MONITORING REHABILITATED KOALAS AT TWO RELEASE SITES ON THE GOLD COAST

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Abstract

Koala populations in the Gold Coast area are under threat from habitat loss through land development, dog attacks and motor vehicle accidents. Animals that are not killed from these impacts are sometimes rescued, rehabilitated and later released back into the wild, usually in their area of origin. Although the translocation of these animals is a relatively common practice, little post release monitoring has been carried out and reported to assess the success of the animals in the wild.

This study monitored the movements and health of 27 rehabilitated and translocated koalas over two separate studies: one conducted by Wildcare Australia in 1995-1996, the other in collaboration with the University of Queensland. Two sites in the greater Gold Coast area were chosen: Coombabah Lakelands Conservation Area and Kokoda Barracks. The results indicate that while all but three of the released animals established new home ranges during the tracking period, the release site was critical to this process. Coombabah Reserve, with its close proximity to urban areas and high density of resident koalas, was found to be unsuitable for the males released into it. In contrast, 22 of the 23 reintroductions into Kokoda Barracks appeared to be successful, suggesting that this area may retain more suitable habitat for translocation of this species. Consequently, while this study confirms that the reintroduction of koalas may be a viable management strategy, the release area must be chosen carefully. Thus it is recommended that further research of sites such as the Coombabah Reserve be undertaken before they are used for future releases.

1. Introduction

There are a number of important factors that affect the success of wildlife following release back into the wild in rehabilitation and relocation programs. These include: the health and fitness of the individual at the time of release; its ability to integrate into and contribute, either socially or reproductively, to the resident population; its ability to establish a suitable home range that provides food, water, shelter and social needs; and its ability to develop or learn normal behaviours appropriate for a wild individual of the species. Some of these factors are largely influenced by the standard of the rehabilitation process, others are dependent upon the choice of site or habitat that the animal will be relocated to. It is important, for example, to consider factors such as the resident population density and availability of habitat in a given area, so

that additional stress is not placed upon a population that may be already at its maximum carrying capacity.

Perhaps more than any other Australian native animal, koalas have been subjected to numerous translocation programs over the past century. This has largely been because of overpopulation problems in certain areas of Victoria resulting in over browsing and death of trees (Martin and Handasyde, 1999). However, over the years there have been large numbers of koalas taken in by wildlife carers, shelters and zoological institutions as either sick, injured, orphaned or displaced individuals. Many of these animals have been rehabilitated and returned to the wild, but to date there have been few post-release monitoring studies aimed at determining the success of this practice Carrick et al, 1990; Ellis et al, 1990; Sutcliffe, 1997). This paper briefly describes two koala radio tracking studies conducted in the Gold Coast region. The koalas monitored included animals treated for trauma and chlamydial disease, as well as hand reared orphans and animals displaced by land clearing. The first study was conducted in 1995 – 96 by Wildcare Australia and has been reported briefly by Sutcliffe (1997). The second was commenced in 2002 and is ongoing at the time of writing. Its results have never been reported before.

2. Materials and methods:

2.1 Release sites:

Two release sites were used in the course of these koala tracking studies: a 6000 hectare site at Kokoda Barracks near Canungra on the Gold Coast City/ Beaudesert Shire border; and an 800 hectare site in the suburb of Coombabah, close to the centre of the Gold Coast City.

Kokoda Barracks
The Kokoda Barracks (Canungra) site comprises approximately 6000 hectares of protected bushland owned by the Australian Army. The vegetation is predominantly open eucalypt forest but also contains complex notophyll vine forest, tall open forest, riparian forest and pockets of rainforest (Driscoll and Plowman 1990). The area is continuous with forested areas of the Gold Coast hinterland and Beaudesert Shire and provides ample opportunity for dispersal, immigration and emigration of most native species occurring in the region. The koala population density appears to be relatively low, based on anecdotal reports and observations during the study.

Coombabah
The Coombabah site is contained within the boundary of the 778 hectare Coombabah Lakelands Conservation Area (CLCA), which is administered by the Gold Coast City Council. Vegetation types include mangrove and saltmarsh communities, *Casuarina*, *Melaleuca* and lowland *Eucalypt* forest and woodland a total of 516 ha of which was considered suitable habitat for koalas (Forestman, 1998).

In contrast with the Kokoda Barracks site, the CLCA is almost completely surrounded by urban development and seems to offer limited opportunities for dispersal of juveniles, emigration and immigration. Koala sightings are common, and there has been a suggestion the area may be at its maximum koala carrying capacity (Phillips,

pers. comm.). Despite this, the CLCA is regularly used as a translocation site for koalas displaced by urban development in the northern half of the Gold Coast City.

2.2 Koalas:

a) **The 1995 – 96 study** the release of 16 radio collared koalas into 6000 hectares of protected bushland at Kokoda Barracks. Six koalas were female (two with pouch young) and 10 were males. The details of these koalas and the reasons for their admission to care are shown in Table 1. Eight koalas were brought into care because of traumatic injuries or disease and the remainder were translocated from their original habitat due to land clearing.

Koala ID	***Young***	***Origin***	***Sex***	***Estimated age (yrs)***	***Reason for admission***	***Weight (kg)***
Fuji	No	Gaven	F	2-3	Threatened	5.4
Chester	No	Helensvale	M	5-6	Threatened	7.8
Casper	No	Studio Village	M	2-3	Threatened	6.5
Pania	Yes	Helensvale	F	10-11	Threatened	6.4
Eukiki	No	Gaven	M	2-3	Car hit	6.2
Jemima	Yes	Biggera Waters	F	3-4	Threatened	5.0
Sam	No	Runaway Bay	M	7-8	Car Hit	6.5
Captain Harris	No	Oxenford	M	3-4	Car Hit	7.4
Sweatpea	No	Boonah	F	2-3	Chlamydiosis	4.7
Pete	No	Ashmore	M	3-4	Car Hit	5.5
Tim	No	Banora	M	2-3	Threatened	5.9
Leah	No	Helensvale	F	5	Dog attack	5.4
Kyla	No	Labrador	F	4	Car Hit	4.8
Ernest	No	Ernest	M	2	Threatened	4.3
Max	No	Oxenford	M	5-7	Chlamydiosis	7.3
Jim	No	Runaway Bay	M	2	Threatened	4.5

Table 1: Admission details for koalas in 1995-96 study.

b) **The 2002 – 03 study** utilized both release sites. This was done to allow comparisons to be made between them. Details of the koalas are shown in Table 2.

Name	***Age (at admission)***	***Sex***	***Admission Date***	***Origin***	***Reason for Admission***	***Weight***
Max	11 mths	M	02/12/01	Wildcare	Orphan	800g
Kathy	6 mths	F	02/09/01	Wildcare	Orphan	540g
Sam	14 mths	M	26/08/01	Wildcare	Orphan	1550g
Shine	7 mths	F	03/02/01	Wildcare	Orphan	680g
Hackett	3 yrs	M	15/03/02	Hope Island	Translocated	-
Jedd	1-4 yrs	M	27/03/02	Hope Island	Translocated	4.5kg
Jemima	2-4 yrs	F	05/09/01	Coombabah	Chlamydiosis	5.69kg
Belinda	1-4 yrs	F	04/10/01	Gaven	Chlamydiosis	4.8kg
Jack	15 mth	M	20/01/03	Runaway Bay	Car hit	3.8kg
Baby	7 mth	F	02/01/02	Beechmont	Orphan	550gms
Sally	7.5 mth	F	17/10/01	Canungra	Orphan	612gms

Table 2: Admission details for koalas in the 2002-03- study.

2.3 Health assessments:

All koalas were examined by a veterinarian prior to release back into the wild. Generally koalas were subjected to general anaesthesia, given general physical examinations, ear tagged with swivel-type plastic ear tags, and collared. Swabs were collected from conjunctiva and urogenital sinus (females) or penile urethra (males) and tested for *Chlamyida* antigen using the Clearview Chlamydia MF antigen detection test (Unipath Ltd, UK). Blood samples were collected from either the cephalic or femoral veins and analysed at an external veterinary laboratory (Idexx VPS, East Brisbane) or at the Dreamworld Veterinary Clinic using the Vet Scan HMT Blood Analysis Machine (Agen, France).

2.4 Radio collars:

All koalas were fitted with radio transmitters in the 150 or 150 MHz range, fixed to collars that contained a 50-60mm elastic insert (Titley Electronics, Ballina, NSW; Sirtrack, New Zealand). The intention of the elastic insert was twofold: it allowed degradation of the collar over time should the collar be unable to be removed due to signal failure or loss; and it allowed the koala to slip out of the collar in the event that the collar became caught on a branch.

2.5 Radiotelemetry:

Koalas were radio tracked using either a Regal 2000 receiver (Titley Electronics) or a Telonics TR4 receiver (Sirtrack, NZ) fitted with a yagi directional antenna. All koalas released into Kokoda Barracks started from the same release point, whereas koalas released into the CLCA site were released at various points. After release, each koala was tracked and observed daily for the first 21 days, then no less than 3 times per week for the remainder of the study. Data collected at each observation included spatial position using GPS, date and time, distance and bearing since last fix, tree species height and diameter at breast height (DBH), visible signs of injury, illness, or behavioural abnormality, weather conditions, and other worthy observations.

2.6 Koala capture:

At the end of the tracking period koalas were caught using traditional methods of tree climbing, pole and flag, and manual capture, or alternatively, using a koala trap. Noosed poles were not used. The koala trap was either that described briefly by Hanger (1998) or a modification of the same, described by Phillips (manuscript in preparation). Koalas were given general physical examinations at or shortly after the time of capture, the radio collars removed, and they were then released at the point of capture. Examinations were conducted in the field using the Mobile Disease Ecology Unit (Ecopath Environmental, Qld) or at the Dreamworld Veterinary Clinic (Coomera, Qld).

3. Results

3.1 Post-release koala survival, fecundity and health:

a) **In 1995 - 96 study** there were no confirmed koala deaths during the study period. However, one koala's radio transmitter signal failed ("Eukiki") close to the end of the study period, and the radio signals from two young rapidly dispersing males ("Ernest" and "Jim") were lost and not recovered during the period of study. One koala ("Sam") was found at the base of a tree two weeks after release and was returned to care for additional rehabilitation. A further release attempt failed in a similar time period and the koala was re-homed in a captive institution. The definitive reason for his failure to thrive in the wild was not determined, although chronic injuries from motor vehicle trauma may have contributed to a reduced ability to climb and forage.

All of the 13 koalas that were captured for collar removal at the end of the study were in good or excellent body condition. The three remaining koalas, whose signals were lost or failed were unable to be assessed, but were in apparently good health and body condition at their final sighting.

Both of the female koalas with joeys in the '95-'96 study ("Parnia" and "Jemima") had weaned their original joeys, and were supporting new pouch young at the time of collar removal. Of the six female koalas released in the current study, one was supporting an early pouch joey at the time of release, which was subsequently weaned. One koala "Jemima" was euthanased because of reproductive tract disease, and one koala "Baby" was found dead. The remaining females "Belinda", "Shine" and "Sally" had not, at the time of writing, shown evidence of pouch young.

b) **In the 2002 – 03 study,** one young female koala ("Baby"), released at the CLCA site, was found dead three months after release. There had been no apparent illness or injuries up until the time of death. There was no evidence of trauma or predation on examination of the carcase, but a definitive cause of death was not established. One mature female koala "Jemima" that had been treated for chlamydiosis (also released at CLCA) was euthanased shortly after final capture due to complications arising from surgery to remove her diseased reproductive tract. One koala "Shine" was returned to care for further rehabilitation due to poor body condition at final capture. She had been released 3 months earlier. One month later she was re-released into the project and has remained in good health since.

Of six koalas caught for health and body condition assessment, four had gained weight and either maintained or improved condition score; one koala ("Shine") had lost both weight and body condition, and one koala ("Kathy") with dependent young, had maintained weight but dropped body condition. Two koalas ("Sam" and "Hackett") slipped their radio collars and were lost: they had been radio tracked for 5 months and 6 months respectively. Both were in apparently good health and body condition at their final sighting.

All of the koalas treated for chlamydiosis **in both studies** remained free of active disease for the duration of the tracking period, and were free of clinical signs of active infection at the time of collar removal and release. One koala "Jemima" had

reproductive tract cysts that had grown in size over the period of the study. This is not indicative of active infection but is a sequel of scarring and adhesions in the reproductive tract.

3.2 Dispersal and home range establishment:

a) **In the 1995 – 96 study** all koalas established stable home ranges with the exception of the two young male koalas ("Jim" and "Ernest") and the koala "Sam" that was removed into captivity. Eight of the sixteen koalas established home ranges within 1 km of the release point, four koalas established home ranges 1-2km from the release point, and one koala ("Casper") established a home range 5-6 km from the release point. The koalas "Jim" and "Ernest" were dispersing away from the release site at the time that radio signals were lost.

b) **In the 2002 – 03 study**, two of three males ("Hackett" and "Jedd") released at the CLCA site failed to establish stable home ranges and were considered to be vulnerable to motor vehicle trauma or misadventure because they had moved close to busy roads bordering the conservation area. Consequently they were translocated to the Kokoda Barracks site, where "Hackett" established a stable home range within one month. In contrast, "Jedd" continued dispersing for a further 3 months, eventually establishing a stable home range in the neighbouring Numinbah Valley. The young male "Jack" established a stable home range in the Coombabah site close to the release point.

Three female koalas released at the CLCA site all established stable home ranges within one month of release, although the young female "Baby" subsequently died, and the mature female "Jemima" was euthanased nine months after release because of surgical complications.

Six of seven koalas either initially released at the Kokoda Barracks site, or translocated from the CLCA site ("Hackett" and "Jedd") established stable home ranges within the boundaries of the Kokoda Barracks. As described above the young male koala "Jedd" continued to disperse until settling in his current home range over 10 km from the release point. Of the remaining six, five established home ranges less than 1 km from the release point, and one koala established a home range 2.3 km from the release point.

The following table (Table 3) summarises the results of home range size estimation and distance of home range from the release point. The first 16 koalas were in the '95-'96 study at Kokoda Barracks, and home range sizes were estimated without the use of computer programs. The home ranges of the remaining koalas, used in the current study, were estimated with the Ranges V software (Natural Environment Research Council, UK) using the minimum convex polygons (95% convex polygon).

Name	*Age at release (yrs)*	*Sex*	*Home range size (ha)*	*Distance from release point (m)*
Fuji	2-3	F	11	855
Chester	5-6	M	13	1864
Casper	2-3	M	27	5300
Parnia	10-11	F	23	346
Eukiki	2-3	M	18	1729
Jemima	3-4	F	11	546
Sam	7-8	M	N/A	N/A
Captain Harris	3-4	M	13	819
Sweatpea	2-3	F	13	1000
Pete	3-4	M	55	546
Tim	2-3	M	10	830
Leah	5	F	18	182
Kyla	4	F	20	582
Ernest	2	M	Not determined	N/A
Max	5-7	M	19	485
Jim	2	M	Not determined	N/A
Max	1.5	M	187	2250
Kathy	2	F	6.13	325
Sam	2	M	30.69	700
Shine	2	F	7	150
Hackett	3 yrs	M	20.16	700
Jedd	1-4 yrs	M	Not determined	11 500
Jemima	2-4 yrs	F	10.76	344
Belinda	1-4 yrs	F	7.19	0
Jack	16	M	Not determined	0
Baby	2	F	Not determined	0
Sally	1.5	F	Not determined	Not determined yet

Table 3. Home range size estimations and distances of home range from the release point for the koalas released in both the 1995 – 96 and 2002 – 03 studies.

3.3 Home Range Sizes

a) **In the 1995-'96 study** of koalas released into Kokoda Barracks the average home range size of males was 21.7 ha and for females 16 ha.

b) **In the 2002 – 03 study** the average home range size of males in Kokoda Barracks was 79.28 ha and females 6.56 ha. The average home range size of females in the CLCA site was 8.97 (2 only).

4. Discussion

A number of important conclusions may be drawn from the results of these two koala radio tracking studies. The first is that koalas are well able to establish stable home ranges and become reproductively successful following translocation into unfamiliar territory, as long as the habitat provides appropriate food trees. The second is that rehabilitation efforts are not wasted on either orphaned joey koalas or those suffering

from trauma or disease, so long as the animals are fit and healthy at the time of release: of five koalas treated for traumatic injuries, four successfully established home ranges following release and were healthy at the time of completion of the study; of four koalas treated for chlamydial disease, none had signs of active infection over the period of the study. (One required euthanasia because of surgical complications during an attempt to remove a chronically diseased reproductive tract.); of six hand reared orphaned koalas, only one succumbed during the period of the study.

The issue of translocation of koalas (due to land clearing or other threatening processes) is a controversial one: some would argue that remaining habitat is assumed to be at its carrying capacity and that translocation of koalas into that habitat may have detrimental effects on the resident population. However, frequently on the Gold Coast, and in other areas of rapid urban development, the only humane alternative to translocation is euthanasia. In addition, the factors affecting koala population densities in various areas are so poorly understood, such as to make such an assumption invalid. It is therefore ideal to monitor not only individuals that have been translocated or reintroduced, but also to monitor the health, fecundity and population dynamics of resident populations in areas receiving translocated animals.

The results of this study suggest that high densities of resident koalas (such as in the CLCA site) may affect the ability of a translocated koala to settle the area, particularly if it is a male. Unpublished data from the current study also suggests that there is significant overlap or even superimposition in the home ranges of koalas inhabiting the CLCA site. Whilst this site provides some suitable koala habitat with high densities of food trees, it is a relatively small and isolated habitat fragment with limited opportunities for safe emigration or recruitment. It is therefore susceptible to overpopulation pressure whether from natural increases in the population or by artificial methods such as translocation. Koalas are frequently rescued from the suburbs and roads surrounding the site, and these are often juveniles of dispersal age (18mths – 3 years) (Gail Gipp, Wildcare Australia, pers. comm.). This observation supports the suggestion that the CLCA may be nearing, at, or exceeding its natural carrying capacity for koalas.

It is therefore recommended that koala populations at sites such as the CLCA be actively managed on the basis of thorough investigation and monitoring of population health and dynamics. This requires a substantial commitment of money and resources from the relevant authorities, but is the only logical and realistic way of managing the area for conservation of koalas.

In contrast, the Kokoda Barracks site, with its 6000 hectares of native forest, and its contiguity with adjacent woodland and forest in the surrounding district, is a more attractive site for translocation of koalas. It provides ample room for movement of individuals, without the hazards of urbanisation, and ample corridors for emigration and recruitment. Furthermore, its koala population density appears to be lower than CLCA, so agonistic interaction between resident individuals and translocated animals could be presumed to be less frequent. The overlap in home ranges of koalas released at Kokoda Barracks was less than that of those released at Coombabah (in which three translocated koalas and at least one resident all shared a similar home range). In addition, the mortality rate of koalas released into the Kokoda Barracks was low, compared with other studies (Ellis *et al.*, 1990; Lee *et al.*, 1990).

Currently, Queensland Parks and Wildlife Service recommend that koalas requiring translocation due to threatening processes or land clearing be moved to the closest area of substantial bushland. Whilst this recommendation is supported by some basic ecological principles, in practice (particularly in rapidly developing urban regions), it may not provide the most acceptable or humane outcome unless adequate post-release monitoring of translocated individuals is carried out. The results of the current study in respect of CLCA attest to that.

5. Conclusions

- Koalas are a relatively robust species with regard to their ability to adapt to translocation.
- Translocation sites need to be chosen carefully with regard to the availability of browse species; density of resident populations; overall size and protection status; and availability of corridors for emigration and recruitment.
- Ideally, translocated koalas should be monitored by radiotelemetry.
- Radio tracking at a frequency of at least 3 times per week for a minimum of 3 months is recommended to ensure adequate monitoring of translocated koalas. Longer studies provide much more data on seasonal variation in behaviour and movement patterns.
- The fecundity, health and population dynamics of resident populations should be established prior to translocation programs, and monitored during and after.
- The use of elastic inserts in the koala collars is recommended to prevent accidental deaths due to entrapment of the collars on vegetation. Accidental deaths by hanging are not unusual in radio collaring studies, although they are rarely reported.
- The use of a degradable material insert in the collar (such as elastic) is recommended to allow degradation and loss of the collar within 2 years, should the signal fail or the collar be unable to be recovered for other reasons.

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