CAMPBELLTOWN KOALA RESEARCH AND DATABASE

1989-2016

The Campbelltown koala research and database

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Dedication

This document is dedicated to the researchers, volunteers and the general public who have contributed to the study of koalas in the Campbelltown region. By contributing to this research of one of the greatest natural resources in the LGA, these people have helped preserve this special marsupial by showing where it lives, how it uses its peri-urban environment, what plant species it uses and where and how it has dispersed or established home-ranges throughout the eastern Campbelltown region.

Besides the local community members who reported to us when they sighted koalas, we are particularly grateful to the many people who assisted with the catching, surveying, radio-tracking and caring for injured koalas. We are particularly grateful to Mick and Wendy Fairs, Mariette Ennik, Kieran Griffin, Marilyn Jones; Graham Groves, Brett Tyler, Marian Lean, Cate Ryan, Pat Harding and Gaylene Parker. Without their help this project would not have been possible.

We are indebted to the following people and groups who have supported this project financially: *The Macarthur Advertiser*; Western Sydney University, The Australian Koala Foundation, The Macarthur branch of the NPA; Georges River Environmental Action Team, NPWS of NSW, Kieran Griffin, Mick and Wendy Fairs and John Longhurst.

Foreword by Jeff McGill

"Dr. Livingstone, I presume," was the famous greeting of journalist Henry Stanley upon meeting scientist David Livingstone in Africa in 1871.

Well, it wasn't nearly so dramatic but…
I clearly remember the day, about three decades ago, that I met up with Dr Robert Close in the bushland wilds of Wedderburn and we went 'hunting' koalas – to check them for disease and attach radio collars to better study their activities.

There I was, holding a net under a tall gum tree as Rob swung about in the treetops high above, inching out toward a koala along a branch, when I suddenly felt stuff hitting me in the head.

"Don't worry, it's only koala poo", Rob yelled.

Something I didn't expect when I dressed for work that day, but just another day in the outdoor office for one of the greatest figures of Campbelltown's modern history.

Indeed, some of my fondest memories as a journalist are tramping through the Georges River bushland with Dr Robert Close, as he kept a close eye on his beloved koalas, or as we tried to convince a conga line of politicians to protect the animals' habitat.

When Rob asked me to write a Foreword for this account of research and database of the Campbelltown Koala population, I was deeply honoured. My involvement as reporter and editor of the Macarthur Advertiser almost closely matches the 25-year research period for the koalas. During that time I was often in the front line of the battle between conservationists and developers. That battle was fought despite the paucity of information about distribution, numbers and health of the koalas. We at the Advertiser devoted considerable time informing readers of the problems, with the result that a petition was presented with 13,000 signatures. Actual support from the Advertiser for koala research came in the form of a $15,000 contribution towards Steven Ward's PhD, but perhaps the most significant role played by the paper was in fostering the weekly Mac Koala column (see collated columns in Campbelltown library).

This column provided stories of the activities of ear tagged and radio-collared koalas as well as other local bushland species. Most important was the provision of the koala pager number which allowed citizens to report koala sightings. In fact the whole project was a fine example of the value of local newspapers in assisting researchers with biological surveys. Now known as Citizen Science it allows thousands of eyes to be employed at little cost. The Mac Koala columns have also led to the local reporting of unusual animals such as platypuses, greater gliders, pygmy possums, bandicoots and wombats.

Besides their role in reporting koalas and unusual species, the Mac Koala columns have emphasised the tremendous value of Campbelltown bushland and the need to protect it. Our partnership between Western Sydney University and the Advertiser contributed to the saving of koala habitat in the now-gazetted Dharawal National Park and led to the production of the attached, huge database of local koalas which will be available to developers and conservationists alike.

I am proud to have played a part in this project

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Abbreviations and Terminology

CSIRO	Commonwealth Scientific Research Organisation;
GDA94	Geodetic Datum of Australia, a mapping grid or UTM (Universal Transverse Mercator that replaced the MGA94 (Map Grid of Australia) in 1994 and before that the AGD66 (Australian Geodetic Datum66) and AGD84;
GIS	Geographic Information Systems;
GPS	Global Positioning Systems;
LGA	Local Government Area;
NP	National Park;
NPA	National Parks Association;
NPWS	National Parks and Wildlife Service;
TRNP	Tarlo River National Park;
UTM	Universal Transverse Mercator, a coordinate mapping system;
UWS	University of Western Sydney;
WGS84	World Geodetic System;
WSU	Western Sydney University;

'The Strip' is land located between the Georges River and Appin Road and the eastern suburbs of Campbelltown which supports the greatest concentration of Campbelltown's koalas.

Chlamydia pecorum and *C. pneumoniae* are bacterial species that affect the eye and urogenital systems of koalas, with the latter bacterial species tending to damage only the eyes. The disease is widespread and only the koalas of Campbelltown (unpublished) and certain islands are considered free of the disease. (Casteriano and Higgins 2018).

1. Introduction

This publication covers the history and results of a research program which ran during the period 1989 to 2016 focussing on a population of koalas that lives in the Campbelltown area (Figure 1) some 70 km south-west of Sydney's CBD. Additional data came and are still coming from animals that were ear-tagged prior to 2016 and whose lives extended beyond that year.

Figure 1 Location of Campbelltown NSW
Source https://www.google.com.au/maps

This Campbelltown koala population is particularly important because it is the only one listed in NSW by McAlpine et al (2017) as expanding. Although koala populations immediately to the south of Campbelltown (Wilton, Mittagong, Colo Vale, Upper Nepean catchments, Robertson), now also appear to be thriving, some are affected with chlamydia, an affliction so far spared the Campbelltown animals. Other colonies near Sydney occur in the Windsor/Colo River/Hawkesbury area, Yengo National Park (Curtin et al 2002) and Ku-ring-gai Chase (Cowper 1987). Unfortunately, a colony has disappeared from Avalon over the past 80 years (Smith and Smith 1990). The status of the population in Ku-ring-gai NP is not known. However, a male koala was discovered in South Turramurra on September 2017.

Publishing 27 years of data is a difficult and lengthy task so we have opted to provide access to the database so that people can use the data to answer their own questions. Copies of the database and relevant source materials will be available at the Campbelltown City Library. This material would be of interest to students, environmental consultants, council officers and members of the public.

The sort of information available is maps of distribution, home-ranges and movements of animals and data on tree use, longevity, reproduction, and health. Users of the database will be able to draw up their own maps of specific areas of individual animals or areas. Unfortunately, because koalas survive for about 13-17 years the database will become outdated in terms of individual activities of koalas. However, unless there are changes in the current environment the data should remain viable. An exception is when koalas are dispersing into previously unoccupied territory or have increased density in areas where formerly koalas were too few to be recorded. Recent examples were sightings at South Turramurra (see above), Tarlo River NP (Close et al 2017), Silverdale in February 2018, and Menangle Road, Broughton Anglican College, in October 2017.

1.1 History of the Campbelltown koala population

Campbelltown koalas were sufficiently common in the early years of the 20th century to support a local hunter who shot koalas for their skins (Fowler 2004). However, numbers subsequently slumped following a pattern observed in other colonies at the time in NSW. Keith Longhurst, who spent his childhood in the Kentlyn bush, never saw a koala until they

were rediscovered near O'Hares Creek in Wedderburn in 1986 only 10 km from Central Campbelltown (Durman, P. pers. com., Sheppard 1990, Fowler 2004).

The Macarthur branch of the National Parks Association of NSW investigated the colony, and led by Keith Longhurst and David Homer, recorded 85 sightings over 28 months.

The tally included numerous juveniles and none showed clinical signs of chlamydia (Sheppard 1990). However the known extent of what was then recognised as 'the Wedderburn colony', was relatively small comprising the area bordered by the western bank of O'Hares Creek, the southern bank of the Georges River for about 6 km upstream of the junction of the two rivers (Sheppard 1990). Most of the sightings occurred in an area known as "H-Range" controlled by the Australian Army. The rediscovery of koalas at Wedderburn was preceded by the approval by Campbelltown Council for a subdivision by the developer Yap Yan Pin Pty Ltd. The subdivision was of an area, overlooking O'Hares Creek, divided into 26 building blocks, varying in size from 4 to 10ha. When it became known by the general public that the proposed development was adjacent to the Wedderburn koala colony, there was a massive protest. The story of this protest and its outcome is worthy of a book alone. That story, however, is beyond the scope of this publication. Suffice to say that a petition was presented bearing 13500 signatures, green bans were applied, the development was aborted and the site eventually became part of the newly gazetted Dharawal National Park. Jeff McGill, former Editor of the *Macarthur Advertiser* has published detailed accounts of this remarkable story (19th and 25th July, 1989) and these are accessible at the Local History section of the Campbelltown Library.

1.2 History of research

The arguments of the conservation groups fighting the Wedderburn development were that the colony was the largest group of koalas on the outskirts of the Sydney basin, that it was apparently disease-free, and that the development would remove habitat and increase mortality caused by dogs, cars and disease. The developers and Councillors, on the other hand, claimed that at the time, the application to develop was submitted, they were unaware of the presence of the colony. Furthermore, the developers pointed out that koalas were not confined to the development area but were "established over an area of 5200 ha mainly in land owned by the army" (Lean 1988).

Clearly research was needed to resolve these differences. In August 1988, therefore, Campbelltown City Council commissioned CSIRO to conduct a two month, $20000 study of the colony to determine its extent, to predict the effects of the proposed development on the koala population and to suggest a management plan (Cork et al 1988, McGill 1989a), The CSIRO method was to identify the plant communities that the koalas were known to use and map these areas to determine the extent of the koala habitat. Such a short study period severely limited its value and the results supported both sides of the debate. That is, the CSIRO found that the development site did not impinge directly on the koala habitat, as defined by plant communities featuring the Grey gum *Eucalyptus punctata*. On the other hand, there was likely to be an effect on the koalas and their habitat from the proximity of dogs and cars. More research was needed to test the developer's claim of local koalas having a 5200 ha range and to verify the health of the colony. A capture and ear-tagging program followed by a radio-collaring study was necessary to measure the size of the colony in area and number, to estimate reproductive state, longevity, dispersal success and health.

Studying the Wedderburn koala population, however, is not easy. Firstly the terrain is rugged with the O'Hares Creek gorge dropping steeply 200m from the plateau to the river below. This makes movement difficult and dangerous. Secondly, the population was of such low density that it was difficult to find sufficient animals with which to conduct a study. Thirdly, the bushland on the eastern side of O'Hares Creek is Army Firing Range or catchment for the Woronora Reservoir. Both areas are restricted for the public and the Range contains unexploded ordnance. The H-range which contains most of the koala habitat identified by the CSIRO does not contain unexploded ordnance but requires army approval to enter.

One of us, (Robert Close) had recently joined the staff, of what was to become Western Sydney University, in 1987 when the battle between developers and the conservation groups was at its peak. In 1988 one of his undergraduate students, Craig Davenport, prepared an essay on the koala dispute and this formed the basis of a Case Study on the topic for Environmental Science students in 1989 and subsequent years. A copy of the Case Study resides in the Campbelltown Library and contains Craig's essay, the CSIRO report, Jeff McGill's summaries and several articles from the local press and Letters to the Editor.

Robert Close had had no previous experience with koalas but had studied rock wallabies and bandicoots for many years. He applied to the WSU (then University of Western Sydney {UWS}) for funds to conduct a pilot study. A grant was provided to purchase an Ag bike (Honda 125cc) and for part-time employment of a field worker. The aims of the study were to determine the extent of the colony at Wedderburn and to test the idea (see Lean above) that koalas were spread across the 5200 ha of adjoining bushland. A questionnaire was then prepared asking whether the reader had seen koalas and if so, where and when. The stamped, addressed questionnaires were hand-delivered to all houses on the Wedderburn plateau. Of 210 questionnaires delivered, 25 were returned and two respondents reported having seen 2 koalas, two saw 1 koala, while one heard bellowing and another reported bark scratches. Today there would be few residents who had not seen a koala. Indeed local residents, Julie Wasson and Lou Melham between them have reported many.

The second phase was a stratified survey involving transects across the H-range to develop a method for detecting koalas in previously unsurveyed bushland; This method required that all Grey gums within 30m of the line of the transect be examined for presence of koalas or faecal pellets or scratch marks. Used trees were marked with a numbered metal disc and existing scratches in the soft, grey bark were marked with a pencil. This marking allowed tree usage to be recorded between visits of the field worker. Approximately 1 in 4 Grey gums in H-range had pellets beneath them and enough animals were seen in the 60-metre-wide transects to estimate a density of one koala per 10 ha of suitable habitat (Close 1993). This compares with much higher densities in Victoria which reached up to 9 per ha in places, yet were as low as one per 67 ha in Queensland (several studies summarised in Martin and Handasyde 1999). The transects allowed us to plot areas used by koalas and were a useful way of searching likely habitat in the disputed Wedderburn area and also for surveying areas beyond the H-range. Several sites were surveyed as student projects and transects were also conducted by research assistants Wayne Foster, Anthony Scarman, and volunteers Marion Lean and Pat Harding.

Robert Close then spoke to as many koala researchers as he could and visited all their sites between Melbourne and Brisbane, where koalas were being actively studied, in order to be up-to-date with the latest catching, holding, tagging and radio-tracking techniques. He then

used a method that he had employed to locate rock wallaby colonies: to appeal to the community via local newspapers for reports of sightings. This technique is now known as Citizen Science and its widespread uptake has energised biological surveys. It proved successful on our very first appeal published in the *Macarthur Advertiser*. A local naturalist, Graham Groves, spotted a koala not far from Kentlyn Primary School, the first animal observed outside of Wedderburn. Graham then conducted extensive transects in the Kentlyn area and showed that the area was used regularly by koalas that were likely to be in established home-ranges rather than be dispersing. We then purchased basic equipment: an extendable pole, ear punch and ear tags, ropes, gloves, scales, holding bags and climbing harnesses. Soon thereafter a koala appeared in a suburban garden beside Georges River Road, Kentlyn and was tagged and released. The project then acquired radio-tracking collars and a receiver (Titley Regal 2000) and soon we captured an old male and two young males at Wedderburn.

A Masters student working on the chemistry of koala food, Wayne Foster, was doing the radio-tracking supported by funds from the Macarthur branch of the National Parks Association (NPA), UWS and GREAT (Georges River Environmental Action Team). Roaming over large distances, the three males proved very time consuming to radio-track particularly because the radio signal would bounce off the gully walls. We needed to follow many more animals so a full-time PhD student was required. Fortunately *the Macarthur Advertiser* had access to a Fairfax fund donated by the community for koala research. It provided funds to finance half a PhD scholarship while the UWS provided the other half. The Australian Koala Foundation provided funds for equipment and running costs. The Sydney Water Board and NPWS both donated receivers (Regal 2000).

We selected Steven Ward (SW) for the scholarship. He had just completed an Honours project at the University of Wollongong on *Antechinus stuartii*. He set up the initial koala database upon which the present one in this paper is based and used the program *Access* to enter and manipulate the data. Steven then used the MapInfo GIS to map out his findings such as koala distributions and dispersal. He also streamlined all the procedures for engaging the community and handling the animals (Ward and Close 1998, 2002). These were as follows:

2. Methods

2.1 Engaging the community

2.1.1 Mac Koala club:

This club was for young readers of *the Macarthur Advertiser*. Members would have their birthdays listed and subscriptions would go to fund the research. A full-size koala suit would visit community events and would accompany a display of the research findings.

2.1.2 Mac Koala column:

Steven Ward and Robert Close wrote a weekly column for almost 20 years in *the Macarthur Advertiser* describing what the tagged animals were up to (a copy of all Mac koala column stories is held in the Campbelltown library). Other biological topics were also discussed. Because of the richness of the Georges River ecosystem we were never short of topics and this allowed us to shine a light on the biological treasures that Campbelltown residents have at their backdoors.

2.1.3 Naming rights:
When a resident reported a sighting and we were able to catch the koala, the resident could name it. This honour was fiercely claimed and led to some unusual names.

2.1.4 Pager and telephone contact:
To enable residents to report sightings, two of us carried pagers the telephone number of which was included at the end of the weekly column. The number was also included on Koala crossing road signs that Campbelltown City Council installed for us. For a time we had another telephone number which led to a recorded bellow from an adult male koala. This allowed residents to identify koala presence without actually sighting the animal. In later years we used mobile phones to receive reports of sightings.

2.1.5 Research video:
With the help of the UWS film unit, Steven Ward and Robert Close prepared a 19 minute video describing our research, emphasising the pager number and outlining how the community could assist in the survival of the Campbelltown koalas. The video was publicised in the column and taken up by local schools and residents. A copy can be found in Campbelltown Library. Costs were paid by a generous couple who wished to remain anonymous.

2.1.6 Mail out survey:
As part of his PhD studies, Steven Ward (2002) studied koala distribution across southern Sydney. This included a postal survey sent to 25925 residences on Sydney's southern bushland border seeking to find the extent of the koala distribution in the Holsworthy Range, the Woronora Catchment and the Heathcote National Park. He employed a number of filters to ensure that the reported sightings were reliable. As a result 93 filtered sightings were recorded from across the target area (Ward 2002, Ward and Close 2004). This number included 68 reports of mothers with young. In addition, his map of the koala distribution included filtered sightings from the following groups; Army and Water Board (10), Community sightings (310), National Parks Association (68) and UWS team (89). Steven Ward also found that koalas preferred Shale/Sandstone Transition Forest. However, this comprises only 3.7% of extant vegetation in the Georges River catchment.

2.2 Field Procedures

2.2.1 Captures:
Ideally there were at least three people in the capture team; two people flagging the koala down with a flag-topped extendable aluminium pole, and a third with gloves and a bag who waited at the base of the tree for the koala to descend. Ideally the two flaggers could operate from the ground, but we often had to climb the tree or adjacent trees and either drive the koala down or capture it in the tree. Sometimes the koala did not react to the flag and occasionally would cry. We think that the cry is to indicate submission rather than fear. Never-the-less, if we could not complete the catch in a few minutes we would abort the attempt. If we had residents watching or helping we would explain what we expected to happen and what difficulties might arise. On some occasions we had to erect a corflute fence around the tree with an opening for a large box trap. The trap was very effective except when the koala stayed in the tree and required an all-night vigil.

2.2.2 Handling:

Most animals soon calmed down once in the bag and allowed us to weigh and measure them and inspect their teeth, examine the pouches of females and the testes and sternal glands of males and fit a numbered, coloured ear-tag in each ear. In the early years the koalas were taken to the Elizabeth Macarthur Agriculture Institute where vets checked their condition and took swabs for chlamydia testing. In later years the koalas were taken to David Phalen at University of Sydney vet school at Cobbitty but only if there was a health problem. If an animal was found dead, died in care or was euthanised, the skull was prepared for study. These skulls will eventually be placed in the N.S.W. Australian Museum.

Koalas were then released in bushland that we deemed safe. In the early years of our project the release site might have been a km or so from the capture site. Later when we realised how faithful the mature females were to their home-ranges, we released them as close to the capture site as possible.

The final decision on release site depended on the age and gender of the koala and proximity to dangers and trees. In general we think that younger koalas can cope with translocation better than older ones.

2.2.3 Ear-tagging:

Each animal was given its own distinctive number and colour pattern. Tags were plastic sheep tags (Leader products) and were inserted with an applicator after using a leather punch to make a small hole in the ear. The small punchlets of ear tissue were stored in 70% alcohol for DNA studies.. An occasional tag was torn out of the ear, thus requiring identification of the number of the remaining tag to recognise the animal. Sometimes, however, observers had difficulty distinguishing similar colours such as red and orange, white and light blue. Tags were numbered, standard sheep swivel tags (Leader Products).

2.2.4 Radio-Tracking:

Collared animals were usually tracked every one to two weeks, mostly by a hard core of volunteers. Depending on the terrain, the vegetation, the experience of the tracker and the height and shape of the tree it could take an hour or so to locate the koala. Sometimes we failed and had to triangulate in order to estimate a location. The battery life originally was 6 months which required frequent catches but later battery life increased which resulted in less frequent catches.

2.2.5 Database:

Data from field sheets were transferred to a database which comprised three major files: *Public un-tagged sightings*, which included Steven Ward's Postal Distribution survey (see above 2.1.6.). also include sightings by members of the koala research team, that did not result in a capture or aborted capture. *Tracking data* (which included information derived from animals seen more than once, as well as from radio-tracked animals) and *Capture data* (which included information gained from each initial capture and subsequent collar changes and collection of dead animals). Data sheets from all three files included location, time, date, tree species, estimated age, gender and height in tree. *Tracking* and *Capture data* included koala's name, collar frequency (if fitted) date, time, weather, GPS reading, tree species, tree tag number, if applicable (in the early years, any tree that was used by a koala would be marked with a numbered, metal disk), tree height, tree circumference at chest height, foliage rating (1- where 1 is open and 10 is densely foliated), tree condition (1-4), scratches on tree (1-3), signs of fire on trunk (1- 4), location of koala in tree and activity with estimated

number of faecal pellets per metre at tree base, and location sightability (1-5). Capture data included, in addition, gender, weight, head-length, sternal gland dimensions, testicle or pouch condition, general condition (measured by the size of the muscle bulge (1-4) on the blade of the scapula) and estimated age (based on body size and weight, and wear of the premolar (Martin and Handasyde (1999)).

2.2.6 Mapping:

The original project spanned 27 years and in that time there have been significant developments in organising and mapping data. Data were first stored in field notes, then in *Access*, then in *Excel*. Topography maps were based on GDA66, but today GDA94 or WDS84 UTM (Universal Transverse Mercator) are used, both being practically the same and acceptable to National Parks and Wildlife Service.

Early in the project all locations were calculated and mapped from topographical maps by hand, but when GPS became affordable they were used with an offset added. Data were mapped by the GIS *Ranges 6*, then *Mapinfo*. An APP can now be downloaded to smart phones that show an error of just +-15 metres. GDA94 is a time-dependent datum and moves with the Australian continental plate. It was identical to the WGS84 datum in 1994, but since then has drifted at the rate of approximately 6cm north per year. In 2000, the difference was approximately 45cm.

To provide the current report with accurate locations the project's data were placed into a mapping program (*Expert GPS*) and with the help of Dan Forster from *Expert* it was possible to check every location and then change them into GDA94/WGS84. We were also able to map the data on *Google Maps* which made them more accessible and versatile.

3. Concurrent research

3.1 Diet and faecal pellet studies

As part of their preparation of a Draft Campbelltown Koala Plan of Management, Phillips and Callaghan (2000) surveyed quadrats across the bushland of Campbelltown and graded the area into koala habitats of different quality according to the component tree species. They then measured the "activity" (proportion of trees with one or more pellets beneath) of each site. They were then able to estimate the use of the different tree species. Highest scoring species followed Cork et al (1988) in that Grey gums, *Eucalyptus punctata*, had the highest activities; however, koalas may not be feeding on the trees with the highest activities. In fact, our studies at the time were showing that koalas often rest in the day in Turpentines (*Syncarpia glomulifera*), a densely foliated species not known to be eaten by koalas. Bev Ellis worked on this question by analysing leaf fragments from the collected faecal pellets. She prepared and stained the undigested pieces of cuticle and compared them with a set of standards that she had prepared. She found no sign of Turpentine, but Grey gum and Stringy barks predominated (Ellis et al 1997). Using Ellis' standards, Sluiter et al (2002) examined cuticle fragments in the pellets of three radio-tracked females (Shirley, Lyn and Sarah). Their results were consistent with those of Ellis et al (1997). For each sighting and capture, the species of tree that the koala was sheltering in was recorded. Because several people with different botanical experience were involved, no attempt was made to distinguish the several Stringybark species.

3.2 DNA studies

Houlden et al (1999) compared mitochondrial DNA profiles of koalas from several sites in Victoria, Queensland and NSW including 22 koalas from our Campbelltown study. The technique uses short sequences of DNA which differ in length from population to population and are inherited like a genetic marker such as the ABO blood typing system. The variable sequences are bordered by non-variable DNA sequences (primer pairs) at both ends of the variable sequences (microsatellites). The authors found little evidence of gene flow between populations and Campbelltown animals had four haplotypes out of 18 that were not found in the other areas sampled.

Grace Hey (2003) conducted MSc studies on extracting DNA from koala faecal pellets. She used 63 tissue samples as standards and eight primer pairs and found that Campbelltown microsatellite DNA alleles did not conform to Hardy-Weinberg expectations (H-W) whereas data from Colo Heights (North) and Bargo (South), and Heathcote (East) could distinguish all four populations and conformed to H-W Equilibrium expectations (Figure 2). When the data conform to H-W expectations, then the expected frequencies of alleles of each microsatellite are found, for example in the human ABO system if AA people had resistance to a serious disease then there would be more A alleles in the population than expected. Inbreeding can also lead to H-W disequilibrium.

Another study, by Tristan Lee, as part of his MSc studies at the University of Sydney, examined nuclear microsatellite DNA collected from the same sources as Hey (2003) but with more samples (144) and 12 primer pairs, five of which were also used by Hey. Unlike Hey (2003), he could not distinguish the Campbelltown animals from the eastern koalas by their genetic profiles (Lee et al 2010). He found the genetic diversity of the Campbelltown koalas to be the lowest of the three sites. He also differed from Hey (2003) in that he considered that the results were consistent with animals from Campbelltown and Heathcote belonging to one population that had suffered a previous genetic bottle-neck. His data were consistent with there being a previous low point in the Campbelltown population of as littl as about 20 animals. Furthermore, if the genetic diversity of the Southern and Campbelltown populations was pooled, the profile would be similar to that of the northern koalas. Thus the three sites were likely to have once been a single Sydney population that has now fragmented into at least three sub groups. The larger sample size and greater number of microsatellite primer pairs used by Lee et al (2010) gives greater confidence to Lee's conclusions of three populations rather than Hey's conclusion of four.

3.3 Survey comparison

Lunney et al (2010) compared three independent survey methods to study the distribution of the Campbelltown koala population; namely our WSU tracked animals (till 2006), an Office of Environmental Heritage Postal Survey; and the Wildlife Atlas of the Office of Environment Health. They found that the community surveys matched the modelled habitat and that overlaying the koala habitat map that was drawn from the Greater Southern Sydney region study with the 2006 state-wide survey, showed how the Campbelltown population is connected to other populations.

4. Research questions

As stated above, the main questions are those that were sought by developers and conservation groups; that is, how far does the Campbelltown population extend and how robust is it? These broad questions were divided into the component questions which are the same asked today whenever development is planned in actual or potential koala habitat.

4.1 How far does the Campbelltown population extend?

Initially Campbelltown koalas were generally known only from the Wedderburn plateau (Figure 2). Now we know that they occur from Moorebank in the North, to Appin and beyond in the South, and to Heathcote in the East. Within these boundaries, DNA studies (Lee et al 2010) and absence of chlamydia suggests that the koalas in this area represent a single population.

The relatively few sightings of koalas recorded prior to 1986 and the much higher frequency in recent years indicate that the population is expanding in numbers and in distribution (Figures 3, 4 and 5).

Figure 2 Distribution of koalas around Sydney basin showing Campbelltown, southern, northern and Heathcote populations.

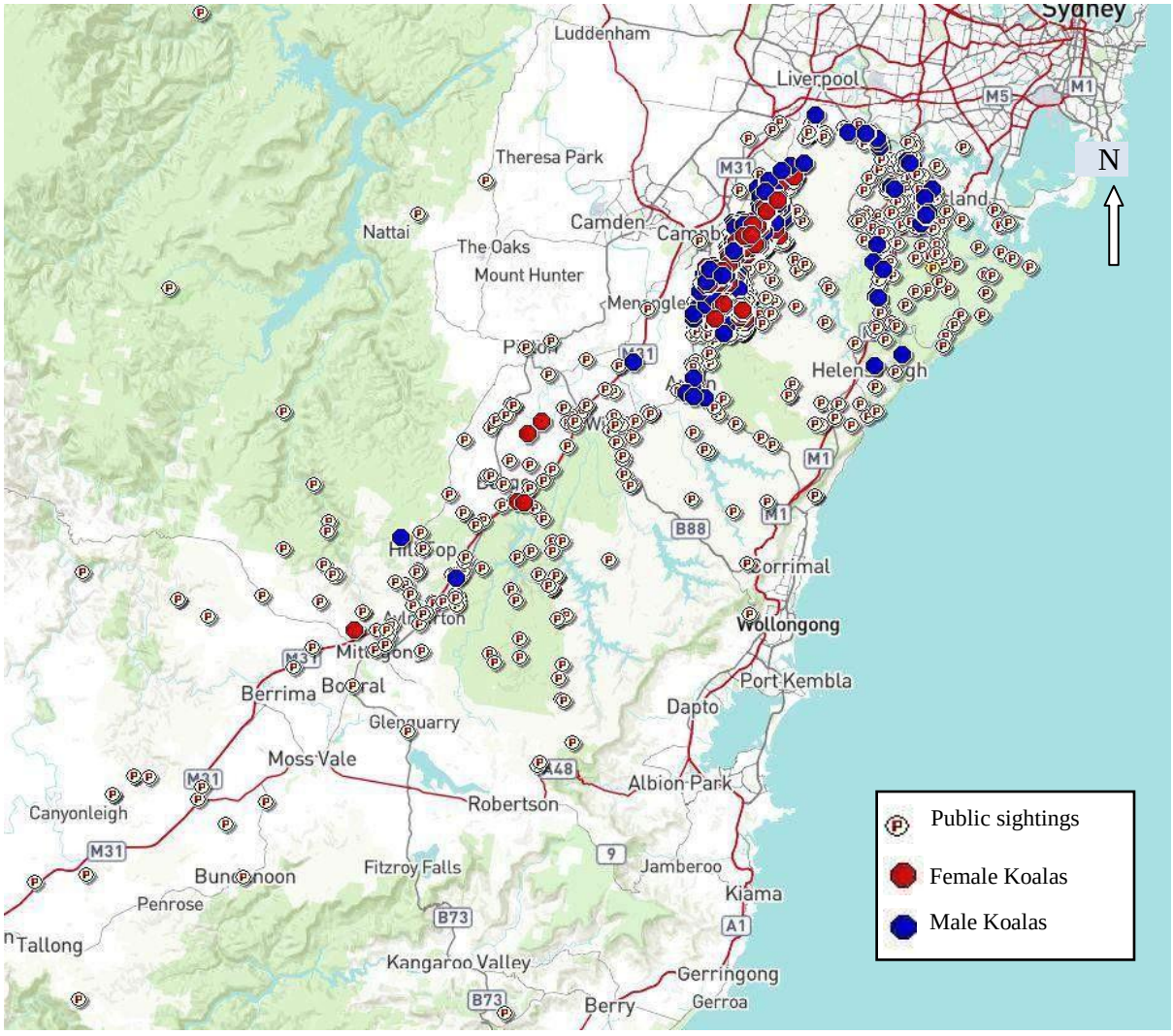


Figure 3 Records from northern sites

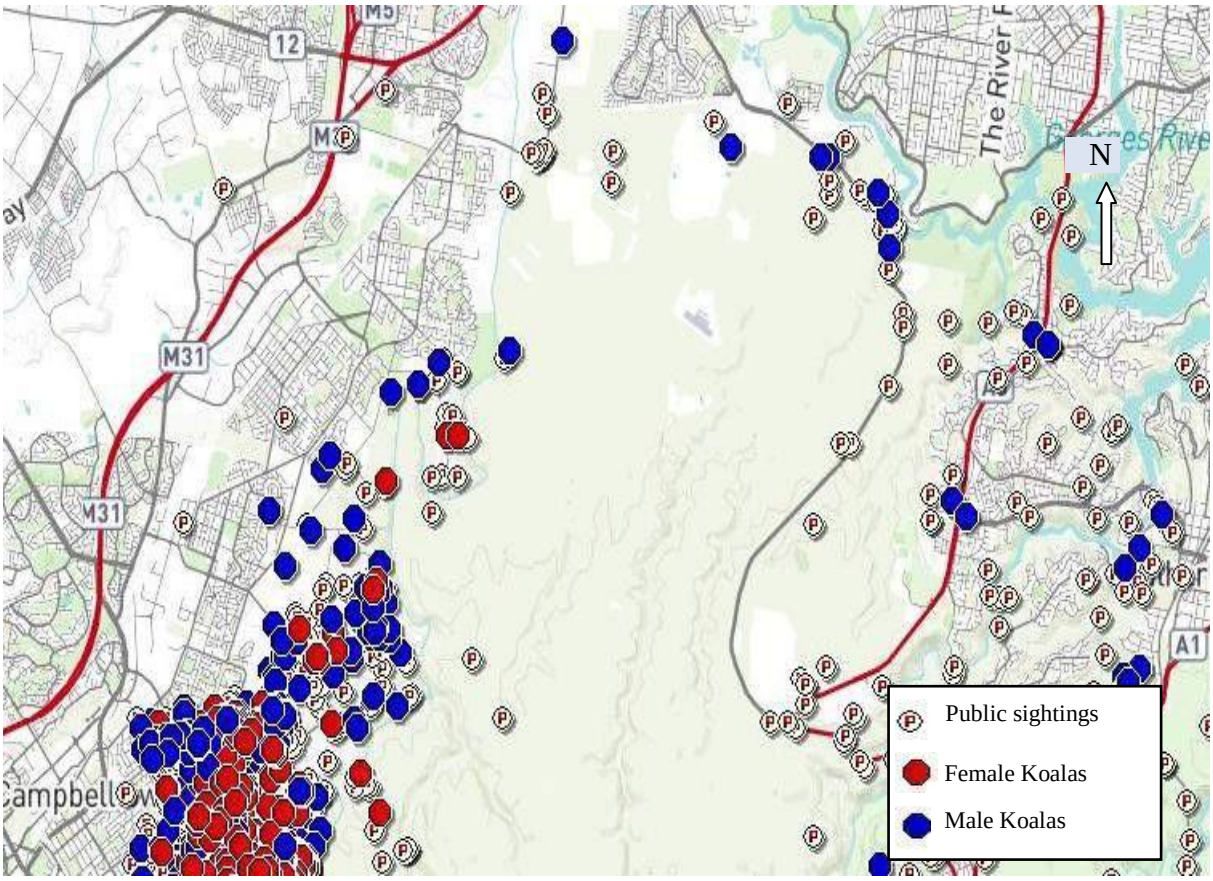


Figure 4 Records from central sites

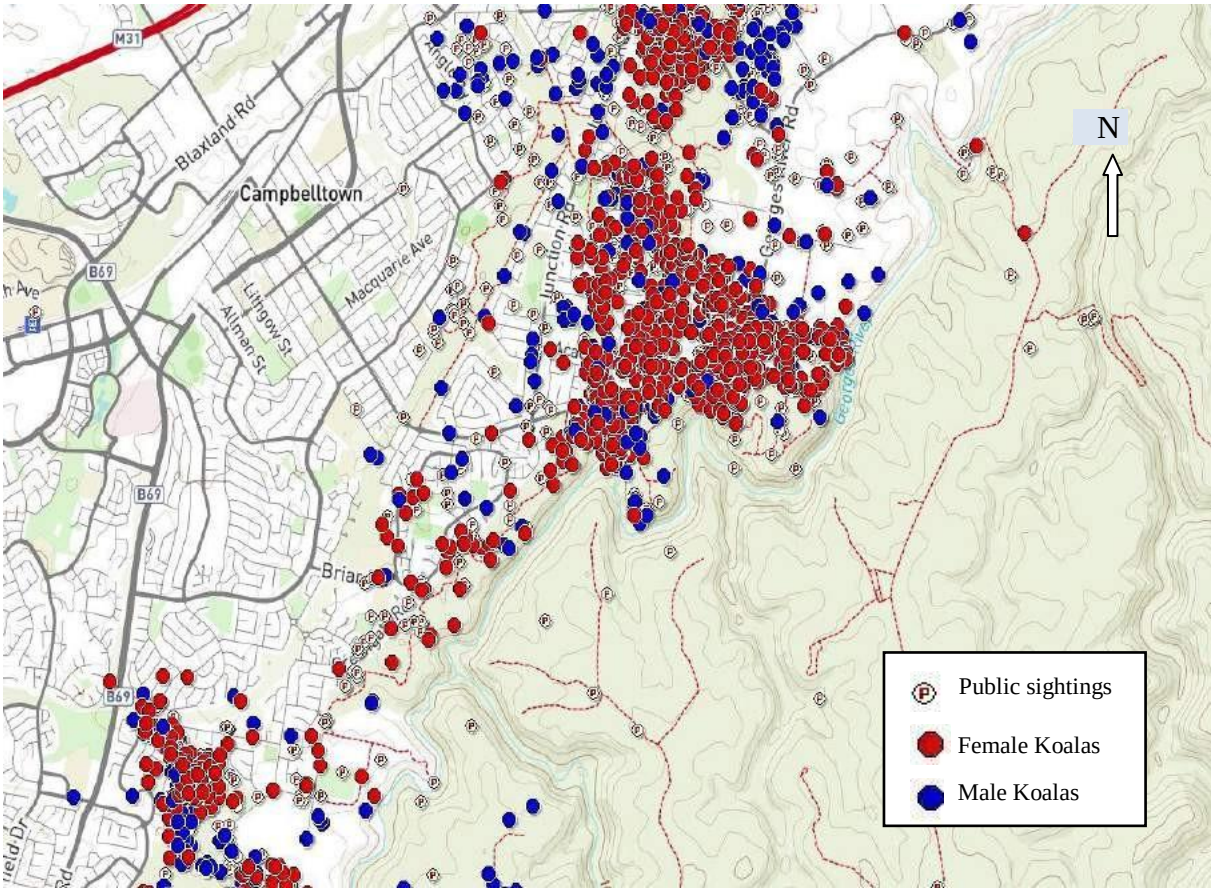
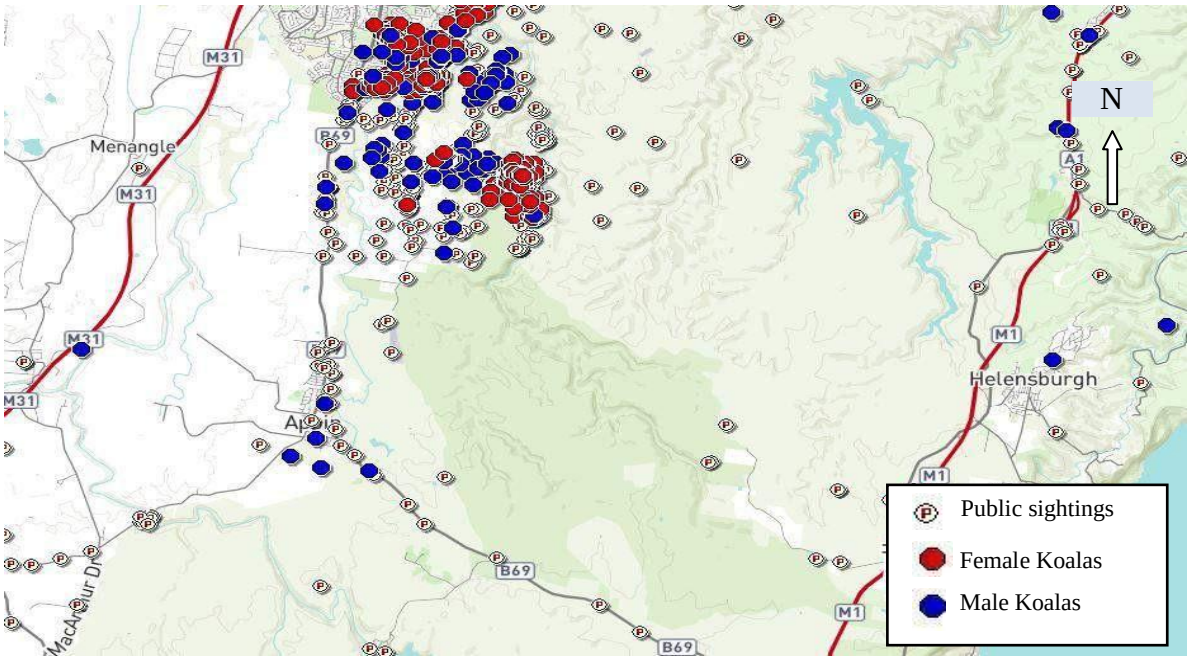


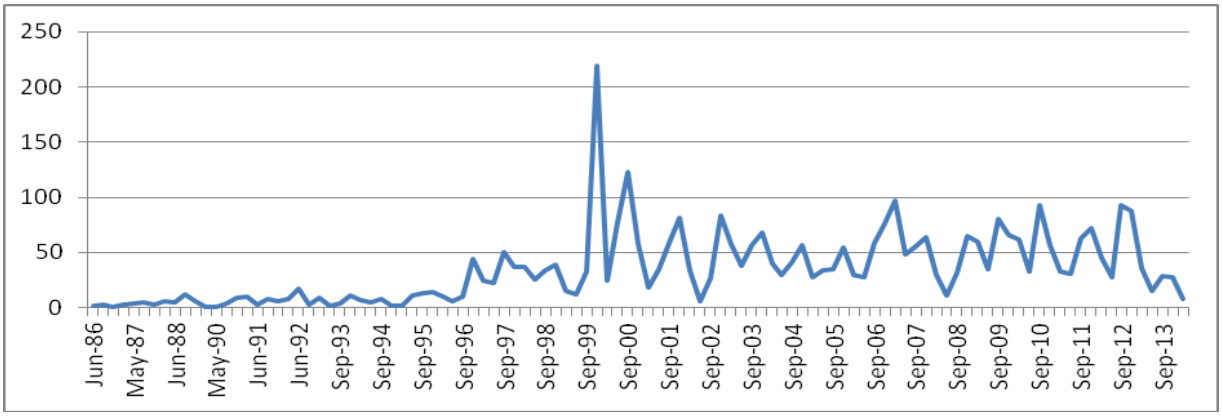
Figure 5 Records from southern sites



However, it is possible that koalas were seen equally as often prior to 1986 as since, but few sightings were recorded. Never-the-less, few long-term Campbelltown residents who have reported several sightings since 1986 had ever spotted koalas prior to that date. It is also possible that the distribution is unchanged, but the density has increased. Koalas may function well at low densities (Close et al 2017). What is clear is that the distribution of koalas is extensive across the southern bushland areas of Sydney and is probably expanding (McAlpine et al 2015).

Similar findings are being reported from the LGAs to the South (Wollondilly and Wingecarribee). This trend is not seen in other areas of NSW (McAlpine et al 2015). However the separation between Campbelltown koalas and those from further south must be small and becoming smaller as koalas disperse. Chlamydial infection from the southern animals could occur at any time if contact is the only prerequisite for an epidemic. Figure 6 shows a remarkable increase of sightings in 1999 followed by a succession of peaks and troughs, the causes of which are not known. Never-the-less, Figure 6 and all our other data are consistent with the hypothesis that Campbelltown koalas are expanding in numbers and distribution such that we can expect that all potential habitat that is

Figure 6 The number of sightings reported yearly



connected to the Campbelltown 'Strip' will be colonised by koalas provided that the habitat is not disturbed.

4.2 What are the sizes of female home-ranges?

Sizes of home-ranges for females vary from 10 to 52 ha (mean approximately 25 ha) and for males from 18 to 276 ha (mean approximately 100 ha) (Figures 7-16). These figures show the movements of radio-tracked animals from year to year and the area enclosed by joining the individual fixes. These areas combine to define the home-ranges of each animal.

Figure 7 Shirley's home-range combined tracked locations. Total area 15 ha

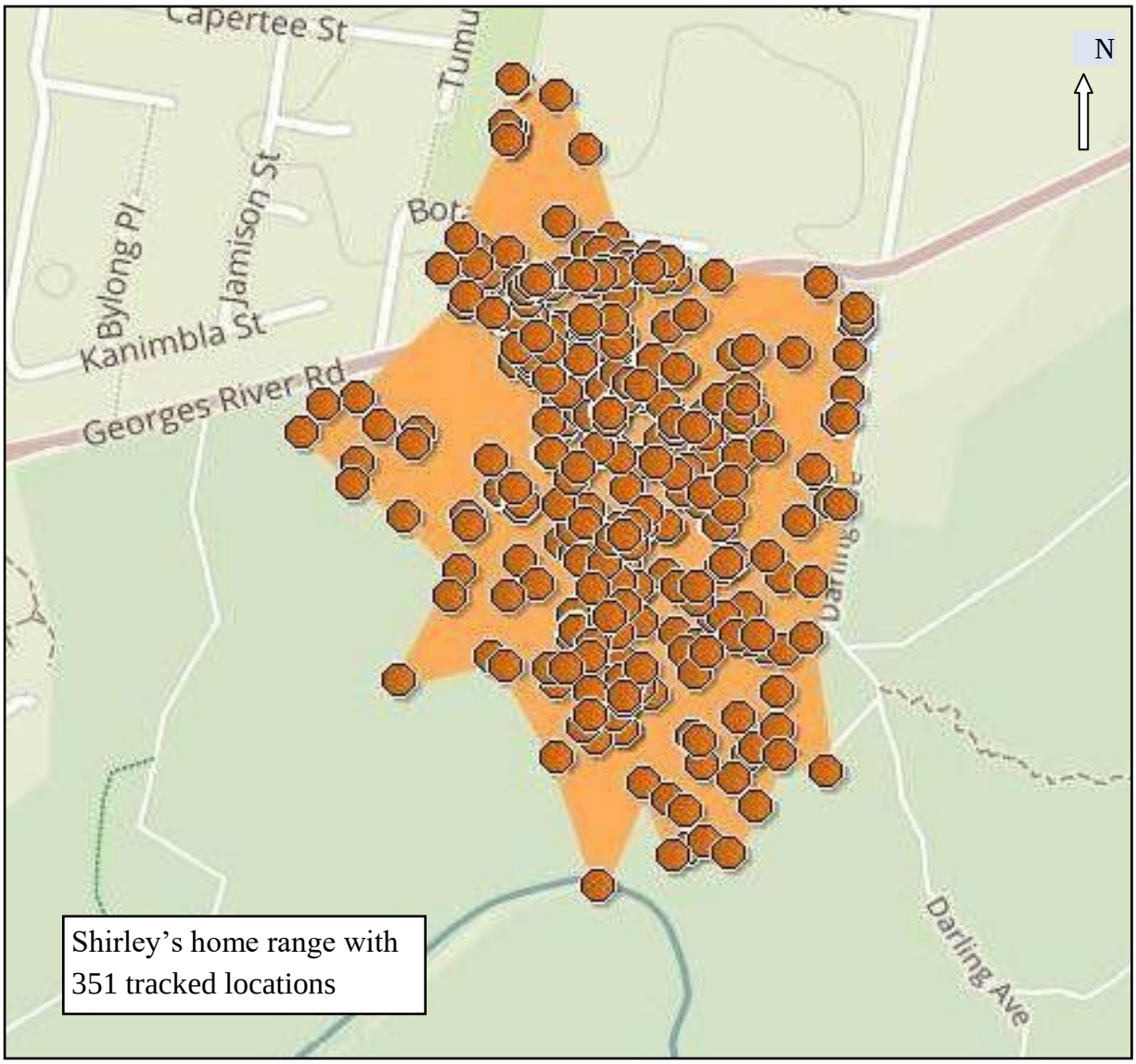
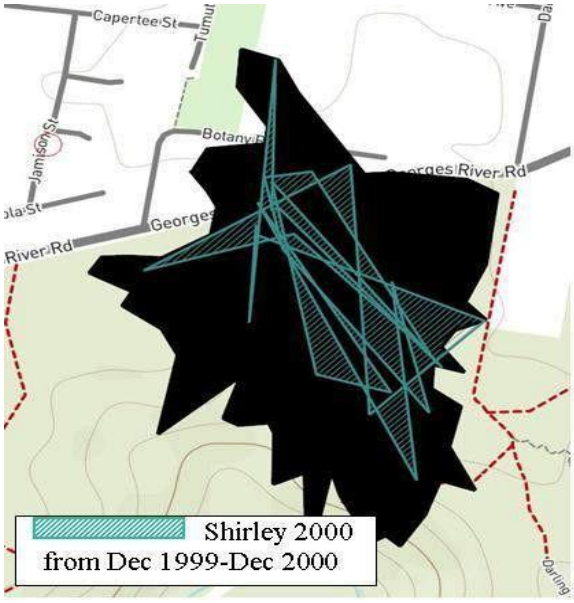
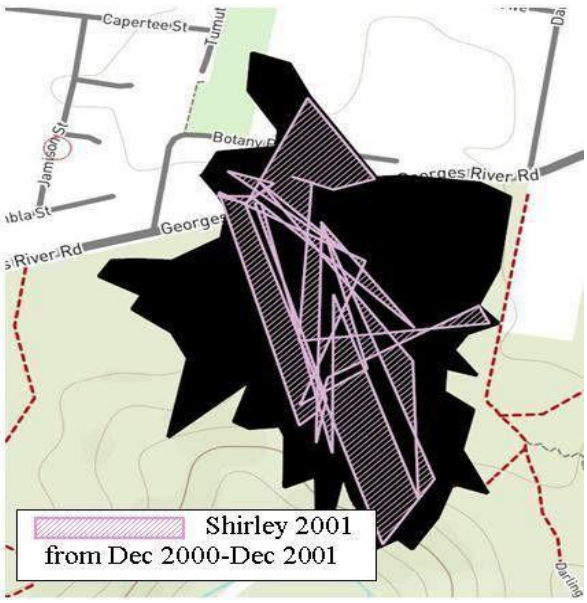


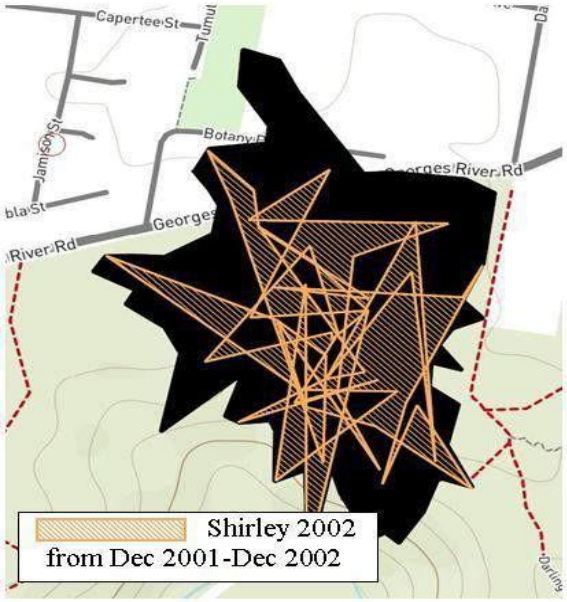
Figure 7 shows all fixes for Shirley and indicates that she was faithful to her established area and used natural or human-made markers such as fences and a track to demarcate her territory. Although home-ranges may include roads and gardens with the attendant risks of car strike and dog attack, none of the radio-collared females died from those factors. One possible exception is Charlotte who was found dead in a household garden but wedged into a tree fork; her joey was dead in the pouch. Unfortunately the corpses were too decomposed to determine the cause of death

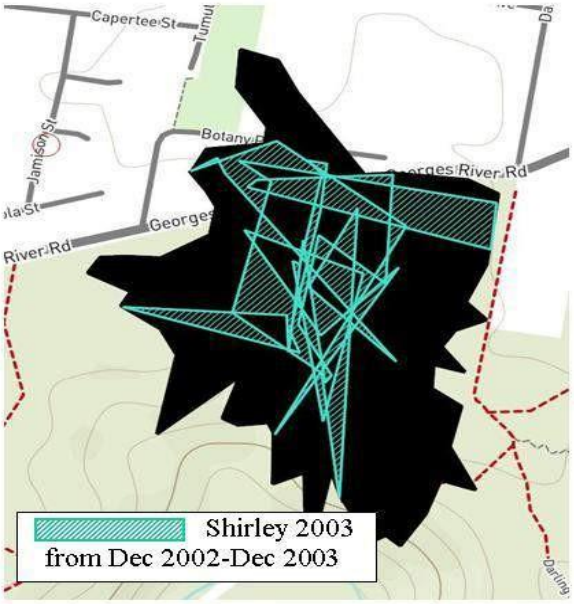
Figure 8 Shirley home-range from 1993-1997

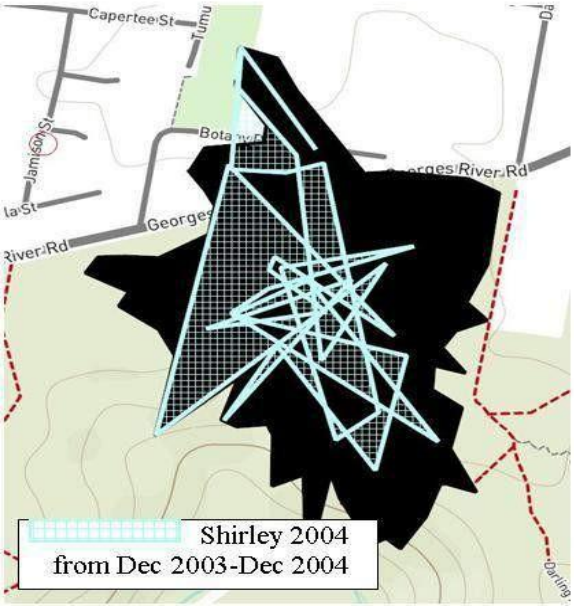
Figure 9 Shirley home-range from 2000-2005











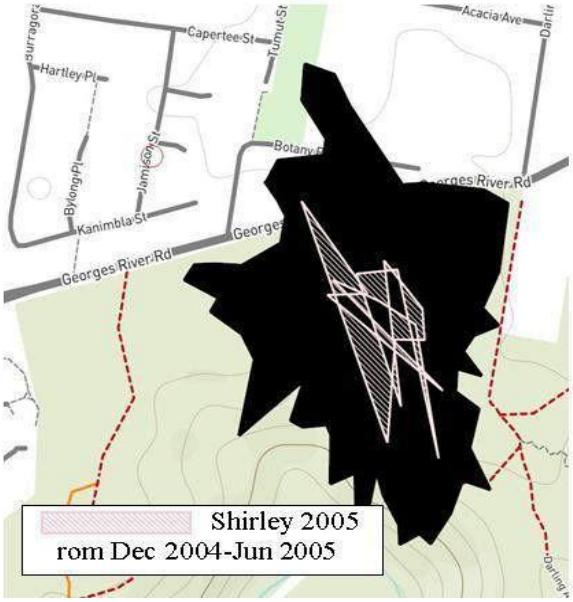


Figure 10 Shirley home-ranges combined years 1993-2005

Figure 11 Index Shirley home-range

Colour by years	year	Km travelled	Area used (ha)
	1993	0.99	0.36
	1994	0.95	0.15
	1996	2.76	1.81
	1997	4.88	3.29
	1998	4.36	2.18
	1999	6.06	3.95
	2000	7.61	4.66
	2001	5.85	4.15
	2002	4.67	0.28
	2003	5.52	0.95
	2004	5.3	1.83
	2005	2.28	0.89

Once females establish their home-ranges, they don't seem to vary from year to year or from season to season Figure 6 also shows a concentration of fixes north/south down the centre of Shirley's home-range reflecting a small perennial water-course. This would provide moisture for tree roots and protection from drought. Establishing a home-range appears to be a critical event for females. Once established, a home-range provides familiar trees for food, water and shelter and familiar pathways between resources such as rock caves (Close et al 2017). Females will sometimes leave the core area of their home-range and travel one km or so to

meet a bellowing male. The maximum convex polygon was determined for each interval period, usually a year, or thereabouts with the distance travelled being the summation of movements between fixes. These are largely under-estimates because of the intervals between fixes; Animals such as Shirley and Amanda, however, (see Figures 7, 8, 9, 10, 13, 14 and 15), provide a clear picture of how they use their home-ranges. Home-ranges for all other tagged females can be determined from the data base in a similar manner.

Some of the home-ranges will be over-estimates because they include the period before the female has selected her home-range. Amanda's movements are an example in that during her first year of telemetry she wandered widely but gradually condensed her area (see Figure 12). Even with her condensed home-range it was still large enough to include a section of Peter Meadows and Junction Roads and houses with dogs. Figures 13, 14 and 15 show Amanda's yearly movements which include many crossings of Peter Meadows Road and occasional visits to Peter Meadows Creek which would provide trees with access to the water-table during droughts. Her final home-range is about 25 ha. Figure 12 (central left complete grid square) shows fingers of vegetation within the urban area. The largest finger is Smiths Creek which includes the home-ranges of at least two other females and part of two males' home-ranges. The smaller strip running from James Ruse Park via Stromlo and Cook Reserves to Junction Road (central lower right complete grid square) is part of the home-range of ear-tagged Liz and is also a corridor for koalas moving through Ruse from the Georges River to Peter Meadows Creek. It is important to know how the female koalas subdivide the suitable habitat and if there is any such habitat that is not used.

Figure 12 Amanda's home-range 2010

Figure 13 Amanda's home-range from 1997-2003

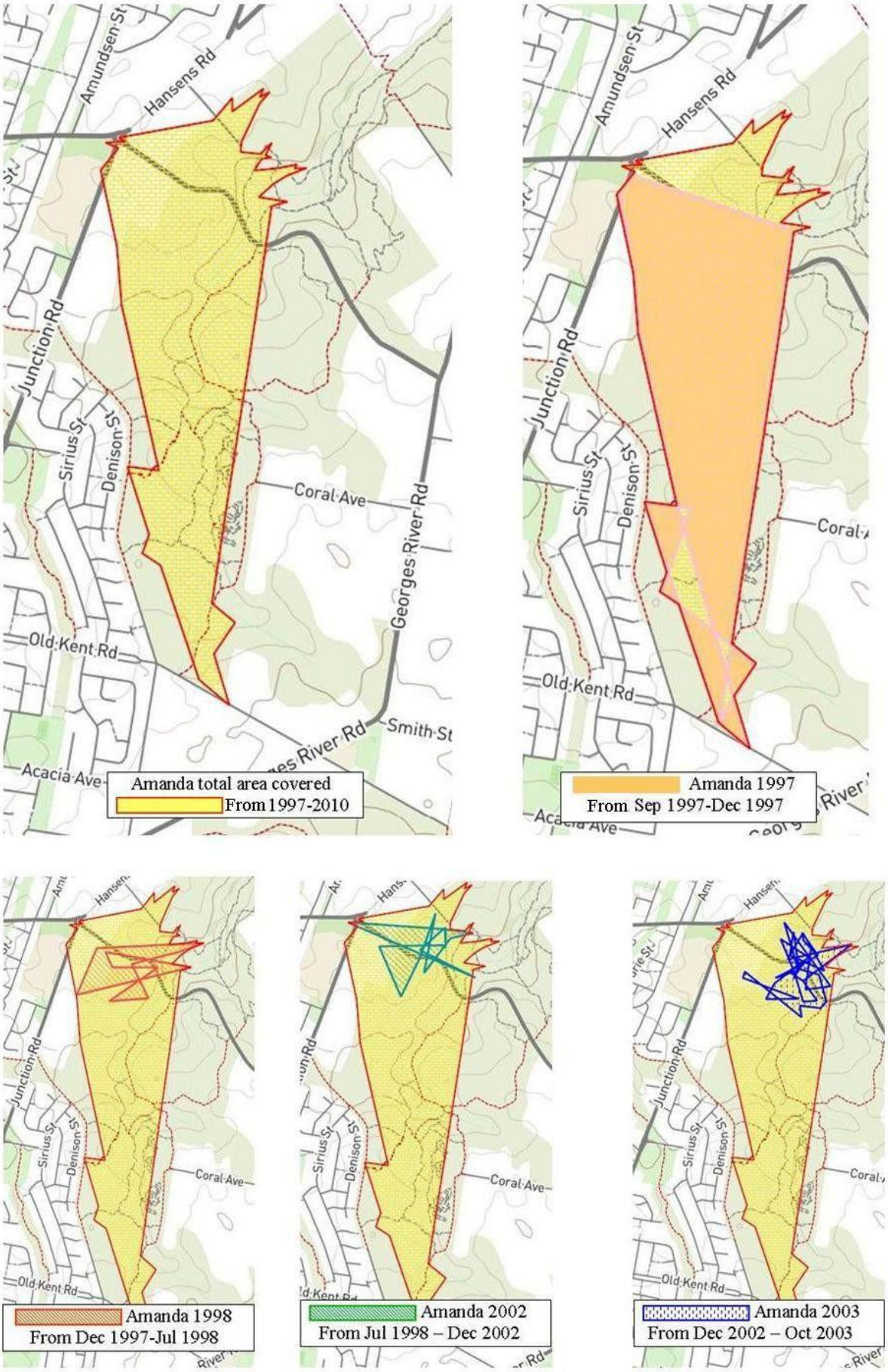


Figure 14 Amanda's home-range from 2003-2010

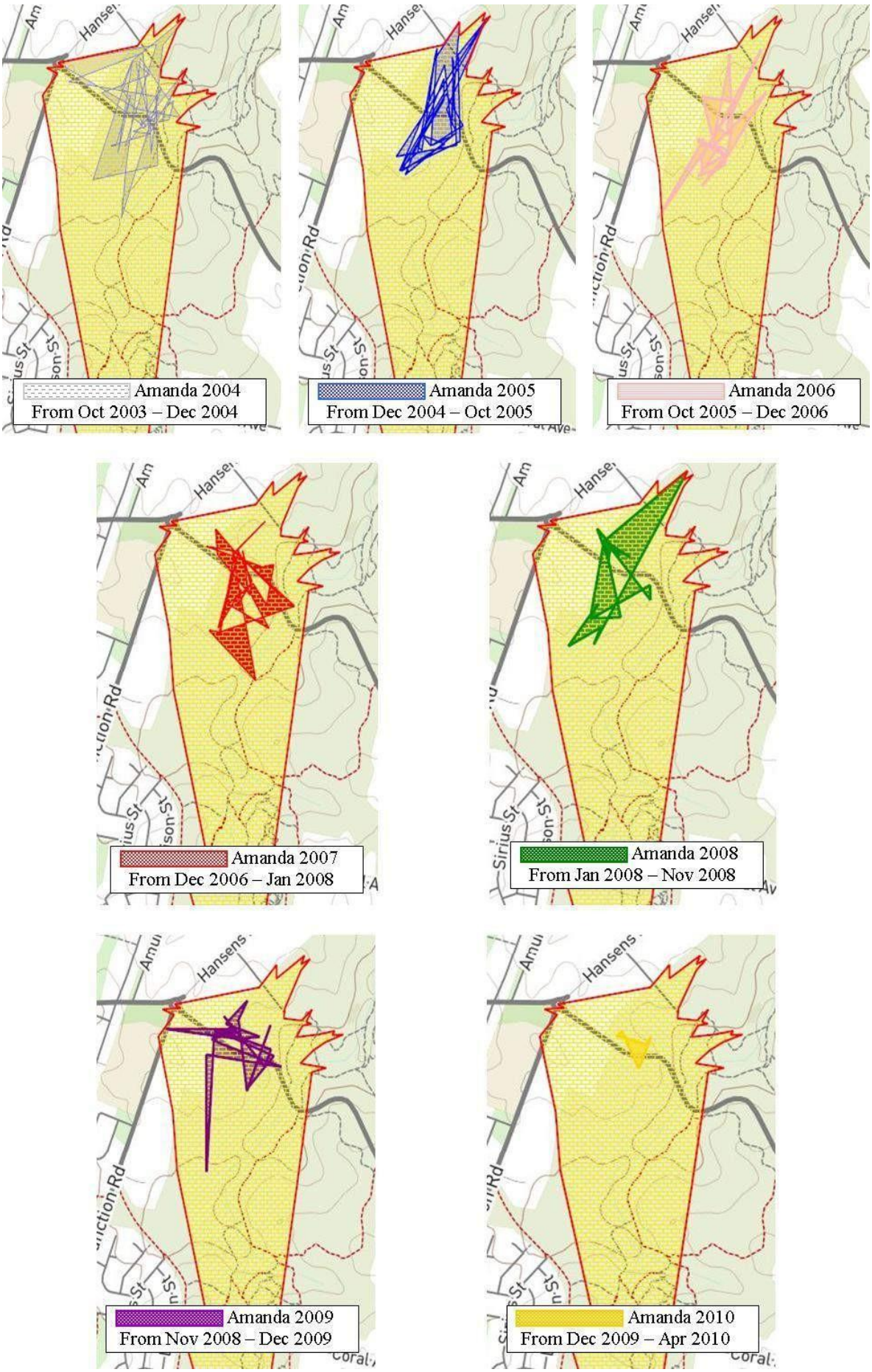


Figure 15 Amanda's home-ranges combined years

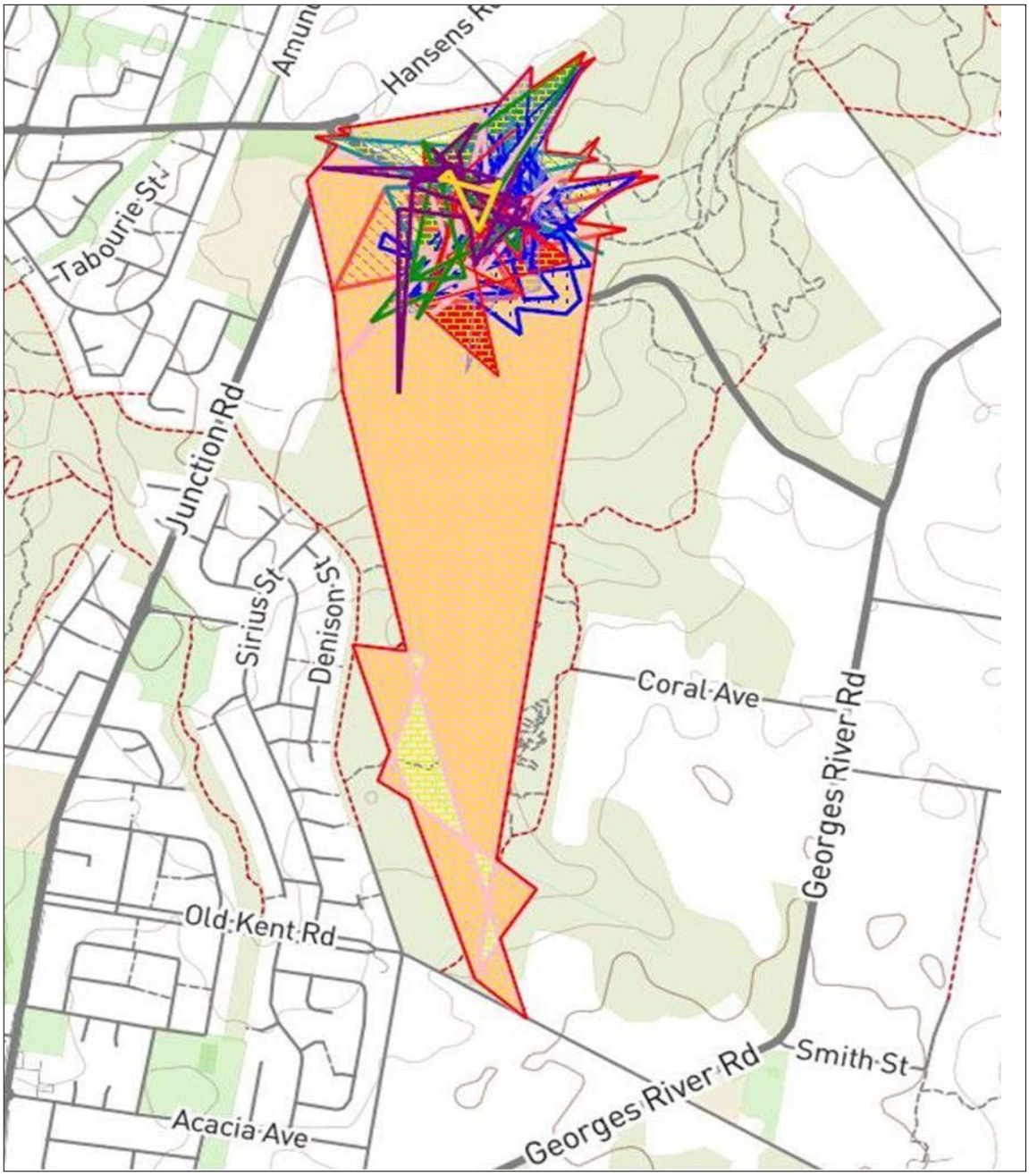


Figure 16 Amanda's home range

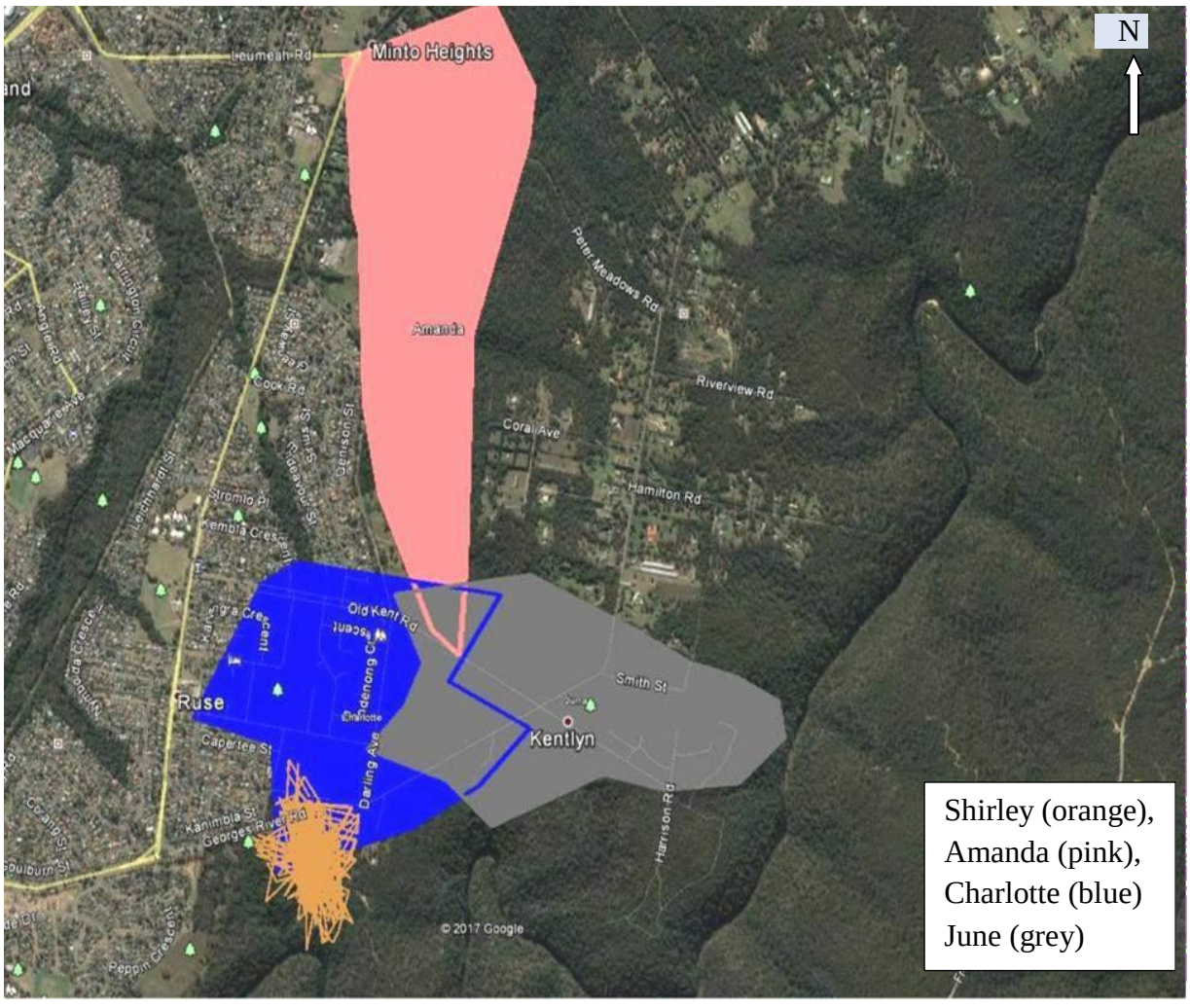
Colour by years	year	Km travelled	Area used
	1997	6.88	53.39
	1998	3.59	11.2
	2002	7.18	3.67
	2003	6.24	9.45
	2004	9.56	13.94
	2005	8.26	12.94
	2006	5.04	5.09
	2007	5.81	4.5
	2008	3.64	2.36
	2009	5.01	1.44
	2010	0.47	0.43

Figure 17 shows some of the Kentlyn area's home-ranges. We have found that Shirley's daughter, June, moved one km north, past Charlotte's home-range, and settled in the Kentlyn Primary School grounds (see Figure 15, corner of Old Kent Rd and Georges River Rd) and adjacent retirement village. Her daughters, Vicki and Shy, in turn, settled on either side of her, although Vicki took over from June in the School grounds. It was interesting that later, when June was suffering from a fatal lymphoma, she returned to the School grounds. We did not have a collar on Shy and relied on her ear-tags for identification. She was sighted in gardens beside Smiths Street but not in the retirement village.

Subsequently Amanda contracted northwards while June contracted to allow her daughters Vicki and Shy to settle beside her to the north and south. A fourth female, Lyn, (not shown), occupied the area north of June and east of Amanda

A fourth female, Lyn, occupied bushland on the western side of Georges River Road opposite to the School. Vicki ventured into Lyn's home-range but her stay was brief. The prediction would be that if all the available habitat was occupied for maximum productivity then young koalas would be seen regularly wandering along the edge of suburbia. The former hypothesis, where young females establish their home-ranges close to or adjacent to their mothers is consistent with the data for June, Vicki and Shy. However, movements of some young females along the bushland fringe are consistent with the hypothesis that all suitable habitat was occupied adjacent to their mothers' home-ranges. For example, Charlotte's daughter, Curls, wandered back and forth, generally parallel to the Georges River over a period

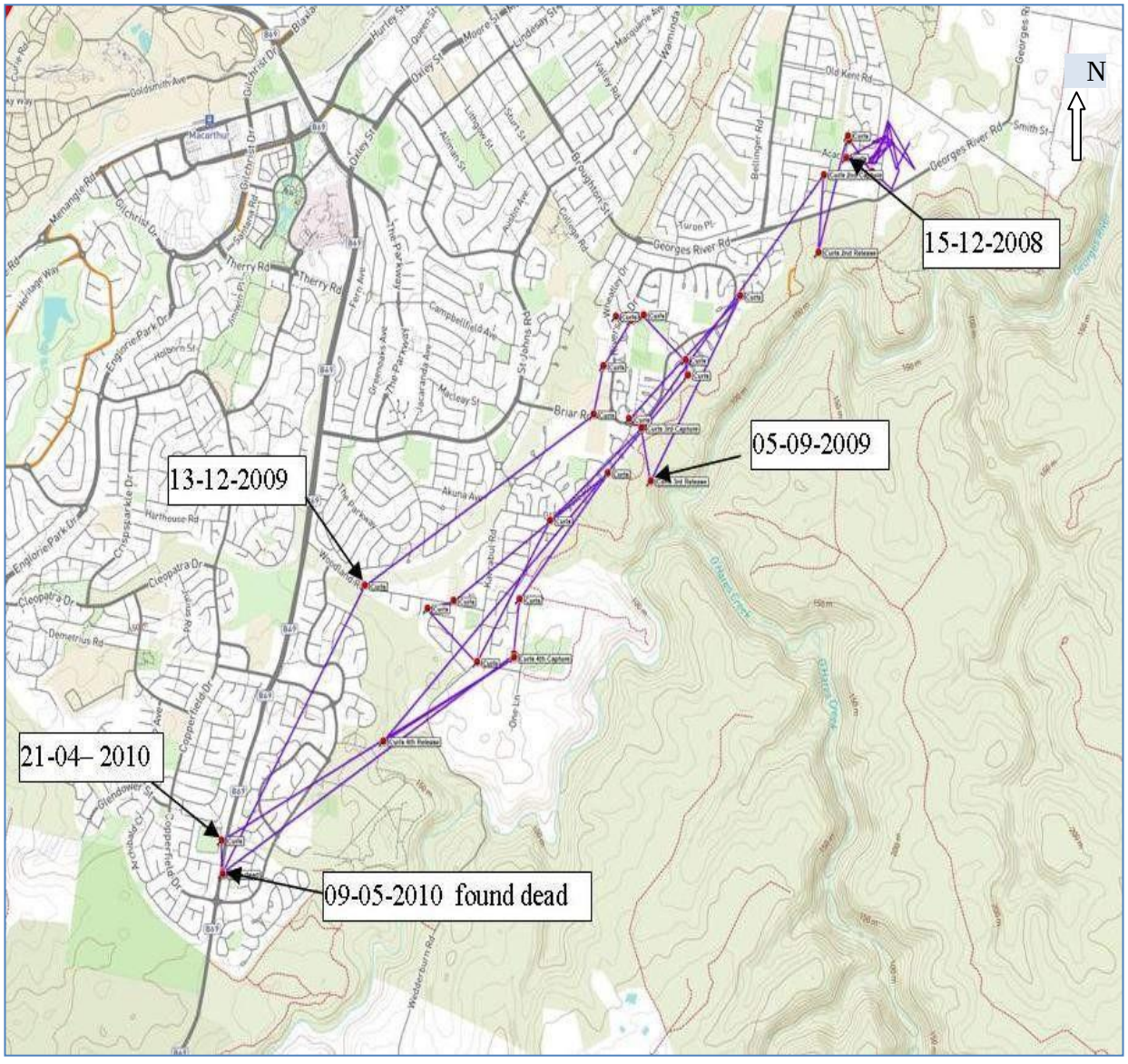
Figure 17 Home-range of Kentlyn females.



of 17 months, visiting several household gardens on the way (Figure 18). She eventually was hit by a car and killed on Appin Road. She had a joey that was also killed. Her movements showed that females don't need established home-ranges to breed but face many hazards in the search for a suitable site. Curl's example indicates that she didn't pass through unoccupied habitat suitable for establishing a home-range. Figure 18 shows that she repeatedly moved into the peri-urban housing rather than move though the riverside vegetation.

Another young female, Flossie, followed a similar path, which is consistent with the hypothesis that all the suitable habitat is occupied. We predict, therefore, that home-ranges will contract until the productive limit is reached and more young koalas will appear on the edge of housing. In general, the Campbelltown bushland is occupied by females with contiguous or partly contiguous home-ranges. There appears to be some capacity for sharing portions of an established home-range particularly with offspring. However, this generosity may not apply during droughts or after fire.

Figure 18 Movements of Curls from weaning (top right) up and down the Strip for 10 months before her death with joey on Appin Road



4.3 Home range of male koalas

The sex ratio of the koalas captured was approximately 50:50 (See Appendices 10.1, 10.2 and 10.3) and the measured home-ranges (MCPs) of the males were 19 - 276 ha (mean 113). However, plotting home-ranges for males is more difficult than for females because the formers' movements may be dictated by their maturity and the locations of females and males rather than the quality of habitat. An animal living on the outskirts of territory held by a more dominant male may roam over a larger territory than the latter. See Figure 19 (Cramar and Barney). Barney died a month after the two males were seen in close proximity beside Spring Creek. A post mortem showed that Barney had skin wounds, presumably from fighting, but actually had a severe infection of the gall bladder, a rare and serious disease (D. Phalen pers. com.). Cramar suffered a torn ear and a swollen hind leg. Likewise, male, Amica, who also resided in the Spring Creek vicinity, was taken into care on three occasions with serious injuries (broken digit, punctured eye, fractured tibia).

Figure 19 Proximity of males at Spring Creek (Cramar and Barney) to each other and to a female (Courtney) in February 2008

A local resident reported fighting at the time and we found Barney (Light Blue circles) badly wounded and ill on 12/3/08

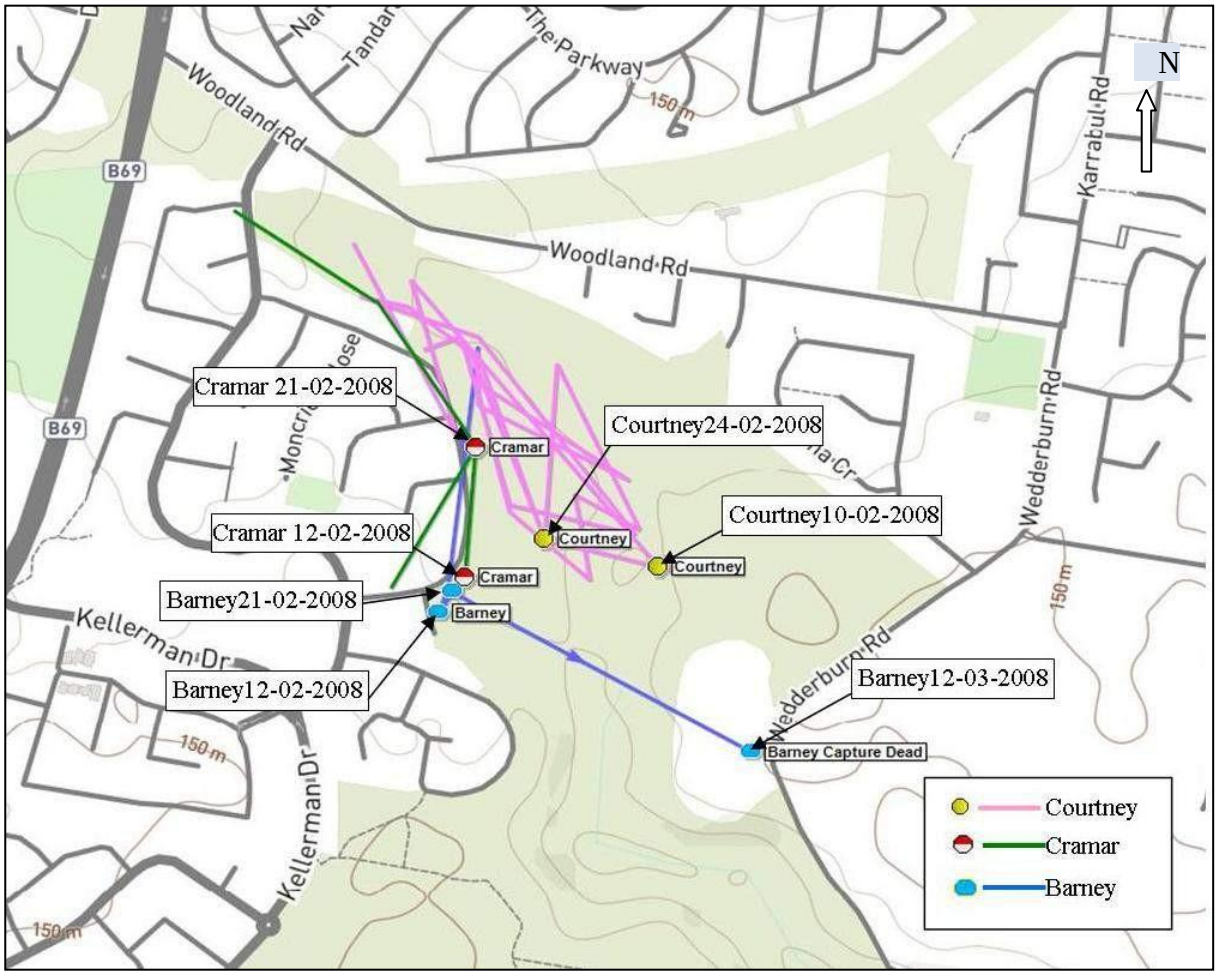
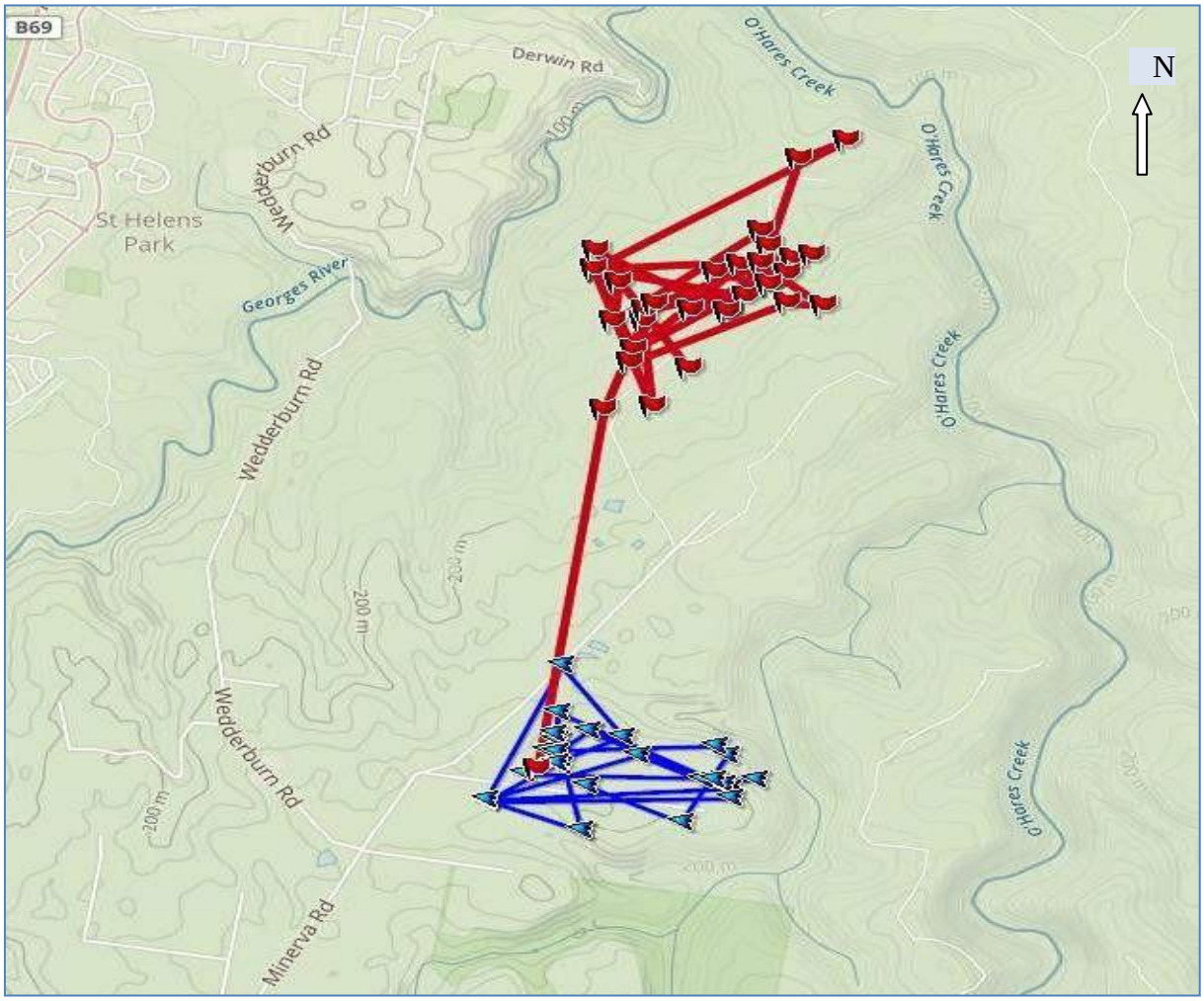


Figure 20 Old Boy. Blue lines mark out the first home-range and red for the second



See also Old boy's path (Figure 20) through two apparently established territories, the second being in apparently poorer quality habitat (based on paucity of grey gums, tree height, and soil type). Martin, another old male, also apparently moved into new, hazardous surroundings

beside Wedderburn Road. It appears, then, that some males occupy large home-ranges but when older and no longer able to compete with younger males, they move into poorer quality habitat. This can distort measurements of home-range size and expose old males to danger.

4.4 What is the population density?

By plotting the home-ranges of all the established females, the extent of suitable breeding habitat can be estimated and, therefore the population size. Figure 17 shows the spatial relationship between several females. In addition, June's daughters (Vicki and Shy) occupied the spaces north and south of their mother, June, while Lyn occupied habitat west of Georges River Road and opposite Kentlyn Primary School.

Assuming that home-ranges have continuous and complete occupancy, the population density can be estimated. In this case the female densities were approximately 1/25 ha. However, different soil types can support different densities of koalas and all suitable habitats might not always be occupied. Phillips (2017 pers. com.) estimates 50% to be more likely.

However, given an area of suitable habitat of 15275 ha (soil types with a positive Relative Exploitation {Ward and Close 2004}) then the female population, assuming continuous

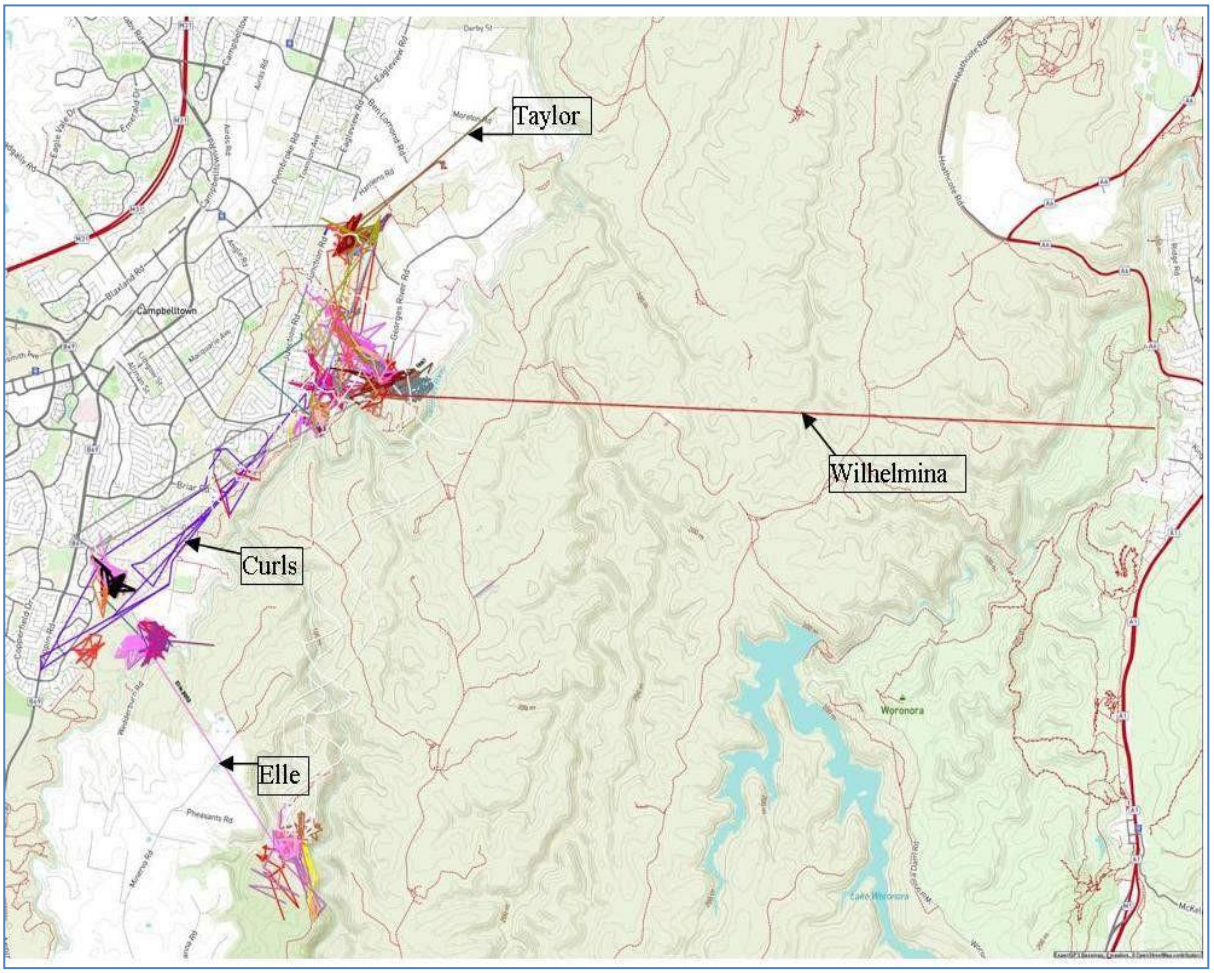
occupancy, would be 15275 ha divided by the size of female home-ranges (25 ha); that is, 611 females. Assuming equal numbers of males and females (see numbers from database or appendices 10.1, 10.2 and 10.3) the total maximum population estimate of the Georges River catchment would be about 1200. Such a density would not be expected throughout the Holsworthy Firing Range, the Woronora Catchment and Heathcote NP to the East because of the less fertile sandstone soils.

However even if female densities are only 1/100 ha then the total female population for this large area would be 15275/ 100/ha; that is, 153, and the combined male and female population would be about 300. Actual numbers are likely to be between 300 and 1200; we predict 1000, but the distribution is more important than the actual number.

4.5 What are the dispersal rates and routes of young koalas?

Figure 21 shows the movements of tagged female koalas. The longest journey was by Wilhelmina who crossed the Firing Range to Heathcote. Other movements generally followed the Georges River and the built-up areas of St Helens Park, Airds, Ruse, Kentlyn, Leumeah and Minto Heights. Some travelled northwards and others southwards. Some established home-ranges adjacent to their mothers (June, Vickie, Shy) while others set off into new areas (Flossie, Curls, Debbie). The fact that some koalas were able to establish next to their mothers indicates that occupancy was not yet 100%.

Figure 21 Female dispersal



On the other hand, Curls was tracked for 17 months moving along the edge of suburbia, a minimum direct distance of nine km and a minimum actual distance of 30 km. During this time she conceived, demonstrating that females do not require an established home-range in order to breed. Like many young dispersants, however, she and her joey died on Appin Road (Figures 17 and 20). Males generally left their mothers and travelled further than females (Dan, Bill, Steve). Figure 22 shows these dispersals while Figure 23 lists the minimum distances travelled. The longest dispersal was from Ruse via Wedderburn Rd. and Appin Rd to Douglas Park, a venture of 19 km from the Georges River catchment to that of the Nepean.

Figure 22 Male dispersal

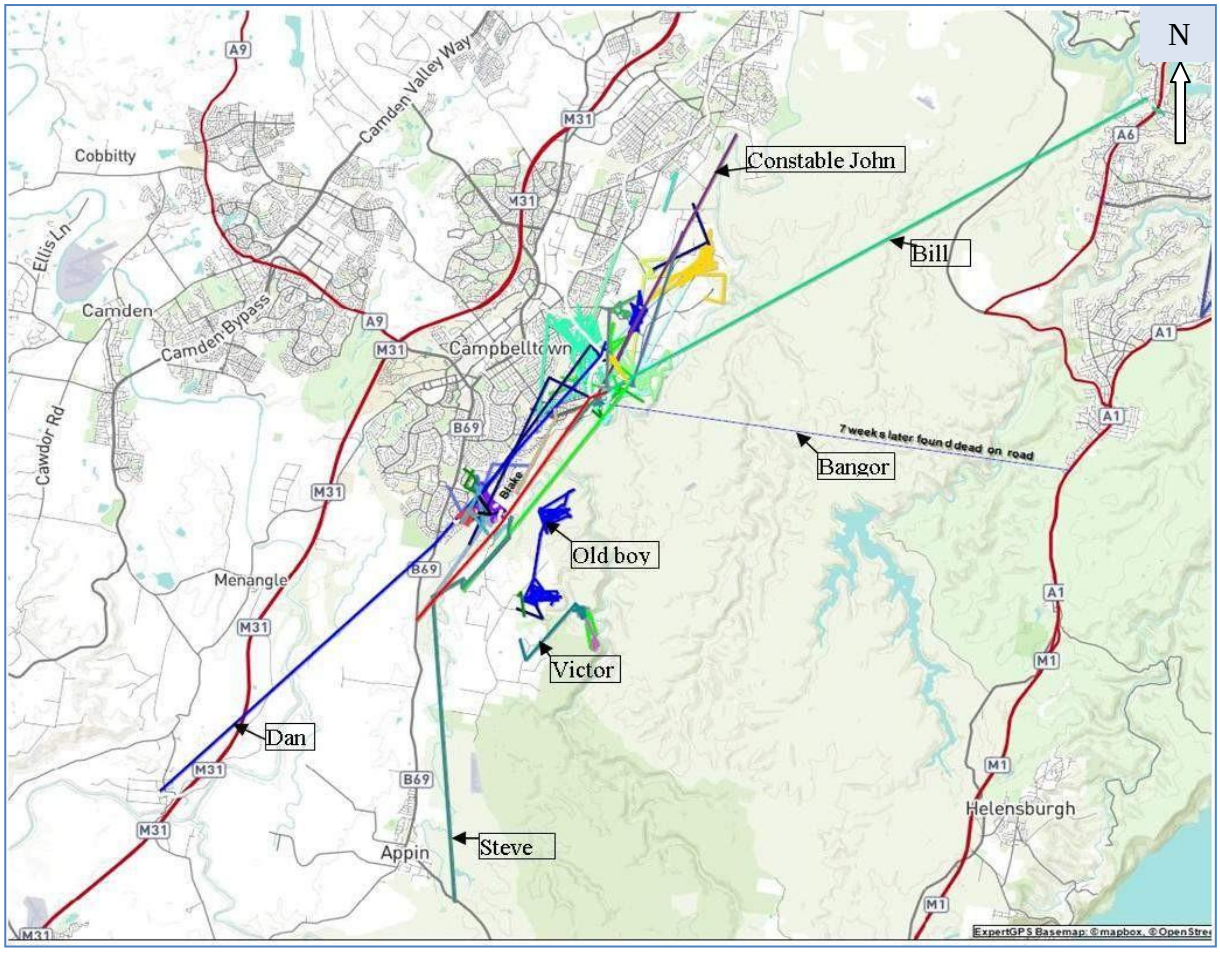
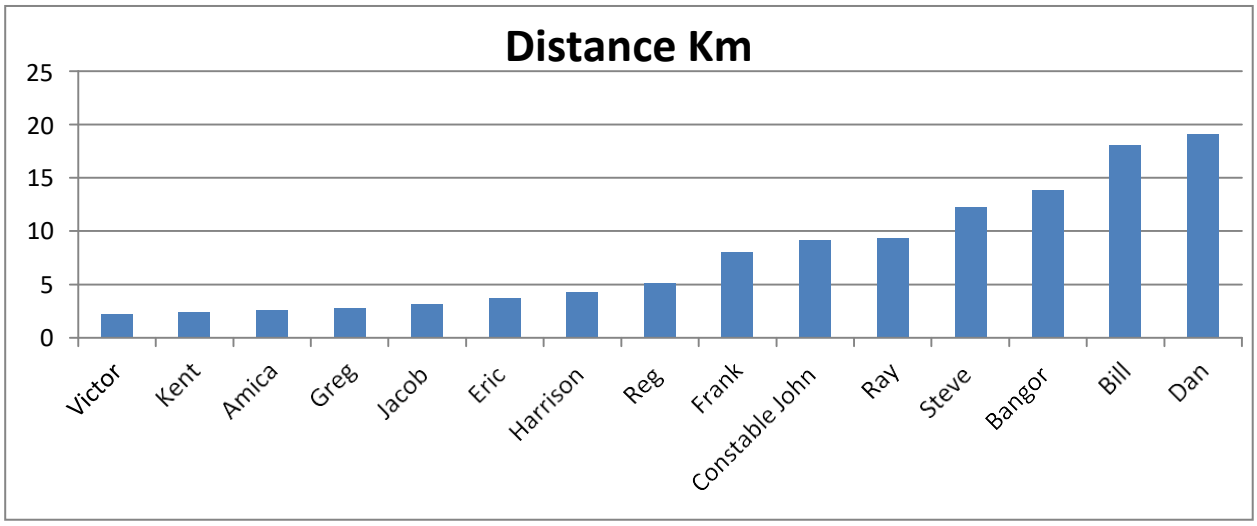


Figure 23 Dispersal distances of males



Of special interest were the journeys of Constable John and Bangor. These two were translocated from dangerous locations on the northern perimeter of koala habitat to Darling Avenue, Ruse. The former then moved 9.4 km northwards towards his original capture point (see Figure 24) while Figure 25 shows the 13.8 km eastward movement of Bangor in less than two months after his translocation from Bangor to Kentlyn.

Figure 24 Movement of Constable John after translocation

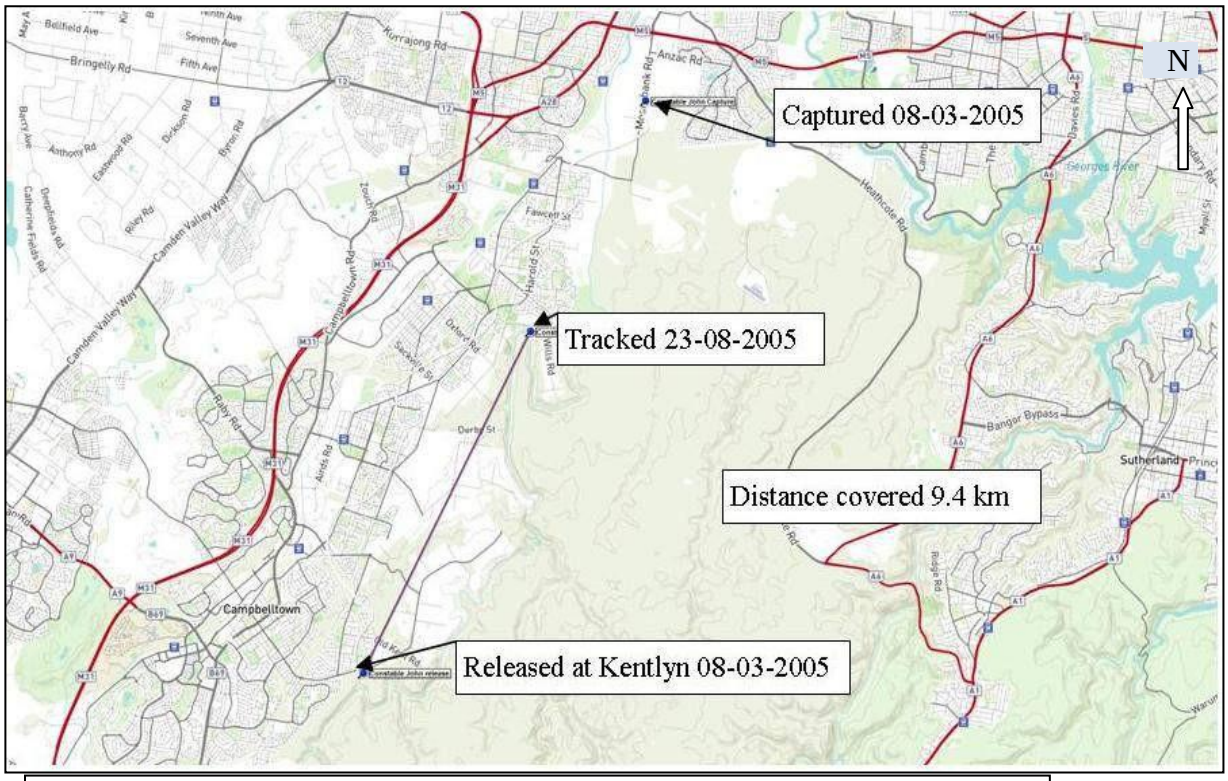
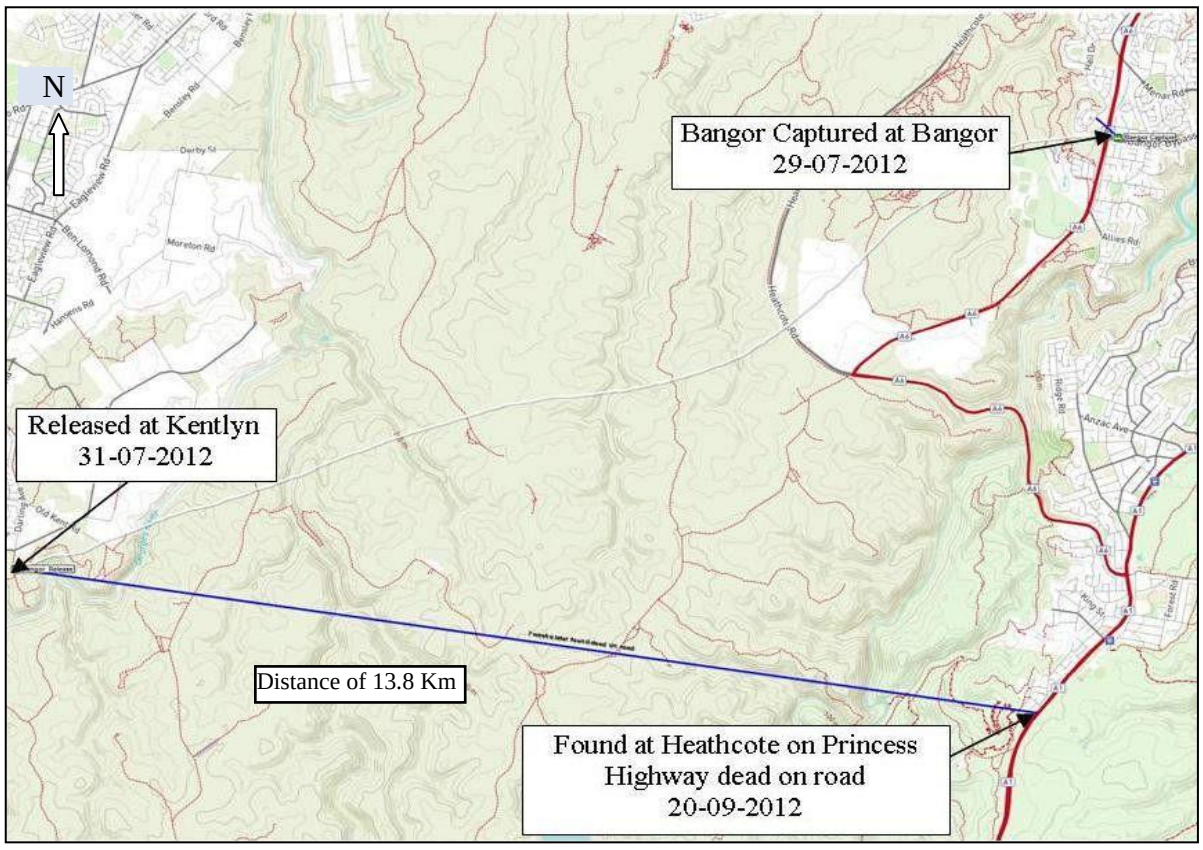


Figure 25 Movement of Bangor captured at Bangor released at Kentlyn



4.6 What is the longevity of Campbelltown koalas?

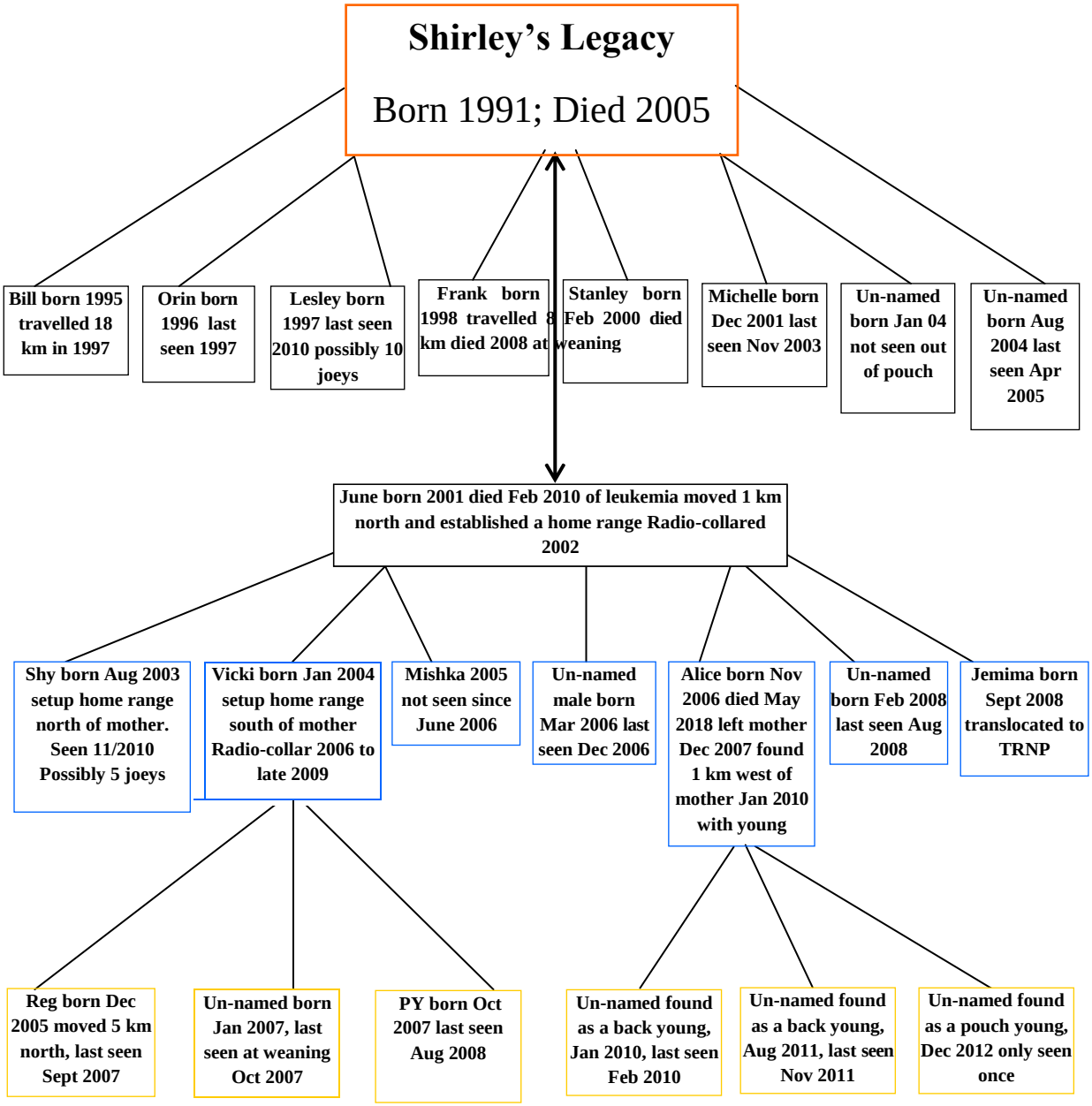
A surprising finding was that, once established in their home-ranges, radio-collared females can live up to 17 years (Appendix 10.1). This survival occurred despite the proximity of dogs, cars and people to many of the home-ranges. Therefore, any reduction of size and/or quality of home-ranges could affect the survival or reproduction of established females. Teeth wear and gum disease were common among the older animals (Figure 26). Examination of teeth wear of dead male koalas revealed that some males were also long- lived (Martin, Nathan).

Figure 26 Amanda's skull showing gum erosion and teeth wear

4.7 What is the reproduction rate?

Appendix 10.2 shows the offspring accorded to radio-tracked and tagged females. Because we were unable to follow complete lives of all females, the table is incomplete and the actual numbers of offspring would, in fact, be greater than those shown. Most, but not all females produced a joey each year and most joeys survived to weaning. Given the longevity of the females, three or four generations may be breeding concurrently (Shirley, June, Vicki) which increases the possibility of a male mating with his daughters and granddaughters.

Figure 27 Family tree of Shirley, only a fraction of her potential legacy is known



Such a reproduction system could readily account for the relatively rapid recovery from a population bottleneck that Lee et al (2010) proposed for the Campbelltown koalas. Figure 27 shows Shirley's partial family tree. She was 18 months old when collared and we missed one year of breeding due to a thrown collar. Her last two joeys did not survive weaning but her contribution to the population was still significant. She died of natural causes. In summary, Campbelltown koalas are producing surviving offspring at a relatively rapid rate. Many of the joeys that we ear-tagged, were never recorded again, but enough have been sighted for us to know that young koalas are dispersing widely across the landscape see (Appendix 10.3).

4.8 What are the causes of death?

Appendix 10.1 shows the recorded fatalities. Cars and dogs are the major causes. However, it is sometimes difficult to apportion individual blame without a post-mortem because wounded animals such as Charlotte, Georgia and Amica can sometimes struggle off the road and into a dog's domain and a dog might kill a koala beside a road (Casey), to be recorded as a car strike. Appin Road has been the major blackspot for koalas. Alternatively a dog may find a corpse or a wounded koala in the bush and partially devour it (Elmo, Georgia).

No deaths from bushfires were recorded. However, there was only one major fire during the study period and it only affected one collared, one tagged, and one untagged koala in a group comprising Franchesca, her daughter and a young male, all found in the same unburnt tree. Some animals bore the marks of fighting (e.g. Amica, Cramar, Barney) while others were dead or dying beneath trees e.g. Barney, Elmo, Harry and Frank (possibly) suggesting that deaths from fighting are relatively common. Remains of one furred joey were found, probably the work of a Powerful Owl. Small teeth marks in another furred joey were probably the work of a fox or a cat. One young koala drowned in a swimming pool. Two died from jumps during capture and one, Gary, was wounded in the rump, probably with a slug gun.

4.9 What is their health status?

The most significant health feature of the Campbelltown koalas was the absence of clinical signs of chlamydia which led to the population being wrongfully declared "disease-free". Unfortunately, chlamydia are found in koalas to the south and given the tendency of koalas to undertake long distance dispersals, the eventual arrival of the disease in the Campbelltown population is highly likely, probably inevitable. Since 2007, no Campbelltown koala that has been presented to the Avian Reptile and Exotic Pet Hospital at the University of Sydney has exhibited clinical signs of Chlamydial infection. Additionally, no koala from the Campbelltown area since 2012 has tested clearly positive for *Chlamydia pecorum* or *C. pneumoniae* by PCR testing of ocular swabs and cloacal swabs (D. Phalen, pers. comm). One koala tested possibly positive from the urogenital swab but David is not convinced that the animal is definitely infected.

All koalas tested to date are positive for koala retrovirus A (D. Phalen pers. comm. 2017) which is an endogenous retrovirus and is inherited from both parents as it is integrated into the genome. It is not transmitted horizontally from koala to koala. All koala populations tested in Queensland and New South Wales have this endogenous retrovirus.

Other causes of death or suffering have been as follows: Lymphoma (2) possibly caused by the Koala Retrovirus; Mange (2); Oxalosis (1); Facial bone tumour (2); Infection of lower jaw; (1). Genetic problems: microphthalmia (1); scoliosis (1) single kidney (1). In addition examination of skeletons of 25 koalas revealed four broken, then healed, long bones and one badly damaged, fused wrist (road kill) and one damaged shoulder with signs of past, serious arthritis (Georgie). Damage to gums and teeth was common (see Figure 26).

4.10 What plant species are they using?

Our studies are consistent with those of Cork et al (1988), Phillips and Callaghan (2000) and Sluiter et al 2002) who recognised Grey gums, *E. punctata*, as being the most significant dietary species for Campbelltown koalas. It can be used as an indicator of Transition soils and likely koala presence. Unfortunately, besides the 'Strip', there are few other areas east of

Campbelltown, where Grey gums are frequent, so koala densities will be low. Stringybarks, particularly, *E. agglomerata*, are also eaten by koalas while the densely foliaged Turpentines, *Syncarpia glomulifera*, are frequently used for shelter. Recently Phillips (2018) has been surveying bushland corridors between the Georges and Nepean Rivers and has discovered relatively plentiful faecal pellet signs in the remaining vegetation. The vegetation, west of Appin Road is mainly Cumberland Plain for which the dominant tree species is Forest red gum, a well-known dietary species for koalas. See Section 6 folder 10 and 13 for more details on tree usage.

5. Conclusions

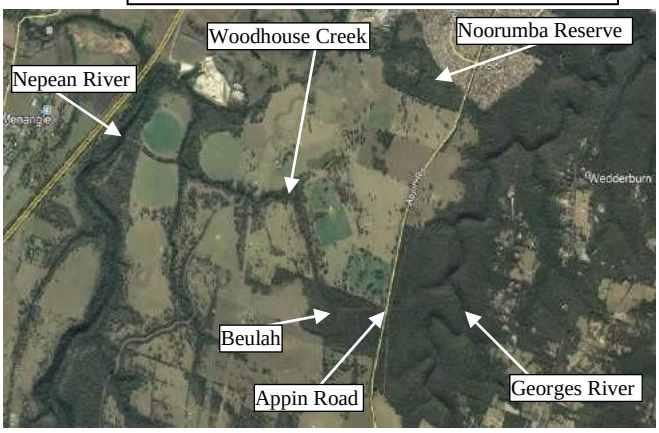
5.1 Status of the population

The koala population is currently in good shape. There is suitable habitat in the bushland strip that runs from Liverpool to Appin between the Georges River and the suburbs and Appin Road. This 'Strip' can support female home-ranges and dispersal of young animals. The females with established home-ranges are healthy, long-lived and produce a young almost every year. Animals that do not establish home-ranges in the 'Strip' disperse widely thus ensuring that koalas fill vacant home-ranges, in adjacent regions and maintain genetic diversity. An important gap in our knowledge is the status of the population on the eastern side of the Georges River. This large, protected area is a valuable resource for koalas in case of fire or loss of habitat from development of the Georges River western bank strip which is so favoured by koalas. We estimate that the population lies between 300 and 1200 and we favour a middle value of 1000. However, koalas are notoriously difficult to spot and the terrain so rough, and the risk from unexploded ordnance so high, that an accurate count requires an aerial, military-quality infrared detector. Estimations of population numbers, however, are not as important as distribution, because koalas can persist at levels of density so low that standard survey techniques may not detect them (Close et al 2017).

5.2 The importance of the Campbelltown koalas

Besides being a focal point for people who enjoy the rich, unspoilt Georges River bushland, the koalas are a major reservoir to supplement or restock adjacent habitat in the Holsworthy Military Reserve, Woronora Catchment and Heathcote NP. These three comprise a large, protected area. Moreover, this area is connected to Royal NP and the protected catchments of the Cataract, Cordeaux and Avon Rivers (Tilley and Uebel 1990). Although these three catchments are known to support koalas, the link to Campbelltown koalas is important for maintaining genetic diversity and being mutual reservoirs of koalas in case of fire or chlamydiosis. For the same reason it is important that dispersing young animals can move around the Sydney Basin by moving from beside the Georges River directly to the Nepean River. The rivers are separated by Appin Road, are only four km apart and are linked by several creek lines (see Figure 28). Animals can follow these creeks to the Nepean River (Dan) then follow it across the Sydney Basin to link with koalas in the Lower Blue Mountains, at Kurrajong and eventually, Ku-ring-gai chase NP.

Figure 28 Location of Two Rivers



5.3 Threats

5.3.1 Chlamydia:

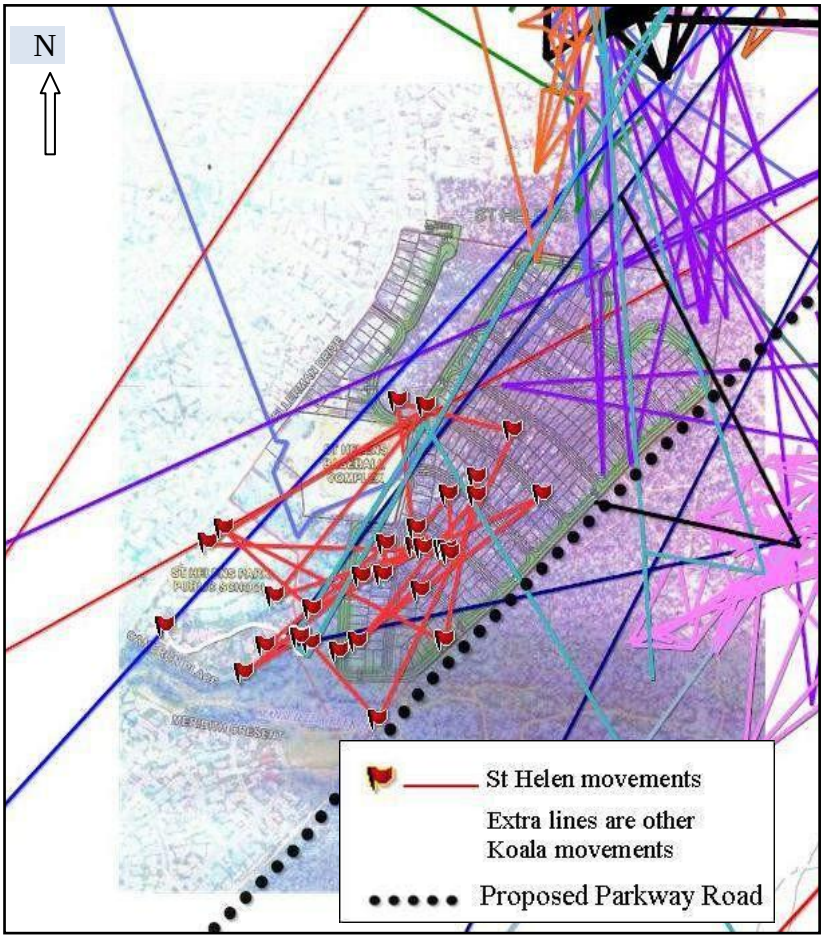
The greatest threats to the Campbelltown koalas are chlamydiosis, habitat loss, vehicles, fire and climate change. It is ironic that the importance of maintaining bushland corridors will allow arrival of chlamydia into the naïve Campbelltown population. However, genetic diversity of the population is already low and the key to long-term survival is to maintain links between koala populations. The arrival of chlamydia could have severe effects on Campbelltown koalas with an increase in pain and mortality and a decrease in longevity and fertility. With the development of a local, 'one shot' vaccine, it might be possible to vaccinate females with home-ranges in the Georges River 'strip' and their joeys, and dispersing young that can be captured.

5.3.2 Development:

The effect of development is the gradual destruction of koala habitat For example plans exist for a road, The Parkway, planned to follow the Georges River 'Strip' which separates existing houses and the Georges River between St Helens Park and Glenfield. Planning is also in progress for an upgrade of the notorious Appin Road which will be widened thus enabling higher vehicle speeds and causing greater koala mortalities.

Housing developments will remove much habitat. (Lunney et al 2010a). The proposed Mt Gilead development, for example, will increase vehicle traffic on Appin Road and put pressure on the creek-line corridors linking the Georges and Nepean Rivers.

Figure 29 Movements of St Helen on the site of a proposed housing development



At St Helens Park, the site of a 330 house development is planned in the 'Strip' on the home-range of St Helen (Figure 29).

If the plan is approved, one home-range for a breeding female will be lost and the Georges River 'Strip' will be diminished in width for dispersal of young koalas.

5.3.3 Fire:

Fire is an ever present threat and one that will worsen with global warming. Those females that have home-ranges that include rocky caves where they can shelter from the heat and flames (Close et al 2017) are more likely to survive. The Georges River and O'Hares Creek gorges provide that kind of shelter. A second safeguard is for the koalas to have a wide distribution thus ensuring that there will always be some koalas that will escape a given threat.

5.3.4 Global warming:

The effects of global warming are likely to be serious. Higher temperatures might decrease rainfall, increase evaporation and lower water tables. These factors could lower the water content of the dietary leaves and cause the death or decline of the principal dietary species, *E. punctata*, and diminish their nutrient levels or raise their toxin levels. Fungal infections of the eucalypts such as Myrtle disease could also become more problematic. However, koalas have survived millions of years of climate change; so the wider the distribution that koalas can survive in today, the more likely that there will be some places that will survive climate changes in the future.

5.3.5 Protection of habitat and dispersal routes:

This report has stressed the fact that long-term survival of Campbelltown koalas depends on preserving habitat and maintaining dispersal routes. Loss of the latter means that mortality of dispersing young koalas would increase while loss of the former would mean that the 'Strip" would no longer be generating young koalas. Protection of both factors would also lead to protection of the rich flora and fauna that share the existing habitat with the koalas.

5.3.6 Dog attacks:

Appendix 10.1 shows that dog attacks are relatively common, particularly in the bushland areas that are adjacent to suburban housing. However none of the radio-tracked koalas was attacked, despite their proximity to housing. For example, the eastern boundary of Shirley's home-range was a fence of a property in which up to five large dogs were given the run (see Figure 6). However Charlotte was found dead in a tree fork in the same property and may have been killed by a dog.

5.3.7 Road-kills:

Appendix 10.1 shows that the rate of vehicle kills is high, particularly on Appin Road. Again the radio-tracked females were not affected. Appendix 10.2 shows that many female offspring are produced each year and they have to find a suitable home-range eg Curls (see Figure 18). Appendix 10.3 shows that many ear-tagged koalas disappear after initial tagging. These animals include the dispersants that maintain genetic diversity in adjoining populations (eg Dan and Bill).

6. Management suggestions

6.1 Limit development in the "Strip"

For every 25 ha of bushland that is removed or damaged, a female koala will lose its livelihood. The proposed Georges River Parkway (Figure 29) would eliminate many home-ranges.

6.2 Maintain corridors

All woodland areas should be linked by corridors. Corridors do not have to be large, although the wider the corridor, the more effective it will be. For example, the link between Cook Reserve and James Ruse Park in Ruse is almost 2km long but is less than 100m wide (See Figures 12-17) yet is used regularly by koalas. Culverts should be kept clear to allow movement of animals under roads e.g. Smiths Creek under the Georges River Road leading into Airds. "Floppytop" fences could direct koalas to the culverts. Unfortunately there are no suitable places on the Appin-Campbelltown Road to install a culvert, except, perhaps, Lilypond Creek and Mulaty Creek. These creeks, however, are at the southern end of the Appin Road while most car-strikes occur at the northern end.

Existing and planned corridors could be planted with species that we found were used extensively by koalas. Grey Gums would be staples but may not be suitable as a food species when planted in inappropriate soil types. So mixtures of species would probably be more suitable and would explain the popularity of the many and varied species of trees found at Kentlyn Primary School (June, Lyn, Vicki, and Shy).

6.3 Reduce traffic impact

Koalas appear regularly on Georges River Road and Appin Road but many more are killed on the latter than on the former. One difference between the two roads is that the speed limit on the former is 60 km/h whereas the limit on the latter is 80 km/h. Perhaps the sites on Appin Road where car accidents have occurred could be mapped along with sites of koala strikes. Where the sites overlap the speed limit could be reduced.

6.4 Dog control

A significant but simple step that the community can take is not to keep dogs or at least only a small one.

6.5 Tree planting

Residents living within a km of the Georges River 'Strip' may be visited by dispersing or breeding koalas. Planting small eucalypts in gardens and nature strips can provide shelter and a snack and a way of escaping the trap of a colour bond-fenced backyard. Council could plan plantings to enhance corridors, nature strips and public reserves. Schools, likewise, provide the opportunity to plant a variety of eucalypts. Kentlyn Primary School is a role model for other schools. So far, koalas have visited ten local schools, to the delight of the students.

6.6 Coordination of official groups responsible for protecting koalas

Since WSU has finished its studies there has been no protocol for making decisions about caring for koalas that are ill, wounded or in dangerous situations. At one time or another, the police, fire brigade, Council, WIRES, RSPCA and Southwest animal rescue have been called out. Records have been inadequately kept, and ear-tagging has been spasmodic and uncoordinated.

7. Procedure for using the database.

There are three types of database. The first is a hand-written version which contains much information collected in the field, and is stored in large folders. The second is digitised in "Access" and contains all the information from the folders; this information has been modified into a user friendly 'Excel" database. The third is also electronic but opens up only in Google Earth and lacks some of the less essential fields. It is the third which accompanies this Review. Once you have obtained your copy double click and it will then open in Google Earth, right click on MY Places and then "Save to my Places ".

Uncheck all so that it is easier to use as there is a lot of information stored. At this point be sure to save the master copy in 'Documents', and then make another copy to use, as this is not a locked programme and folders are easily moved. Hit the ▾ sign and the programme will open up to another 13 folders. In the ▢ left click and all locations will come up. Note the straight lines are the koala track and the white twisted lines are where they were relocated to.

Folder 01 Public un-tagged Sightings: These are sightings of koalas by citizens that did not lead to a capture or were not confirmed by the team

Folder 02 Capture and release: This whole folder is koalas that were captured and released during the survey. Sometimes the capture and release sites are different due to the relocation of koalas to less dangerous positions.

Folder 02.1 Capture
Folder 02.2 Release sites
Folder 02.3 Capture and release sites maybe a small distance apart
Folder 02.4 Capture and relocation of a koala but its translocated position was not recorded
Folder 02.5 Tarlo River was a project to relocate a few koalas to another area
Folder 02.6 Where ear-tagged and un-tagged koalas were found dead

Folder 03 Aborted catches: These may be due to several conditions where it was found that it would be best to either leave or try again later.

Folder 04 Ear-tagged koalas, location points only: This folder opens up to show all the tagged Koalas that have been captured and named and by just clicking onto the box you will be able to see all the located sightings of each koala.

Folder 05 Gender distribution: This Folder shows where all the male and females have been located that have been tracked captured and sexed

Folder 06 Movements of ear-tagged koalas: This is by far the largest folder as it contains the family trees studied in detail. For example click on the ▾ sign of Amanda and offspring and you get 17 other folders and you can then trace her, and her offspring through the years. Note it is better to print out the ear-tagged animals and known offspring list to help keep track of the koala tree (Appendix 10.2).

Folder 07 Tree species: Once again click on the ▾ sign and a list showing where koalas were found will be shown, there is also a number beside the name this is the number of times it was seen in that particular tree species.

Folder 08 Tree species by times seen: Once again click on the ▾ sign and a list showing, the number of times a koala was seen in that particular tree species.

Folder 09 Annual sightings: Sightings of individual years, or is also divided into separate folders, female, male and female with joey

Folder 10 Females with young: Either click on all or open the folder and scroll down to an individual koala and click on that box.

Folder 11 Koalas ear-tagged no name: Ideal for making maps.

Folder 12 Public un-tagged sightings no name: Ideal for making maps.

Folder 13 Trees visited by koalas: Left click, route folder will appear, scroll down to *show elevation profile* you can re trace koalas' movements as they were recorded.

8. Procedure for using the database Excel.

The folders labelled Sightings, Capture and Tracking are individually broken down into sheets extracting information answering some of the questions the user maybe looking for. Each record has been given a number so that it can be traced throughout each folder.

Capture ID	Tracking ID	Sighting ID	Koala's Name	Eastings GDA 1966	Northings GDA 1966	Eastings WGS 84	Northings WGS 84
C96001	blake001	96012	Blake	301580	6227180	301683	6227370

The above example shows Capture ID, Tracking ID and Sighting ID in all the folders the original data were collected in GDA 1966 so this is shown as well as the WGS 84 in all the folders. These folders are locked to secure the data from being corrupted.

8.1 Sighting Folder (Green Header)

Sightings are records of koala sightings alive or dead reported by various sources within NSW especially The Sydney Basin. The data comprise information on where the koala was located, its gender, age and young if any. This is devided into 19 sheets (below).

- ***Field Study***- is the raw data collected from different sources within and outside the study area. The data are broken down into various categories.
- ***Study Area***- the data were taken from the \Field Study file which covers a specific area South of Liverpool and North of Appin where the data were collected from different sources.
- ***Non Study Area***- the data are taken from the Field Study file and includes all sightings from outside the study area; the data were collected from different sources.
- ***NPWS***- reported to or from NPWS personal or taken from the Atlas records.
- ***NPA***- reported to or from NPA members within or outside Study Area.
- ***Army***- reported to or by Army personal on military land.
- ***WIRES/Wildlife Carers***- reported to or by the organisation's members within or outside the Study Area.
- ***Water Board***- on or outside Water Board land.
- ***Public Sightings***- reported by citizens within or outside the Study area.

- ***Koala Team-*** comprises University staff students and volunteers.
- Surveys taken from the Field Study file within or outside the Study area.
- ***Blue Mt Survey***- is outside the Study Area.
- ***Wedderburn Survey-*** is inside the Study Area.
- ***UWSM Postal Survey-*** *is* inside the Study Area
- ***Dead Koalas***- taken from the Field Study file reported from different areas including study area and different sources. The koala's body was not always collected.
- ***Bellowing-*** taken from the Field Study file reported from different areas and sources
- ***Scats and Scratches-*** taken from the Field Study file reported from different areas and sources.
- ***False Alarms-*** taken from the Field Study file when a reporting a koala sighting turns out to be something other than a koala.
- ***Historic-*** taken from the Field Study file report of koala sightings prior to 1940.
- ***Other Sightings***- taken from the Field Study file are reports of other fauna not koala.

Each of the 19 sheets opens up to reveal various labelled columns.

8.2 Capture (Red header)

Captures are records arising from koala sighting Sightings are records of koala sightings alive or dead reported by various sources within NSW especially The Sydney Basin.
The data comprises information on where the koala was located, its gender, age and young if any. A catch is a koala caught alive or dead and also includes an attempted catch. Information covers a range of details about the koala's gender, age, condition and if there is any young. A catch also maybe a routine catch to change the battery in a radio collar tracked koala or its young.

Capture Folder: Contains nine sheets with numerous headings.

Each of the nine sheets opens up to reveal different information.

- ***Field Study***- is the raw data collected at the time of the catch from outside and is within study area reported from different sources**.** The data are broken down into various categories.
- ***Study Area***- the data were taken from the Field Study file is a specific area where the data were collected and from different sources.
- ***Non Study Area*** -the data were taken from the Field Study file and include all information from different sources outside the study area.
- ***Aborted Tagged***- the data were taken from the Field Study file is when a catch of a koala already tagged is stopped for a variety of reasons.
- ***Aborted Untagged-*** the data were taken from the Field Study file when a catch of an untagged koala is stopped for various reasons.
- ***Dead Tagged***- the data were taken from the Field Study file is a record where the koala had been caught before found dead or died later.
- ***Dead Untagged***- the data were taken from the Field Study file and includes records where the koalas had not been caught previously were found dead or died soon after capture.
- ***Tarlo River NP Project-*** the data were taken from the Field Study file as part of a relocation project of koalas from the study area to Tarlo River NP.
- ***Blood Tests Report-*** the data were taken from the Field Study file and are records of the blood taken from koalas at veterinary inspection.

8.3 Tracking (Purple header)

Tracking is when a koala has been caught and ear tagged and the movements of the koala recorded there may arise by radio tracking or from independent sightings.
Data recorded are more about the location where the koala was found, description of tree species and usage also weather conditions and if young are present or other koalas.

- ***Field Study***- is the raw data collected at the time of the catch from outside and is within study area reported from different sources**.** The data are broken down into various categories.
- ***Study Area***- the data were taken from the Field Study file which covers a specific area where the data were collected and from different sources.
- ***Non Study Area*** -the data were taken from the Field Study file which includes details from outside the study area and from different sources.
- ***Tarlo River NP Project***- the data were taken from the Field Study file as part of a relocation project of koalas from the study area.
- ***Dead Named***- the data were taken from the Field Study file and include koalas that were caught and named but died shortly after capture due to injury or illness either naturally or by euthanasia.

Tracking Folder: Contains sheets with numerous headings. Key to Colours used in Excel files. For areas where the fields are coloured in pink these data are duplicated.

Here are three examples; Data of Mother and young (Lyn and Kent).

Tracking ID	Koala's Name	Date	Eastings	Northings
Lyn094	Lyn and Joey Kent	11/25/2000	301724	6228013
Kent025	Kent with mother Lyn	11/25/2000	301724	6228013

Data entry for Tarlo River NP Project has been coloured BROWN.

Tracking ID	Name	Date	Capture ID	Other notes
flo041	Flossie	10/3/2006	C2006-025	Caught and relocated to Tarlo River Project

Data entry for Non Study Area has a highlighted background. YELLOW

Tracking ID	Name	Date	Capture ID	Location
Hilltop001	Hilltop	1/13/2008	C2008-002	Hilltop

9.

10. Publications and reports relevant to Campbelltown koalas

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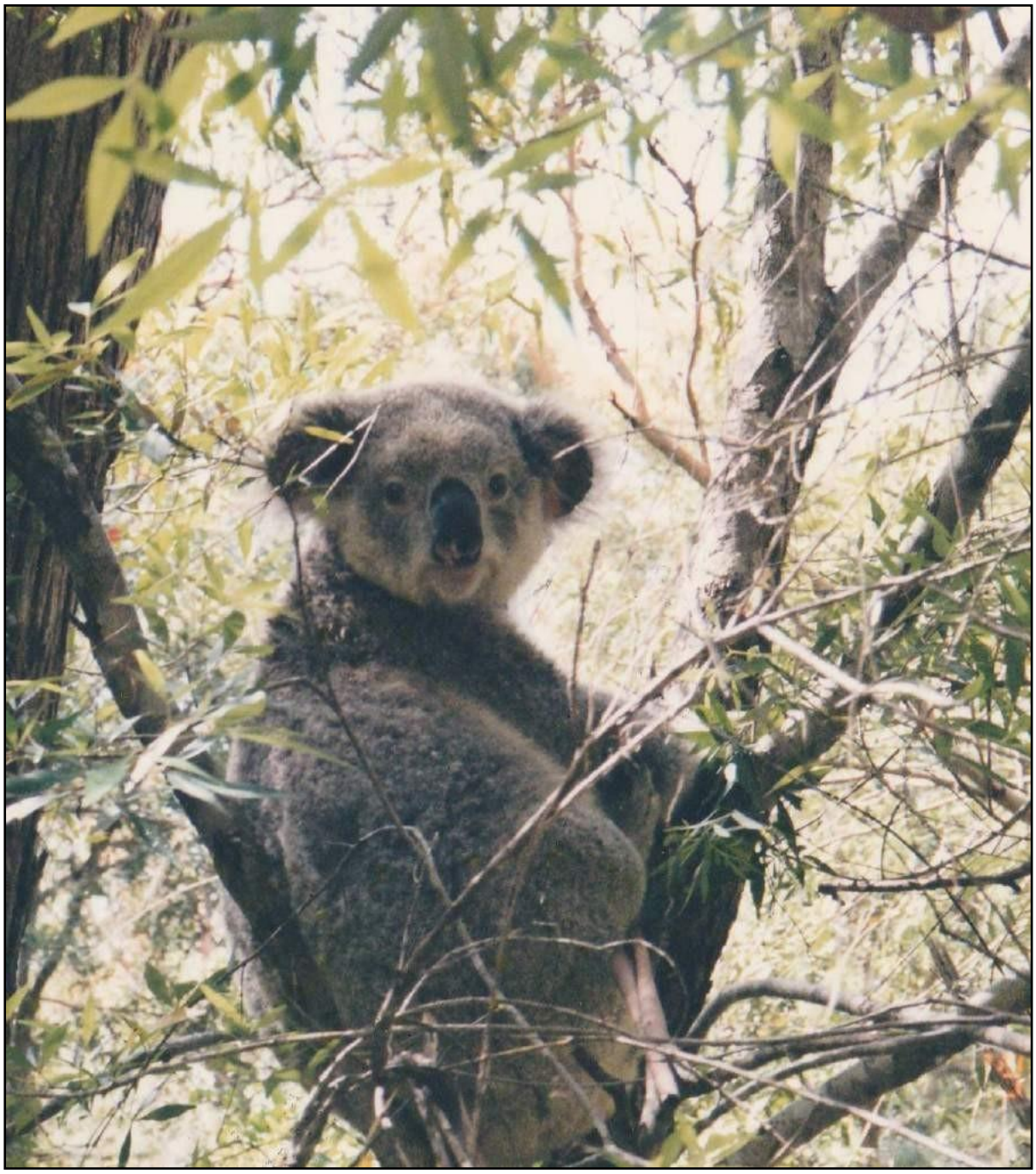


Shirley 1991-2005 Photograph by Lynn Bowden

11. Appendices

11.1 Causes of death (Includes animals from outside Campbelltown)

ID	Capture Date	Gender	Age	Cause of death	Location	Eastings	Northings	Public Sightings	Capture	Skull Collected	other
D-RK-2000-002	17-08-00	F	Juv 18mths	Roadkill	Yanderra	274720	6198000	2000070	C2000-019	yes	Found dead with extreme bruising to right chest and apparently a pneumothorax. Some bruising to skull. No ribs broken but musculature torn
D-RK-2000-001	07-11-00	M	2-3yrs	Roadkill	Pheasants Nest	283012	6205010	2000108	C2000-025	yes	Found dead weight 7.1k was in good condition ash grey fur colour
D-Eu-2000-004 (Gary)	12-10-00	M	7yrs	Injury and illness	Kentlyn	301777	6227217	2000181	C2000-035	yes	Euthanised on 27/12/2000 Xrays indicates mass in anterior mediastinal area (Tumour)pneumonia and infected wound on rump, weak with discharging sinus, rump and congested chest
D-2000-003	16-10-00	M	Adult	Train	Yerrinbool	273500	6193200	2000237	C2000-037	yes	on train line
D-RK-2001-001	28-01-01	M	3-4yrs	Roadkill	Sandy Point	314500	6238010	2001006	C2001-005	yes	Broken radius
D-RK-EU-2001-002	19-05-01	M	6yrs	Roadkill	Appin Road	296398	6219200	2001031-034-035	C2001-007	yes	Euthanised
D-D-2001-004 (Bruce)	12-09-01	M	3 yrs	Dog attack wound to rump	Ruse	301187	6227120	2001168	C2001-026	yes	Died in care
D-RK-2001-003	1/0/2001	F	2yrs	Roadkill	Upper Colo	288750	6299300		C2001-030	yes	Badly fractured skull
D-D-2001-005 (Karla)	12-11-01	F	14mths	Dog attack	Appin	296330	6213520	2001172	C2001-028	yes	Skull badly bruised and stomach, broken right femur
D-Rk-2001-006 (Pajinka)	10-08-01	F	12mths	Illness	Mittagong	262764	6186900		C2001-032	yes	Eye problems and snuffly nose then developed an infection
D-RK-2002-001	04-05-02	F	?	Roadkill	Colo Heights	288550	6305890	2002030	C2002-011	yes	Fur still damaged by fire
D-RK-2002-002 (Steve)	29-07-02	M	7.5yrs	Roadkill	Appin	297480	6211510	2002045	C2002-015	yes	Right eye cataract and eye small, bleeding from left ear, nose and mouth.RHS claws damaged (split) and large. Left side of jaw a large scab an old wound

D-D-2002-003	22-09-02	F	3yrs	Dog attack	Mittagong	262250	6186850	2002057	C2002-021	yes	Dark brown fur colour in poor condition. Damage and bleeding to right hindquarters with puncture into abdominal area died later.
D-Eu-2002-004	4/1/0/2001	M	8yrs	Fall from a tree	Canyonleigh	242100	6171575	2002064	C2002-024	yes	Badly broken leg was shot to euthanase
D-RK-2002-005	11-03-02	F	3-4yrs	Roadkill	Colo Heights	290300	630300	2002098	C2002-036	yes	Small hole in skull
D-Rk-2002-006	11-06-02	F	Juv	Roadkill	Catherine Hill	273620	6194000	2002101	C2002-037	yes	Concussed and stunned
D-RK-2002-008	11-10-02		?	Roadkill	Yerrinbool	272850	6189820	2002104	C2002-039	no info	
D-2002-009	12-04-02	M	3-4yrs	Fallen tree branch fell on koala	Quiera Crossing	239570	6128700	2002132	C2002-050	yes	Skull burnt across nasals
D-RK-2001-010	25-09-02	M	adult	Roadkill	Bilpin			2002060	C2002-056	yes	Skull badly smashed
D-2003-001 (marly)	04-12-03	F	2.6yrs	Not known	Wedderburn	301085	6220275	2003063	C2003-010	yes	Poor condition and underweight, upper body fur grey with brown back and sides fur in balls of dreadlocks. Head rolling then died.
D-RK_2003-002	24-09-03	M	adult	Roadkill	Mittagong	276400	6198900	2003151	C2003-025	yes	Head looks unusual swollen forehead could be because of collision with car.
D-RK-2003-003	20-10-03	M	Juv	Roadkill	Sandy Point	314440	6237650	2003161	C2003-028	yes	Light grey fur colour no other info
D-RK-2003-004	31-10-03	M	4yrs	Roadkill	Pheasants Nest	285600	6210500	2003179-180	C2003-029	yes	Good light grey fur colour and brown across the shoulders no other info
D-RK-2003-005	25-11-03	M	juv	Roadkill	Wilton	289546	6205715	2003205	C2003-031	yes	Most of the body was all over the road, head shattered
D-2003-006	29-10-03	M	adult	Bone tumour	Colo Vale	266350	6192000	2003176	C2003-032	yes	Bone tumour (porous) size of a small apricot on left side maxilla
D-RK-2003-007 (Ricky)	25-11-03	M	4yrs	Roadkill	Appin	296190	6219585	2003206	C2003-033	yes	Hobbling across the road then died
D-D-2003-008 (Justin)	12-02-03	M	2.5yrs	Dog attack	Leumeah	300200	6229650	2003210	C2003-034	yes	Body bruised on left upper and rear shoulders and lower left groin and puncture marks
D-2003-009	17-12-03	F	adult	Chlamydia	Colo Bridge	297500	6308250	2003224	C2003-038	yes	Chlamydia and internal cysts

D-RK-2004-001	04-03-04	M	PY	Roadkill	Wedderburn	298670	6223500	2004042	C2003-004	No	Mother hit by car and pouch young (pink and furless) fell out, mother escaped young taken into care died a day and half later
D-2004-002 (Louise)	16-07-04	F	1yr 10mths	Illness	Wedderburn	298310	6223715	2004072	C2004-007	yes	Poor condition, lethargic, drinking excessively. Mild neutrophilla and (pre renal) azotaemia. Abdomen swollen possible ascitis; oxalosis
D-2004-003 (Frank)	13-12-04	M	6yrs	unknown	Ingleburn	303307	6233099	2004154	C2004-026	yes	Found at base of tree decomposed body
D-2005-001	01-12-05	M	2-3yrs	unknown	Wedderburn	298140	6222015	2005006-007	C2005-001	?	Found on property close to road also had dogs which had decomposing body
D-2005-002 (Shirley)	06-01-05	F	13yrs	unknown	Airds/Kentlyn	301278	6226944		C2005-006	yes	Old age, granular spleen
D-RK-2005-003	26-07-05	M	5-6yrs	Roadkill	Wedderburn	298500	6223590	2005072	C2005-008	yes	Roadkill
D-RK-2005-004	19-08-05	F	juv	Roadkill	Hume Highway Bargo exit	278000	6200000	2005084	C2005-010	yes	Roadkill
D-2005-005 (Gaya)	29-10-05	F	12mths	unknown	Leumeah	301806	6229520	2005121	C2005-015	yes	Found under tree mother in tree above
D-2005-006 (Grant)	16-12-05	M	14yrs	unknown	Kentlyn	301539	6226810	2005148	C2005-023	yes	Found under a tree
D-RK-2005-008	23-08-05	F	adult	Roadkill	Mt Lagoon Road	279500	6296200		C2005-025	yes	Broken back
D-D-Eu-2006-001	03-02-06	M	10yrs	Dog attack	Kentlyn	303912	6229706	2006021	C2006-001	yes	Injured left arm bone exposed tips of right paw damaged, euthanised.
D-2006-002 (Nathan)	16-05-06	M	13yrs	unknown	St Helens Park	297950	6223400	2006054	C2006-005	yes	Poor condition, bones prominent mange like condition of skin, all four paws worn with lacerations
D-D-2006-003	06-05-06	M	3yrs	Dog attack	Colo Heights	297170	6290120		C2006-006	yes	Dog attack, euthanised
D-RK-2006-005 (Robert)	18-08-06	M	3yrs	Roadkill	Appin	296200	6220075	2006195	C2006-012	yes	Skull damaged
D-D-2006-005	22-08-06	M	adult	Dog attack	Kentlyn	302814	6229433	2006079	C2006-014	yes	Nose had been eaten away
D-2006-007 (Elle)	26-09-06	F	14yrs 6mth	unknown	St Helens Park	298095	6223190		C2006-023	yes	Slight brownish shoulders, fur on left arm moist, fluid seepage on right cheek and flesh on cheek appears swollen. Seepage seems to be coming from the mouth. Lots of eggs in fur(maggots) scattered in groups on chest, arms and belly

D-RK-2006-008	14-10-06	M	4-6yrs	Roadkill	Sandy Point	314450	6237600	2006117	C2006-029	yes	Head smashed with teeth dislodged, claws show some damage. Penis exposed .Infection in both ears between layers of skin near punch hole extending. Ear tags missing
D-2006-009	13-11-06	M	10+yrs	unknown	Holsworthy	307010	6227000	2006114	C2006-037	yes	Too decomposed, brown fur weight 7.3, testes shrunk
D-RK-2006-010	14-11-06	M	5-6yrs	Roadkill	Lower Portland	304310	6299360	2006145	C2006-038	yes	Skull smashed and shoulder damaged
D-2006-011	25-12-06	M	12-18mths	unknown	Minto Heights	302982	6231389	2006183	C2006-049	yes	Blood around mouth
D-RK-2007-003	02-05-06	F	adult	Roadkill	Colo Heights	287880	6305328	2007048	C2007-003	?	6-7kg pouch empty
D-RK-2007-004	06-05-07	?	?	Roadkill	Allens Ck Bridge	270780	6207810	2007090	C2007-009	Yes	Squashed on roadside
D-RK-2007-005	20-06-07	M	5yrs	Roadkill	Bilpin				C2007-010	yes	Severe damage to skull
D-RK-2007-006 (Diamond Jr)	20-06-07	F	4yrs	Roadkill	Lower Portland	306380	6300570	2007083	C2007-011	yes	Severe internal bleeding, liver ruptured. Uterine cysts
D-RK-2007-007	29-06-07	M	4yrs	Roadkill	Mittagong				C2007-012	?	Skin around eye infected, mucus membrane infected thickened right mandible
D-RK-2007-008	09-03-07	F	4yrs	Roadkill	Hume Highway Bargo exit	279100	6200625		C2007-020	yes	Tapeworm in duodenum
D-RK-2007-009	09-02-07	M	adult	Roadkill	Pheasants Nest	284406	6208700		C2007-021	yes	Fur wet weight 4.2kg
D-2007-010(Lyn)	09-11-07	F	14yrs 6mth	unknown	Kentlyn	302040	6228344		C2007-022	yes	Tapeworm in top of small intestine, ovaries (left very swollen large a fibrous solid cyst)
D-RK-EU-2007-011	11-04-07	?	?	Roadkill	Rosemeadow	296250	6219500		C2007-029	yes	No info
D-EU-2007-012	19/20/2007	M	10+yrs	unknown	Kentlyn	303200	6228185		C2007-030	yes	Poor condition, nose dirty inside, dehydrated
D-EU-2007-013	10-01-07	M	adult	unknown	Bilpin	278900	6296880		C2007-035	?	Euthanised, all glands up emaciated
D-RK-2007-014	25-12-07	F	5yrs	Roadkill	Kentlyn	303079	6228605	2007210	C2007-037	yes	Euthanised, lethargic no effort to move
D-RK-2008-001	29-01-08	M	2-3yrs	Roadkill	Appin	300405	6209080	2008006	C2008-003	yes	Lower jaw smashed
D-EU-2008003 (Barney)	15-03-08	M	7yrs 6mth	injured	Wedderburn Gorge	298253	6223938	2008020	C2008-006	yes	Injured with deep wounds and gall bladder infection, euthanised.
D-RK-2008-002	28-07-08	M	adult	unknown	Appin	297120	6212230	2008059	C2008-015	yes	Adult male with ash grey fur in good condition
D-2008-004	11-08-08	F	juv	unknown	Wedderburn	297800	6221000	2008108	C2008-028	yes	Juvenile female
D-RK-2008-008	11-10-08	M	2-3yrs	Roadkill	Kurrajong Heights	280075	6286500	2008161	C2008-030	yes	Car collision
D-RK-EU-2008-005 (Alan)	24-11-08	M	13yrs 6mth	Roadkill	Minto Heights	304000	6233000	2008119	C2008-033	yes	Euthanised, several breaks to right humerus (arm), old break in femur (calcified) arthritis in knee joints. Heart enlarged

D-RK-EU-2008-006 (Becky)	27-11-08	F	3yrs 6mth	Roadkill	Kentlyn	301300	6227009	2008123	C2008-036	yes	In care operation 3/12/2008 euthanised
D-2008-009	27-11-08	M	8-10yrs	unknown	Kurrajong			2008162	C2008-037	yes	In good condition grey fur colour
D-2008-007(Hendo)	20-12-08	M	4yrs	Fell from tree	Leumeah	301700	6229750		C2008-044	yes	Fell 14m dies under anaesthesia, primary cause brain damage
D-RK-2009-001	07-08-09	M	adult	Roadkill	Gilead	296125	6219480	2009103	C2009-013	yes	Head and nose smashed, diaphragm ruptured and faeces embedded into rib area
D-2009-002(Brittany)	11-01-09	F	7yrs 6mth	Illness	St Helens Park	297770	6224400	2009190-191	C2009-034	?	Poor condition, dehydrated and gut empty, ticks. Found out to have Leukaemia (lymphoma)
D-RK-2010-001	14-01-10	M	adult	Roadkill	Minto Heights	302590	6230890	2010244	C2010-002	yes	Pelage dark, skin on palms and feet lighter colour than usual.
D-RK-2010-011 (Bower)	01-04-10	M	3-4yrs	Roadkill	Bowen Mountain	279860	6282417	2010245	C2010-003	yes	Brown fur on shoulders otherwise good, tiny lesion on lip (like Jeremy's)
D-RK-2010-003	02-03-10	M	3-4yrs	Roadkill	Rosemeadow	296700	6222300	2010029-030	C2010-004	yes	Good condition with some brown fur on back and shoulders. Picked up alive died soon afterwards.
D-2010-005(June)	25-03-10	F	9yrs 6mth	Illness	Kentlyn	302450	6227230	2010053-056	C2010-005	yes	On the ground, thin, lymphosarcoma 2mm hole
D-RK-2010-002	28-03-10	M	3-4yrs	Roadkill	Gilead	296130	6219820	2010059	C2010-006	yes	Good condition found on the side of the road
D-2010-008(Amanda)	19-04-10	F	17yrs	Gum disease teeth	Leumeah	301600	6229585		C2010-007	yes	Sitting at base of tree in poor condition with severe gum disease, taken into care died a few days later
D-RK-2010-006(Curls)	05-09-10	F	2yrs	Roadkill	St Helens Park	296850	6223100	2010072	C2010-010	yes	Dead at base of tree internal bleeding from ruptured liver, joey not found.
D-D-2010-004	07-05-10	M	juv	Dog attack	Kentlyn	303460	6229500	?	C2010-011	No	Dog attack, got away climbed fence. Caught and taken into care died soon after
D-2010-015(Maitri)	08-02-10	F	1yrs	unknown	Minto Heights	304450	6232000	2010112	C2010-014	No	died in care following day
D-RK-2010-009 (Lindsay)	18-10-10	M	Adult	Roadkill	St Helens Park	296750	6222700	2010195-196	C2010-018	yes	Dead on road
D-RK-2010-014(Appin10)	29-11-10	M	2-3yrs	Roadkill	Appin Road	296369	6214083	2010227	C2010-023	yes	Found dead fur very wet no teeth marks in flesh, heavily bruising below shoulders probably killed by car and retrieved by dog
D-2010-007(Georgie)	25-07-10	F	12yrs	Injury dog	Kentlyn	301880	622880	2010108	C2010-025	yes	Skeleton found with teeth marks to skull, humerus badly arthritic, seen 22/5/10 photo shown with damaged arm

D-D-2011-012 (marlee)	20-02-11	F	adult	dog attack	Kentlyn	302710	6228230	2011018	C2011-004	yes	Female and pouch young dead had been drooled on wounds to ear and ribs.
D-2011-013 (charlotte)	29-03-11	F	8yrs	unknown	Kentlyn	301728	6227310		C2011-007	yes	Female and pouch young in tree very decomposed no obvious causes of death
D-EU-2011-001	04-09-11	F	8yrs	unknown	Colo	297000	6299900	2011119	C2011-008	yes	Dark fur colour and skinny. Left eye damage and weeping. Bottom stained but not damp. Euthanised
D-EU-2011-004 (Amica)	13-04-11	M	5yrs 6mth	injury	TRNP trans located from St Helens Park				C2011-008b	yes	In care with a broken leg on 5/3/2011. After release found at base of tree the next day. PM showed Hb in urine and ulcers in mouth
D-D-2011-002 (Hereford)	06-09-11	M	adult	Dog attack	Leumeah	301750	6229900	2011054	C2011-009	yes	Dog attack koala had teeth marks in genital area, dried saliva all over back and neck. Cuts to chin (old)
D-2011-010 (Greenway)	07-09-11	M	2yrs	Drowned in swimming pool	Ruse	301188	6228930	2011067	C2011-011	yes	Koala got caught in filter outlet and drowned
D-2011-011 (Dippo)	07-09-11	M	2-3yrs	unknown	Minto Heights	302600	6231000	2011068	C2011-012	yes	Found alive, no obvious signs of large damage died 40minutes later
D-D-2011-003(Ham)	30-07-11	M	adult	Dog attack	Kentlyn	302749	6227702	2011077	C2011-013	yes	Dog attack was in excellent condition
D-RK-2011-004 (Deadman)	08-03-11	M	2yrs	Roadkill	Heathcote	314300	6238000	2011081	C2011-015	?	Roadkill found dead on roadside
D-2011-005	10-01-11	M	12mths	Powerful owl attack	Minto Heights	304200	6232400	2011128	C2011-019	No	Back young head missing and fore limbs cleared of flesh most likely a Powerful owl attack
D-RK-2011-007	19-10-11	M	3-4yrs	Roadkill	Gilead	296200	6209050	2011148-149	C2011-022	yes	Male koala crossing road hit by car was taken to vet Died
D-RK-2011-008	11-05-11	M	juv	Roadkill	Ruse	301000	6228560	2011166	C2011-025	yes	Roadkill koala died as WIRES picked it up
D-D-2011-009	23-12-11	F	adult	Dog attack	Kentlyn	301527	6227071	2011195	C2011-028	?	Dog attack on female koala with pouch young, female died but young still suckling not viable to save young.
D-2012-014 (Courtney)	04-05-12	F	13yrs	injury	St Helens Park	298200	6224500		C2012-003	yes	Found dead one day. Post mortem showed only one kidney, granular spleen and an empty stomach all else ok. Small wound under chin, incisor broken and porous section of lower jaw infected.
D-2012-006	22-09-12	M	adult	unknown	Airds	297150	6225540	2012159-160	C2012-014	yes	Large male dead for 2-3 weeks
D-RK-2012-007	28-09-12	M	3yrs	Roadkill	Appin	296200	6213780	2012167	C2012-015	yes	Skull badly crushed

D-RK-2012-008	10-04-12	M	4yrs	Roadkill	Wedderburn Gorge	298680	6223390	2012169-170	C2012-016	yes	Hit by car and died
D-RK-2012-009	10-10-12	M	2yrs	Roadkill	Gilead	296130	6219500	2012176	C2012-017	yes	Juvenile male hit by car and died
D-RK-2012-010	21-11-12	M	juv	Roadkill	Gilead	296150	6219600	2012224	C2012020	yes	Koala hit by car was still alive but soon died after getting to vets.
D-EU-2012-011	12-08-12	M	6yrs	Injury	Wedderburn	298920	6220790	2012243	C2012-022	Yes	Euthanised, wound in shoulder, flyblown, possible from a dog or possible fighting. The injury possibly occurs some weeks ago.
D-EU-2012-012 (Cyn)	13-12-12	F	10yrs	Injury	Gilead	296211	6220032	2012246	C2012-023	yes	3cm wound in bicep area, deep and full of maggots, coat brown and pre molars worn flat. Taken into care euthanised a week later.
D-2012-013	30-12-12	?	?	unknown	Ingleburn	303100	6233150		C2012-024	?	Severe dermatitis of digits and a dirty bottom. Taken to vets for tests and this animal subsequently died.
D-2012-014 (Heather)	12-11-12	F	2yrs	unknown	Kentlyn to TRNP				C2012-025	yes	Transferred to TRNP later found dead
D-2013-001 Helen)	01-09-13	F	14yrs	Old age	St Helens Park	298800	6224550	2013007-008	C2013-002	yes	Old koala and dehydrated taken into care and euthanised later
D-2013-002	14-01-13	F	adult	unknown	Canyonleigh	242100	6171500	2013010	C2013-003	?	Euthanised, very undernourished and possibly in pain
D-Eu-2013-003 (Simo)	23-03-13	M	18mths	Fall	Macquarie Fields	307000	6235765	2013032	C2013-005	?	Both legs broken and wound infected thought to be from a fall. Juvenile koala found on ground for some time, taken to vet then into care later euthanised.
D-RK-2013-004	18-10-13	M	adult	Roadkill	Wilton	291550	6202050	2013081	C2013-008	?	Roadkill
D-D-90-1(K-90-1)	12-12-90	M	adult	Dog attack	Mittagong	268800	6190500	90009	C90-001	yes	Koala at base of tree attacked by dogs no signs of grievous damage. Taken to vets died due to incorrect medication.
D-1992-002 (Marion)	19-12-92	F	2yrs	Illness	Wedderburn	300000	6219500		C92-008	?	Found dead with marked dehydration, some pulmonary congestion, blood clots in nose. No left kidney. conclusion dehydration and stress caused the death
D-RK-1992-001	05-01-92	M	adult	Roadkill	Heathcote	314380	6237920	92009	C92-009	yes	Hit by car and died
D-1993-002 (Phea)	03-08-93	F	4yrs	Injury	Wedderburn	300900	6219275		C93-001	yes	Died after jumping from a tree during a catch. Died 10 minutes later with respiratory difficulty (traumatic pneumothorax)
D-EU-1993-001 (K7/10/93)	10-07-93	F	adult	Illness	Mittagong	265000	6187000	93001	C93-007	yes	Euthanised koala it was emaciated, depressed with lesions to its forearm and area flyblown.

D-1994-001	13-04-94	F	adult	Illness	Wedderburn	300910	6220600	94018	C94-003	yes	Emaciated animal found on ground did not respond to vet treatment. Heavy tapeworn burden in duodenum, stomach and upper jejunum. Left kidney deformed and right kidney a bit gritty also.
D-1995-001 (Elmo)	08-02-95	M	5yrs	unknown	Wedderburn	301192	6220531	95018-022	C95-005	yes	Found dead
D-RK-1995-002(95/1)	20-08-95	M	adult	Roadkill	Wilton	290300	6203400	9503400	C95-007	yes	Koala hit by car and killed, skull smashed
D-D-1995-003(casey)	22-08-95	M	2yrs 6mth	Dog attack	Kentlyn	302400	6227600	95020	C95-008	yes	Multiple lesions consistent with attack by large dog. Skin not broken but underlying muscle is punctured in several locations over head, thorax and abdomen. Fractured skull (cracked) with a avulion of temporal muscle and 2 fractured(crushed) ribs. Left lung haemorragic and collapsed.
D-D-1995-004	19-10-95	M	7mths	Dog Attack	Wedderburn	299380	6220360	95025	C95-012	yes	Found dead with teeth marks (presumably killed by a dog or fox)
D-EU-1996-002 (Hodge)	22-01-96	M	10yrs	Illness	Wedderburn	299550	6220830	96041	C96-001	yes	Found crossing the road taken to vets, euthanised koala had very brown fur colour and a kidney problem
D-RK-1996-007 (Roger)	17-08-96	M	6yrs	Roadkill	Wedderburn Gorge	298472	6222830	96013	C96-007	yes	Hit by car and died. Left eye swollen and red (blood present in eye)
D-EU-1996-004	19-10-96	M	adult	injury from koala bite	Bargo	280400	6195500	96022	C96-013	yes	Euthanised koala had a puncture wound in right shoulder (thought koala bite) humerus broken clean through and wound infected and seeping pus
D-RK-1996-005 (D96-2)	12-09-96	M	adult	Roadkill	Sandy Point	314460	6237700	96032	C96-020	yes	Hit by car and died right side of skull matted with blood, skull crushed
D-RK-1996-001 (D96-3)	01-09-96	M	adult	Roadkill	Penrose	243850	6165020	96002	C96-022	yes	Roadkill
D-1997-001(Mac)	25-05-97	M	3yrs 5mth	Injured	Kentlyn	302100	6229600	97027	C97-004	yes	Lethargic and appeared groggy, would sit on back haunches. Some spots of blood seen but no wound detected and source unknown. Koala held overnight died early morning
D-RK-EU-1997-002 (Alby)	15-10-97	M	8yrs	Roadkill	Wedderburn Gorge	298700	6223444	97083	C97-017	yes	Koala hit by car, some scars present on nose and damage to left of head air was puffing up beneath skin along side of face to about left ear. Euthanised 2 days later.
D-RK-EU-1998-001 (Heath)	05-10-98	M	4-5yrs	Roadkill	Sandy Point	314500	6237569	98039	C98-009	yes	Koala hit by car taken to vets and euthanised. Right arm broken near shoulder and tips of claws snapped off. Bleeding from nose and right forearm

											(humerus) broken
D-RK-EU-1999-002 (Martin)	18-12-99	M	11yrs	Roadkill	Wedderburn	298390	6220850		C99-017	yes	Koala hit by car taken to vets and euthanised. Old male koala abrasions to left eye, nostril, left knee and right thigh. Some abrasions on body and bare patches of fur. Could have recovered from injuries but due to old age and cloudy corneas (eyes) and worn teeth the vet advised koala to be euthanised.
D-RK-1999-001	14-09-99	M	3+yrs	Roadkill	Waterfall	314600	6219300	95050	C99-018	yes	Koala hit by car and died. Eyes closed plus a little damage from impact, fur and skin missing halfway down body. Trauma around nose/mouth area and dried blood.
Bangor	20-Sep-12	M	2yrs	Roadkill	Heathcote	315183	6225063	2012155	C2012-012	yes	Roadkill
Georgie	25-7-2010	F	12yrs	injury	Kentlyn	301880	6228640	2010108	C2010-025	yes	Found dead, skeleton found, teeth marks to skull
Harry	21-9-96	M	10yrs	unknown	Wedderburn	301070	6220590	96040	C96009	No	5 claws and 2 bones, skull not found, hair also recovered and intestines found (remains R. Close estimates less than 6mths, but could be older.
Kiri	18-11-13	F	2 mth	Roadkill	Wedderburn	298250	6219586	2013086	C2013-009	No	On the ground, koala up taken into care WIRES
Peter	20-10-11	M	No data	Injury	Leumeah	301550	6229716		C2011-023	No	Bite to shoulder. Euthanised
Wendy	25-12-07	F	5yrs 5mth	Roadkill	Kentlyn	303079	6228605	2007210	C2007-037	Yes	On ground, lethargic taken to Cobbitty died later

11.2 Ear-tagged animals and known offspring

Female	JOEY NAMES	Male
5 Bolts		Abel
Alexis		Alan
Alice	three Untagged	Alby
Amanda	Joey Andrew	Alex
	Joey Debbie	Amica
	Joey Gaya	Balook
	Joey PM	Bangor
	three Untagged	Barney
Amber		Benedict
Angela		Bill
Ann		Bilpin Bill
Barbara		Blake
Becky		Bluey
Bernie		Breyke
Betty		Brian
Bridgett		Bruce
Brittany		Burraneer Bobby
Carrie		Casey
Charlotte	Joey Brendan	Constable John
	Joey Darling	Cramar
	Joey Curls	Dan
	three Untagged	Darling
Cheeky		Dippo
Cherlye		Dougie
Chloe		Edmond
Cindy		Elliot
Cloe		Eric
Courtney	Joey Brittany	Ernie
	one Untagged	Ethan
Curls		Fil
Daphne		Frank
Debbie		Gary
Dee		Gerald
Dobbo		Gorilla
Elle	Joey Julie	Grant
	Joey Robert	Greening
	one Untagged	Greenway
Elmo		Greg
Flossie		Ham
Franchesca	Joey Sarah	Harrison
	Joey Kerry	Harry
	Joey Victor	Harry 2
	Joey Marly	Heath
	Joey Pam	Hendo
Gaylene		Hilltop

Female	JOEY NAMES	Male
Kieran		Lindsay
Kerry		Lynchy
Kiera		Mac
Kiri		Marshall
Kris		Martin
Lesley		Mathew
Linda		Matiri
Liz	Joey Greg	Mattie
	two Untagged	Max
Lorraine		Maximus
Louise		Mitch
Lyn	Joey Georgie	Nathan
	Joey Kent	Neal
	Joey Rimas	Newman
	Joey Wendy	Old Boy
	five Untagged	OOJ
Maitri		Oscar
Margo		Peter
Marie		Pindari
Marion		PM
Marlee		Poko
Marly		Price
Martine	Joey Louise	Ray
	Joey Lace	Reg
	four Untagged	Richard
Megan		Ricky
Melham		Robert
Melissa		Roger
Michelle		Sandy
Mishka		Scott
Molly	Joey Gaylene	Simo
	one Untagged	Sirius
Mykala		Steve
Orin		Steve 2
Pajinka		Symbio
Pam		Ted
Patricia		Tim
Phea		Tyjo
Reid		Victor
Samantha		Wazza
Sarah	Joey Elliot	Will
Sharon		
Shelly		
Shirley	Joey Bill	
	Joey Orin	

Georgie		Hodge
Heather		Hugh
Helen		Jack
Irene	Joey Janice	Jacob
	one Untagged	Jimbo
Janice	Joey Lorraine	Johnny
	Joey Amber	Junior
	one Untagged	Justin
Jemima		Kade
Jessica		Kent
June	Joey Shy	
	Joey Vicki	
	Joey Mishka	
	Joey Alice	
	Joey Jemima	
	three Untagged	
Kath		Kevin
Kathleen	two Untagged	Lance

	Joey Lesley	
	Joey Frank	
	Joey Stan	
	Joey June	
	Joey Michelle	
	one Untagged	
Shy		
St Helen	one Untagged	
Susan		
Taylor		
Varrowville		
Vicki	Joey Reg	
	Joey Py	
	one Untagged	
Wendy		
Wilhelmina		
Zeena	Joey Barbara	

11.3 Longevity of Koalas

Koalas name	Captures date	Last seen date	Tracking span	Approx age at capture	Total age	Date when found dead
Amanda	31-Aug-97	18-Apr-10	12 yr, 7 mth, 18 days	4-5 yrs	17 yr	19-04-10
Martine	13-Oct-98	02-Feb-12	13 yr, 3 mth, 20 days	2 -3.5 yr	16 yr	*Never seen again*
Hugh	27-Jul-00	07-Jun-07	6 yr, 10 mth, 11 days	8 yr	15 yr	*Never seen again*
Lesley	06-Aug-98	11-Feb-13	14 yr, 6 mth, 5 days	8 mth	15 yr	*Never seen again*
Shy	26-Feb-03	15-Feb-16	13 yr,9 mth,19days	*10 mth*	14 yr 07 mth	*Never seen again*
Elle	26-Sep-93	25-Sep-06	12 yr, 11 mth, 30 days	1 yr	14 yr 06 mth	25-09-06
Lyn	06-Feb-96	11-Sep-07	11 yr, 7 mth, 5 days	3 yr	14 yr 06 mth	11-09-07
Franchesca	15-Sep-95	14-Feb-07	11 yr, 4 mth, 30 days	3 yr	14 yr 04 mth	*Never seen again*
Helen	08-Jan-02	09-Jan-13	11 yr, 0 mth, 1 days	3 yr	14 yr	09-01-13
Kevin	17-Oct-95	21-Dec-02	7 yr, 2 mth, 4 days	7 yr	14 yr	*Never seen again*
Will	09-Aug-95	01-Jul-01	5 yr, 10 mth, 22 days	8 yr	14 yr	*Never seen again*
Grant	04-Dec-98	16-Dec-05	7 yr, 0 mth, 12 days	6-8 yr	14 yr	16-12-05
Alan	24-Mar-98	24-Nov-08	10 yr, 8 mth, 0 days	3 yr	13 yr 06 mth	24-11-08
Molly	08-May-94	12-Feb-06	11 yr, 9 mth, 4 days	1 yr 5mth	13 yr 02 mth	*Never seen again*
Nathan	16-Aug-01	16-May-06	4 yr, 9 mth, 0 days	8-9 yr	13 yr	16-05-06
Shirley	22-Sep-93	01-Jun-05	11 yr, 8 mth, 10 days	*1.75 yr*	13 yr	01-06-05
Cheryle	17-Jun-00	24-Aug-10	10 yr, 2 mth, 7 days	3 yr	13 yr	*Never seen again*
Courtney	07-Mar-03	05-Apr-12	9 yr, 0 mth, 29 days	4 yr	13 yr	05-04-12
Wazza	14-Dec-08	18-Jun-18	9 yr, 6 mth, 4 days	*2.5 yr*	12yr	*Never seen again*

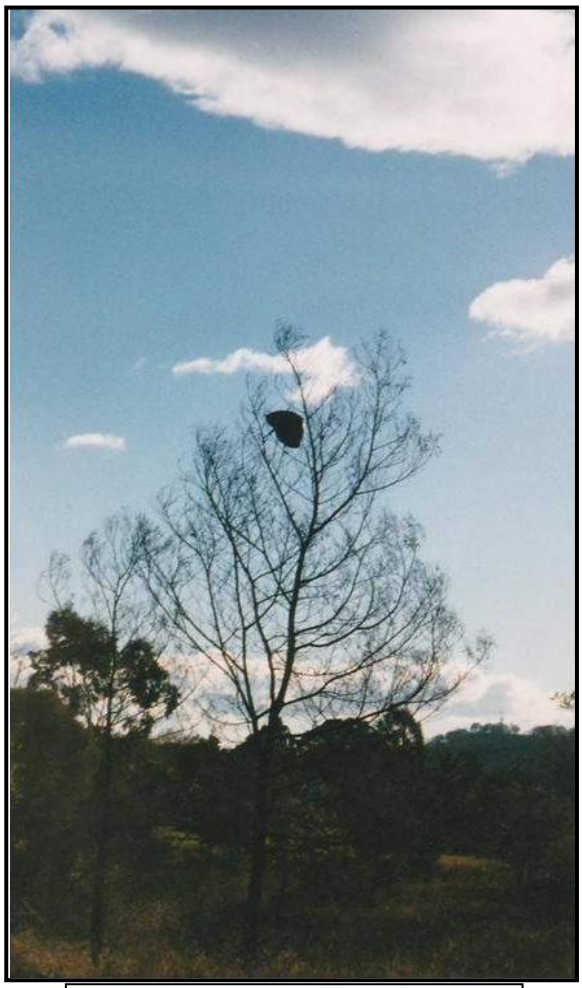
Janice	07-Nov-02	23-Dec-12	10 yr, 1 mth, 16 days	6 mth	12yr	*Never seen again*
Tim	24-Aug-00	31-Oct-09	9 yr, 2 mth, 7 days	*3-4 yr*	12 yr 08 mth	*Never seen again*
Cindy	31-Oct-00	31-Jan-12	11 yr, 3 mth, 0 days	18 mth	12 yr 06 mth	*Never seen again*
Susan	22-Aug-07	01-Mar-18	10 yr, 6 mth, 7 days	*2 yr*	12 yr 06 mth	*Never seen again*
Barbara	31-Oct-02	02-Nov-13	11 yr, 0 mth, 2 days	12mth	12 yr 06 mth	*Never seen again*
Alice	24-Jun-07	25-May-18	10 yr, 11 mth, 1 days	9 mth	12 yr	*25-05-18*
Gary	10-Apr-95	10-Dec-00	5 yr, 8 mth, 0 days	7 yr	12 yr	10-12-00
Georgie	01-May-99	25-Jul-10	11 yr, 2 mth, 24 days	1 yr	12 yr	25-07-10
Jacob	12-Sep-97	16-Nov-02	5 yr, 2 mth, 4 days	7 yr	12 yr	*Never seen again*
Abel	04-May-03	05-Oct-08	5 yr, 5 mth, 1 days	6 yr	11 yr 06 mth	*Never seen again*
Marie	14-Oct-96	17-Dec-01	5 yr, 2 mth, 3 days	7 yr	11 yr	*Never seen again*
Alex	20-Oct-00	16-Oct-09	8 yr, 11 mth, 26 days	2 yr	11 yr	*Never seen again*
Martin	22-Oct-98	18-Dec-00	2 yr, 1 mth, 26 days	8-10 yr	11 yr	*Never seen again*
Jessica	12-Jul-10	20-Oct-10	0 yr, 3 mth, 8 days	10 yr	10 yr 03 mth	*Never seen again*
Fil	30-Nov-06	30-Nov-06	0 yr, 0 mth, 0 days	10 yr	10 yr	*Never seen again*
Hodge	27-Nov-93	22-Feb-96	2 yr, 2 mth, 26 days	8 yr	10 yr	22-01-96
Newman	08-Sep-01	02-Sep-04	2 yr, 11 mth, 25 days	7-8 yr	10 yr	*Never seen again*
Harry	10-Sep-93	21-Sep-96	3 yr, 0 mth, 11 days	7 yr	10 yr	21-09-96
Liz	08-Dec-08	01-Aug-15	6 yr, 7 mth, 24 days	3 yr	9 yr 09 mth	*Never seen again*
Debbie	28-Jul-03	15-Jul-12	8 yr, 11 mth, 17 days	10 mth	9 yr 08 mth	*Never seen again*
Cramar	15-Jan-07	26-Aug-13	6 yr, 7 mth, 11 days	3 yr	9 yr 06 mth	*Never seen again*
June	05-Jun-01	25-Mar-10	8 yr, 9 mth, 20 days	8 mth	9 yr 06 mth	25-03-10
St Helen	25-Nov-10	30-Apr-12	1 yr, 5 mth, 5 days	*8 yr*	9 yr 05 mth	*Never seen again*
Steve2	07-Mar-11	15-Jun-18	7 yr, 3 mth, 8 days	*2 yr*	9 yr 03 mth	*Never seen again*
PM	23-Aug-07	19-Jan-16	8 yr, 5 mth, 9 days	10 mth	9 yr 3 mth	*19-1-2016*
Taylor	13-Nov-01	21-Jun-08	6 yr, 7 mth, 8 days	*2-3 yr*	9 yr	*Never seen again*
Price	16-Jul-08	29-Aug-12	4 yr, 1 mth, 13 days	5 yr	9 yr	*Never seen again*
Angela	20-Oct-98	20-Oct-98	0 yr, 0 mth, 0 days	8-10 yrs	9 yr	*Never seen again*
Tyjo	12-Nov-08	15-Jul-11	2 yr, 8 mth, 3 days	6 yr	9 yr	*Never seen again*
Kiera	23-Dec-02	01-Nov-07	4 yr, 10 mth, 9 days	3-4 yr	8 yr 06 mth	*Never seen again*
Gerald	07-May-00	04-Nov-00	0 yr, 5 mth, 28 days	8 yr	8 yr 06 mth	*Never seen again*
Benedict (B16)	15-Jul-08	13-Nov-14	6 yr, 3 mth, 29 days	2 yr	8 yr 03 mth	*Never seen again*
Old Boy	08-Jun-92	01-Nov-93	1 yr, 4 mth, 24 days	7 yr	8 yr	*Never seen again*
Zeena	31-Oct-02	31-Oct-02	0 yr, 0 mth, 0 days	*8 yr*	8 yr	*Never seen again*
5-Bolts	27-Jul-08	27-Jul-08	0 yr, 0 mth, 0 days	8 yr	8 yr	*Never seen again*
Alby	10-Oct-97	10-Oct-97	0 yr, 0 mth, 0 days	8 yr	8 yr	10-10-97
Charlotte	06-Oct-05	29-Mar-11	5 yr, 5 mth, 23 days	2-3 yrs	8 yr	29-03-11
Chloe	15-Nov-02	14-Oct-04	1 yr, 10 mth, 29 days	6 yr	8 yr	*Never seen again*
Harrison	06-Nov-03	24-Jan-10	6 yr, 2 mth, 18 days	2 yrs	8 yr	*Never seen again*
Lorraine	25-Sep-04	22-Feb-12	7 yr, 4 mth, 28 days	7 mth	8 yr	*Never seen again*

Lynchy	13-Aug-04	02-Apr-06	1 yr, 7 mth, 20 days	7 yr	8 yr	*Never seen again*
Bridgett	25-Mar-94	25-Mar-94	0 yr, 0 mth, 0 days	08 yr	8 yr	*Never seen again*
Steve	25-Jul-97	29-Jul-02	5 yr, 0 mth, 4 days	*2.5 yr*	7 yr 06 mth	29-07-02
Barney	01-Feb-04	12-Mar-08	4 yr, 1 mth, 11 days	3 yr	7 yr 06 mth	12-03-08
Brittany	07-Mar-03	23-Oct-09	6 yr, 7 mth, 16 days	7-8 mth	7 yr 06 mth	01-11-09
Melham	12-Jun-11	12-Oct-13	2 yr, 4 mth, 0 days	5 yr	7 yr 04 mth	*Never seen again*
Vicki	15-Apr-04	30-Aug-11	7 yr, 4 mth, 15 days	*10 mth*	7 yr 02 mth	*Never seen again*
Junior	15-Nov-02	02-Aug-09	6 yr, 8 mth, 18 days	15 mth	7 yr	*Never seen again*
Richard	17-Oct-97	17-Oct-97	0 yr, 0 mth, 0 days	7 yr	7 yr	*Never seen again*
Kathleen	27-Nov-02	24-Jan-07	4 yr, 1 mth, 28 days	3 yr	7 yr	*Never seen again*
Alexis	06-Nov-12	09-Jan-16	3 yr, 2 mth, 3 days	3 yr	6 yr 02 mth	*09-01-16*
Dougie	12-Nov-06	07-Aug-07	0 yr, 8 mth, 26 days	6 yr	6 yr 06 mth	*Never seen again*
Eric	15-Dec-98	09-Jul-01	2 yr, 6 mth, 24 days	3-5 yrs	6 yr 06 mth	*Never seen again*
Kerry	12-Jul-98	17-Jul-03	5 yr, 0 mth, 5 days	1 yr	6 yr	*Never seen again*
Marshall	17-Sep-04	17-Sep-04	0 yr, 0 mth, 0 days	6 yr	6 yr	18-12-99
Poko	31-Oct-09	31-Oct-09	0 yr, 0 mth, 0 days	6 yr	6 yr	*Never seen again*
Frank	14-Jun-99	23-Dec-04	5 yr, 6 mth, 9 days	8 mth	6 yr	23-12-04
Roger	17-Aug-96	17-Aug-96	0 yr, 0 mth, 0 days	6 yr	6 yr	17-08-96
Shelly	25-Jan-03	25-Jan-03	0 yr, 0 mth, 0 days	6 yr	6 yr	*Never seen again*
Sarah	13-Apr-96	23-Sep-01	5 yr, 5 mth, 10 days	5 mth	5 yr 10 mth	*Never seen again*
Burraneer Bobby	03-Apr-12	13-Oct-15	3 yr, 6 mth, 10 days	2 yr	5 yr 6 mth	*Never seen again*
Margo	26-Mar-94	22-Sep-95	1 yr, 5 mth, 27 days	4 yr	5 yr 06 mth	*Never seen again*
Kris	27-Jul-02	01-Aug-06	4 yr, 0 mth, 5 days	18 mth	5 yr 06 mth	*Never seen again*
Amica	25-Nov-08	05-Mar-11	2 yr, 3 mth, 8 days	3 yr	5 yr 06 mth	*05-03-11*
Brian	27-Jun-01	28-Jan-03	1 yr, 7 mth, 1 days	4 yr	5 yr 06 mth	*Never seen again*
Wendy	05-Jul-02	25-Dec-07	5 yr, 5 mth, 20 days	*5 yr*	5 yr 05 mth	25-12-07
Lance	21-Aug-09	31-Aug-12	3 yr, 0 mth, 10 days	2 yr	5 yr	*Never seen again*
Elmo	16-Sep-94	02-Aug-95	0 yr, 10 mth, 17 days	4 yr	5 yr	02-08-95
Sharon	26-Jan-04	25-Nov-07	3 yr, 9 mth, 30 days	1 yr	5 yr	*Never seen again*
Gaylene	12-Jun-97	25-Nov-01	4 yr, 5 mth, 13 days	6 mth	5 yr	*Never seen again*
Irene	12-Aug-00	13-Nov-02	2 yr, 3 mth, 1 days	3 yr	5 yr	*Never seen again*
Jack	16-Sep-03	03-Jun-06	2 yr, 8 mth, 18 days	2-3 yr	5 yr	*Never seen again*
Mathew	02-Sep-99	02-Sep-99	0 yr, 0 mth, 0 days	4 yr	4 yrs	*Never seen again*
Edmond	12-Jan-95	02-Aug-95	0 yr, 6 mth, 21 days	4 yr	4 yr 06 mth	*Never seen again*
Melissa	03-Aug-08	07-Nov-10	2 yr, 3 mth, 4 days	2 yr	4 yr 03 mth	*TRNP*
Ray	08-Nov-97	18-Dec-98	1 yr, 1 mth, 10 days	3 yr	4 yr	*Never seen again*
Betty	29-Sep-06	24-Jul-09	2 yr, 9 mth, 25 days	2 yr	4 yr	*Never seen again*
Kath	23-Jun-97	28-Aug-97	0 yr, 2 mth, 5 days	3.5 yr	4 yr	*Never seen again*
Phea	06-Aug-92	08-Feb-93	0 yr, 6 mth, 2 days	3-4 yr	4 yr	08-02-93
Ann	30-Aug-00	30-Aug-00	0 yr, 0 mth, 0 days	4 yr	4 yr	*Never seen again*

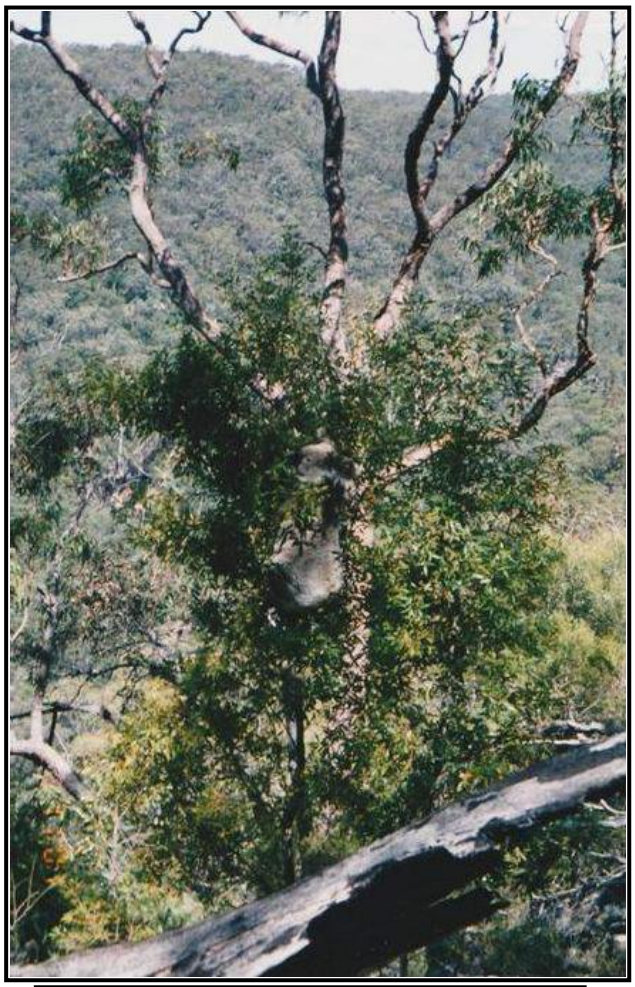
Ricky	07-Oct-02	25-Nov-03	1 yr, 1 mth, 18 days	3 yr	4 yr	25-11-03
Constable John	08-Mar-05	23-Aug-05	0 yr, 5 mth, 15 days	3-4 yr	4 yr	*Never seen again*
Ethan	06-May-13	06-May-13	0 yr, 0 mth, 0 days	4 yr	4 yr	*Never seen again*
Balook	23-Aug-08	23-Aug-08	0 yr, 0 mth, 0 days	4 yr	4 yr	*Never seen again*
Blake	09-Sep-91	01-Sep-92	0 yr, 11 mth, 23 days	2-5 yr	4 yr	*Never seen again*
Dee	20-Apr-92	20-Apr-92	0 yr, 0 mth, 0 days	4 yr	4 yr	*Never seen again*
Hendo	24-Feb-08	20-Dec-08	0 yr, 9 mth, 26 days	4 yr	4 yr	20-12-08
Kade	04-Oct-05	31-Dec-05	0 yr, 2 mth, 27 days	4 yr	4 yr	*Never seen again*
Reid	26-Aug-11	18-Jun-18	6 yr, 9 mth, 23 days	4 yr	4 yr	*Never seen again*
Scott	13-Sep-97	13-Sep-97	0 yr, 0 mth, 0 days	4 yr	4 yr	*Never seen again*
Ernie	01-Dec-02	01-Dec-02	0 yr, 0 mth, 0 days	4 yr	4 yr 06mth	*Never seen again*
Becky	06-Sep-06	27-Nov-08	2 yr, 2 mth, 21 days	18 mth	3 yr 06 mth	27-11-08
Mykala	14-Jun-03	14-Jun-03	0 yr, 0 mth, 0 days	3-4 yr	3 yr 06 mth	*Never seen again*
Whilelmina	05-Apr-92	08-Dec-93	1 yr, 8 mth, 3 days	*2 yr*	3 yr 08 mth	*Never seen again*
Symbio	14-Jan-02	14-Jan-02	0 yr, 0 mth, 0 days	*3-4 yr*	3 yr 06 mth	*Never seen again*
Bernie	23-Aug-10	12-Feb-12	1 yr, 5 mth, 20 days	2 yr	3 yr 06 mth	*Never seen again*
Mac	27-Nov-96	25-May-97	0 yr, 5 mth, 28 days	3 yr	3 yr 05 mth	25-05-97
Varrowville	15-Sep-02	16-Dec-04	2 yr, 3 mth, 1 days	*1 yr*	3 yr 03 mth	*Never seen again*
Victor	03-Jul-99	28-Dec-01	2 yr, 5 mth, 25 days	*10 mths*	3 yr 03 mth	*Never seen again*
Gorilla	28-Aug-07	28-Aug-07	0 yr, 0 mth, 0 days	3-4 yr	3 yr 0 mth	*Never seen again*
Bill	16-Nov-96	31-Dec-97	1 yr, 1 mth, 15 days	2 yr	3 yr	*Never seen again*
Bruce	04-Nov-01	09-Dec-01	0 yr, 1 mth, 5 days	3 yr	3 yr	09-12-01
Keran	31-Dec-00	31-Dec-00	0 yr, 0 mth, 0 days	3yr	3 yr	*Never seen again*
Lucky	29-Aug-09	29-Aug-09	0 yr, 0 mth, 0 days	3 yr	3 yr	*Never seen again*
Patricia	26-Nov-04	26-Nov-04	0 yr, 0 mth, 0 days	3 yr	3 yr	*Never seen again*
Sandy	08-Jun-98	08-Jun-98	0 yr, 0 mth, 0 days	3 yr	3 yr	*Never seen again*
Greening	07-Apr-02	07-Jul-03	1 yr, 3 mth, 0 days	2 yr	3 yr	*Never seen again*
Kent	20-Apr-00	31-Oct-02	2 yr, 6 mth, 11 days	12 mth	3 yr	*Never seen again*
OOJ	21-Apr-09	21-Apr-09	0 yr, 0 mth, 0 days	3 yr	3 yr	*Never seen again*
Robert	16-Jul-04	18-Aug-06	2 yr, 1 mth, 2 days	1 yr	3 yr	18-08-06
Jeremy	02-Oct-06	02-Oct-06	0 yr, 0 mth, 0 days	3yr	3 yr	*TRNP*
Bilpin Bill	21-Aug-02	21-Aug-02	0 yr, 0 mth, 0 days	3-4 yr	3 yr	*Never seen again*
Harrytwo	27-Oct-10	27-Oct-10	0 yr, 0 mth, 0 days	03 yr	3 yr	*Never seen again*
Sirius	01-Jan-10	11-Oct-11	1 yr, 9 mth, 10 days	1 yr	3 yr	*Never seen again*
Linda	28-Jan-00	12-Sep-00	0 yr, 7 mth, 15 days	2 yr	2 yr 06 mth	*Never seen again*
Justin	05-Aug-03	02-Dec-03	0 yr, 3 mth, 27 days	2.5 yr	2 yr 06 mth	02-12-03
Carrie	13-Sep-09	31-Jan-10	0 yr, 4 mth, 18 days	2 yr	2 yr 06 mth	*Never seen again*
Casey	09-Jun-95	22-Aug-95	0 yr, 2 mth, 13 days	2 yr	2 yr 06 mth	22-08-95
Dan	19-Feb-98	13-Sep-99	1 yr, 6 mth, 25 days	1 yr	2 yr 60 mth	*Never seen again*
Lace	02-Jul-06	14-Apr-07	0 yr, 9 mth, 12 days	1 yr 6 mth	2 yr 06 mth	*Never seen again*

Breyke	10-Sep-01	11-Sep-01	0 yr, 0 mth, 1 days	2-3 yr	2 yr 06 mth	*Never seen again*
Elliot	05-Jan-99	11-May-00	1 yr, 4 mth, 6 days	11 mth	2 yr 06 mth	*Never seen again*
Flossie	09-Jul-06	03-Oct-06	0 yr, 2 mth, 24 days	2 yr	2 yr 06 mth	*TRNP*
Jemima	18-May-08	14-Dec-10	2 yr, 6 mth, 26 days	3 mth	2 yr 06 mth	*TRNP*
Jimbo	27-Nov-06	27-Nov-06	0 yr, 0 mth, 0 days	2.5 yr	2 yr 06 mth	*Never seen again*
Marly	09-Jun-01	12-Apr-03	1 yr, 10 mth, 3 days	11 mth	2 yr 06 mth	12-04-03
Mattie	19-Sep-11	22-Sep-11	0 yr, 0 mth, 3 days	2-3 yr	2 yr 06 mth	*Never seen again*
Dobbo	20-Sep-12	06-Dec-12	0 yr, 2 mth, 16 days	2 yr	2 yr 04 mth	*Never seen again*
Bangor	23-Jul-12	20-Sep-12	0 yr, 1 mth, 28 days	2-3 yr	2 yr	20-09-12
Curls	25-Aug-08	09-May-10	1 yr, 8 mth, 14 days	7 mths	2 yr	09-05-10
Katie	25-Sep-11	25-Sep-11	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
Marion	09-Dec-92	19-Dec-92	0 yr, 0 mth, 10 days	2 yr	2 yr	19-12-92
Maximus	12-Jul-06	12-Jul-06	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
Megan	22-Nov-97	22-Nov-97	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
Michelle	05-Jul-02	03-Nov-03	1 yr, 3 mth, 29 days	9 mth	2 yr	*Never seen again*
Pam	17-Mar-06	17-Feb-07	0 yr, 11 mth, 0 days	15 mth	2 yr	*Never seen again*
Rhowyn	08-Jan-01	10-Jan-02	1 yr, 0 mth, 2 days	1 yr	0 yr	*Never seen again*
Heather	08-Nov-11	12-Jan-12	0 yr, 2 mth, 4 days	2 yr	2 yr	*TRNP*
Louise	15-Aug-03	16-Jul-04	0 yr, 11 mth, 1 days	01 yr	2 yr	16-07-04
Pindari	18-Jul-12	30-Oct-13	1 yr, 3 mth, 12 days	1	2 yr	*Never seen again*
Ariel	20-Dec-08	20-Dec-08	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
Bluey	30-Oct-96	30-Oct-96	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
James	15-Sep-96	15-Sep-96	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
Neal	07-Mar-01	07-Mar-01	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
Oscar	08-May-92	08-May-92	0 yr, 0 mth, 0 days	2 yr	2 yr	*Never seen again*
Reg	27-Jul-06	24-Sep-07	1 yr, 1 mth, 28 days	1	2 yr	*Never seen again*
Samantha	08-Nov-06	08-Nov-06	0 yr, 0 mth, 0 days	2 yr	2 yr	*TRNP*
Ted	12-Sep-12	12-Sep-12	0 yr, 0 mth, 0 days	*2 yrs*	2 yr	*Never seen again*
Mitch	04-Oct-08	04-Oct-08	0 yr, 0 mth, 0 days	02 yr	2 yr	*Never seen again*
Orin	16-Oct-97	15-Jan-98	0 yr, 2 mth, 30 days	1 yr	1 yrs 03 mth	*Never seen again*
Mishka	17-Aug-05	25-Jun-06	0 yr, 10 mth, 8 days	12 mth	1 yr 10 mth	*Never seen again*
Cloe	12-Nov-07	12-Nov-07	0 yr, 0 mth, 0 days	18 mth	1 yr 06 mth	*Never seen again*
Darling	05-Aug-07	24-Feb-08	0 yr, 6 mth, 19 days	1 yr	1 yr 06 mth	*Never seen again*
Amber	16-Dec-06	14-Aug-07	0 yr, 7 mth, 29 days	12 mth	1 yr 06 mth	*Never seen again*
Cheeky	20-Oct-00	30-Oct-00	0 yr, 0 mth, 10 days	18 mth	1 yr 06 mth	*Never seen again*
Martin	22-Oct-98	18-Dec-00	2 yr, 1 mth, 26 days	8-10 yr	11 yr	*Never seen again*
Andrew	31-Aug-97	11-Nov-97	0 yr, 2 mth, 11 days	1 yr	1 yr 05 mth	*Never seen again*
Gaya	01-Aug-05	01-Aug-05	0 yr, 0 mth, 0 days	12 mth	1 yr	29-10-05
Julie	06-Jun-03	24-Nov-03	0 yr, 5 mth, 18 days	8 mth	1 yr	*Never seen again*
Johnny	26-Jan-11	26-Jan-11	0 yr, 0 mth, 0 days	1 yr	1 yr	*Never seen again*

Meadows	23-Nov-07	23-Nov-07	0 yr, 0 mth, 0 days	12 mth	1 yr	*Never seen again*
Matiri	26-Sep-11	26-Sep-11	0 yr, 0 mth, 0 days	1 yr	1 yr	27-Sep-11
Alexandra	07-Oct-10	07-Oct-10	0 yr, 0 mth, 0 days	1 yr	1 yr	*Never seen again*
Greg	08-Dec-08	21-Oct-09	0 yr, 10 mth, 13 days	7 mth	1 yr	*Never seen again*
Maitri	02-Aug-10	02-Aug-10	0 yr, 0 mth, 0 days	1	1 yr	02-08-10
Brendan	21-Sep-06	17-Nov-06	0 yr, 1 mth, 27 days	8 mth	00 yr 08 mth	*Never seen again*
Max	22-Sep-95	22-Sep-95	0 yr, 0 mth, 0 days	7 mth	00 yr 07 mth	*Never seen again*
Danny	24-Jun-00	24-Jun-00	0 yr, 0 mth, 0 days	6 mth	00 yr 06 mth	*Never seen again*
Kiri	19-Oct-13	18-Nov-13	0 yr, 0 mth, 30 days	no data	02 mth	19-Nov-13
Lindsay	28-Aug-10	18-Oct-10	0 yr, 1 mth, 20 days	no data	00 yr 01 mth	18-10-10
Peter	20-Oct-11	20-Oct-11	0 yr, 0 mth, 0 days	no data	no data	20-Oct-11



Rob was called out but it turned out to be a false alarm
Photo by Lynn Bowden



Hard to find and even harder to catch. Gaylene (daughter of Molly) overlooking O'Hares Gorge.
Photo by Lynn Bowden

Assoc Professor Robert Close and Lynn Bowden changing Franchesca collar

Frank (son of Shirley) during a capture Photo by Lynn Bowden