

Koala Management Plan: Eden Management Area

State Forests of NSW



1. INTRODUCTION	3
2. SPECIES INFORMATION	3
2.1. CURRENT CONSERVATION STATUS.....	3
2.1.1. <i>Legislative Status</i>	3
2.1.2. <i>Reasons for Conservation Status</i>	4
2.2. DESCRIPTION AND TAXONOMY.....	4
2.2.1. <i>Taxonomy</i>	4
2.2.2. <i>Description</i>	5
2.3. DISTRIBUTION.....	5
2.4. MANAGEMENT AREAS.....	7
2.5. TENURE.....	8
2.6. CRITICAL HABITAT.....	8
2.7. SIGNIFICANT HABITAT.....	8
3. LIFE HISTORY	9
3.1. LIFE CYCLE.....	9
3.2. ECOLOGY.....	9
3.3. SOCIAL STRUCTURE AND FECUNDITY.....	10
3.4. DISTURBANCE REGIMES.....	10
3.5. POPULATION.....	11
3.6. HABITAT AND DIET.....	12
4. CURRENT EX-SITU PROGRAMS	13
5. RELEVANT LEGISLATION	13
6. MANAGEMENT ISSUES	14
6.1. THREATS.....	14
6.2. CONSIDERATION OF SOCIAL AND ECONOMIC CONSEQUENCES.....	15
6.3. BIODIVERSITY BENEFITS.....	16
6.4. PREVIOUS ACTIONS UNDERTAKEN.....	16
6.5. SPECIES ABILITY TO RECOVER.....	17
6.6. ALTERNATIVE MANAGEMENT STRATEGIES.....	17
6.7. COMMUNITY INVOLVEMENT.....	17
7. SPECIES MANAGEMENT PLAN	18
7.1. OBJECTIVES OF THE MANAGEMENT PLAN.....	18
7.2. RECOVERY ACTIONS.....	18
7.3. PRIORITISATION OF TASKS AND IMPLEMENTATION.....	20
7.4. PERFORMANCE INDICATORS.....	20
7.5. IMPLEMENTATION OF THE MANAGEMENT PLAN.....	22
7.6. PREPARATION DETAILS.....	22
8. CONTACTS: JIM SHIELDS, NATIVE FOREST DIVISION, STATE FORESTS	23
9. REFERENCES	23
10. APPENDIX 1	27
11. APPENDIX 2	35

Koala Management Plan: Eden Management Area

1. Introduction

In the Eden Management Area EIS (1994), one of the conditions of approval was the preparation of a management plan for the Koala *Phascolarctos cinereus*. This document has been prepared for compliance with that part of the EIS determination. It is based on site specific research, community input, and the philosophy espoused in Commonwealth and New South Wales endangered species legislation. It is intended that this document form the basis for the immediate management of koala populations in the Eden Management Area, and that it should lead to the formation of a Management Team to formalise this document into a Management Plan following the principles of the NSW Threatened Species Conservation Act.

2. SPECIES INFORMATION

2.1. Current Conservation Status

2.1.1. Legislative Status

The Koala is listed as:

- Threatened by the Commonwealth Government (Endangered Species Act). Threatened is the less sensitive of two categories, and indicates that the species in question is in danger of becoming Endangered. Endangered, as a category, indicates that the species is in danger of becoming extinct. Endangered Status was proposed for the Koala by the AKF in 1996 and this proposal was rejected.
- Threatened by the NSW Threatened Species Conservation Act. The definitions are the same as for Commonwealth Listings.
- In Victoria, the Koala is not listed in any category; Menkhorst 1996, states that the Koala is not endangered in that state and that control measures may be necessary in areas with high Koala populations as release sites become limited for translocation programs.
- On the International Union for the Conservation of Nature Red Lists, the Koala is listed as “near threatened”, not a status requiring action under the categories defined by the IUCN.

- The Koala is not on listed in the Foreign Species section of the United States Endangered Species Act, although many Australian species are.

2.1.2. Reasons for Conservation Status

The Koala was once common in the southeast of NSW, and the historical status is reviewed in depth by Lunney and Leary (1988). The Koala population in the Bega Valley grew to a high level in the late nineteenth century before crashing in the first decade of the twentieth century. The precipitous and permanent decline at that time was caused by clearing of the valley vegetation, especially *Eucalyptus tereticornis*, for farmland (Lunney and Leary 1988).

A comparison of koala records from three surveys using questionnaires in 1949, 1975 and 1986 (Reed et al 1990) shows an increasing distribution of records in the Eden Management Area. Lunney et al (1997) suggest that koala numbers in the Eden region have been constantly low for the last four decades.

The major arguments for concern about the status of the Koala at Eden can be summarised as follows:

- possible long term effects of timber harvest
- known decline due to clearing for agriculture in the late 19th and early 20th century
- known decline due to commercial harvest in the late 19th and early 20th century
- probable high mortality rate during catastrophic wildfires 1930 - 1983
- predation by feral canids
- development of a roaded infrastructure throughout coastal parts of the EMA for high speed traffic
- development of a dual carriage-way barrier in the form of the Princess Highway
- increased development in the coastal belt for rural residences and hobby farms
- increased suburban and recreational development
- increased predation by dogs associated with the previous two factors
- increased regime of catastrophic wildfire in reserves and wilderness areas

2.2. Description and Taxonomy

2.2.1. Taxonomy

The Koala is an arboreal foliovore, and the single living species contained in the Family PHASCOLARCTIDAE. Its closest living relatives are the terrestrial herbivores in the Family VOMBATIDAE, the Wombats.

Taxonomic Significance

Koalas at Eden are morphologically intermediate between Queensland and Victorian koalas (Jurskis and Potter 1997). Their genetic diversity is similar to other natural populations and greater than the diversity in artificial populations (ibid). It has been put forward that the koalas in the southeast forests are, in some way, genetically distinct from other forms of the koala. There has been no indication of this in the genetic samples taken thus far. Although limited in size, the sample is clearly large enough to pick up any genetic uniqueness at the sub-specific level. There is no indication that any alleles or genetic heterogeneity amongst the southeast Koalas are significantly different than any other free ranging population.

The southeast population nevertheless maintains genetic continuity of the species through this geographic portion of the species' range. It may be desirable to increase the genetic diversity of the local population through introduction of new gene stock at some time in the future. Conversely, the southeast koalas may provide a source of genetic variability for other populations across the range as more comprehensive management plans are drawn up for the species.

There are no detectable morphological differences between the southeast forest koalas and other nearby populations (but see below for changes in morphology across the range).

2.2.2. Description

The pelage is grey to grey brown above, white below, and varies from thick and dense in southern animals to sparse and light in northern populations. The Koala demonstrates Allen's rule - larger animals are found in the south (male weight 11.8 k mean) and smaller animals occur in the north (male weight 6.5 k mean) (Martin 1988). The fore and hind limbs, manus and pes are adapted to climbing, although the Koala travels well on the ground by a bounding gait (similar to that used climbing trees) and by quadrupedal walking.

2.3. Distribution

Found from tropical northern Queensland to South Australia (historically), the Koala has one of the widest distributions of Australian arboreal marsupials, and is found in a correspondingly wide variety of habitats (Melzer 1994). It has been recorded in recent times in high altitude alpine forests (Kosciusko National Park, Webster and Belcher, pers com), as well as moist coastal forests, sub humid woodlands and eucalypt communities fringing water courses in semi arid areas (Melzer 1994).

As a species, the range has generally remained the same in areas since European settlement (Gall 1978, Lunney et al 1997). However, the continuity of its distribution has been disrupted by agricultural or urban development (Phillips 1990).

A further change is the extension of the range into areas where the Koala was not found prior to European settlement. These areas are primarily in South Australia, and the most notorious one at present is that of Kangaroo Island. The populations on this, and other islands have built up to the point where they exceed carrying capacity, and food resources are being destroyed (Possingham et al 1996).

In the Eden area, high density populations were found in river valleys until the first decade of the twentieth century (Lunney et al 1988). These high density populations were found in woodland and forest on the fertile soils of the Bega, Toowoomba and Pambula river valleys (ibid).

Extensive wildlife surveys in the Eden region since 1970 have produced few records of koala (Jurskis et al 1994) as have koala specific playback surveys and intensive prelogging koala surveys (Jurskis and Potter 1997). Community surveys reported breeding populations on Tantawangalo State Forest (Allen 1995). A postal survey in 1994 was reported by Lunney et al (1997). Most field surveys have been carried out by State Forests and Community surveys have also concentrated on State Forests. There has been little survey effort on private lands or NPWS lands (Jurskis and Potter 1997). The formal surveys conducted on NPWS tenure (Newsome et al 1983, Lunney 1985) did not target koalas, or make specific searches for the species, and consequently it is not surprising that none have been located in these studies.

Koalas have been most frequently reported from Tantawangalo-Yurramie and Bermagui-Murrah State Forests but records are widespread throughout the region (Lunney et al 1997) and it is likely that low density populations extend through the escarpment forests from Victoria to the Hunter River and thence further north into New South Wales (Jurskis and Potter 1997). Recent survey efforts (Sept-Oct. 1997) have confirmed the spread of Koalas in the southeast from Wadbilliga N.P. and Nimmitabel in the northwest through Murrabrine S.F. and Bermagui in the northeast to Nadgee and Nalbaugh in the southeast and southwest, respectively (SEKRC Survey, 1997, unpubl data).

Previous surveys have been largely associated with forestry activities. Records are shown in Map 1. Community surveys in the late 1980s recorded Koalas in the Tantawangalo area. Subsequent surveys have detected Koalas in Yurramie State Forest and in the Bermagui-Murrah State Forest area. Incidental records have indicated the presence of the Koala on private property and in National Parks (Mimosa Rocks, Bournda Nature Reserve) but there has been little active investigation of these sites. The vast majority of the National Park estate has not been surveyed for Koalas (with the exception of recent areas converted from State Forest to National Park). The Tantawangalo and Yurramie State Forest Koala areas are deferred from harvesting, or have been converted to full reserve tenure (as at July, 1997). Consequently, the major population within State Forest tenure is in the Bermagui-Murrah State forest area.

Populations of Koalas are known from areas adjacent to the Eden Management Area. There is a well documented population in Vacant Crown Land near Numeralla. A

Koala was removed from a utility pole in Numeralla township in November 1996 (Cooma Express, November, 1996) by NPWS personnel. The SEFCC Koala survey team located koala scats in this area in 1997 (Allen, pers. com.) The Koala is known to occur in Kosciusko National Park (Belcher and Webster pers com 1994), where they were recorded by NPWS pre-burning surveys. There are other known populations on the periphery of Kosciusko.

Recent SFNSW playback surveys in Bermagui Nature Reserve and Wallaga Lake National Park, directly to the north of the EMA, detected 9 Koalas in September-October 1996 (Jurskis and Potter 1997, SFNSW Fauna Data Base, Narooma District). Other surveys (1993-96) have recorded 204 Koala observations in Narooma District, most from the northern (non-EMA) parts of that forestry unit. Included in these are records at Dignams Creek, which is also a location known from local anecdotal records, historical records and recent surveys.

Further to the north, Koalas have been recorded near Mossvale (SFNSW Data Base, Southern Region) in two locations on the escarpment and in the upper Nepean catchment (Tilley & Uebel 1990). After the January, 1994 bushfires in Royal National Park, a Koala was recorded there by NPWS personnel (Sydney Daily Telegraph, February 1994). There is a well known population at Campbelltown (Sheppard 1990), and there are remnant populations in the northern parks of the Sydney Metropolitan areas (Curtin and Lunney 1995). The urban populations are extremely endangered or very recently extinct (Smith 1996).

There is a continuous forested link between the northern EMA records and Royal National Park. The link is primarily reserve tenure (Dua, Morton, Wadbilliga National Parks). These reserves have had no targeted surveys for koalas until recently, although Catling and Burt (1994) did not record koalas during surveys in this region, W. Braithwaite (pers. com.) record them in low numbers (1/1000 hr spotlight) during surveys for other arboreal marsupials. Prelogging surveys in Batemans Bay have not recorded the Koala on State Forest. However, it is likely that the Koala occurs in low numbers throughout the forest estate in the areas between Narooma and Royal National Park, in that there are no differences in threatening processes or habitat quality (in general terms) within that region.

A continuous forest link may not be a definitive indication of a continuous link in koala habitat, and it could be argued that habitat quality is variable throughout the areas linking southeast forests with those to the north. However, the forest types and vegetation associations are similar, the climate is the same or warmer, and there are no indications of other factors at work (disease, high predation, unusual human activity or occupancy) to create a discontinuity. This is particularly true since a large proportion of the forests concerned are in Reserve tenure.

2.4. Management Areas

This plan is defined by the State Forests Eden Management Area. Contained within that geographic area are the following local government units:

Bombala Shire
 Bega Shire
 Eurabodalla Shire
 Cooma-Monaro Shire

2.5. Tenure

Within the Southeast Forests area, the major land holders are SFNSW and NPWS. Although boundaries are currently in flux, the general breakdown is as follows:

SF - 202 00 ha
 NPWS - 210 000 ha
 Private forest - 101 000 ha

Cleared or urban private property and Crown Lands account for the remainder of the management area.

Virtually all areas that contained high quality habitat are on private property (IAP Mapping Project 1996).

Records compiled in Lunney et al 1997 indicate that about 38% of recent Koala records come from private property, 45 % from State Forest and the 17% from nature reserves. The records from State Forest were obtained prior to the dedication of the new national parks, so the percentage on reserve tenure has increased.

2.6. Critical Habitat

The TSC Act 1995 does not provide for the definition of critical habitat for species on Schedule 2, which is where the Koala is listed. State Environmental Protection Policy 44 lists koala tree species and habitats, but none listed are found in the Eden Management Area to any extent at present. Forest Red Gum is listed in SEPP 44, and it was once "critical habitat" (in the ecological rather legal sense) in the EMA.

2.7. Significant Habitat

The work of Jurskiss and Potter (1997), Lunney (1997) and preliminary results from studies by community groups have all indicated the importance of dry forest containing *E. cypellocarpa*. At Murrah-Bermagui, containing Woollybutt *E. longifolia* or Yertchuk (*E. consideniana*) may be important as well as spotted gum forests (Jurskis and Potter 1997).

Heuristically, the gently undulating river valleys which were dominated by *E. tereticornis*-*Angophora floribunda* were critical habitat for the Koala in the region (Lunney and Leary 1988). It is known that these areas contained high Koala populations before they were cleared. Historical evidence indicates that forests near the coast with Bangalay may have been highly used by the Koala, particularly near Kalaru (Evans and Evans 1987).

3. Life History

3.1. Life Cycle

The Koala breeds in spring and early summer. Males advertise/defend territories vocally with a series of grunts and bellows. In high density populations, male territories may overlap several female territories at this time. Specific trees may become important in these populations, as they are used repeatedly and traditionally for social contact (Sharp 1995). Although Mitchell's (1990) detailed study of social activity in koalas supported the observation that koalas in dense populations tend to use a few trees repeatedly it identified a significant correlation between the use of stand trees in only two pairs of koalas, one of which was a female, and her offspring. In low density populations social contact is infrequent (Jurskiss and Potter 1997), and males and females apparently move about relatively large territories to make contact during the breeding season.

The female gives birth to a single offspring. In harsh conditions, females may breed every other year. Given the breeding life of a female (3-5 years), there is the possibility of exponential increase in populations if there are no limiting factors, and this potential has been realised in several sites, notably French and Kangaroo Islands.

The young are independent after about twelve months and females usually breed during their second year (Lee and Martin 1988). Males must successfully compete with older males for access to females before they can breed (ibid).

Life expectancy of a Koala is around ten years. Predation and disease are major mortality factors. At Eden known mortality causes include predation by dog/dingo and the Powerful Owl and stochastic factors (death by spearing on a limb, entanglement in wire grass). It is probable that wildfires are significant mortality events, in that the Koala does not use any external structure for shelter and is inherently exposed to crown fires.

3.2. Ecology

The koala is associated with habitats dominated by trees of the genus *Eucalyptus*. In general, the koala is more closely associated with woodlands and open forests rather than closed forests (Phillips 1990), and optimal habitat appears to be woodlands rather than forests (CSIRO 1996, Melzer 1994) particularly in fertile soils (CSIRO 1996).

Koalas in NSW are generally associated with what are now agricultural lands (Reed et al 1990). In forests, the koala occurs frequently in areas subject to natural or human related disturbance (Braithwaite 1993, Kavanagh et al 1995, Jurskis and Potter 1997)

Dense koala populations are often associated with communities dominated by particular eucalypts species such as *E. viminalis* or *E. tereticornis* (Hindell and Lee 1987, Melzer 1994) although preference for individual tree species within these communities may not be apparent (Hindell and Lee 1988). Floristic associations may indicate preferred environments (Reed et al 1990) while individual tree species may be more important in sub-optimal environments (Jurskis 1997). Although population densities vary with habitat quality (Melzer 1994), low density populations can be self sustaining (Melzer 1994, White and Kunst 1990, Jurskis & Shields 1995).

3.3. Social Structure and Fecundity

Although the koala is a solitary species (Martin 1983), a mating system driven by male dominance hierarchies can be described (Mitchell 1990a). Dominant males move more often and further than other koalas and therefore compete more successfully for breeding opportunities than subordinate males (Mitchell 1990b).

Females may produce one young per year for about 10 years (Lee and Martin 1988). This is a relatively high reproductive rate for animals of this body size and longevity, and can lead to very rapid population expansion in areas of good quality habitat (eg Possingham et al 1996). In other areas population growth appears to be limited by dispersal and/or reduced fecundity associated with nutritional stress (Martin 1985) or disease (Gordon et al 1990, Mitchell et al 1989).

3.4. Disturbance Regimes

Under natural disturbance regimes (primarily fire), the koala is disadvantaged by the disturbance event itself, initially. That is, the fire may kill individual Koalas. Removal of foraging and shelter resources then further disadvantages the Koala after fire - there may be no fresh leaf for many kilometres around the survival site. This sequence of events has been well documented by animal care groups (eg Starr 1990). Following the fire, recovery of koala populations is a function of the amount of food and cover remaining, and the recovery of the forest canopy. In terms of canopy recovery, this can be a matter of days, weeks or months, depending on the severity of the fire, with Koala populations following the recovery curve (Tilley and Uebel 1990). However, recovery may be very good in the early years post fire.

Response to human caused disturbance follows a similar pattern. The disturbance event itself may harm individual Koalas, and recovery of populations is commensurate with recovery of habitat. Disturbance which is part of a permanent change in land use (forest to agriculture or urban developments) usually results in permanent changes to the Koala population (Phillips 1990). Forestry activities such

as logging or hazard reduction burning are not permanent changes to Koala habitat, and the size and direction of responses vary with the intensity of the operation. Clear felling of large blocks in a single event may have negative medium term impacts, whilst other less intense operations may have positive medium term impacts. No Before-After-Control-Impact (BACI) studies have been carried out in an experimental context but *apostieori* monitoring of radio collared Koalas at Eden has been carried out.

Two out of three koalas living in mosaics of logged and unlogged forest at Eden preferred logged coupes while the third showed no preference (Jurksis and Potter 1997). Another koala lived in regrowth forest created by heavily logging and TSI (Jurksis and Potter 1997). Kavanagh et al (1995) found that koalas in northern NSW forests were associated with heavily logged areas and plantations.

Braithwaite (1993) reported an association of koalas with disturbance including logging. Gordon et al (1990) found higher densities of koalas in regrowth Bimble Box *E. populnea* than in mature woodlands of the same species. Martin (1985) studied a dense koala population in a 30 year old regrowth forest while Gall (1980) studied a dense population in a 15 year old plantation. A comprehensive review (Braithwaite 1997) could find no association between logging disturbance and the decline of koala populations in the scientific literature.

Throughout the range, the Koala is found in a variety of seral stages of forest and woodland. In the west, the Koala is abundant in the Pilliga Scrub (Date 1993), which is regrowth from an area cleared for grazing in the late 19th century.

3.5. Population

Several estimates are available for the size of the total wild population of the Koala. It has been put at over a million animals by some authorities (Commonwealth Listing) and as low as 10 000 by others. The extremes are probably inaccurate, and a figure at the median of the range is more likely to be correct.

The National Koala Survey identified 3,145 sites containing koalas (Phillips 1996).

Populations in South Australia and Victoria continue to grow and despite some contractions of their range in NSW and Qld., koalas remain widespread and abundant (Phillips 1996). Phillips (1996) stated that koalas are not endangered according to IUCN definitions. However, the total population at present is well above thresholds set for imminent extinction (IUCN 1996).

In New South Wales, population estimates vary as for national populations. A conservative estimate would be 20 000 individuals. This is based on a conservative territory size (60 ha) and a conservative estimate of habitat (1 220 000 ha) within the State.

At Eden, population estimates have not been possible until recently. Allen (in lit 1996) has estimated the population at 30 to 150 animals for the Eden Management area (approx. 500 000 ha). The text did not explain the process for making this estimate. However, it appears to be an underestimate, in that in the study upon which that estimate was based, 28 Koala sites were located in a two month period, whilst a further 27 records were made in areas not sampled by the Community Survey (SFNSW Database, Narooma District). Thus, there were 55 records within a relatively small part of the EMA. Although each record does not equate to a Koala, it is reasonable to expect that at least half of them did, yielding a population of 25 animals within the one small subset of the EMA.

Jurskis and Potter (1997 draft) have made an estimate of population size based on mean home range (169 ha) and availability of dry forest types in the Eden Management area (260 000 ha). Assuming that 50% of these forests have no koalas they estimated that the population in the Eden area would be about 800 animals. An alternative calculation, based on mean MCP home range (495 ha) and all forest types (about 470000 ha), gave an estimated population of 1 000 adult Koalas. Jurskis and Potter (1997) put forward the opinion that the regional population is not isolated but is likely to be a subset of a larger population extending through the continuous belt of forests between east Gippsland and the Hunter Valley. Other authors have expressed different opinions, and contend that the population in the southeast is an isolate. Results of recent surveys support the position of Jurskis and Potter, with Koalas found from one end of the EMA to the other. The main discontinuity in distribution is across the Monaro Tablelands to the Kosciusko populations in the west.

3.6. *Habitat and Diet*

The Koala is restricted in nature to feeding on the leaves of trees found in forests, woodlands and plantations. In captivity it has taken a wide variety of foods (including cheese, chocolate and pine needles, J. Shields pers obs) and an artificial diet supplement has been developed by Hume and others (Pahl and Hume 1990).

To summarise the known factors, nutrient status in combination with the phenolic plant defenses present in the leaves determine the quality of the forage in the diet (Cork 1992). These characteristics vary between Eucalypt species, which normally form the bulk of the diet, and there is further variation within tree species according to the geographic distribution of the tree.

Specifically, Koalas prefer younger eucalypt leaves and there is a threshold of minimum moisture content and nitrogen content for preferred foliage (Pahl and Hume 1990). There is also a threshold level of essential oils in preferred leaves (Hume 1995). Preferred leaves have higher concentrations of crude protein, phosphorous and potassium and lower concentrations of fibre (Ullrey et al 1981). Preferred tree species have more simple sugars in their leaves and less complex sugars than less preferred species (Osawa 1993) Preferred species have more volatile oils and less heavy oils than other species (Hume 1995). These results had limited sample size and frequently

refer to studies conducted using captive animals. Therefore, generalisations to a wider context must be considered with caution.

A recent finding by Andrew Smith in northern NSW (*in litt* 1997) was that casuarina was highly ubiquitous in koala scats.

Jurskis (1996) suggested that the composition and thus the nutritional quality and palatability of eucalypt leaves will be affected by tree physiology which is influenced by environment and history as well as tree species. Melzer (1994) found that moisture content thresholds in fodder selection by koalas varied seasonally as did utilisation of tree species and communities.

White and Kunst (1990) considered that the importance of a few tree species to koalas was overstated. Hindell and Lee (1988) found that most koalas in preferred vegetation communities did not show tree species preferences. Melzer (1994) found no relationship between koala densities and densities of preferred tree species. Jurskis (1997) suggested that floristic composition (relative density) was a good indicator of preferred environments and that environmental and historical factors (as indicated by floristics and structure) are more important than tree species in determining habitat quality for koalas. In the Eden region koalas are associated with dry and disturbed forests (Jurskis and Potter 1997, Lunney et al 1997). Preferred tree species include monkey gum, Woollybutt and yertchuk (Jurskis and Potter 1997). Adult koalas prefer medium sized trees in the range 30 to 90 cm diameter at breast height (DBH) rather than very small or very large trees (Jurskis and Potter 1997).

4. Current ex-situ Programs

There are a wide range of ex-situ programs for Koala management. These range from international programs (colonies at Tokyo, San Diego Zoos) to small fauna parks in Australia (Yellow Pinch Wildlife Park near Bega has koala facilities) through introductions into the wild in areas outside the natural range of the Koala.

At present, there are no ex-situ programs which target the Koala population in south-eastern New South Wales.

5. Relevant Legislation

The legislation under which this management plan is prepared is the Environmental Protection Act, NSW. Other relevant NSW acts are the Threatened Species Conservation Act (1995), the National Parks and Wildlife Act (1974) and the Forestry Act (1916).

6. Management Issues

6.1. Threats

A variety of management issues affect the Koala populations in the EMA. The most well publicised is undoubtedly the interaction between the Koala and timber harvest activity. It has been variously put forward as theory that the Koala is detrimentally and intensively impacted upon by forestry activity, that forestry activity has no effect, and that forestry activity (specifically logging with koala prescriptions) has a positive effect.

State Forests has expended approximately \$180 K per annum on research to answer the questions surrounding logging effects since 1990. Although definitive answers are not at hand, statistically viable research results indicate that the Koala inhabits and successfully reproduces in regrowth forest.

Although less well publicised, far greater and less equivocal threats are those from wildfire, land clearance, disease and increased numbers of feral dogs associated with increased rural (hobby farm) residence.

Natural predation constitutes a threat to individuals. In pre-European times, predation by native people occurred. Dingos undoubtedly took individual animals, and probable predation by the Powerful Owl has been recorded in recent times (Jurkiss and Potter 1997).

Large scale wildfires have occurred over the past sixty years (Eden EIS 1994). These undoubtedly had detrimental effects on the populations of koalas in areas where they occurred as total crown removal fires. Since 1981, the rate of uncontrolled wildfire on State Forests has declined dramatically with changes to logging operations and increased access for fire suppression. (The large fires in 1983 started hundreds of kilometres away from the EMA, and were extinguished there). With increased areas of reserve and wilderness, and consequent road closures, it is certain that intensive wildfires will increase over the broad scale in the EMA, and decrease in areas near human habitation (eg. towns, camp grounds) unless specific measures are undertaken to change this scenario.

Disease (chlamydia) is known to be present, but not active, in current populations. In the past, disease has been recorded as a cause of decline in the EMA. Evans and Evans (1987, p. 55) write the following account of the Koala at Kalaru, describing the period from 1880 to 1980:

"There were plenty of koalas about then [1880], locals calling them monkey bears. Dad would tell us of people felling the saplings to get the bears, which were killed and roasted for the dogs.

A disease swept through the koala population in about 1900, killing most of them, some survived to build up their numbers; a few are still around today."

Although not possible to prove, it is highly likely that the Koalas that survived clearing and hunting were concentrated in localised areas, where populations built up beyond carrying capacity and disease broke out amongst animals in high density populations.

Direct killing of koalas by humans is still a possibility. It has been alleged that Koalas have been shot as a reaction to the controversy surrounding them in the currently volatile socio-economic situation. No evidence or direct testimony is available to substantiate these allegations, despite intensive enquires.

Collisions with road traffic will inevitably increase with the development of a dual carriage way for the Princess Highway and a high speed road infrastructure to service rural residential areas.

It has been put forward that die-back associated with Bell Miner (*Manorina melanophrys*) colonies and psyllid infestations are a possible threatening factor (Allen and Bertram *in litt*). As most such infestations occur in moist gully situations, where the Koala seldom forages (Jurskiss and Potter 1997), this threat appears tenuous. Dieback in Forest Red Gum remnants occurs in the Bega Valley. This is largely a function of the isolated nature of the stands and individual trees. It is easily remedied by active land management (excluding stock, appropriate water regimes).

6.2. Consideration of social and economic consequences

The social and economic consequences of Koala management have been, to date, largely negative. There are no tangible economic benefits associated with the current status quo for Koala management, and large economic losses have occurred in the form of timber mill closures at Eden and Nimmitabel. The details of these, and future, economic consequences are given in the Socio-Economic Report from the Interim Assessment Process conducted by the NSW State Government. Of course, not all job losses are solely as a result of the losses from the local economy caused by the Koala Moratorium areas and their subsequent dedication as national park, but the issue has been one of the primary driving factors behind the change in land tenure and resource availability.

There are positive economic consequences from the current management scenario in that forest management has been shown to be responsive to environmental values. Trade sanctions could be imposed if this were not the case. In the long term, tourism will benefit from the implementation of positive management actions detailed in this plan.

Socially, the issue of Koala management has created deep divisions within local communities. There has been no development of a sense of community involvement with Koala management, and the issue has been used to divide and polarise the local community. External to the EMA, the perception of the greater public is that the timber industry has been the major and sole cause of the decline of the Koala in the

EMA. This view is well documented in metropolitan newspapers (particularly the Sydney Morning Herald) and transcripts of broadcasts from the ABC 1989-1996.

6.3. Biodiversity benefits

Management of the Koala population in the EMA has had a minor impact on total biodiversity. The major effect has been associated with the reservation of known low density populations of the Koala on areas which were available for timber harvest. No endangered vegetation communities or fauna populations have received a demonstrable increase in security through Koala management, in that none of the known endangered communities or populations are associated with preferred Koala habitat in areas of public land tenure.

The measures put forward in this plan have wide ranging benefits to biodiversity. The grassy woodland and associated moist forest in riparian areas were habitat to a suite of species that are now endangered or extinct in the Eden Management Area. These include the Squirrel Glider *Petaurus norfolkensis*, the Southern Brown Bandicoot *Isodon obesulus*, the Rufous Bettong *Aepyprymnus rufus*, Tuan *Phascogale tapoatafa* and the Eastern Quoll *Dasyurus viverrinus*. Associated plant communities, primarily Forest Red Gum-Angophora woodlands and Casuarina-dominated riparian areas, would benefit from proposed measures for Koala management. Water quality, and fauna associated with such conditions, would also benefit.

6.4. Previous Actions Undertaken

Previous actions undertaken have primarily involved research, establishing moratoria on areas previously available for timber harvest, and the conversion of land tenure from multiple use forestry to nature reserve status. Research has generated methods for survey (call playback, scat searches and sweeps), methods to delineate home range (the asterisk survey), and population estimates.

Land management decisions based on Koala management have resulted in Moratoria on logging operations in approximately (9 000) ha of State Forest, and modified logging practices (including reservation of habitat) on a further 800 ha of State Forests. Burning practices and feral animal control have been altered or instituted respectively in Koala Moratorium areas of State Forests (Ridley 1993).

Koala management on other tenures (private property, the nature reserve system, VCL) is largely by default. State Environmental Protection Policy 44 relates to Koala management on private property, but is not generally applicable in the EMA. To be activated, SEPP 44 requires the presence of preferred forage species listed in the Policy. Forest Red gum *E. tereticornis* and Ribbon Gum *E. viminalis* are the only species on this list which also occur in the EMA.

No action has been taken with regard to SEPP 44 in the Eden Management Area., although there has been a case presented recently in the Land and Environment Court which involved this issue.

6.5. Species Ability to Recover

The Koala has a demonstrated ability to increase population rapidly in high quality habitat. In these areas, the reproductive potential (1 young per female per year, reproductive life of up to 10 years, Lee and Martin 1988) can be achieved, which leads to exponential population growth.

Populations on Phillip Island, Victoria, and Kangaroo Island, South Australia have shown dramatic increases in a relatively short period of time (10 years).

The ability to achieve this potential is limited by the absence of good quality foraging habitat in areas currently managed for nature conservation or multiple use purposes. In the EMA, this habitat is largely on private property.

Further factors controlling recovery are mortality agents. Known mortality agents include predation fire, poor nutrition and disease (Lee and Martin 1988, Martin 1988). Predation by dogs is a major factor in preventing recovery of populations. In particular, predation in the form of uncontrolled domestic dogs and feral canids is high in areas which previously carried productive koala habitat.

6.6. Alternative management strategies

Alternative management strategies would include total reservation of koala habitat, total removal of restrictions on logging in State Forests, and an active re-introduction program. All alternatives have real or potential difficulties which preclude their further development.

6.7. Community Involvement

There has been intensive involvement by a small section of the community. The Southeast Conservation Council and its subsidiary groups have actively lobbied to stop logging on the grounds of Koala conservation. A publicly funded research program has been activated by this group. Research has concentrated on known areas of Koala habitat, primarily on State Forests.

There has been little or no involvement of the broader community in Koala recovery activities.

None of the local government bodies, service groups, or industrial associations (in particular the Farmers Federation and the National Association of Forest Industries) have been active in Koala management. However, there is a general positive attitude towards Koala conservation, and individual farmers, the Farmers Federation and NAFI have not been officially or informally invited to participate in activities.

7. SPECIES MANAGEMENT PLAN

7.1. Objectives of the Management Plan

The objectives of the Management Plan are set out in point form below:

1. accurately determine Koala distribution on all land tenures in the EMA
2. establish a core area of high carrying capacity habitat with secure tenure of sufficient size to support a population of 500 koalas
3. establish a captive breeding population of at least 50 animals from local genetic stock over the next 20 years.
4. establish koala habitat recovery or maintenance plans, as appropriate, on private land tenure
5. establish logging systems that take into account koala management in multiple use forests
6. establish an interconnecting system of koala corridors between areas of high carrying capacity.
7. establish feral animal control programs in priority areas for koala management
8. develop community involvement with koala management across the EMA

7.2. Recovery Actions

The recovery actions to be carried out are listed in point form below:

1. Maintain State Forests and Community survey efforts which locate individual koalas and populations of koalas
2. Establish a survey program within the Reserve system

3. Establish and enhance a strong working relationship with all relevant agencies, landowners, and levels of government. Those not currently involved actively with koala management include:

councils
individual farmers and graziers
DUAP
DLWC
Dept. of Agriculture
RLPB
Commonwealth Government Agencies (DPI, DEST)
RACAC
Aboriginal Land Councils
Victorian Land Management Authorities

4. Identify and acquire for koala management at least 3 000 ha of *E. tereticornis- A. floribunda* woodland (or habitat of similar carrying capacity) in a manner that provides connectivity to known populations of koalas in the Brogo, Bega and Towamba River catchments
5. Identify and acquire for koala management at least 3 000 ha of *E. rubida- stellulata - pauciflora* woodland (or habitat of similar carrying capacity) in a manner that provides connectivity to known populations of koalas on the tablelands.
6. Carry out logging according to prescriptions developed in the Conservation Protocols (appendix 1) in multiple use forests on public and private tenure.
7. Monitor by radio tracking koala(s) in areas where logging prescriptions have been applied to manage habitat for koalas.
8. Use the results of the monitoring above to develop further management actions in multiple use forests.
9. Establish a multiple-use forestry system in and around areas acquired for koala management.
10. Develop a system of habitat links following major drainage lines in conjunction with Regional Vegetation Plans, Total Catchment Management Plans, and Farm Management Plans which connect key koala areas from the coast to Kosciusko.
11. Develop a system to protect key koala areas from wildfire
12. Monitor disease in the koala population
13. Establish a breeding facility for koalas in the EMA and appropriately acquire local breeding sock.

14. Write a public awareness package centred on the koala and the integrated management of the koala in the south east forests.

This package would include information on:

koala biology
habitat requirements
effects of forestry
effects of domestic and feral dogs
effects of agriculture
effects of urban developments
effects of road systems
effects of wildfire
positive management techniques
heritage and recreational values

15. Develop a management system for koalas that ameliorates the effects of rural land occupancy, urban development, and the attendant transportation system.
16. Establish a Management Team to develop the actions listed above.

7.3. Prioritisation of Tasks and Implementation

The tasks listed above are listed in order of priority, except for the last two (Points 15 and 16). A defacto Management Team has existed in various formats for the past 5 years. The Koala Steering Committee, comprised of representatives from State Forests and National Parks and Wildlife Service, coordinated management initiatives in multiple-use forests from 1991 to 1994. The Koala Research Committee has reviewed and proposed research initiatives since 1995. Creation of an effective Management Team should be the first priority in tasks. This management plan can be used as the initiating step in the creation of such a team. This team can work effectively with the state wide Koala Recovery Team that is required to be established by the TSC Act when that body is initiated.

Point 15 - development of a plan for the Koala on essentially private land - should be considered as a high priority. The exact status and implementation of this part of the management plan should be determined by the Management Team in the first instance.

7.4. Performance Indicators

The performance indicators listed below correspond to the recovery actions of the same number listed above. Generally, they relate to the first year of operation of the plan.

1. State Forests will have surveyed all compartments before harvesting using a survey protocol that has broad community support and will continue with its proactive surveys of areas important to Koala conservation. Community survey efforts will be reported upon as indicated in the project proposals.
2. Areas with high potential for koala conservation will have been surveyed according to a plan established for that purpose. Bournda National Park, Mimosa Rocks National Park, Bemboka National Park, Wadbilliga and Coolangubra National Park will be a focus. A stratified approach will have been used to establish the survey.
3. This management plan will have been circulated to all relevant parties within 2 months of its agreement by DUAP.
4. Fifty hectares in the first year of high quality (Forest Red Gum) koala habitat will be established in coastal areas.
5. Fifty hectares in the first year of high quality koala habitat will be established in the tablelands.
6. Any logging operation carried out in the Eden management area will have followed the protocol listed below (appendix 1).
7. A monitoring program - using at least four radio tracked individuals - will be established in logged areas and in comparable control areas.
8. The results of the monitoring program will be reported upon, and this report used to prepare an updated logging prescription.
9. Fifty hectares of multiple use forest will be established in high carrying capacity koala habitat.
10. A document outlining which drainage lines are important for koalas will have been prepared, with recommendations for further work. Trial re-establishment of native riparian vegetation will have been carried out along 300 metres of the Bega River. One farm management plan will have incorporated koala management as a priority.
11. A fire management outline for high carrying capacity koala habitat will be prepared for review and discussion.
12. Four koalas will have been checked for disease, physiology, and genetic analysis according to a plan prepared for the purpose of further documenting the physical and genetic make-up of the local population.
13. A plan for captive breeding will be prepared for review and discussion.
14. A public awareness package will have been prepared, distributed by mail, and released to the media.

15. An official draft Management Plan will have been prepared for review and discussion according to the Threatened Species Conservation Act.

16. An operational Management Team will be established.

7.5. Implementation of the Management Plan

After this plan has been submitted to DUAP, a meeting should be convened between the relevant agencies (State Forests, NPWS, DUAP) to organise the first meeting of the Management Team. Members of this team should be selected from the group of stakeholders listed, and must include conservation groups, community representatives, the timber industry, farm and dairy representatives, independent scientists, and the Commonwealth.

7.6. Management Plan Completion

- The management plan will be completed when:
- Koala habitat has been reserved as outlined in the plan
- There is a secure captive population of koalas
- There is a secure, sustainable social and economic environment with regard to land areas where the koala occurs in south east NSW.

7.7. Preparation Details

The plan was prepared during 1996, and discussion about the plan's status and the timing of its submission to DUAP took place during that time. The preparation of the formal version of this plan took place in the first six months of 1997. The plan was submitted to the National Parks and Wildlife Service in January, 1997 (Southern Zone Team, Threatened Species Unit). It was submitted to the South East Koala Research Committee in March 1997. The South East Forest Conservation Council was provided with a draft - separate to their involvement with the Southeast Koala Research Committee - in April 1997. Dr. Andrew Smith was provided with a draft in August, 1997 as was Mr. Charlie Mackowski (CFMEU Ecologist). The plan was presented to the Australian Koala Foundation in their annual conference at Port Stephens, NSW in August 1997. The plan was presented to the local Total Catchment Management Committee in Bermagui in July, 1997, and a written draft provided to the Farmers Federation (via Kerry Pfeiffer) in late July 1997. A draft was provided to the Department of Land and Water Conservation in March, 1997. A draft was provided to the Scientific Committee, NSW TSC Act, in September 1997 for their information. A draft was provided to CSIRO Wildlife Division in September 1997 at their request.

The review date of 15 August 1997 was clearly stated to appropriate recipients. State Forests thanks all those who took the opportunity to comment. In particular, Dr. S. J. Cork provided useful, pragmatic criticism.

A draft was provided to DUAP on 15 August, 1997 for preliminary consideration.

Herewith, the Koala Management Plan is submitted to comply with the determination requirements of the Eden Environmental Impact Statement (1994).

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 5 October, 1997

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9. References

- Allen, C. 1995 Koala Research in the Tantawangalo State Forest. In Koala conservation in the south east forests: proceedings of an expert workshop. Cork, S., Feary, S. and Mackowski, C. (eds.). NSW National Parks and Wildlife Service and State Forests of New South Wales. (in press), pp 24-33.
- Braithwaite, L.W. (in press) Conservation of Arboreal Herbivores: The Australian Scene. Australian Journal of Ecology.
- Braithwaite, L.W., Belbin, L. and Austin, M. 1993 Land Use Allocation and Biological Conservation in the Batemans Bay Forests of New South Wales. Australian Forestry. 56,4-21.
- Cork, S.J., Margules, C.R. and Braithwaite, L.W. 1990 Implications of Koala Nutrition and the Ecology of other Arboreal Marsupials in South-eastern New South Wales for the conservation Management of Koalas. In Koala Summit: Managing Koalas in New South Wales, Proceedings of the Koala Summit held at the University of Sydney 7-8 November 1988. Lunney, D., Urquhart, C.A. and Reed, P. (eds.). New South Wales National Parks and Wildlife Service, Sydney, pp 48-57.
- Cork, S.J. (1992) Polyphenols and the distribution of arboreal folivorous marsupials in Eucalyptus forests of Australia. In: Plant Polyphenols. Synthesis, Properties, Significance. Hemingway, R.W. and Laks, P.E. (Eds). Plenum Press, New York.
- Cork, S.J. 1994 Koala Conservation in the South-East Forests. Consultancy for the National Parks and Wildlife Service and State Forests of New South Wales. CSIRO Division of Wildlife and Ecology.