp.	
Senecio linearifloius	
Tylophora barbata	
Veronica sp.	
Xanthorrhoea sp.	
Zeira smithii	

7. ILLAWAMBARA FIRE TRAIL 3.1 KM NORTH EAST OF MURRABRINE FIRE TRAIL

Site location: long spur northwest from Illawambra Fire Trail, 3.1 km north east of junction with Murrabrine Fire Trail
Floristic assemblage identified as: probably type 35, though presence of *E. baueriana* is unusual

Trees	
Acacia falciformis	2
Acacia mearnsii	3
Acacia melanoxylon	1
Eucalyptus baueriana	2
Eucalyptus bosistoana	1
Eucalyptus cypellocarpa	1
Eucalyptus elata	1
Eucalyptus fastigata	2
Eucalyptus globoidea	3
Eucalyptus maidenii	3
Shrubs	
Bursaria spinosa	
Cassinia aculeata	
Cassinia trinerva	
Indigophora australis	
Pimelea axiflora	
Pittosporom revolutum	
Pomaderris aspera	
Grasses	
Poa meionectes	
Graminoids	

Lomandra longifolia	
Lepidosperma lateral	
Lepidosperma sp.	
Ferns	
Blechnum nudum	
Cyathea australis	
Pellaea falcatta	
Pteridium esculentum	
Climbers	
Eustrephus latifolius	
Clematus aristata	
Smilax australis	
Forbs	
Desmodium varians	
Dichondra repens	
Geranium potentilloides	
Geitonoplesium cymosum	
Gahnia seiberiana	
Glycine clandestina	
Goodenia ovata	
Helichrysum bracteatum	
Hydrocotyle laxiflora	
Menthe sp	
Oxalis sp..	
Rubus parvifolius	
Solanum sp.	
Senecio linearifloius	
Tylophora barbata	
Veronica sp.	
Xanthorrhoea sp.	

8. NORTH WEST OF JUNCTION OF ILLAWAMBARA AND MURRABRINE FIRE TRAILS

Site location: two spurs and gully northwest from junction of Illawambra and Murrabrine Fire Trails
Veg type identified as: probably type 10

Botanical data not collected at this survey area