Research Projects - South-East Australia

Australian Wildlife Conservancy

The Australian Wildlife Conservancy (AWC) is a non-government, non-profit organisation dedicated to the conservation of Australia's wildlife and their habitats. AWC's south-east region has a team of 7 ecologists who work closely with the land managers to carry out AWC's Conservation and Science Program. The Science Program includes strategic research designed to help us manage threatened species more effectively. Several of these research projects are suitable for Honours, Masters or PhD projects.

This prospectus provides an outline of the student projects that are currently on offer in the south-east region. The majority of the projects are based on one sanctuary, although some aspects of the research may be carried out on other AWC sanctuaries and/or government conservation areas.

AWC will partially support these projects with equipment, staff time and expertise, and accommodation. In some cases, AWC may also provide some vehicle use, fuel and office facilities and access to the fully equipped Cook Laboratory on-site at The Scotia Field Research Centre. We anticipate these projects will be collaborative efforts with input from students, academics and AWC staff, with appropriate acknowledgement for all involved. These projects are offered on a first in, first approved basis and havebeen offered to multiple universities.

More details on the sanctuaries and AWC available at: **www.australianwildlife.org**

Next steps: If you are keen to have a student conduct one of these projects, please contact Matt Hayward and we will then formulate a research proposal and research agreement. You will also need an academic supervisor from a university.

Contact: **Dr Matt Hayward, Regional Ecologist (SE)**
matt.hayward@australianwildlife.org
0428 963 931

1. Mesopredator interactions between cats and foxes at Scotia Sanctuary

- ***Study type***
  - PhD.
- ***Sanctuaries:***
  - Scotia (95%)
  - Danggali Conservation Park, South Australia (5%)
- ***Resources available*:**
  - Supervision
  - Field assistance and expertise
  - Radio collars (8 GPS collars for cats and 12 VHF collars for foxes)
  - Accommodation at Scotia
  - Office space at the Scotia Field Research Centre and access to the Cook Laboratory
  - Limited vehicle use (subject to operational requirements)

The removal of foxes in Western Australian forests may have led to mesopredator release of cats and other predators [1], and thus an increase in predation pressure on a suite of native fauna. This process may explain the current decline of the woylie [1] and other species in Western Australia. This and other research suggests that large carnivores may be useful in reducing the impact of smaller predators on native fauna [2]. A critical element of this is that intraguild predation [3] by the dominant predator limits the population density of the smaller [2,4] or whether the smaller mesopredator simply alters its spatial and temporal behaviour to avoid the apex predator.

In this study, we aim to determine dietary, spatial and temporal behaviour and mortality rates of radio collared cats before and after being freed from persecution by dominant mesopredators – the red fox. We aim to monitor both species for 2-3 months and then eradicate foxes and monitor the response of collared individuals of both species (obviously, the expectation is that foxes will have a rapid turnover). Key components of this research will be:

a) Population estimates of cats and foxes in control and baited sites at Scotia. Accurate, robust, repeatable and reliable population estimates are fundamental to effective wildlife management. It is impossible to monitor management activities without robust monitoring methods. The existing method of monitoring foxes involves deriving an index based on footprints in sand or along tracks [5,6], however this is more an index of activity rather than abundance and there are gross problems associated with such indices [7]. Work in Western Australia suggests that the actual density of foxes is largely unrelated to such indices (P. de Tores, DEC WA *pers. comm.*) and yet the entire theory of using dingoes to suppress foxes and cats is based on these indices [2,8]. More robust techniques are desperately required [9]. We will compare the estimates derived from the following methods and conduct a cost – benefit analysis to determine which is the optimal method of population estimation of foxes and cats:
   a. Catling-Allen indices
   b. Camera trap density estimates [10,11]

c. Track count density estimates [12]
d. Call playback responses using Distance Sampling along the lines of that done with spotted hyaenas and lions in Africa [13,14]
e. Genetic mark-recapture could be incorporated into this project with additional financial support that is not available from AWC.

b) Activity patterns of cats for 3 months before and after 3 months fox control is initiated with the expectation that cats will increase their activity in the absence of foxes akin to the activity patterns that allow temporal partitioning of the African carnivore guild [15].
c) Movement patterns of cats and foxes for 3 months before and after 3 months fox control is initiated.
d) Macro and microhabitat preferences of cats before and after fox control.
e) Diet of cats before and after fox control.
f) Home range of foxes during fox control compared to an unbaited site in Danggali Conservation Park, South Australia.
g) Habitat use and preferences of foxes in semi-arid Australia.
h) Activity patterns of foxes.
i) Diet and prey preferences of cats and foxes in an area of fox control and a control site (Danggali).
j) Review of the prey preferences of foxes and cats in their native range compared to their introduced range following previously used methods [16,17,18,19,20].

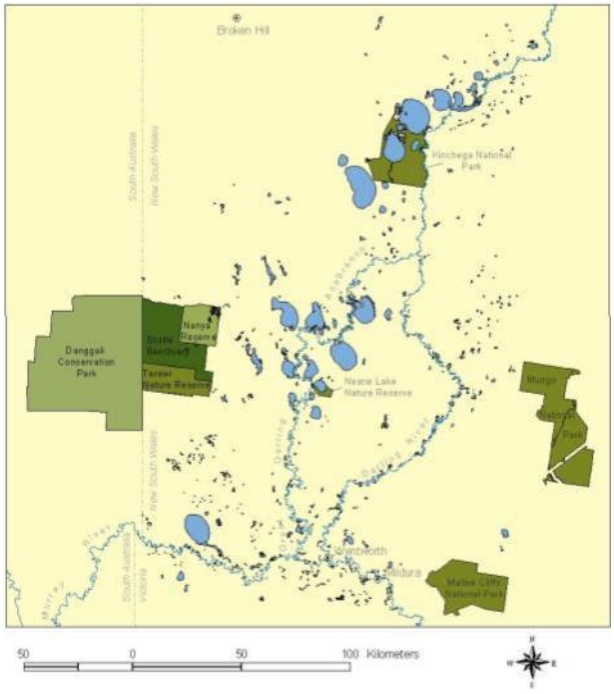

Fig. 1. Location map of Scotia Sanctuary in far-western NSW.

Scotia Sanctuary is a 65,000 ha conservation area in far western NSW owned and managed by AWC (Fig. 1).

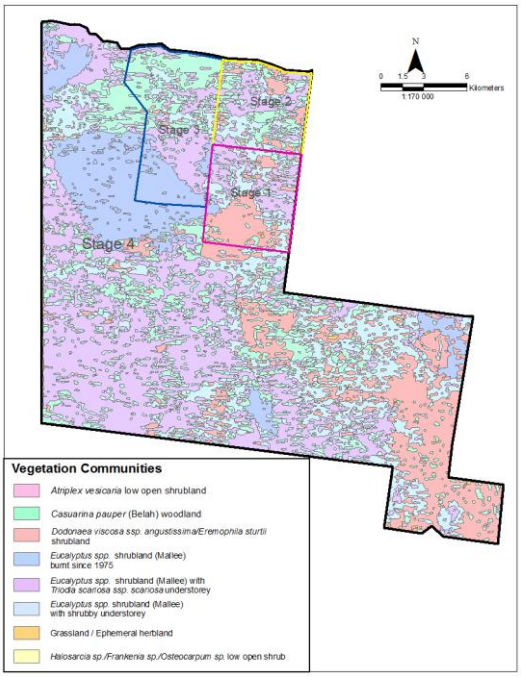

Fig. 2. Vegetation map of Scotia showing the feral exclosures

Scotia has two fully-fenced, 4000 ha feral-free areas (Fig. 2) which together comprise the largest feral-free area on the mainland. Stage 1 protects populations of Woylies, Boodies, Bridled Nailtail Wallabies, Bilbies,

Numbats and Greater Stick-nest Rats; whereas Stage 2 has populations of Woylies, Bridled Nailtail Wallabies, Numbats and Bilbies.

Stage 3 consists of an unbaited control region where no introduced species control is occurring. Stage 4 is a 30,000 ha region where intensive pest animal control is occurring to a level that will allow native species to persist in the presence of foxes and cats. Danggali Conservation Park in South Australia (immediately to the west of Scotia) offers a control site for the Stage 3 manipulation in this project as no fox or cat control is occurring or planned there.

2. Conservation ecology of mala or rufous hare wallabies at Scotia Sanctuary

- ***Sanctuaries:***
  - Scotia (100% of project time)
- ***Project type:***
  - MSc or Honours, unless other components can be added
- ***Resources available*:**
  - Supervision
  - Field assistance and expertise
  - Radio collars (60) and telemetry equipment
  - Accommodation at Scotia
  - Office space at the Scotia Field Research Centre
  - Limited vehicle use (subject to operational requirements)

Scotia Sanctuary has a semi-captive colony of mala living in a 100 ha feral-free area. The population was established in 2001 with animals from Alice Springs Desert Park (ASDP; 5 individuals) and Monarto Zoo (1) and was supplemented in 2004, with 19 individuals from ASDP after 12 were transferred from Scotia to the Mala Paddock, and again in 2008 when 7 were supplemented from Monarto. Since then, the population has increased to between 40 and 50 individuals based on mark-recapture estimates, but we would expect a more rapid population increase and larger population size given the population is fed and watered *ad libitum*. We suspect that nocturnal raptors are preying upon mala, although we have seen no evidence of this.

Sixty radio collars are available for use on mala at Scotia; these will operate for 3 months on 20 individuals for almost a year. This will be coupled with seasonal trapping to derive population estimates based on recaptured individuals.

The components of this project include:

a) Population dynamics of mala at Scotia based on long-term mark-recapture estimates and analysis with Program MARK.
b) Home range and activity patterns of mala.
c) Habitat use and preferences of radio collared mala at Scotia.
d) Survivorship of mala.
e) Diet of mala.

3. Carcass breakdown with and without introduced predators

- ***Study type***
    - Honours unless more is added
- ***Sanctuaries:***
    - Scotia (100%)
- ***Resources available*:**
    - Supervision
    - Field assistance and expertise
    - Camera traps (4 – 20) depending upon availability
    - Provision of 20 goat carcasses
    - Accommodation at Scotia
    - Office space at the Scotia Field Research Centre and use of microscopes.

(C) D. Eldridge

The extinction of the larger marsupial carnivores and the persecution of dingoes has likely altered the rate of carcass decomposition in Australia and the speed and way in which carcasses breakdown. Nuria Selva's work in Europe suggests there is a succession of scavengers that utilise carcasses [21,22,23]. This succession must be different at sites where introduced predators have been eradicated and where native species have been reintroduced.

We plan to place harvested goat carcasses in the field (three treatments: no introduced species but reintroduced critical weight range mammals/introduced species control/no introduced species control) to monitor their decomposition at sites with and without introduced predators and native fauna. The carcasses will be weighed at frequent intervals to determine the rate of carcass breakdown. Camera traps will be used to monitor the larger scavengers, while targeted sampling of invertebrates will monitor their succession as the carcass is broken down.

The components of this project include:

a) Describe the breakdown of carcasses at Scotia:
    a. What species initiate entry into the carcass and how does that affect breakdown.
    b. What parts of the carcass are first to be eaten.
b) Describe the scavenging community of mammals, birds, reptiles and invertebrates at sites with and without introduced predators and succession within this community.
c) What factors affect carcass utilisation at Scotia.

4. Reintroduction ecology of bush stone-curlew

- ***Study type***
  - MSc or PhD
- ***Sanctuaries:***
  - Scotia (100%)
- ***Resources available*:**
  - Supervision
  - Field assistance and expertise
  - Radio transmitters for each translocated bird (20) for 1 year and associated telemetry equipment
  - Accommodation at Scotia
  - Office space at the Scotia Field Research Centre
  - Limited vehicle use (subject to operational requirements)

The bush stone-curlew is a ground-dwelling bird that has declined throughout much of southern Australia. Twenty captive bred bush stone-curlews will be reintroduced to Scotia in two groups – the first in Stage 1 (4000 ha feral-free) and the second in Stage 4 (an fenced area where pest animal control is occurring). The animals will be held in soft release pens for three months on site, before being released. Thereafter, they will be monitored by radio transmitters for a year to determine their survivorship and site fidelity. Consequently, key aspects of this project could involve:

a) Ecological niche modelling (Maxent[24,25]) of the original distribution of bush stone-curlew.
b) A review of bush stone-curlew reintroductions – there have been several bush stone-curlew reintroductions throughout NSW and northern Victoria (Albury-Wodonga and Moulamein).
c) Captive behaviour of bush stone-curlews.
d) Home range establishment and movements of bush stone-curlews at sites with and without introduced predators.
e) Habitat use of bush stone-curlews at sites with and without introduced predators.
f) Diet of bush stone-curlews at sites with and without introduced predators.
g) Survivorship of bush stone-curlews at sites with and without introduced predators.
h) Breeding success of bush stone-curlews at sites with and without introduced predators – this could incorporate the use of camera traps at nest sites to monitor fledging and the presence of potential nest predators. This could also incorporate an experimental aspect of monitoring the detectability of curlew nests by potential predators using clay eggs and scent obtained from the captive breeding enclosures.

5. Predatory behavioural ecology of Dingoes, Red Foxes and Feral Cats at Kalamurina Sanctuary

Kalamurina is a 667,000 ha wildlife sanctuary that links the Simpson Desert Regional Reserve with Lake Eyre National Park in arid northern South Australia (Fig. 5). The Warburton Creek flows through Kalamurina *en route* to Lake Eyre and the Warburton separates the Tarari Desert from the Simpson.

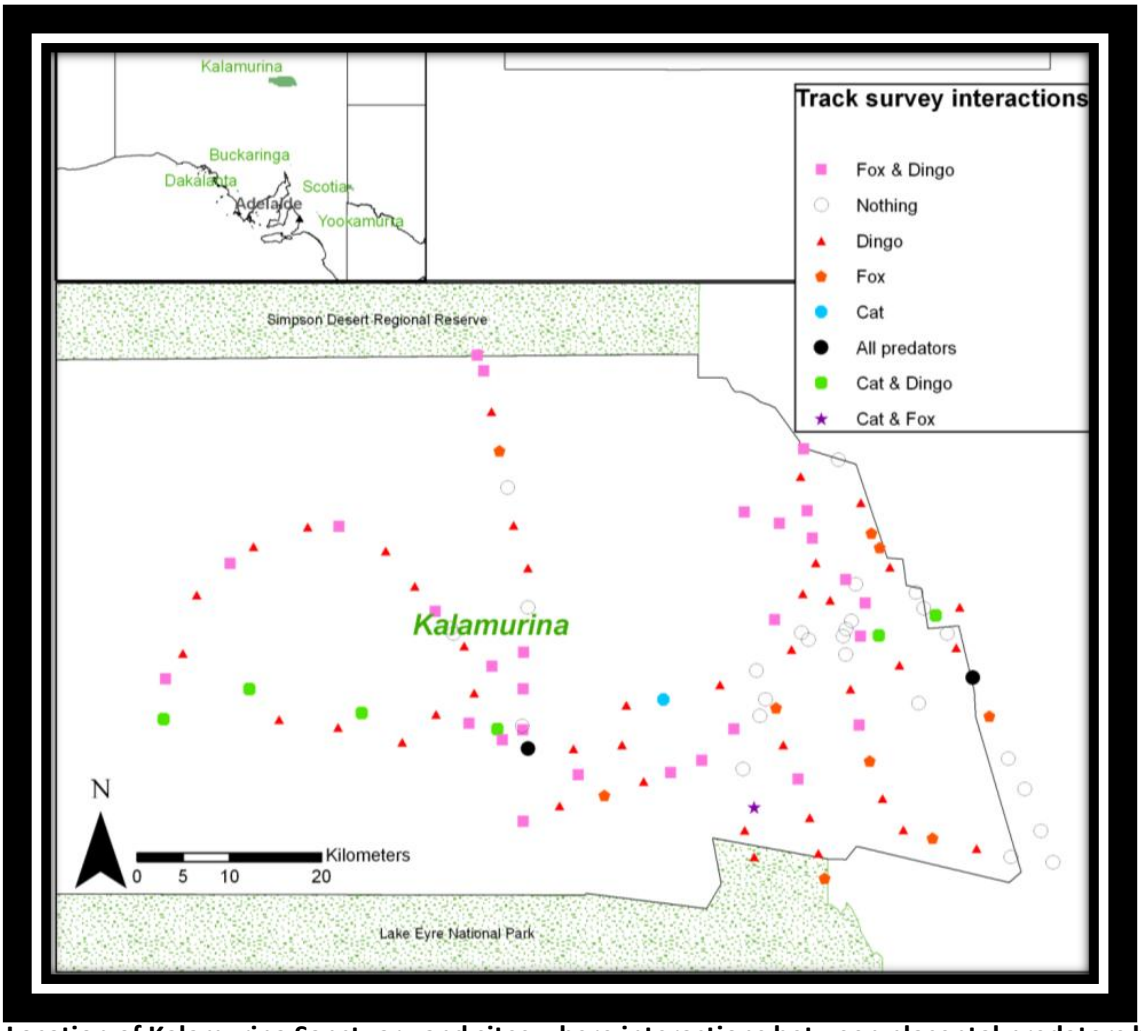

Fig. 5 Location of Kalamurina Sanctuary and sites where interactions between placental predators have been recorded.

Dingoes, red foxes and feral cats are sympatric at Kalamurina (Fig. 5). This study aims to investigate the interactions between the placental predators on Kalamurina. Specifically, it aims to measure spatial interactions, dietary overlap and prey preferences across a gradient of resource availability (distance from water) to ascertain whether they are competing for the same resources or whether they have partitioned resources.

This study will use GPS telemetry to determine the movements, activity patterns, interactions and habitat preferences of Kalamurina's larger predators coupled with scat analysis to determine the diet of these species.

Scat analysis is a common way of determining the diet of predators by identifying the hairs of prey species within the scat [26,27,28]. Scats for all three predators have been collected at Kalamurina since 2009. The

results of these analyses will be combined with relative prey availability data derived from annual pitfall trapping at Kalamurina to derive prey preferences using Jacobs' [29] index as has occurred with large predators elsewhere [17,20]. Combining this lab work with a detailed literature review along the lines of that conducted for African lions; [16], may provide comparison of red fox and cat prey preferences where they are native and where they are exotic. Ultimately, this kind of information can be used to predict carrying capacity and diet of dingoes, cats and foxes [30,31] and also to direct integrated pest animal control on AWC sanctuaries.

- ***Study type***
  - PhD
- ***Sanctuaries:***
  - Kalamurina (100%)
- ***Resources available*:**
  - Supervision
  - Field assistance and expertise
  - Radio transmitters for 10 dingoes, 10 foxes and 10 cats.
  - Assistance fitting these radio transmitters
  - Accommodation at the Kalamurina Cottage during field trips.
  - > 200 predator scats from 2009 (Dingo = 70; Cat = 23; Fox = 56 @ Sept 2010; scat collection is ongoing)
  - A large body of literature on diet and prey availability of foxes, cats and dingoes.
  - Limited fuel and vehicle use (subject to operational requirements) on Kalamurina.

Key components of this study will be:

- Home range of dingoes, foxes and cats along a resource gradient with distance from permanent water at Kalamurina. We would hypothesis that home ranges would be larger in more resource scarce areas [32].
- Habitat use and preferences of dingoes, foxes and cats along a resource gradient with distance from permanent water at Kalamurina. Optimality theory suggests that species would be less preferential in their behaviour when resources are scarce (i.e. further from permanent water).
- Activity patterns of dingoes, foxes and cats along a resource gradient with distance from permanent water at Kalamurina. If resources are limiting, we would predict that predators would be more active where resources are scarcer in order to allow them to meet their metabolic and reproductive needs.
- Intraguild interactions of dingoes, foxes and cats along a resource gradient with distance from permanent water at Kalamurina.
- Diet and prey preferences of dingoes, foxes and cats along a resource gradient with distance from permanent water at Kalamurina. AWC has conducted small vertebrate censuses since 2009 and this can be used as an index of relative abundance for inclusion in electivity indices.
- Assessment of the potential for managing water availability in the arid zone to promote optimal densities of dingoes, foxes and feral cats.

6. Diet of black-breasted buzzards at Kalamurina Sanctuary

- ***Study type***
  - Honours or MSc
- ***Sanctuaries:***
  - Lab based with data collected from Kalamurina (100%)
- ***Resources available*:**
  - Supervision
  - Field assistance and expertise
  - 100 buzzard pellets
  - Opportunity to visit Kalamurina and collect more pellets.

Although John Gould was told that black-breasted buzzards break open eggs using stones [33], the majority of their diet appears to be birds, invertebrates and small vertebrates [34]. AWC's ecology team has collected approximately 100 black-breasted buzzard pellets from Kalamurina in 2010 for assessment of historical (pre-2010) diet. We will also collect all pellets deposited at the roost henceforth for analysis of modern diet. Pellet contents will be identified based on shell, hair, bone and exoskeleton within them leading to an interpretation of historic and recent diet of buzzards at Kalamurina.

8. Crest-tailed Mulgara diet at Kalamurina Sanctuary

- ***Study type***
  - Honours or MSc
- ***Sanctuaries:***
  - Lab based with data collected from Kalamurina (100%)
- ***Resources available*:**
  - Supervision
  - 100 mulgara faecal pellets
  - Opportunity to visit Kalamurina and collect more scats.

Mulgaras are widely distributed throughout Kalamurina (Fig. 6). AWC currently uses their characteristic scats at the entrances to their burrows to monitor mulgara presence and distribution. By April 2011, we had collected 121 mulgara scats and this is continuing. We also record the number of invertebrates (to Order), reptiles and small mammals captured in pitfall traps, so prey preferences will be derived using the same methods as described for the placental predators at Kalamurina.

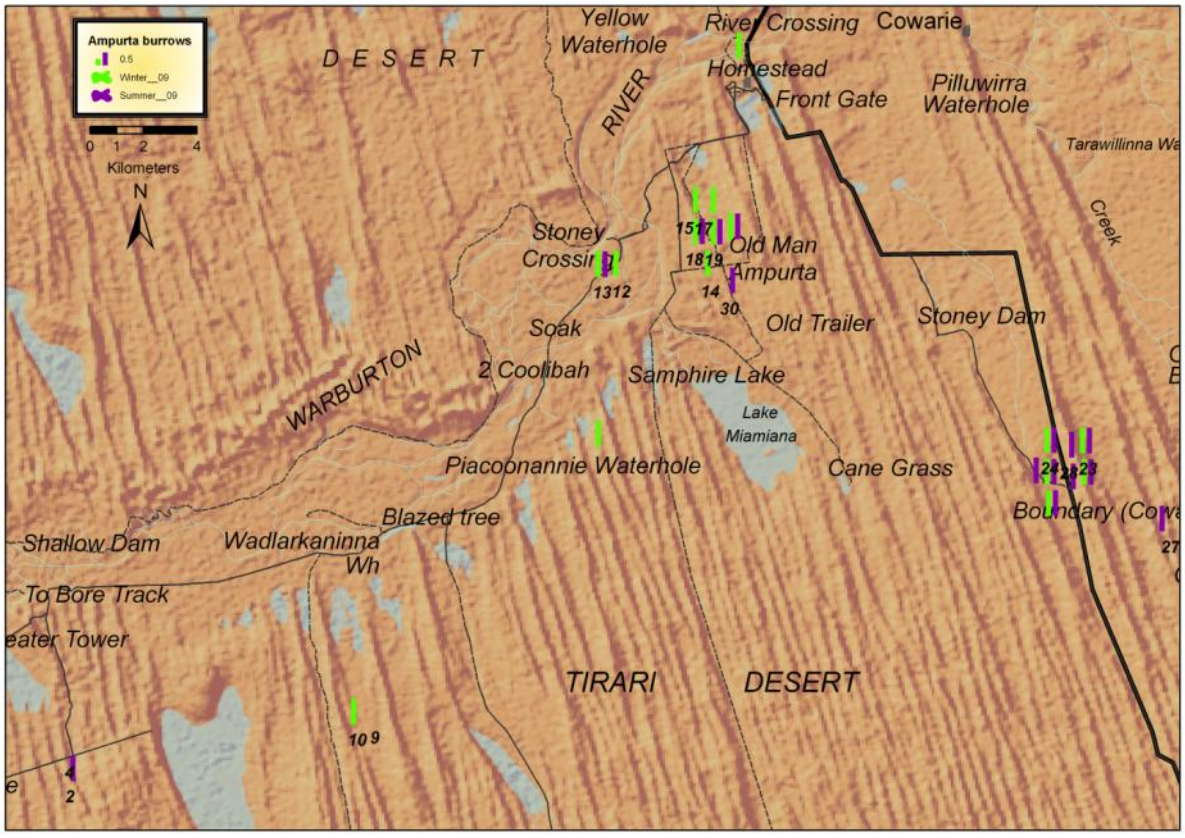

Fig. 6. Location of active crest-tailed mulgara burrows on Kalamurina in 2009.

*9. Conservation ecology of the critically endangered woylie (*Bettongia penicillata*) and competition with boodies (*B. leseuer*).*

- ***Study type***
  - PhD
- ***Sanctuaries:***
  - Scotia (90%), Yookamurra (10%)
- ***Resources available*:**
  - Supervision and field assistance
  - Radio collars (36) for use at Scotia in Stages 1 and 2.
  - Accommodation at Scotia and Yookamurra
  - Office space at the Scotia Field Research Centre
  - Limited vehicle use (when they are not being used for other conservation related activities).
  - Fuel whilst on site

Woylies are critically endangered, with most populations decreasing rapidly in size. The population of Woylies at AWC's Karakamia Sancturay in the southwest of WA, is one of the few exceptions. AWC has also reintroduced the species to Yookamurra (where the population has increased and is now stable), and into the two fenced area at Scotia. The woylie population in Scotia's Stage 2 has increased to 120 individuals after 57 were reintroduced. In contrast, the woylie population in Stage 1 is declining toward extinction as the reintroduced individuals appear to be senescing and dying of old age. While adult females in Stage I invariably have pouched young, these pouched young rarely recruit into the adult population. The different trajectories of the AWC woylie populations, particularly at Scotia, offer an opportunity to investigate some of the factors that influence population processes in this species.

There are several hypotheses as to the causes of the woylie decline nationally. These are:

- Mesopredator release: with the reduction in fox density, cats and native predators have increased in abundance and now place more predation pressure on critical weight range fauna like the woylie;
- Competition: boodies are present and increasing in Stage 1 of Scotia, whereas there are none in Stage 2. Conversely, both species are present at the more mesic Yookamurra Sanctuary. We hypothesise that competition in the more arid extremes of woylie distribution favours boodies, whereas woylies can successfully compete in more mesic areas.
- Food availability: in enclosed (actual or metaphorical) areas, animals cannot move to new locations to obtain sufficient food when food resources have been used up at a site.

Scotia is free of introduced predators, however native predatory reptiles may increase in their absence. Scotia's woylies may compete with boodies and bilbies for food resources as these two species occur in much higher abundance than woylies.

The following research topics are available (ideally as a PhD):

a) Population dynamics

i. Use the long-term data set available at Scotia to describe the population trends of the woylie populations in Stages 1 and 2 (i.e. with and without competition from boodies).

b) Home range
   i. Radio collared individuals will be monitored to measure movement patterns. We'd expect that woylies would move further when they are resource limited, hence we'd anticipate woylies in Stage 1 would have larger home ranges than those in Stage 2 (although this will be confounded by population density of conspecifics or competitors).

c) Habitat use
   i. Under resource limitation, optimally foraging individuals will have a broader diet and potentially habitat use than those individuals where food is not limiting. We'll compare habitat use in Stages 1 and 2 using both telemetry (coarse habitat) and spool-and-line (fine habitat).
   ii. Compare the microhabitat use/preferences of woylies with boodies in Stage I using spool-and-line.

d) Survivorship and mortality
   i. Using radio collared individuals for short-term (18 month) mortality causes and survivorship and the mark-recapture trapping data for longer–term survivorship, we will compare survivorship and mortality causes in Stages 1 and 2.

e) Diet and food preferences
   i. Diet will be assessed by the microstructure of food items found under a compound microscope in faeces. A reference collection of plant leaf epidermis and fungal spores will be created.
   ii. Faeces will be collected from known trapped animals seasonally from Stages I and II.
   iii. Food availability will be determined by digging 50 1x1m quadrats to 40 cm in each habitat of Scotia and Yookamurra each season. The soil from these quadrats will be sieved and potential food items identified.
   iv. Compare the diet and diet preferences of woylies in Stages 1 and 2, and between Stage 1 woylies and boodies.

f) Carrying capacity of woylies
   i. Food availability will be measured at all woylie populations where the population density can be estimated – using the same techniques as described in Section 1c. The biomass of food or key nutrient availability will be related to population density, as has been done to determine the carrying capacity of large predators [31]

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Other Projects

We are also keen to get research projects underway on:

- The conservation ecology of threatened plant species:
    - Harrow wattle *Acacia acanthoclada*
    - Bladder senna *Swainsona colutoides*
    - Fleshy minuria *Kippistia suaedifolia*
    - Bluebush daisy *Cratystylis conocephala*
- The conservation ecology of an endangered ecological community:
    - *Acacia loderi* community
- The conservation ecology of threatened fauna:
    - Greater stick-nest rat
    - Southern ningaui
    - Bolam's mouse
    - Western blue-tongue lizard

Contact Matt is you are interested in developing projects around these species.