

January 2008

Hello St Bees Island koala experts,

Bill and I want to thank you for your support over the last year. Again we have gathered lots of good data and found some really interesting things. Previously we had come to realise that the koalas were using the island in a complex manner – trees selected for feeding at night and different trees and shrubs selected for thermoregulation (probably) during the day. We know that individual koalas consistently adopt different strategies in habitat utilisation. The National Park managers are applying this knowledge in the design of park management strategies – especially fire management. This is especially important when climate change impacts are considered.

During the year, I revisited some mainland sites where we and others have monitored koalas over some decades. These populations have declined catastrophically and tree death is extensive. This is attributable to the unprecedented drought (in modern times). On St Bees Island, we can see the influence of this reduced rainfall but without the catastrophic impact. Data loggers were installed in tree canopies and in vegetation plots to track environmental conditions experienced by the koalas and the habitat that supports them. In this way, we are building an understanding of the mechanism of climate impacts on koala ecology and the implications for park management are significant. So, all that tree- measuring is making a difference!

This year the change of koala generations was almost complete with almost the entire original koala cohort collared in 2001/02 now passed away. Now we have some empirical data on lifespan in a population where traditional aging techniques do not work.

With your help, we continued the study of koala activity commenced in late 2006 and now have data on eight female koalas. These data are being analysed and we'll compare St Bees Island koala behaviour with that reported for populations elsewhere across Australia.

The Queensland National Parks and Wildlife Service has commenced a cull of the goats on the island. Large numbers were removed late last year and culls will be repeated until the goats are eliminated. This occurred at a critical time as much of the island's ground cover had been removed by goat browsing. The extensive, waist-high grass, which so frustrated our treks across the island in the early trips, is now completely absent and replaced by large areas of bare dirt and exotic weed. I am looking forward to monitoring the recovery of the island ecosystem in the coming years.

Gail is back on maternity leave with her second child and is still preparing her thesis for submission and has a paper published! Delma is in the final stages of thesis compilation and also has a paper published.

I am trying to keep a short blog going at (http://www.pulseplanet.com/sci-diaries/sd_melzer/http://www.pulseplanet.com) and will attempt to provide research reports to the Earthwatch web site as well.

Bill will not be leading any Earthwatch trips for a while as he focuses on the associated work with our research partner, San Diego Zoological Society, on St Bees Island and nearby koala populations.

From us all, thank you for your contribution, support and entertainment.

Alistair

Dr Alistair Melzer
Koala Ecology



EARTHWATCH INSTITUTE ANNUAL FIELD REPORT

Project title: Koala Ecology

Date completed: January 2008

Completed by: Alistair Melzer

Period covered by this report: January 2007 to December 2007

Research report

Objective 1

Description of the population: trends in abundance; diet; tree use (size, day/night differences, preferences); tree community composition and population density; breeding success; ranging behaviour; genetics; disease profiles.

1.1 Population density and trends in abundance

Koalas (*Phascolarctos cinereus*) were caught and tagged during the year – adding to the total tagged pool on the island. Catching and tagging will increase in 2008 with an emphasis on more distant regions of the island. This will provide a more accurate estimate of population size and a more meaningful determination of population trends.

1.2 Diet

The diet of koalas on St Bees Island has been determined in previous years. During 2007 the feeding effort and timing of feeding activity has been studied in female koalas. In 2007, 2244 observations of activity over 24 hrs were made on five female koalas. This added to the 820 observations of three female koalas collected in 2006. 10% of koala time was spent feeding. This was largely a nocturnal activity (75% of feeding) occurring in three bouts between 6.00pm and 6.00am. From 2008 we will start to gather data on male koala feeding patterns.

1.3 Tree use (size, day/night differences, and preferences)

Data on tree use was collected throughout 2007. We continued to examine the differences between day and night tree uses and have started to explore the potential reasons for differences.

We are now confident that night tree use is related to feeding (not surprisingly). *Eucalyptus tereticornis* constitutes over 95% of the koala's diet. 82% of nocturnal tree use is of *E. tereticornis*. About 75 % of feeding activity occurs at night.

Day tree use may be associated with predator avoidance or the maintenance of a stable and relatively low metabolic rate. Data collected in 2007 suggests that the latter case is more likely. In 2007 we installed data loggers in tree canopies to measure the microenvironment experienced by koalas during the day. Preliminary results indicate a potential energetic advantage in the use of certain canopy types. We compared the light and temperature environment within two contrasting canopy types known to be used by koalas: *Eucalyptus tereticornis* canopies which are relatively open, and *Pouteria sericia* canopies which are closed. By day the temperature was up to four degrees (Celsius or Fahrenheit?) hotter in *E. tereticornis* canopies than in *P. sericia* canopies and generally, the light intensity was three times greater. Both temperature and light intensity were much less variable within the *P. sericia* canopy compared with the environment within the *E. tereticornis* canopy. Comparative observations of koala behaviour within both canopy types indicated that koalas within the *E.*

tereticornis canopy moved three times as much as koalas within the dense canopy. From this we construed that there is probably an energetic advantage to those koalas using dense canopies during the day – especially in the hottest weather conditions. We also found a suggestion that the frequency of utilisation of the dense canopy trees increased in the hotter weather while use of the more open eucalypt canopies increased in the cooler conditions. This suggests to us that the primary driver for day tree use is more related to environmental conditions rather than predator avoidance. We will continue to explore these hypotheses in 2008 and beyond. Also in 2008, we will be expanded expanding the range of canopy types being monitored to provide a more representative data set.

This area of investigation is particularly important as these trees with dense canopies are usually species that are most sensitive to drought and fire – making them most at risk from climate change impacts and from fire impacts associated with national park fire management strategies.

1.4 Tree community composition

A floristic analysis of the habitat where intensive radio tracking has been undertaken has been completed in previous years.

1.5 Breeding success

This work has been completed as part of Gail Tucker's postgraduate work. We await the completion of her thesis.

1.6 Ranging behaviour

Data collection through intensive radio tracking is largely complete. Elements of this study relating to maternal females and their offspring form part of Gail Tucker's postgraduate work and are being prepared for publication. A broader analysis of ranging behaviour awaits my analysis of the data. General radio tracking will gradually cease in 2008. Radio tracking directed to understanding animal-animal interactions will commence in 2008 as part of the allied San Diego Zoological Society study with Dr Ellis. The Earthwatch team will assist in tracking these animals in coming years.

1.7 Genetics

Collection of tissue samples for genetic analysis continued in 2007 and will be ongoing in 2008. Analysis of existing tissue samples is continuing and awaits interpretation by Dr Ellis.

1.8 Disease profiles

Analysis on the presence, frequency of occurrence and significance of Chlamydia infection among the St Bees Island koalas has been completed and reported on previously.

Data on other potential disease syndromes was collected during 2007 and will be continued in 2008. Analysis of this growing data set will commence in 2009.

Objective 2

Consideration of population limiting parameters (resources, disease, predation, microclimatic influences, gene structure, social structure).

2.1 Resources

Key resources for the St Bees Island koala population have been identified as (a) *Eucalyptus tereticornis*, the sole food and water source providing well over 90% of the diet, and (b) complex habitat providing shelter from environment or predation during the day. We now consider that this makes this population highly vulnerable to (a) any factor that may affect the distribution, abundance and quality of *E. tereticornis* foliage throughout the year and over the longer term. These factors include insect attack, drought and fire and would be exacerbated by predicted climate change; and (b) any simplification of habitat structure in concert with extreme temperatures and reduced rainfall. Risk here is from inappropriate or intense fire and drought, all of which would reduce the availability of mid-storey trees and shrubs with dense canopies. We will be attempting to quantify these issues from 2008 and to incorporate consideration of them into national park management strategies.

2.2 Disease

We have reported previously that Chlamydia infection is not limiting fecundity in this population and that although juvenile mortality is likely to play a role, there is no indication that disease is influencing this.

We are continuing to collect data on another potential disease syndrome that may limit longevity among some individuals.

2.3 Predation

We have reported previously on predators and predation among this population. We concluded that it does occur but that it was a rare event. The predator is the Wedge-tail Eagle (**scientific name**). **From 2008 we will be looking for evidence that eagle predation may increase as the density of the most easily available prey (goats) is significantly reduced by culling.**

2.4 Microclimatic influences

Consideration of this issue forms part of Delma Clifton's post-graduate work and the thesis is currently being compiled. However, some elements of the work have been published in 2007 and it is proposed that the koala's ability to exploit suitable microclimates may be a major determinant in species distribution across tropical Australia. With the assistance of the volunteers we are attempting to quantify the characteristics of the microclimate provided by particular tree species and consider the implications (a) for habitat management and (b) of climate change induced modification of forest structure and composition.

2.5 Gene structure

Dr Ellis has reported previously that there is no indication of any loss of genetic diversity among the St Bees Island koalas and hence no impact on population survivorship.

2.6 Social structure

Dr Ellis's work on paternity is being analysed and we await interpretation. The gps GPS radio collars will provide data on social interaction among individuals. Data on these aspects was collected during 2007 and will continue in 2008.

Objective 3

Compare with similar island populations elsewhere where populations are not stable and seek insight into what is lacking in those plague populations.

In 2007 we commenced a comparative review of knowledge of St Bees Island koala ecology and management and that of island populations in southern Australia. This is at a preliminary stage but will be developed further in 2008.

Project development

We have developed a new aim: to understand the consequences of climate change for the koala in tropical Australia and to (1) apply that understanding to strategies for the conservation and better management of koala habitat, and (2) use this as a model for arboreal fauna (especially folivores (foliage grazers)) in Australia generally. With our preliminary understanding drawn from observations over the last seven years, we intend to develop achievable objectives early in 2008.

Summary of results

Koala activity budgets

During 2007 the feeding effort and timing of feeding activity has been studied in female koalas (*Phascolarctos cinereus*) (Figure 1). Two thousand two hundred and forty four observations of activity over 24 hrs were made on five female koalas. This added to the 820 observation of three female koalas collected in 2006. St Bees Island female koalas spend 18.7 hours resting, 2.4 hours feeding, 58 minutes climbing, 58 minutes moving on the ground, 43 minutes grooming and 14 minutes interacting. Ten percent of koala time was spent feeding. This was largely a nocturnal activity (75% of feeding) occurring in three bouts between 6.00 pm and 6.00 am.

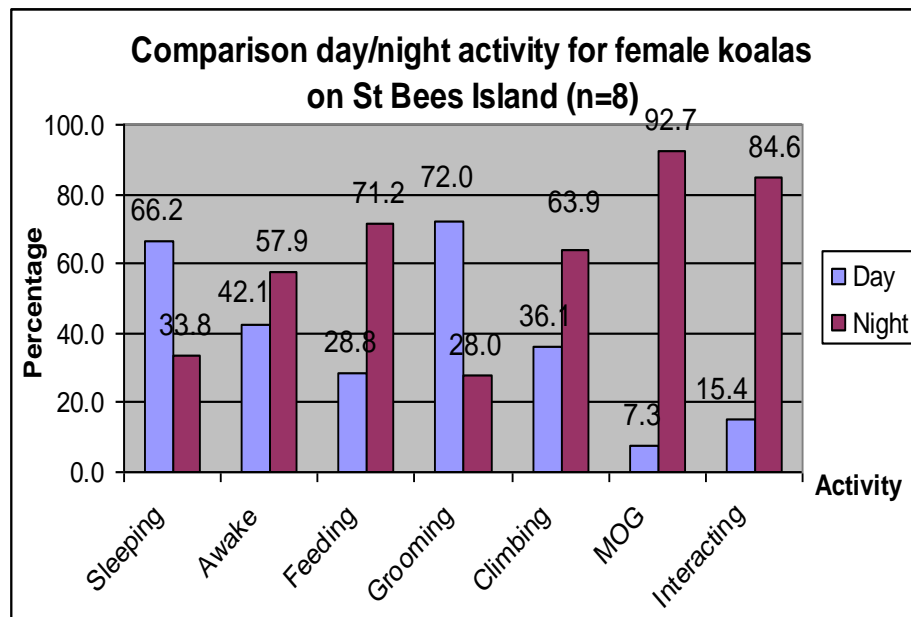


Figure 1. Comparison average day/night activity of female St Bees Island koalas.

Tree use, diet, microclimate and the range of the koala

Data on tree use was collected throughout 2007. We continued to examine the differences between day and night tree-use and have started to explore the potential reasons for the differences.

We are now confident that night tree use is related to feeding (not surprisingly). *Eucalyptus tereticornis* constitutes over 95% of the koala's diet. Eighty two percent of nocturnal tree use is of *E. tereticornis*. About 75 % of feeding activity occurs at night.

Day tree use may be associated with predator avoidance or the maintenance of a stable and relatively low metabolic rate. Data collected in 2007 suggests that the latter case is more likely. In 2007 we installed data loggers in tree canopies to measure the microenvironment experienced by koalas during the day. Preliminary results indicate a potential energetic advantage in the use of certain canopy types. We compared the light and temperature environment within two contrasting canopy types known to be used by koalas: *Eucalyptus tereticornis* canopies which are relatively open, and *Pouteria sericia* canopies which are closed. By day the temperature was up to four degrees (Celsius or Fahrenheit?) hotter in *E. tereticornis* canopies (Figure 2) than in *P. sericia* canopies (Figure 3) and generally, the light intensity was three times greater. Both temperature and light intensity were much less variable within the *P. sericia* canopy compared with the environment within the *E. tereticornis* canopy.

Comparative observations of koala behaviour within both canopy types indicated that koalas within the *E. tereticornis* canopy moved three times as much as koalas within the dense canopy. From this we construed that there is probably an energetic advantage to those koalas using dense canopies during the day, especially in the hottest weather conditions. We also found a suggestion that the frequency of utilisation of the dense canopy trees increased in the hotter weather while use of the more open eucalypt canopies increased in the cooler conditions. This suggests to us that the primary driver for day tree use is more related to environmental conditions rather than predator avoidance. We will continue to explore these hypotheses in 2008 and beyond. Also in 2008 we will be expanded the range of canopy types being monitored to provide a more representative data set.

This area of investigation is particularly important as these trees with dense canopies are usually species that are most sensitive to drought and fire – making them most at risk from climate change impacts and from fire impacts associated with national park fire management strategies.

Ranging behaviour

In 2007 we commenced a trial of the use of radio collars fitted with global positioning systems (GPS). These collars regularly record the location of the koala from satellites. Data can be retrieved periodically and provide us with a more detailed picture of koala movement than the one fix per day available from traditional tracking. This is particularly useful for night tracking and for investigation of how individual koalas move in relation to each other. Figure 4 provides an example of data showing the ranges of a male and a female koala recorded at the same time. This work will continue in 2008.

Ageing young koalas

Since the inception of the project we have been catching, weighing and measuring koalas. For the last two years we have been working in partnership with Zoological Society of San Diego. Together we have analysed St Bees Island data collected by Bill Ellis, Gail Tucker and the volunteers alongside data from the koalas at San Diego Zoo. The weight of known age koalas from San Diego Zoo has been combined with head length data from known age animals on St Bees Island (Figures 5 & 6). The combined analyses have allowed us to accurately gauge the age of immature St Bees Island koalas and to predict the relative proportion of young produced across seasons (Figure 7). We concluded that the St Bees Island breeding season was consistent with that reported for southern koalas. We also found that weight provided a more reliable measure of age than head length.

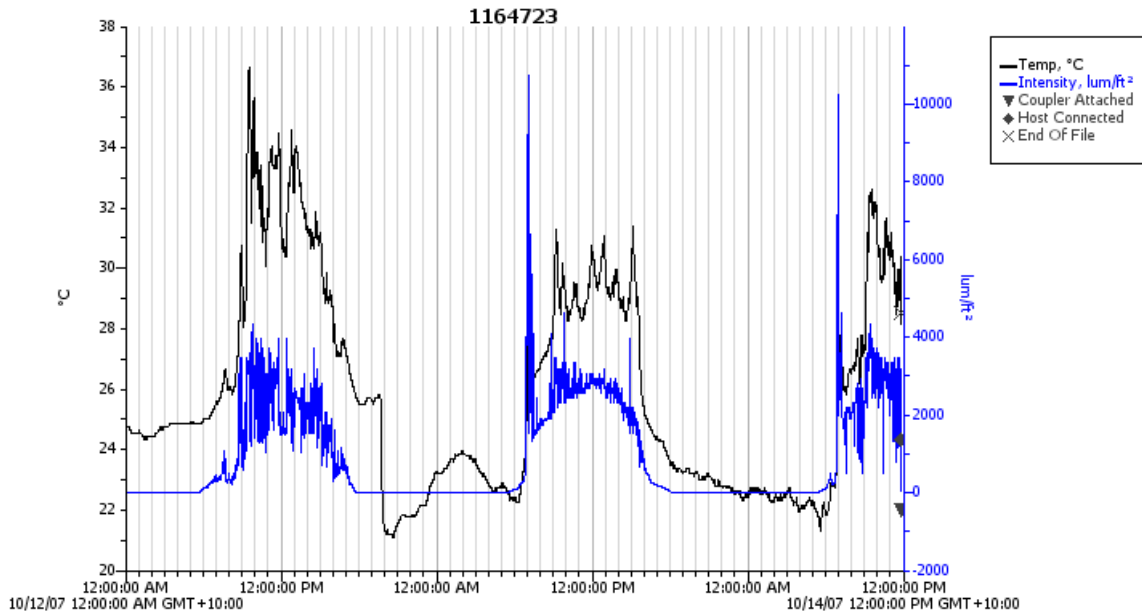


Figure 2 Two day light and temperature within a *Eucalyptus tereticornis* canopy (October, 2007, St Bees Island).

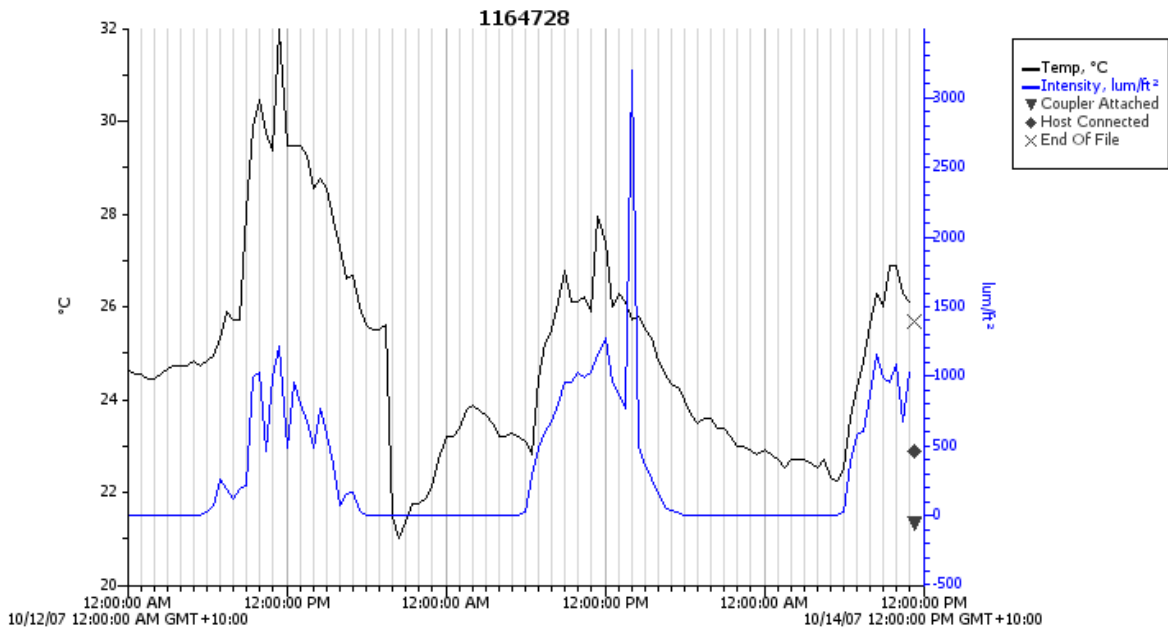


Figure 3 Two day light and temperature environment within in a *Pouteria sericea* canopy (October, 2007, St Bees Island).

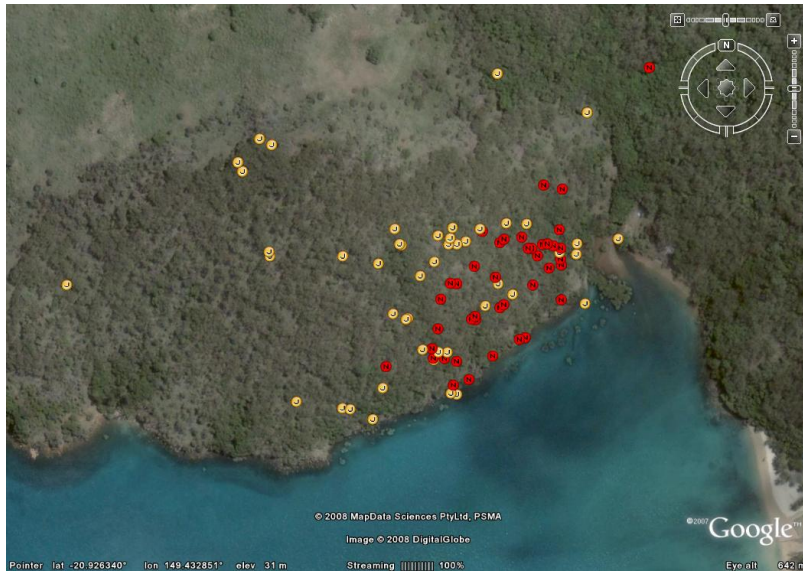


Figure 4. Locations of two St Bees Island koalas (Male J and Female N) tracked during 2007.

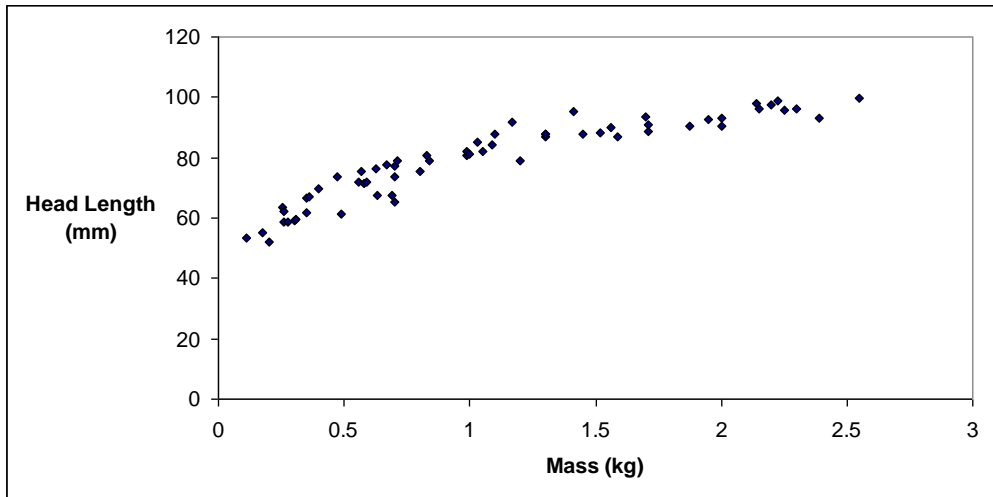


Figure 5 Relationship between body mass and head length of 66 young koalas at St Bees Island. (Head length = $16.607\text{Ln}(\text{mass}) + 82.035$, $R^2 = 0.93$).

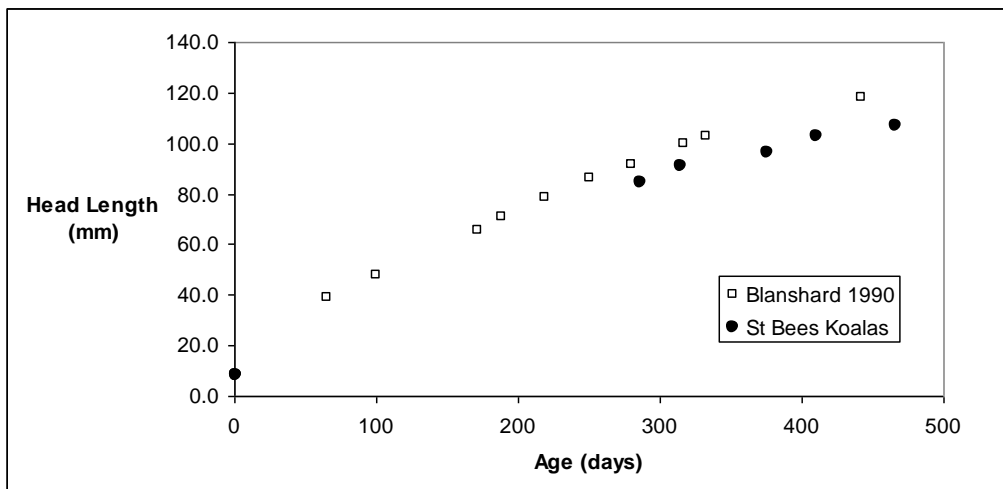


Figure 6 Comparison of known age captive koala head length (Blanshard, 1990) with known age koala head length at St Bees Island, Queensland. **Blanchard, W. H. (1990) Growth and development of the koala from birth to weaning. *Biology of the Koala*. Pp. 193-202.**

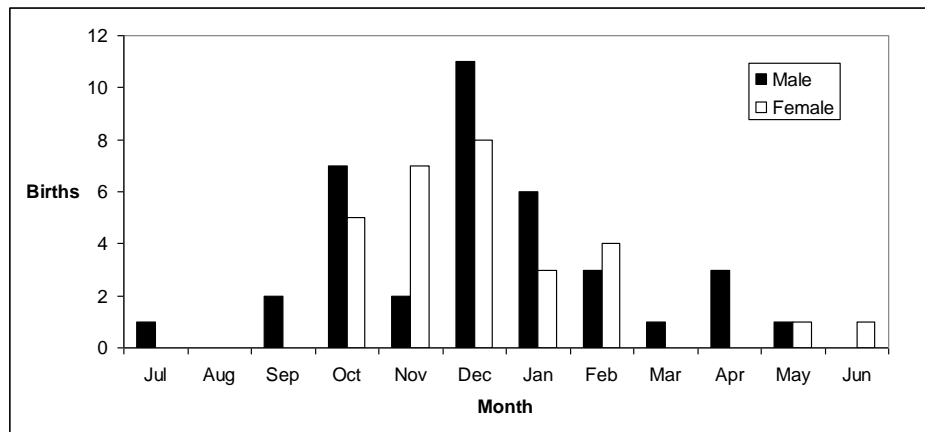


Figure 7 Seasonality of koala births at St Bees Island, Queensland. Data for koalas of mass less than 2.9 kg at capture (n = 66).

Contribution to achieving conservation impacts

The research outcomes on habitat utilisation directly inform land management practices within the St Bees Island National Park, in particular fire and weed management. The results on ageing koalas are critical for establishing accurate demographic information. Demography forms the basis of managing and monitoring population dynamics. These results will be applied at the local level (St Bees Island) but will influence koala management generally including within captive populations.

Significance/ benefits of research

Local

We continue to liaise with the regional Queensland Parks and Wildlife Service (QPWS) in relation to strategies for the protection and enhancement of koala habitat. We are able to provide information on the habitat use and behaviour of koalas to local landowners and raise awareness of the conservation issues at the local level. Our data informs the management of biodiversity in fragmented landscapes and through a partnership with QPWS directly inputs to the management processes for national parks and other reserves or intensively managed habitat isolates. We continue to work in partnership with QPWS to monitor (a) the impact of culling of goats on the reproduction of the koala food tree species, (b) the consequences of fire and weed management on habitat structure, and (c) indications of any prey switch by wedge-tailed eagles as the availability of goats declines.

National

These results contribute to the understanding of a national icon and are of interest to other states where there is conflict over the management of the koala. The work is also a model of management of koalas in habitat fragments, known as “ecological islands,” common after broad-acre land clearing of much of Australia’s woodlands.

International

The koala is the only representative of the family and is consequently of international conservation significance. The work will provide an insight into the research and management of isolated populations.

Communication of results

Printed

- Delma Clifton, William, A. H. Ellis, Alistair Melzer, Gail Tucker (2007) Water turnover and the northern range of the koala (*Phascolarctos cinereus*). *Australian Mammalogy*.**29**. 85-88
- Melzer, A., Ellis, W., Carrick, F., Tucker, G. and Clifton, D. (in progress) Koalas and their habitat on St Bees Island, Qld.
- Melzer, A., Gordon, G., Ellis, W., Carrick, F. (Submitted *Australian Zoologist* April 2007) A problem with tooth wear as an indicator of age in Queensland koalas.
- Tucker, G., Melzer, A. and W. Ellis (2007) The development of habitat selection by subadult koalas. *Australian Journal of Zoology*. **155**, 285 – 289.
- Melzer, A., Kadiri, M., Baudry, C., Ellis, W., Tucker, G. (Submitted *Australian Zoologist* April 2007) Tree use, feeding behaviour and diet of koalas on St Bees Island.
- Melzer, A., Ellis, W., Bercovitch, F. (in progress) Observations of male-on-male aggression among Queensland koalas (*Phascolarctos cinereus adustus*) from central Queensland.

Digital

- Blog at <http://www.pulseplanet.com> includes reference to Earthwatch work and teams.
- Web site at www.cqkoala.org.au contains reference to Earthwatch work and teams.
- Web site at www.cem.cqu.edu.au contains reference to Earthwatch work and teams from time to time.

Mass media

Reference to general koala work in:

Sohn, E. (2007) The Big Dry: Prolonged drought threatens Australia's people, wildlife and economy. *Science News* 127 266-268 (www.sciencenews.org)

Jackson, S. (2007) *Koala: Origins of an icon*. Jacana Books, Allen and Unwin, Crows Nest NSW.

A series of pre-recorded radio interviews was produced in 2007 for broadcast across Australia's community radio network in 2008. Produced by Patricia J. Alchin Production Manager Radio Logan Inc; 101 FM Director of Noah's Legacy (www.101fm.asn.au)

Meetings and conferences

Bill Ellis, Alistair Melzer, Sean Fitzgibbon & Frank Carrick (2007) *Long term Ecological Long-Research Previews Climate Change Effects on Tropical Koalas*. A presentation to the national conference of the Ecological Society of Australia in Western Australia in December 2007.

6. Educational Opportunities

The project involves students, the Queensland Parks and Wildlife Service, Central Queensland Koala Volunteers (www.cqkoala.org.au) and the adjacent regional community.

Research findings and field contact with the koala and its habitat provides the community with an enhanced understanding of the complex needs of the koala and the implications of uninformed management actions in the woodland.

The research findings contribute to the maintenance of biodiversity in fragmented landscapes and provide direct input into the management processes for national parks and other reserves or intensively managed habitat isolates. **We are now able to develop conceptual models of the impact of**

national climate change on koala habitat and consequently on koala survivability across continental Australia. This understanding will be used to inform the National Strategy on the Koala.

Contribution to further education research

The project supports two Central Queensland University postgraduate studies (*Ecology of sub-adult koalas* – G. Tucker continuing Master Candidate, *Environmental water relations of the koala and the importance of the microenvironments in tropical habitats* D. Clifton continuing PhD Candidate). Two international students worked with us on projects related to *koala tree use, feeding activity and metabolic advantage* (Caroline Le Bris), The National Higher Agronomic School of Rennes, France) *24 hr activity budget for tropical koalas* (Maud Cloarec), The National Higher Agronomic School of Rennes, France)