A Survey of Selected Threatened and Priority Fauna of the Gillamii Area.

Photo: John Chapman

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GILLAMII CENTRE
Sustainable Agriculture In Practice

Department of
Environment and Conservation

Summary

In 2012 the Gillamii Centre obtained funding through the Department of Parks & Wildlife's, (formerly Department of Environment & Conservation) Environmental Community Grant Program, Biodiversity Conservation Category, to investigate selected threatened and priority fauna populations in priority remnant vegetation sites to assist with effective conservation strategies.

The Black-gloved Wallaby (or Western Brush Wallaby), was the main focus of the survey, as the Gillamii Centre, through its Conservation Action Plan, has identified this species as a conservation target. Other species investigated were the Red-tailed Phascogale, Quenda (or Southern Brown Bandicoot) and Numbat.

The survey increased the knowledge of the distribution of the Black-gloved Wallaby throughout the Gillamii Area considerably. It was found to be present in a number of remnants where no previous record existed and is still persisting in a number of remnants that it had previously been recorded in, but appears to have disappeared from some of these. This species was found in variety of broad vegetation types, from mallee heath in the east to Wandoo / Jarrah Woodland and Jarrah/Marri forest further to the west. More detailed site based assessment of vegetation is underway which will identify appropriate habitat and aid in using the appropriate species and spacings in restoration and rehabilitation work.

A population of Quenda was confirmed on private property just north of Cranbrook, surrounding a Balicup lake system. This represents a significant outlying population and further work needs to be carried out to determine the extent and degree of isolation of this population.

No Red-tailed Phascogales or Numbats were found to be present during the survey. Both species would have historically been present within the Gillamii Area. The Numbat is currently is found within the forest region to the west of the Gillamii Area and within the Stirling Range NP to the east (translocted population). Increasing linkages from either of these areas may enable Numbats to move into the Gillamii Area and use suitable, large remnants. The Gillamii Area is at the southern limit of the Red-tailed Phascogale's current known range, however apparently highly suitable habitat exists within the Tambellup NR and therefore translocation of individuals into this reserve should be investigated.

Introduction

The Department of Parks & Wildlife, formerly Department of Environment & Conservation funds the Environmental Community Grant program which is available for projects involving biodiversity conservation, sustainable catchment management, rescue and rehabilitation of injured or incapacitated fauna, interpretation and sustainable recreation in natural areas,

regional parks, Bush Forever sites, support for major conservation/environmental organizations or protection of high-value areas by landholders on private land.

The Gillamii Centre, through its Conservation Action Plan, has identified the Black Gloved Wallaby as a species of significance due to its habitat needs. There are a range of smaller mammals that also require similar vegetation that are much harder to locate, so by recognizing where these animals are present, we are identifying vegetation communities that may hold other smaller mammals also.

Funding of $26,000 was awarded through the biodiversity conservation category, to investigate fauna populations in priority remnant vegetation sites to produce information to assist with effective conservation strategies.

This project sought to employ an ecologist to assess these remnant sites to ensure the data was viable and completed in an ethical manner.

Legislation pertaining to fauna

The conservation status of fauna species is assessed under State (*Western Australian Wildlife Conservation Act 1950*) and Commonwealth (*Environmental Protection and Biodiversity Conservation (EPBC) Act 1999*).

The WA State Act comprises two scheduled for fauna;
Schedule 1. *Fauna that is rare or is likely to become extinct*, and
Schedule 4. *Other specially protected fauna*

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). The Wildlife Conservation Act 1950 uses a set of Schedules but also classifies species using some of the IUCN categories. The EPBC Act also protects migratory species that are listed under a number of International Agreements.

In addition to listed threatened species WA's Department of Parks and Wildlife (DPaW) has a Priority Fauna list which is a non-legislative list created by the Western Australian Threatened Species Scientific Community (WATSSC) and serves to protect non-listed taxa that may be threatened, or their status is of concern.

Listings and rankings follow DEC's threatened and priority fauna list current at 17th September 2013.

Threatened and Priority mammal species known to occur or potentially occurring in the Gillamii Area.

The Gillamii Area

The Gillamii area is on the northern edge of the Stirling Ranges and encompasses the shires of Cranbrook and Broomehill-Tambellup. It also includes parts of the Kojonup and Plantagenet shire where they fall under the Kent Catchment. It has varied rainfall ranging from 350mm in the east through to 600mm in the western parts. This combined with suitable soils and landscapes has led to a broad range of agricultural land uses including viticulture and perennial horticulture in the west through to broad acre cropping and mixed livestock and cropping enterprises throughout. Farm Forestry, especially in the western part of the Gillamii is also a significant industry.

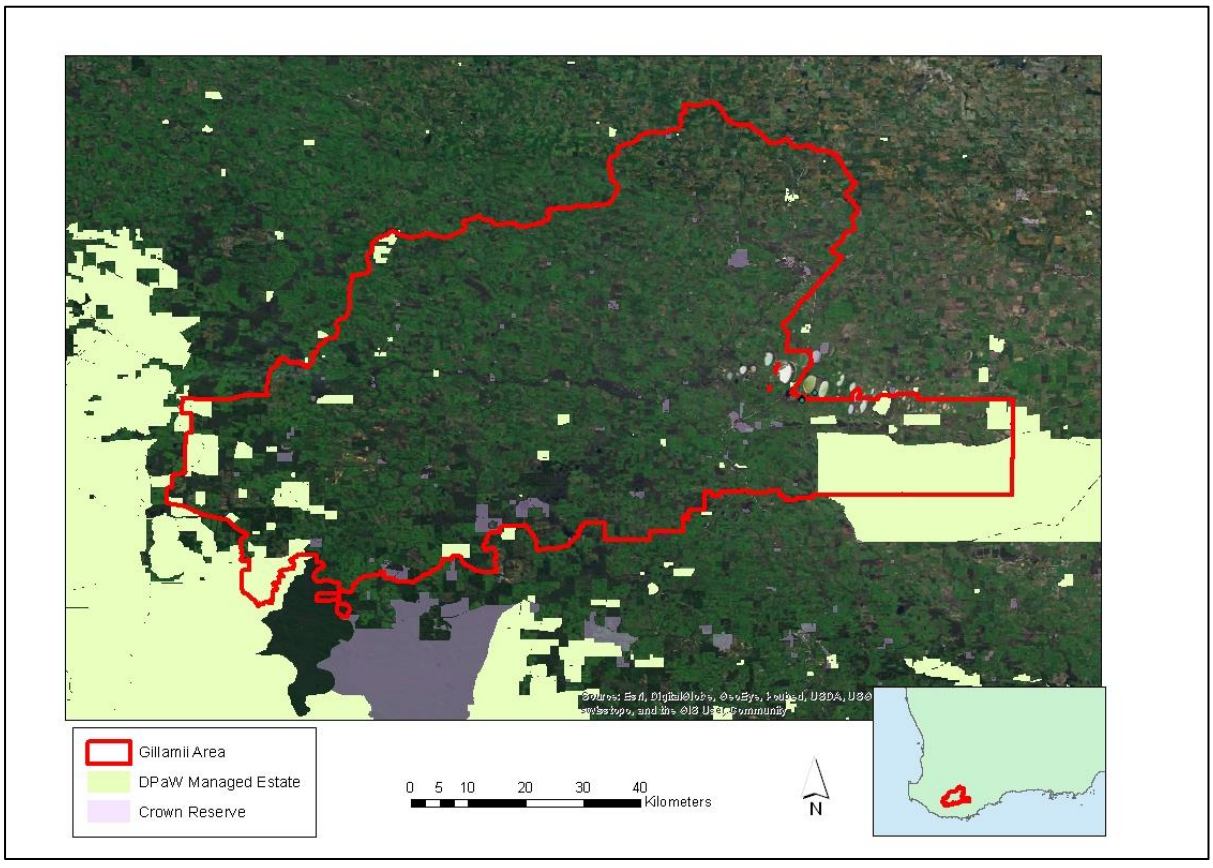


Figure 1: The Gillamii Area

The remnant vegetation in the area is largely fragmented in the most north eastern parts with areas of remnant vegetation being quite small. The westernmost part of the Gillamii area has large areas of remnant forest that form part of the Unicup suite of wetlands and lead into the Walpole Wilderness. Within these two extremes is the bulk of the area which is fragmented, with larger reserves and privately owned remnants varying in size from 60 hectares to over 1000 hectares.

Species targeted in the survey

The main species targeted for survey was the Black-gloved Wallaby due to its habitat requirements being suitable for a variety of smaller mammal species. Other species targeted for survey were those Threatened and Priority mammals who's current distribution within the patch were poorly known and that were known to be threatened or to be declining within the region.

A community surveys targeted Black-gloved wallabies, but also identified a Numbat sighting and possible Quenda population; as such these were also included in this project survey. The investigation into Red-tailed Phasocgales was included due to its EPBC status and potential for occurrence within the Gillamii Area.

The targeted species and their threatened or priority status thus are as follows:

Species	**WA Status[1]**	**WA State Act Ranking**	**Commonwealth EPBC Act Status and Ranking[3]**
Numbat (*Myrmecobius fasciatus)*	Schedule 1	Vulnerable	Listed (Vulnerable)
Red-tailed Phascogale (*Phascogale calura*	Schedule 1	Endangered	Listed (Endangered)
Quenda (*Isoodon obesulus subsp. fusciventer)*	Priority 5	Not Listed	Not Listed *(Isoodon obesulus obesulus* (eastern subspecies is listed as EN)
Western Brush or Black-gloved Wallaby (*Macropus irma*)	Priority 4	Not Listed	Not Listed

[1]Status of taxon under the Western Australia *Wildlife Conservation Act 1959 or Priority category*
[3]Status of taxon under the Commonwealth *Environment Protection and Biodiversity Act 1999*

Three species of Threatened Black Cockatoos also occur within the Gillamii Area; Carnaby's Cockatoo (*Calyptorhynchus latirostris*),Baudin's Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus bankssi naso).* Although the conservation of these species and their habitat is vitally important within the Gillamii Area they were not included in this survey as there is currently some survey and monitoring work being carried out on these species within the area by BirdLife Australia and the WA Museum, while no current work is being carried out on mammal populations.

A description, relevant ecological traits and pre-survey known occurrences are presented for each of the targeted species.

The pre-survey known occurrence of the targeted species within the Gillamii Area was determined by searching the Department of Parks and Wildlife (DPaW) *NatureMap* and collating landholder or community observations.

Numbat *(Myrmecobius fasciatus)*

Status and past distribution

The Numbat is a critical weight range (CWR) marsupial that has undergone a dramatic range contraction since the arrival of Europeans. Numbats were formerly found across southern Australia from Western Australia across as far as northwestern New South Wales. However, the range has contracted significantly since the arrival of Europeans, and the species has survived only in two small populations in Western Australia; Dryandra Woodland and the Perup/Kingston forest blocks. In recent years it has been successfully reintroduced into some reserves, including the Stirling Range National Park, which borders the Gillamii Patch to the east.

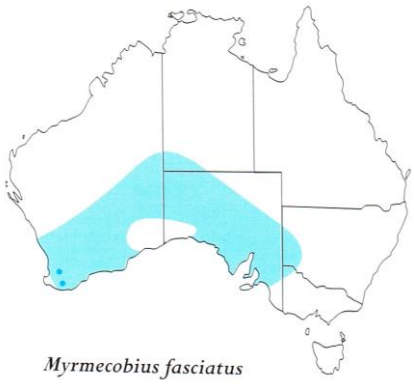


Figure 2: Past (light blue) and current (dark blue) distribution of the Numbat. From Strahan 1995.

Description

Small marsupial with a squirrel-like tail. Body with red-brown fur above, paler below. The rump is darker than upper back, often jet black, with prominent, white, transverse bars. The number of white bars varies from four to eleven. The Numbat has a narrow head with a pointed snout and a conspicuous dark horizontal eye-stripe. The jaw has 50-52 teeth, the largest number recorded in any Australian land mammal. The teeth are poorly developed, and many do not protrude above the level of the animal's gums. The tongue is exceptionally long. The fur is very coarse and the long tail hairs are often erected to give a 'bottle-brush' appearance.

Head and body length
222-290 mm in males
200-267 mm in females

Tail Length
125-207 mm in males
140-113 mm in females

Weight
405-752 g in males
305-647 g in females

Source: DPAW Fauna Profile (Numbat) 2012

Ecology

The Numbat is active during the day, in summer mostly in the morning and late afternoon and winter there is a peak in activity in the middle of the day. Numbats are solitary animals, coming together only to mate, or when young still living with their mother. Male Numbats are very territorial. Home ranges are large; between 25 and 50 hectares in size.

The Numbat's diet consists solely of termites, which are foraged from termite infested pieces or wood or logs on the ground and underground termite galleries which radiate from termite mounds. They seldom forage directly from the mound. Numbats largely use hollow logs on the ground for overnight or daytime shelter, but will also shelter in burrows in cold weather. Termite activity, determined by weather is the main influence on numbat activity and the termites eaten are the most common species occurring (Friend 1995).

Male Numbats start to roam in search of females in oestrus during December and January. Numbat young are born in late January to early February after a short gestation period of 14 days. The female has an open pouch with four teats to which the young attach their mouths. It takes six months before the young can be deposited in a burrow. In late July to early August they are deposited in a nesting chamber at the end of a burrow, where they continue to develop. At this time the female feeds during the day and suckles the young when she returns to the burrow at night. During late September the juvenile Numbats begin to emerge from the burrow. They stay within their mother's home range but are gradually weaned. During late November to early December the juvenile Numbats start to disperse and find territories of their own. Juvenile dispersal movements have been recorded up to 11 kilometres (Australian Wildlife Society (www.australianwildlife.net.au/pdf/numbat/the_numbat.pdf.).

Habitat

Currently occupied habitat consists of Jarrah (*Eucalyptus marginata* and Jarrah/Marri (*Corymbia calophylla)* forest or woodland and open Wandoo *Eucalyptus wandoo* or Salmon Gum *Eucalyptus salmonophloia* woodland with sufficient termite activity and shelter sites in the form of hollow logs on the ground. Hollow logs became more important shelter sites with the appearance of fox as a major predator, but they were once more widespread in

other types of semiarid woodland, spinifex grassland, and even in terrain dominated by sand dunes.

Threatening processes

The main reasons for the severe decline in Numbat populations include predation by foxes, changed fire regimes, and clearing of native vegetation for agriculture. Fox and cat predation are likely the largest current threats to remaining populations. Regular fox control occurs in the area of all current populations. Fox control in Dryandra has lead to a recent increase in cat numbers and hence a marked decrease in Numbats though cat predation.

Pre-survey records in Gillamii Area

Only a few historical records of the Numbat occur within the Gillamii Area. Most of these are from around the 1900s to 1930s in the vicinity of Tambellup and Cranbrook. One exception is a record on private property to the north of Jingalup NR in 1963.

The Gillamii patch occurs directly to the east of the currently known population of Numbats in the Perup /Kingston forest blocks east of Manjimup. A few recent isolated records occur outside of the forested region; one roadkill in 2012 on private property just north of the Gillamii patch in an area fairly well connected to the forest block

A reliable sighting by a landholder in 2009 (the animal was foraging around the house for several hours and was identified by photos from the internet) was situated about 15 km east of the large continuous State forest which comprises Perup NR but only 1 km west of large (c. 1700 ha) remnant consisting of a DPaW NR, Crown Reserve and private property ("L-shaped" Reserve).

A translocated population in the Stirling Range NP on the western edge of the Gillamii Area, from animals bred in Perth zoo, is still persisting and may provide a source of animals for colonisation of suitable habitat within the Gillamii patch.

Red-tailed Phascogale *(Phascogale calura)*

Status and past distribution

The Red-tailed Phascogale is small, semi- arboreal, carnivorous marsupial, which historically occurred across much of arid and semi-arid Australia, from western NSW, to central Australia (Tennant Creek), the Great Sandy Desert, parts of southern South Australia and the south-west of Western Australia. Since European settlement, survey work, as well as Aboriginal information, shows that the species subsequently underwent an enormous contraction in range, suffering a > 90% decline in the extent of occurrence (Maxwell *et al*. 1996).

Within Western Australia, populations are now only currently known from several isolated nature reserves and private remnants in the south-west of Western Australia, from the wheatbelt to the south coast (including Ravensthorpe and Fitzgerald River National Park). There is a concentration of populations in the southern wheatbelt in an approximately 150km long and 80 km wide strip in a north-south direction, extending from Brookton in the north to Katanning in the south and between Williams in the west and Dumbleyung in the east, with sparser populations occurring further east to Hyden and Newdegate (Short and Hide 2012).

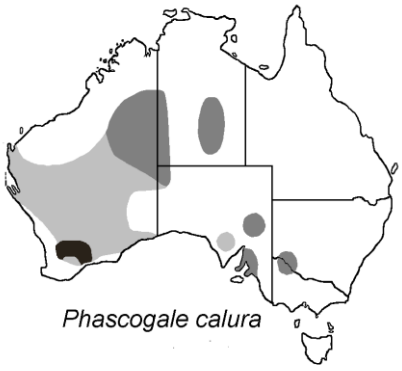


Figure 3: Past and current distribution of the Red-tailed Phascogale.
Dark grey = extant; Mid-grey = historic (> 30 years); Pale-grey = Late-Holocene sub-fossil. Data up to 1996.
From Mammal Maps (McKenzie et al. by N.L. McKenzie, A.A. Burbidge, A. Baynes and many other contributors.

Important areas supporting populations in the southern wheatbelt include Dryandra Woodland and Tutanning, Boyagin, Dongolocking Nature Reserves. Parkeyerring Nature Reserve is the closest population to the Gillamii Patch, other current (post 1990) records south of this are isolated ones.

Description

The red-tailed phascogale (*Phascogale calura* (Gould 1844)) is a small, semi- arboreal, carnivorous marsupial, belonging to the familiy Dasyuridae (subfamiliy Phascogalinae). Females weigh 36 - 48 g (average 43 g) and males 39 - 68 g (average 60 g). Head and body length ranges from 105-122 mm (113) in males and 93-105 (101) mm in females, while tail length is longer than the head and body combined being 134-145 (141) mm in males and 119-144 (132) mm in females.

The fur is ash-grey above and cream to white below with a blackish patch in front of the eye and reddish coloured ears. The species is clearly distinguished by having the proximal short-haired portion of their tail coloured a rich red which extends to the commencement of the brush of long black hair on the distal portion**. Source: Friend (1995).**

Photo- Grant Westthorp

Ecology

Red-tailed phascogales are mainly nocturnal, although have been seen to emerge during the day to investigate potential food sources. They are solitary animals only coming together to breed. Sexual maturity in the red-tailed phascogale is reached at about twelve months. Mating takes place during a three week period in July. All males die following the winter breeding season due to stress related illnesses (Bradley 1987). There is thus complete replacement of the male population each year, and a critical period (August - December) when there are only dependent young and adult pregnant females present in the population.

Female red-tailed phascogales can live for 2-3 years, however, most females die after weaning their first litter in November (Kitchener 1981, Bradley 1985). The gestation period is roughly 28 to 30 days. Although up to 13 young are born there are 3 to 8 (7.5 av) young per litter (teat number is eight), and one litter per year. The young are weaned within 3 months and leave the nest by the end of summer (March, April) (Kitchener 1981, Bradley 1985).

Limited information suggests that the red-tailed phascogale is an opportunistic feeder. The bulk of the diet has been found to consist of a wide range of small terrestrial invertebrates, although *Mus musculus* was observed to form part of its diet in one study (Kitchener 1981). Invertebrates eaten include, in the main, cockroaches, grasshoppers, myriopods, beetles and termites (Kitchener 1981). The red-tailed phascogale does not need to drink, obtaining water from its food, and although it is an agile climber, making leaps of up to 2 metres within the forest canopy, it feeds extensively on the ground (Bradley 1995).

Nesting hollows occur in hollow logs and limbs of eucalypt species (especially *E. wandoo*). With small entrances and about 1.5 - 5 m from the ground. Nests comprising bark feathers fur and leaves are constructed at the base of the hollows (Hussey 2009).

Recorded home ranges are in the order of 5ha, with male ranges being slightly larger than females. Female home ranges show a greater tendency to overlap each other than do male home ranges, and there is considerable overlap between male and female home ranges (Friend and Friend 1993). During the period directly before male die-off male the area covered in nightly movement by males has been found to increase significantly, taking animals well outside the well-developed *Allocasuarina huegeliana* stands as they move over a kilometre away from their usual feeding range (Friend and Friend 1993). This is the time of year (July) when animals may be observed some distance away from their core area of habitat.

Habitat

In the western part of its current range red-tailed phascogales mainly inhabit long-unburnt tall vegetation with a dense canopy cover of *Eucalyptus wandoo/Eucalyptus accedens* and *Allocasuarina huegeliana* alliances (Short and Hide 2012). *Allocasuarina huegeliana* is highly sensitive to fire and there is generally complete mortality and replacement of stands after

fire. Consequently, *A. huegeliana* habitat comprises dense even-aged stands which self-thin over time, but which support little understorey development.

Red-tailed Phascogales prefer unburnt vegetation that provides continuous canopy to assist their arboreal habits, trees of sufficient age to provide hollows for nesting in limbs or logs, and grass trees with ample skirts. Most of the reserves where the red-tailed phascogale is more commonly found have not been burned for many years (20 years or more) and, as a consequence, carry a climax vegetation community which provides these resources.

Figure 4: Favoured Red-tailed Phascogale habitat in the southern wheatbelt; large mature Wandoo with dense stands of Allocasuarina huegeliana (Photo Sandra Gilfillan)

Threatening processes

The main historical threat to Red-tailed Phascogales has been the clearing of their habitat for agriculture, combined with the introduction of the fox in the 1930s. Changed fire regimes, cats and foxes are the major threats to current populations of this species (Maxwell *et al.* 1996; Foster *et al.* 2006).

Cats are a considerable current threat to the Red-tailed Phascogale. They are able to hunt this species both on the ground and in the trees, and can have a significant impact on a population (Foster *et al.* 2006; Friend et al. 1994).

There is evidence that Red-tailed Phascogale populations have responded positively to fox control (Friend & Scanlon 1999). However foxes are only a threat to them when they are on the ground but, as they are primarily arboreal, they can escape provided they are near trees. Thus, they are most at risk from foxes if they have to move to the ground, for example to disperse across cleared farmland, or post-fire when the canopy is destroyed, and therefore impacts of fox predation are low where there is a continuous canopy, and in these

instances populations numbers can be stable in the presence of foxes.

There has been found to be a strong relationship between population numbers and rainfall in the previous year (Friend *et al.* 1994). Populations can respond quite quickly to wet years as they breed every year and produce 8 young per individual. If all these young survive due to good conditions numbers can build up. In these years individuals may colonise areas not occupied in less favorable years. Drought years can cause many of the young not to survive and hence some areas may then become unoccupied. Under these conditions the lack of physical connectivity may not be a large barrier to dispersal of individuals throughout the landscape. Predicted declines in rainfall, which are already occurring (IOCI 2010), are likely to have a detrimental impact on the Red-tailed Phascogale through increased fire frequency and intensity and a decrease in invertebrate food source. Fire causes high mortality amongst resident Red-tailed Phascogales (Friend & Friend 1993) and renders the landscape unsuitable as habitat for years after a fire. In addition, as fire frequencies increase due to increasing aridity, both habitat and food supply may be affected.

Historical habitat loss and fragmentation associated with clearing and agriculture as well as changed fire regimes are the main factor in limiting the possibility of recolonisation of habitat patches from adjacent areas (Foster *et al.* 2006). Hence suitable habitat still exists which remains unoccupied due to historical isolation.

Pre-survey records in Gillamii Area

The NatureMap search returned only one record within the Gillamii Area, in the Broomehill townsite (2010), close to a small patch of Sheoak. Broomehill is at the northern edge of the Gillamii patch and is at the southern edge of the current stronghold for this species.

There were no reports from landholders of this species.

Quenda or Southern Brown Bandicoot *(Isoodon obesulus subsp. fusciventer)*

Status and past distribution

This subspecies of southern brown bandicoot is endemic to south-west Western Australia, historically occurring south west of a line from approximately (Figure 5). Since European settlement, it suffered a range contraction toward the coast –and is now only a patchily distribution throughout this range.

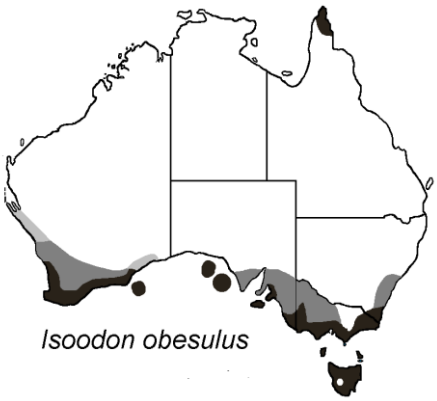


Figure 5: Past and current distribution of the Quenda
Dark grey = extant; Mid-grey = historic (> 30 years); Pale-grey = Late-Holocene sub-fossil. Data up to 1996.From Mammal Maps (McKenzie et al. by N.L. McKenzie, A.A. Burbidge, A. Baynes and many other contributors).

The subspecies was previously listed under the *Wildlife Conservation Act 1950* in 1990 as a threatened species. After extensive fox baiting and further surveys it was removed from the threatened list in 1998 and listed as a Priority 5 species (taxa in need of monitoring - conservation dependent). Although not listed as threatened the Quenda is thought to possibly be declining in some parts of its range, for example the Perth region. In 2012, the World Wildlife Fund (WWF) and Department of Parks and Wildlife organized a Community Quenda Survey of the greater Perth area to provide information to map the current distribution of Quendas across the greater Perth area and are now monitoring these populations via further community counts for any declines in numbers.

Description
Coarse dark grey or yellow brown fur above and creamy-white below and a short, tapered, dark brown tail. The ears are short and rounded. The tail is lightly furred and often shortened or missing altogether, probably as a result of fighting. About the size of a rabbit.

Head and body length
300-360 (330) mm in males
280-330 (300) mm in females
Tail length
96-140 (124) mm in males
90-128 (113) mm in females
Weight
500-1850 (890) g in males
400-1200 (620) g in females
Source: Braithwaite 1995

Photo- Sandra Gilfillan

Ecology

Quendas are omnivorous, eating insect larvae, fungi (truffles), seeds and some plant material. They leave distinct cone-shaped diggings when searching for food. They are generally solitary with a home range of three to five hectares although home ranges of multiple individuals may overlap if food is plentiful. They are largely nocturnal but can sometimes be active during the day. The quenda falls within the critical weight range (50g-5.5kg) of mammals that are particularly vulnerable to predation by foxes.

Quendas breed mostly between May and October, but can breeding is opportunistic and can occur throughout the year. They are capable of a high reproductive rate under favorable conditions, producing up to 3 litters of 1 to 6 young in a season, with usually 2 to 3 surviving. Young are weaned at bout 60-70 days and females can breed at only 3-4 months of age. Therefore the potential for population increase is high if threats are removed. Like all bandicoots, they have a backwards pointing pouch that prevents it being filled with sand when digging (Braithwaite 1995)

The Quenda is classed as a post fire opportunist; it takes advantage of the early stages of regeneration after fire when insect abundance is high. As the vegetation matures post fire food supply decreases. As the Quenda also requires a thick understorey for shelter a mosaic fire regime where only parts of its habitat is burnt regularly provides the most suitable habitat.

The Quenda is part of a group of Australian marsupials (along with bilbies, bettongs and potoroos) that forage for food by biopedturbation (ie. digging) and can alter the biotic and abiotic characteristics of their habitat, influencing ecosystem structure and function by disturbing the ground and turning soil over. Most of these species have declined throughout their range thus reducing the positive impact of digging in these areas. It has been estimated that an individual Quenda could create c. 45 foraging pits per day, displacing c. 10.74 kg of soil, which extrapolates to c. 3.9 tonnes of soil each year. The digging activities of Quendas are likely to be a critical component of soil ecosystem processes (Hope 2012) and hence increasing the distribution and abundance of this species in the Gillamii Patch is highly desirable.

Habitat

Quendas occupy a wide range of habitat types from wet or dry schlerophyll forest through to open woodland and scrubby vegetation on sandy soils, but always require thick dense understorey, for example sedges, for shelter. They also shelter in burrows constructed by other species for example rabbits. The eastern subspecies of southern brown bandicoot (*I. o. obesulus*) has been observed to construct burrows 10cm in diameter and 1 m long after fire (Long 2009). The entrances are flat base and curved ceiling and are very similar to varanid (goanna) burrows. In contrast to the bandicoot burrow the varanid burrows are usually positioned to make use of warm weather conditions for basking, whereas the

bandicoot borrows were found underneath vegetation. Burrow digging has been observed in captivity in *I.o. fusciventor* in WA (Kirsch 1968), before a period of hot weather. Burrows were 10-15 cm wide and 24-38 cm long- shallow with the deepest point 18 cm below ground.

Threatening processes

Historically and currently habitat loss and fox and cat predation are the main threats facing the Quenda. Weighing between 400g to 1.8kg, the Quenda falls within the critical weight range (100g-5kg) of mammals that are particularly vulnerable to predation by foxes and cats.

Quendas in urban areas are also under threat from habitat loss through clearing and degredation, predation from domestic cats and dogs, vehicle strike and poisoning from snail and rat baits.

Pre-survey records in Gillamii Area

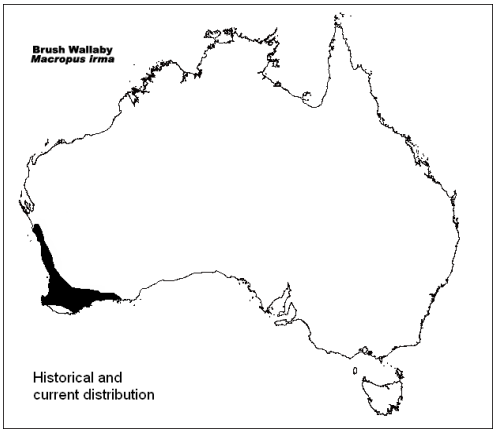
Historical records of Quendas within the Gillamii patch are from the general area in 1904, 1907, Tambelup (no date), "Cranbrook" in 1900, and in Tenterden, on the south side of Brooking St. in 1960.

Current known populations of Quendas within the Gillamii Area occur in forest region in the west and the SRNP in the east. Apart from the these areas, the only current record of this species in the Gillamii Area is a roadkill from Brickhouse Rd., approximately 10km NE of Cranbrook- This record was not registered with any organization, but relayed to The Gillamii Centre.

Black-gloved Wallaby *(Macropus irma)*

Status and past distribution

The Black-gloved Wallaby is endemic to south-west WA, historically occurring from north of Kalbarri to Cape Arid, east of Esperance, however it does not occur in the Karri (*Eucalyptus diversicolor*) forests in the lower south-west (Figure 6).



The species was common in the early days of settlement and large numbers were traded commercially for skins (e.g. 122,000 in 1923 and 105,000 in 1924). They remained common in uncleared areas until the early 1970's, after which, although no range contraction has been observed, they appeared to have suffered a decline in abundance within this range, one estimate by approximately 10%. The species has appeared to disappear from a number of smaller Wheatbelt Reserves since the mid 1980s (Maxwell *et al*. 1996, Courtney 1994).

Figure 6: Past and current distribution of the Black-gloved Wallaby
Dark grey = extant; Mid-grey = historic (> 30 years); Pale-grey = Late-Holocene sub-fossil. From Strahan 1995.

The Black-gloved Wallaby is listed on WA's DPaW Priority Fauna list (listed as Western Brush Wallaby) as *P4: Rare, Near Threatened and other species in need of monitoring*.

In 1994 Courtney argued for an increase in surveys, coordinated monitoring of populations, basic ecological research and a recovery program to clarify the status of this species and ensure its apparent recent decline does not continue (Courtney 1994). Work on this species in Gondwanlink's Fitz-Stirlings Operation Area between 2007 and 2009 found the species to be quite widespread with areas of seemingly higher numbers than others.

Description

The Black-gloved Wallaby is a medium sized wallaby (head and body length is 1200mm, tail length is 540-970mm (720) and weight is 7-9 (8) kg), and is unusual among the Macropodidae in not being sexually dimorphic (Christensen 1995). They are gunmetal grey with a brownish tinge to the neck and back, the chest is grey and the belly buff. It has a distinct white facial stripe; the ears are blackish outside and whitish within and have a clear black tip and it has distinct black gloves and toes. The tail is long and is black at the extremity. Some animals have a series of indistinct dark bars across the back and rump and young animals have a faint horizontal stripe on the rump. Individuals move fast with the head held low and the tail extended (Christensen 1995, Menkhorst 2001).

Photo: Sandra Gilfillan

Ecology

The Black-gloved Wallaby is a solitary animal, although they may aggregate where dense vegetation provides shelter during daylight or where burnt areas provided food at night At Whiteman Park near Perth, females occupy a smaller home range than males (range for males was 34.3 – 69.2 ha (n=2), females 15.3-32.5 (n= 5)) and males sometimes shift range over time. Females foraged over about 5 ha in a night, males 10 ha and these overnight areas of activity tend to be larger in autumn and winter than in spring and summer, perhaps related to patterns of reproduction. Juvenile females probably establish home range alongside mothers but males were aggressive towards one another. Only two of the wallabies tracked had overlapping home ranges and these were likely a mother and still dependent young. Individuals were tolerant of disturbance and crossed busy roads and were therefore not isolated in the park. (Bamford and Bamford 2002).

Pairs usually comprise and adult female and a still dependant young, which is thought to remain with the mother for a year after they emerge from the pouch. The reproductive strategy of the Black-gloved Wallaby is not wholly understood. They appear to be seasonal breeders which is unusual among macropods. The breeding season is thought to occur from April- May (births) to October-November (young emerging from pouch). However, it has been suggested that this seasonality may only be facultative and that seasonality could be reversed with improved nutritional seasonal conditions.

From previous surveying of this species by remote camera within the Gondwana Link area and from results of the present survey some information has been gained on breeding condition throughout the year by examining photographed individuals. Females with very large pouch young (assumed to be near emerging from pouch or young at foot) have been observed in April, May, July, September and October, strongly suggesting that there is more than one breeding season per year, at least in some years.

The Black-gloved Wallaby is categorsied as an intermediate browser-grazer grade based on teeth structure (Sanson 1989, Tyndale –Biscoe 2005). Dietary studies have found that they consume a variety of species and life forms (both monocots and dicots, herbs and shrubs). They tend to consume a large number of species in moderate or small amounts, rather than a few species in large amounts (Shephard *et al.* 1997; Wann and Bell 1997).

At Whiteman Park, within the Perth region, Black-gloved wallabies were found to consume a total of 29 plant species, with ratio of 64% dicot to 36% monocot plant species. The most common introduced species consumed were *Carpobrotus edulis* (pigface) (50% of pellets) and *Cynodon dactylon* (grass) (83%) and the most common native species consumed were *Macrozamia riedlei* (50%), *Tricoryne elatior* (yellow autumn lily)(42%), *Leucopogan conostephioides* (33%) and *Nuytsia floribunda* (Christmas tree) (33%). There was no significant difference in chemical constituents, moisture content, ash content or morphological features of plants consumed or avoided by the Black-gloved Wallaby (Wann and Bell 1997). Algar (1986) also found Black-gloved Wallabies to be principally a browser at a reserve near Perth, with non-herbaceous dicots representing between 80 and 95% of the total diet in all seasons and all years. Grasses were consumed mainly in winter and spring and sedges in spring and summer.

Black-gloved Wallabies rely on moisture content of food and do not need free standing water to survive (Christensen 1995). The succulents eaten were most abundant in summer when free standing water is not available. Algar (1986) also found the succulent *Carpobrotus edulis* (pigface) to be a major dietary item, especially in summer. *Nuytsia floribunda* may be source of moisture in winter due to its ability to absorb water from neighbouring plants (Wann and Bell 1997).

in Jarrah (*Eucalyptus marginata*) forest at Perup Nature Reserve, just west of the Gillamii patch, Shephard *et al.* (1997) found 21 plant species to be consumed by the Black-gloved Wallaby, with the most frequent being and unknown monocot (86%), *Bossiaea ornate* (86%), *Gastrolobium bilobum* (43%) and *Acacia pulchella* (43%) with no particular dietary preferences, the wide range of plant species consumed indicating an ability to shift dietary species when one species becomes less available.

Like most Western Australian herbivorous mammals, Black-gloved wallbies show a high tolerance to the fluoroacetate, the toxic chemical found in *Gastrolobium* species (McIlroy 1982). The lethal dose of 1080 for the Black-gloved Wallaby is 5-10mg/kg (McIlroy 1982). This is supported by findings of the above dietary studies; Black-gloved wallabies being able to consume plants with high levels of this compound (e.g. *Gastrolobium bilobum*) and reflects their length of exposure in evolutionary times to food plants that contain fluoroacetate. The tolerance of native species in Western Australia is the factor underpinning the successful use of this compound (1080) as bait for the control of foxes in Western Australia (Kinnear *et al.* 1988, 1998).

The habitat associations of the Black-gloved Wallaby are not well known. Christensen (1995) reports that they have an optimum habitat of open forest or woodland, particularly favouring rather open, seasonally wet flats with low grasses and open, scrubby thickets and that they are found in some areas of mallee and heathland, but are uncommon in wet sclerophyll forest and absence from the Karri forests which have a dense understorey.

At Harry Waring Reserve near Perth, Algar (1986) reported that Black-gloved Wallaby feeding sites were associated woodland sites with high shrub abundance, and that animals selected shelter sites within their feeding activity areas based on the variables of high shrub abundance and canopy cover.

The most important characteristic of suitable habitat for Black-gloved Wallabies at Whiteman Park, determined by radio-tracking of eight individuals and sweep surveys, appeared to be a dense understorey (foliage cover estimated to be about 40- 60%) of about 1 metre in height. Favoured overstorey vegetation was *Eucalyptus / Banksia* woodland but animals also used dense areas of heath with no overstorey. These habitats were associated with wetlands, damplands and the woodland margins of damplands. The least favoured habitats were open Marri woodland with a low understorey (Bamford and Bamford 2002). Favoured habitat occurred on both low-lying areas of low relief and in a system of high dunes with damplands as inter-dune swales.

Black-gloved Wallabies at Whiteman Park also showed a preference for foraging in recently-burnt areas, if available, for up to 2 years post fire. However, unburnt areas were essential

for shelter. Outside burnt areas they foraged over wide range of habitat types, but only rarely left native vegetation and did not use regular daytime shelter. Animals were seen foraging on artificially watered lawns up to 50 m from dense vegetation (Bamford and Bamford 2002). Surveys of a number of Wheatbelt reserves in the 1970s reported Black-gloved Wallabies occurring in regenerating *Grevillea hookeriana*, regenerating heath, and unburnt heath and shrubland (see references in Courtney 1994).

Within the Fitz-Stirling area the Black-gloved wallabies have to date been observed in mallee (mixed *Eucalyptus tetragona* / *E. redunca*) with a relatively open proteaceous heath understorey, and Jarrah (*E. marginata*)/Marri (*Corymbia calophylla*) woodland with a sparse low proteaceous understorey. Shelter sites were not often observed, but one was seen in regrowth at the Bush Heritage property Beringa (Angela Sanders *pers.com*).

Threats

Little is known about the past and current threatening processes impacting on the Black-gloved Wallaby. Courtney (1994) presented evidence for a decline in abundance of the species in the 1980's. Two spotlight surveys in 1970 and 1990 in the jarrah forest by the then CALM (now DPaW) suggested a decline from *ca.* 10/100km to *ca.* 1/100km; sightings reported to the WA Museum declined during the 1980s; and the species has appeared to disappear from a number of Wheatbelt Reserves since the mid 1980s (Maxwell *et al*. 1996, Courtney 1994).

Although the reasons for this decline are largely unknown it corresponded to a dramatic increase in the number of foxes in the south-west of WA. Although adult Black-gloved Wallabies are too large to be taken by foxes it is thought that juveniles not long out of the pouch may be vulnerable to fox predation (Christensen 1995). However, Black-gloved Wallabies continue to persist in remnants that have not been or are not currently baited for foxes suggesting that fox predation may only impact of vulnerable populations e.g. those on small isolated remnants that cannot be recolinised, or those without suitable safe sheltering sites (e.g. where remnant has been totally burnt).

Pre-survey records in Gillami patch

A NatureMap search returned 15 records of Black-gloved wallabies within the Gillamii patch (Table 1). Of these 9 were pre 1990 and 5 post 1990. Observations by landholders from the landholder survey were: Tenterden NR (2012), South Perilup Rd (2012), Cranbrook – Boyup Brook Rd (2009), Muir Highway/Mill Rd intersection Rocky Gully (2012), Westcup Farm, Stockyard Rd Tenterden (2012), Rockhole Dam NR .

In addition to this, thirteen NatureMap records exists for this species (Table 1)

Table 1 : NatureMap (DPaW) records for Black-gloved Wallabies.

Location	Year
Cranbrook area, approximately	1909
Frankland River, approximately	1912

Cranbrook area	1954
Rocky Gully area	1954
Tenterden Nature Reserve	1970
Yellerup Nature Reserve	1983
South Jingalup Nature Reserve	1984, 2005
Warrenup Nature Reserve	1986
Jingalup Nature Reserve	1989
Mongelup Nature Reserve	1990
Rock Hole Dam Nature Reserve	1993
Water Reserve 39621	2005
Mondurup Views	2007

Black-gloved Wallaby as targets in Conservation Action Plans in the Gondwana Link Forest to Fitzgerald Project Area

The Black-gloved Wallaby has been nominated as a target in all the completed Conservation Action Plans (CAPs) for Gondwana Link's Forest to Fitzgerald project area (*Forest to Stirlings*, *Lindesay Link*, *Ranges Link, Manypeaks* and *Stirlings to Fitz*). Within the Forest to Stirlings CAP area which forms part of the Gillamii Patch, the Black-gloved Wallaby was chosen as a conservation target as is it relies on "*dense understorey for protection from* (fox) *predation*" and on *"landscape-scale bushland connectivity* " (although this is only assumed) thus the presence of self sustaining populations of this species are assumed to benefit other species vulnerable to fox predation and landscape connectivity on a similar scale.

Survey methods

Numbat

Sighting: As Numbats are active during the day their presence can be determined by day sightings, either on foot or from a vehicle.

Feeding signs*:* freshly turned sticks, small shallow diggings, scratches on termite infested logs on the ground.

Scats**:** smooth dark cylinders containing fine fragments of termites and soil particles. The scats are coated with mucus that dries to a firm glaze. Found on fallen logs or near diggings.

Numbat scats. From Triggs (1996).

Red-tailed Phascogale

The presence of Red-tailed phascogales can only be determined by direct sightings of animals. This can be done either by live trapping or the installation of suitable nest boxes which individuals, if present, readily use once installed.

They are too small and fast to be reliably and efficiently detected by remote cameras (Angela Sanders *pers.com*.)

Trapping

Red-tailed phascogales are readily caught using Elliot traps baited with peanut butter and oats.

Nest boxes

Nest boxes of suitable dimensions, installed on the trunk of a tree, will be readily used by red-tailed phasocgales. Thus setting up nest boxes is both a method to determine if individuals are present in an area and to monitor ongoing presence.

Three nest boxes were constructed by Cranbrook Men's Shed to the dimensions outlined in the *Land for Wildlife Note No. 3* (Hussey 1997).

Quenda

The presence of Quendas can be reliably determined by indirect signs (diggings) or by remote cameras.

Diggings: Quendas leave characteristic cone-shaped diggings using their powerful foreclaws with conical ends formed by their long pointed noses when searching for food. These diggings can be distinguished from rabbit digging by the distinct shape. Also rabbit diggings are usually more numerous in an area are accompanied by rabbit droppings and a large amount dug out soil (see below).

A quenda digging with characteristic cone shape

Rabbit diggings with dug out soil and droppings

Scats: Scats comprise plant material and invertebrates (fine particles). Soils ingested also therefore colouring the scat brown or black. As invertebrates are eaten could be confused with reptile scats. However reptile scats have a white cap at one end of the scat (solidified uric acid). Scats are not often seen and scat searches are not a good method for detection.

Black-gloved Wallabies

Detection methods for Black-gloved wallabies have been outlined in detail in Gilfillan (2010). Here the methods are discussed and refined based on subsequent information gathered since this report.

Non-invasive detection methods can either be *indirect* (observations of signs left by animals) or *direct* (observations of animals themselves). In this monitoring protocol both methods are employed to detect the presence of an animals at a site.

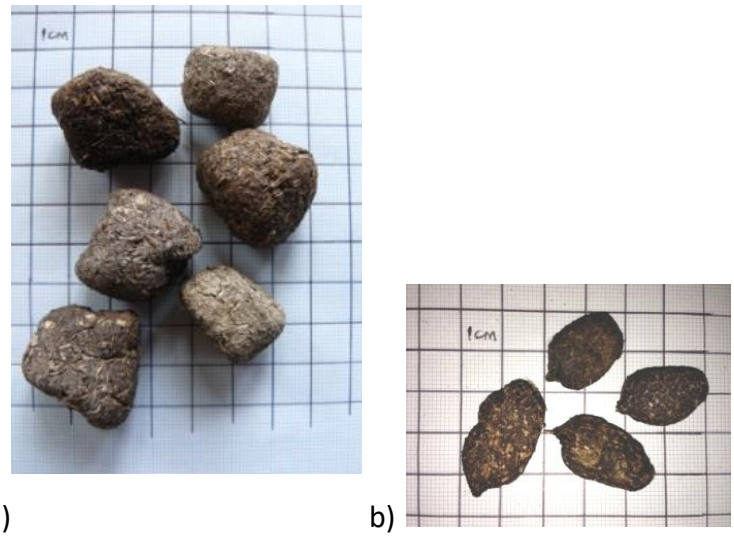
Scat identification (indirect method)

Identification of macropod species based on scat morphology

Only one other macropod species is known to occur within the Gillamii Patch; the Western Grey Kangaroo (*Macropus fuliginosus*).

Woylies (*Bettongia penicillata*) are known historically from the area but no current records exist for this species. It is possible that they still do occur, however if so they would likely be in low densities, and as such, scats would be in very low densities. Therefore when making distinctions of signs only the Western Grey Kangaroo is considered.

Distinctions between Western Grey Kangaroo and Black-gloved Wallaby scats based on morphology can be made with a large degree of confidence. Typically Western Grey Kangaroo scats are much more square, blocky shaped than wallaby scats and can be easily distinguished from the oval shaped wallaby scats (Figure 7). However, some Western Grey Kangaroo scats can look similar to Black-gloved Wallaby scats in shape and size when viewed from above (Figure 8). In this case the characteristic that distinguishes them is the flatter profile of the wallaby scat (Figure 9). Therefore in areas where only Western Grey Kangaroo and Black-gloved Wallaby are known to occur then Black-gloved Wallaby scats can thus be identified by this method with some expertise, and can therefore be used to indicate presence with a large degree of confidence.



a) b)

Figure 7: Typical a) WGK and b) Black-gloved Wallaby

In areas where the tammar occurs in addition to WGKs (Fitz-Stirlings, the forested areas of the Forest to Stirlings, and possibly the NSP) a distinction between Black-gloved Wallaby scats and tammars based on morphology is less accurate and requires a higher level of expertise (Figure 8).

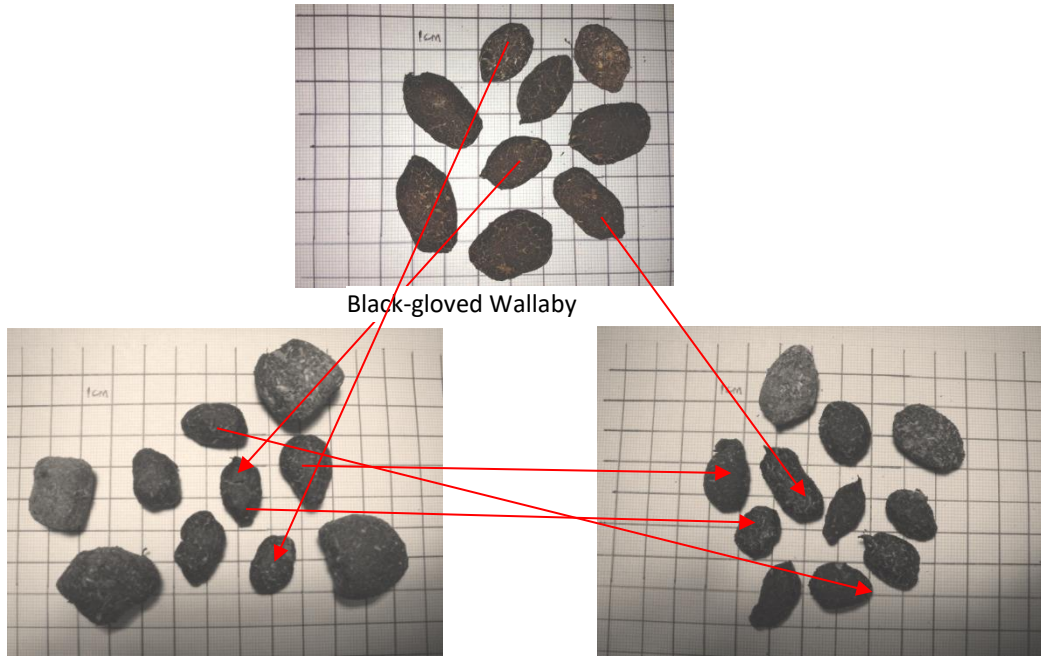


Figure 8: Comparison of a range of scat sizes and shapes of the three Macropod species present within Gondwana Link. Arrows indicate scats that look similar.

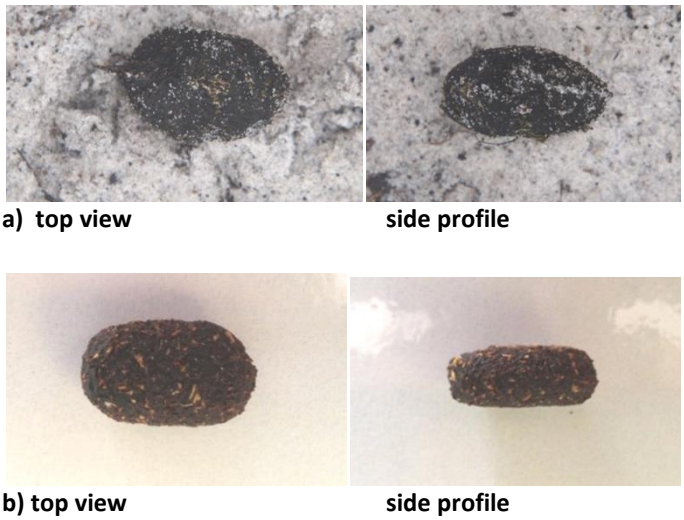


Figure 9: Top and side view of a) WGK and b) Black-gloved Wallaby scat. Although similar in shape form above, the Black-gloved Wallaby is noticeably narrower than the WGK scat in side profile.

This has also been found in other studies (Alacs *et al.* (2003)). However, Tammar scats are generally smaller, and combined with other information (e.g. habitat type), some conclusions can be made about which species the scat is likely to represent; this technique therefore has some use in determining presence in these areas.

The **colour** and **texture** of a scat can vary with the type of plants consumed. In Western Grey Kangaroos the scats, when broken, are green or green brown and are uniform and close textured as only soft grasses are consumed (Triggs 1996). Black-gloved Wallaby, in addition to grasses, also consume herbs and shrubs and hence the texture is more coarse and less uniform.

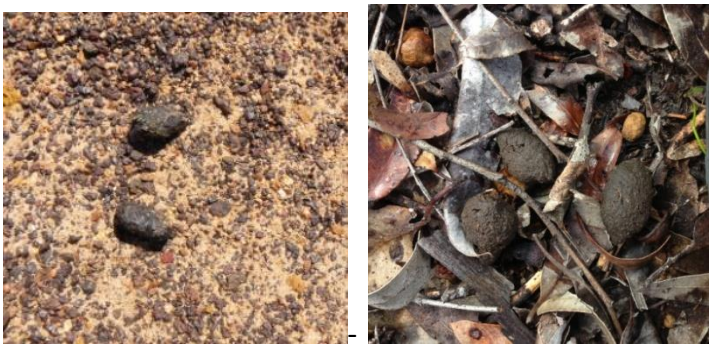
The colour of a Black-gloved Wallaby scat when fresh is an olive green, which is similar to a WGK fresh scat and when dry is usually browner then WGK, and mottled in appearance (Figure 10)

Recent (fresh) scats are shiny in appearance, with dried mucous coating still present, are firm and show no signs of breakdown; the adherence of sandgrains or soil to pellets also indicate recent deposition.

Black-gloved Wallaby scats can be very sparse, and often hard to find, especially if the population is at low densities and the substrate has a deep litter layer or is similar in colour to the scat (e.g. ironstone (Figure 11).

a) photo Vivienne Hillyer b) c)

Figure 10: Typical colour of a) fresh (moist), b) older (brown) and c) older still (grey) Black-gloved Wallaby scat



a) **b)**

Figure 11: Black-gloved Wallaby scats on a) ironstone and b) leaf litter substrate

As there have been no trials into the decay rate of Black-gloved Wallaby scats under various field conditions it is difficult to determine the age of scats in the field, unless fresh scats are found. This means that a distinction between “past” or “current” occupancy based on the presence of scats cannot always be made. Decay rates of scats for other macropod species have been found to vary with conditions (temperature, humidity). Johnson and Jarman

(1987) found decay rates of eastern grey kangaroos and red-necked wallaby scats to be very similar; 48 days (April-June), 30 days (June-July) and 25 days (July-August), and Perry and Braysher (1986) calculated 6 months to decay in eastern grey kangaroos.

Perry and Brayshaw (1986) argue that the point where the pellets break open can be gauged more objectively than colour change or apparent freshness, so suggest that a more accurate standard would be to include pellets until they begin to disintegrate.

Fresh (still moist) +13 days +30 days +60 days +125 days

Figure 12: Appearance of one Black-gloved Wallaby scat left outdoors at a number of days after being deposited (fresh).

Figure 12 shows the Appearance of one Black-gloved Wallaby scat left outdoors at a number of days after being deposited (fresh). The scat is still intact and has maintained its original shape after 125 days. The colour has not changed significantly, apart from between fresh and plus 13 days. It must be noted that this is only from one scat and therefore gives only a tenuous indication of the decay rate of Black-gloved Wallaby scats. The presence of dung beetle larvae may have a large influence on the rate of decay, and would need to be considered in calculating the rate of decay (Figure 12).

Figure 13: Black-gloved Wallaby scat inhabited by dung beetle larvae. Collected whole (age unknown)- photo is 126 days later.

If scats are removed from an area and the area re-inspected at a subsequent date then it can be assumed that wallabies have been present between those dates. Presence of scats in this instance is an indication of current presence, as long as the time between clearance and re-inspection is of a short duration (weeks).

Advantages of scat observation method

- No initial equipment cost.
- No equipment running cost.
- Low labour intensity – 1 person for 1 hr per site of about 50 ha.

Disadvantages

- Potential misidentification of scats, leading to a false presence conclusion
- Inability to determine age of scat without species specific scat decay trials

Scats can therefore be used to:

- provide reasonable initial quick assessment/confirmation that Black-gloved Wallaby's are currently (fresh) or have been present at a site in the past.
- target areas for more definitive survey techniques (remote cameras).
- guide remote camera placement.

Remote sensing cameras (direct method)

Remote cameras are increasingly being used as a non-invasive technique to detect the presence and sometimes abundance of a wide range of fauna (Claridge *et al.* 2004; Meek *et al.* 2012) and are becoming more affordable and more sophisticated.

Determining the presence or absence of Black-gloved Wallabies

To make reliable inferences about site occupancy (presence or absence of Black-gloved Wallabies at a site) using remote cameras it is important to account for detection probabilities, as these may vary spatially and / or temporally. Calculating detection probabilities requires that sites are surveyed repeatedly within a relatively short timeframe (generally days) to minimise the chance of obtaining a **false absence** (i.e. the species is presumed to be absent but more survey effort or better detection methods would lead to detection) (MacKenzie *et al.* 2002). The patterns of detection and non-detection for each species over multiple visits for each site (detection history) permit estimation of detection probabilities and the probability of presence (MacKenzie *et al.* 2002). If each site is only surveyed once, occupancy and detection probabilities are entirely confounded and determination of presence or absence may only be the result of a change in the ability to detect the species rather than a change in occupancy.

Detection probabilities have not been determined for Black-gloved Wallabies. This requires repeated surveys at a site where animals are known to occur, preferably 10 or more times over a short time frame. Therefore the absence of animals from a site cannot be conclusively be determined.

Another thing to consider when determining presence or absence is a **false presence** result. This can be obtained through misidentification of the species. This may occur if the image is blurry or only picks up a portion of the individual. Other species that could be mistaken for Black-gloved Wallaby's are Western Grey Kangaroos and Brush-tail possums. Certain features of Black-gloved wallabies can be used to distinguish the species from these species or if only a portion of the animal is obtained in the image (Figure 14).

Brush-tailed possum

No black tips on ears, no black "gloves" No stripes on back

Shorter brushier tail
(note tail may also have white brush)

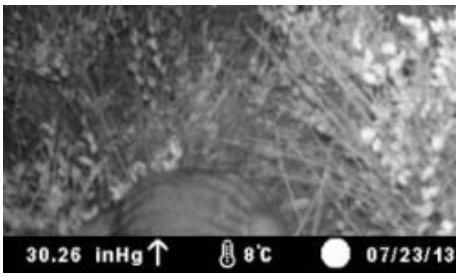
Western Grey Kangaroo

No white stripe on chin and no black tips to the ears

Fatter tail with no "brush"

More bulky chest and shoulders, longer forearms, no stripes on back

Black-gloved Wallaby (partial images)



Black stripes on back

White face stripe and black tip to ears

Black brush on end of tail (less brushier than brush-tailed possum)

Figure 14: Examples of images where a misidentification of a Black-gloved Wallaby may occur, and distinguishing features that enable a positive ID of a Black-gloved Wallaby where the whole animal is not captured.

Field survey

Using the above detection methods, 37 remnants comprising Private Property, Shire Reserve, UCL and DPaW managed land where Black-gloved Wallabies were either previously recorded, and had accurate enough coordinates to relocate or which appeared to have suitable habitat. Suitable habitat was defined as any vegetation type that provided patches of mid-dense understory of about 1m in height interspersed with more open areas and with or without an overstorey.

At each site suitable habitat was first searched for scats that could be distinguished as Black-gloved Wallaby. This searched comprised driving along tracks and stopping at areas of potentially suitable habitat and searching the area on foot for scats. At each stop the search was carried out for approximately 15 minutes by usually two people. The results of the scat search was the determinant of whether time and effort was put in to set up remote cameras; if no scats were found then cameras were not deployed.

If scats were found then remote cameras were set up in the area where scats were found. The number of cameras set up varied and was largely dependent on the number available. As the Gillamii Centre owned 3 cameras these were dedicated to the project and therefore the minimum number deployed was 3. Other cameras were obtained on loan from GLink and Bush Heritage Australia and were therefore not always available. The number of cameras deployed at each site is shown in Table 2 (results).

Results

Numbat

The "L-shaped" Reserve approximately 1km east of the landholder observation of a Numbat in 2009 was thought to be possible source of the observed Numbat, apart from the forest region population at Perup and surrounds which is approximately 15km to the west. This reserve was searched for suitable habitat and any signs of Numbat activity.

No suitable habitat was found. The area to the north had been burnt recently and some termite activity was present, however, there were very few logs with suitably sized hollows and no Numbat activity or signs were observed.

It is likely that the Numbat seen by the landholder was possibly a dispersing male from the forest region. Numbats have been known to travel large distances when trying to establish a new territory.

Red-tailed Phascogale

Potentially suitable habitat for the Red-tailed phasocagale occurred at a number of locations within the Gilamii Area.

***Tambellup Water Reserve (*Coordinates: -34.039090, 117.560446)**

A large water reserve of 675 ha, with approximately half of this area consisting of potentially suitable red-tailed phascogale habitat in the form of mature stands of Wandoo (*Eucalyptus wandoo*) and Sheoak (*Allocasuarina huegeliana*) warranted the effort of trapping to determine the presence of red-tailed phascogales.

Trapping was carried out in May just before the breeding season and subsequent male die off so that any population present would comprise the largest number of animals; after June all males die off, effectively reducing the trappable population considerably.

50 Elliot traps (5 traplines) were baited with oats and peanut butter and were set within the Sheoak/Wandoo woodland habitats (Figure 15). Traps were opened for 2 nights and checked each morning and closed on the second morning. Traps were then reopened for one more night within the same week. Survey effort was therefore 150 trapnights (50 traps over 3 nights).

Trapline	Number of traps	Number of nights set
1	10	3
2	5	3
3	10	3
4	10	3
5	15	3

No Red-tailed Phascogales were caught in the 150 trapnights. The only species caught was the introduced house mouse (*Mus musculus*) (3 captures). The tapping effort was assumed to be adequate to detect the presence of this species. At a Bush Heritage Australia property near Kojonup, where Red-tailed Phasocgales have been released, a trapping rate of about 3% has been obtained in recent trapping surveys (Angela Sanders *pers. com*.).

Broomehill Townsite

The record in 2010 of a Red-tailed Phascogale within the Broomehill townsite was in September. There is a very small area of suitable habitat close to the 2010 record within the Broomehill townsite, but it is not likely large enough to support a population of phscaogales. However the month of the record (September) suggests it is unlikely to represent a wide ranging male just before die off (too late), or a dispersing young male after a good season when Red-tailed Phascogales can increase in numbers and spread out across the landscape (too early).

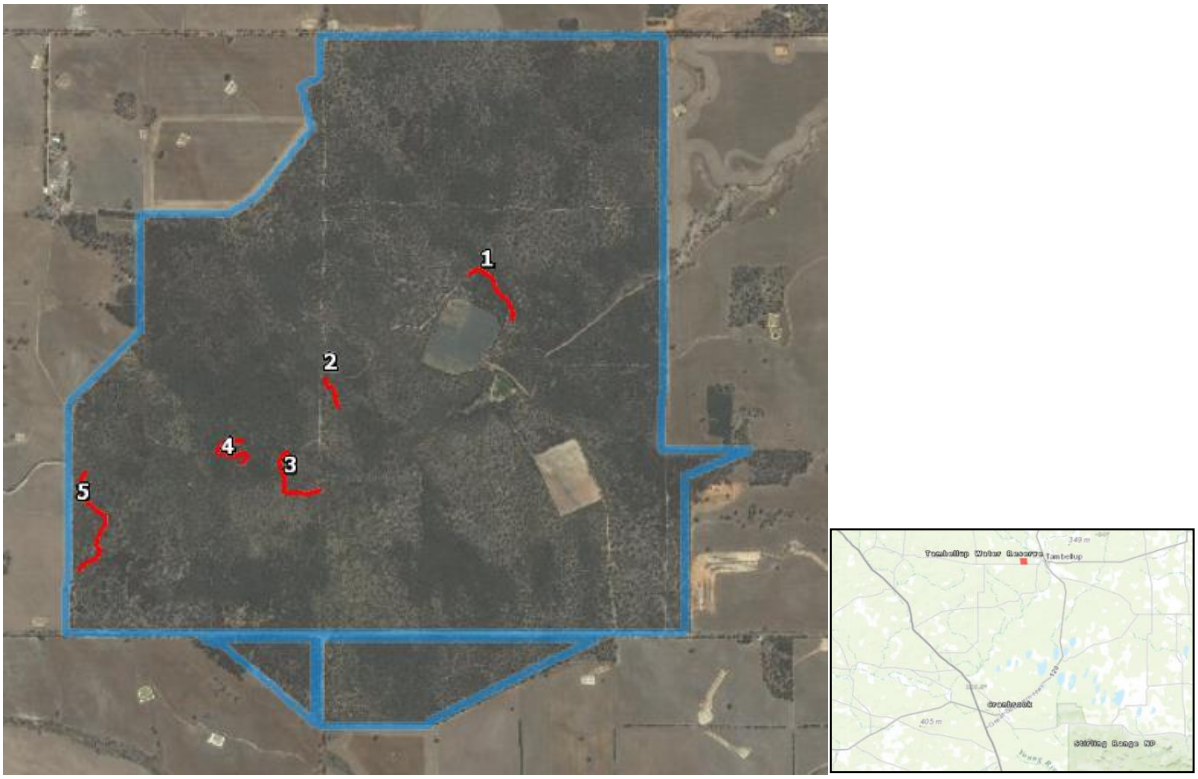


Figure 15: Tambellup Water Reserve. Location of the reserve (right) and location of traplines set for red-tailed phascogales (numbers 1-5) within the reserve (left).

Volunteers – students from UWA, Albany and local landholders on a well earned break after checking traps for Red-tailed Phascogales at Tambellup Water Reserve.

Nest boxes

Three nestboxes were constructed by Cranbrook Men's Shed following the design in Land for Wildlife Note. These were placed in three locations that have been identified as suitable habitat. The Tambellup Water Reserve, Peringillup NR, and Pootenup NR.

Quenda

The area at Brickhouse Rd. was inspected for the characteristic diggings of Quendas initially in November 2012. Diggings were found and cameras were installed (3 reconyx), however no photos were obtained. Only a photo of the introduced Black Rat (*Rattus rattus*) was obtained. The site was revisited again in November 2013 where digging were again observed in high numbers. However deployment of 10 cameras for 12 nights (7 only functioning) at this time failed to record a Quenda.

Further sightings of the Quenda's characteristic diggings were found in this area and from a more extensive search for diggings it appears that animals occur in the vegetation fringing the nearby lake (Figure 16). Three cameras were set up here but again, unfortunately, no photos were obtained.

This is significant find as it represents an outlying, possibly isolated population of bandicoots. The closest known population to this site is within the Stirling Range NP approximately 8km to the south. Further landholder sightings have been obtained closer to the Stirling Range NP, near the Stirling outliers, and diggings were observed in Chininup Rd. Reserve just west of the Stirling Range NP. However, the "lakes" population is approximately 100 km to the nearest post 1990 records of this species both to the north (Dongolocking NR- 115km) and to the west (Palgarup State Forest – 97 km).

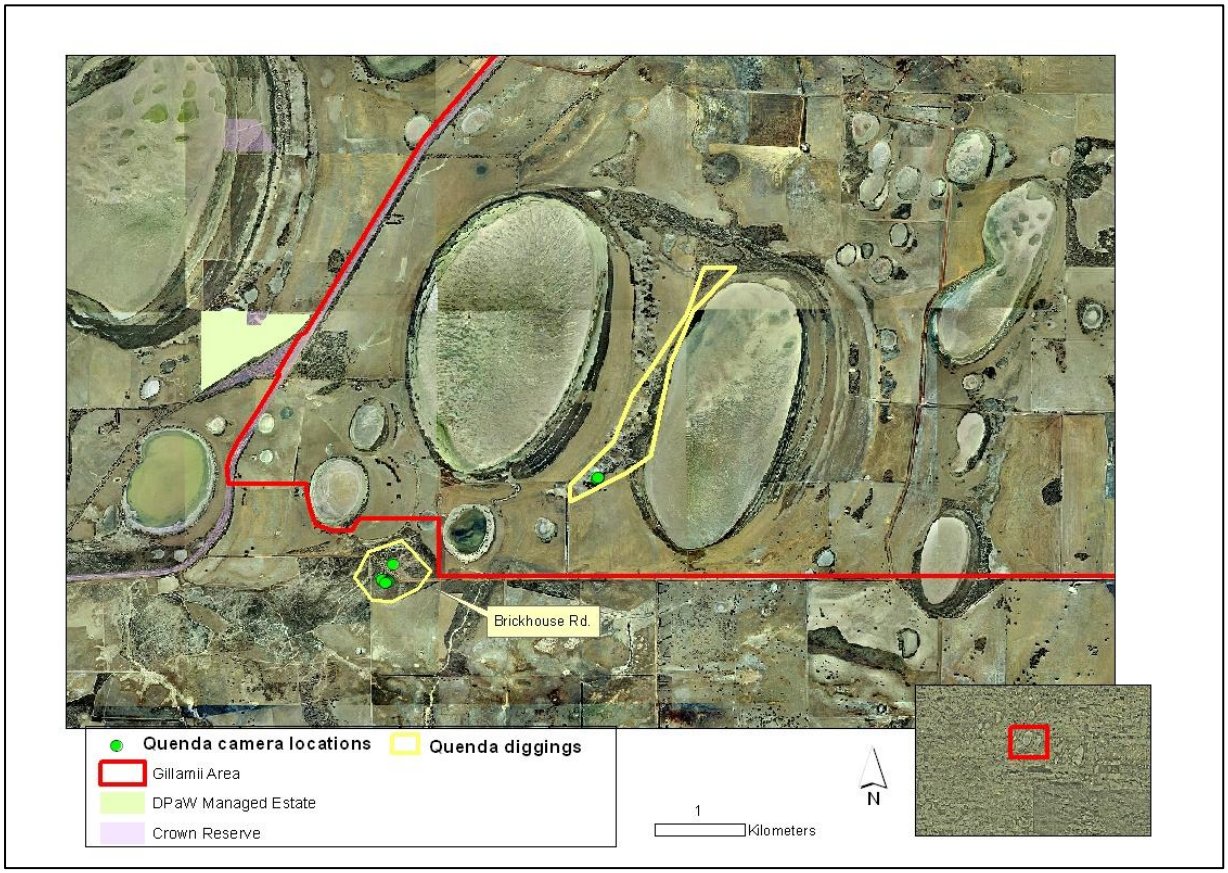


Figure 16: Locations of camera set for Quendas and extent of area where diggings were found.

Black-gloved Wallaby

Survey results

From surveys carried out in this project Black-gloved wallabies were found to be currently using 9 sites (photos and/or fresh scats). Scats (not fresh) were found, but no photos obtained, at an additional 6 sites (Table 1, Figure 17). It is not known if these 6 sites are currently occupied or only occupied in the past due to the lack of data on decay rates of Black-gloved Wallaby scats.

Sites where only scats were found but no photos were obtained cannot be concluded to *currently* support Black-gloved Wallaby's, but give a strong likelihood that they are present. Fresh scats were rarely encountered (only at Rockhole Dam NR and Nunijup Water Reserve) suggesting that animals may move around within a habitat patch or remnant (maybe seasonally or over a shorter time frame), and may be present elsewhere within the patch at the time of sampling. This indicates that it is important when surveying a remnant or habitat patch in one point in time that the whole of the remnant/patch is sampled, if resources allow.

Of the sites that's had previous records of Black-gloved wallabies (NatureMap records) and had accurate enough coordinates to enable the site to be surveyed 5 were re-surveyed and 3 were found to still have Black-gloved Wallaby's present.

Fifteen sites were searched for scats but no scats were found (Figure 17) (and hence no cameras deployed). The likelihood of occupation at these sites is very low, however it cannot be concluded that Black-gloved Wallaby's are absent from these sites.

Table 1: Sites with previous records of Black-gloved Wallaby's plus sites surveyed in this project and the results of survey.

Sites with previous records	Previous record date	Results from this survey (2013)	
		Scats	Photo
Cranbrook area, approximately	1909	Location too vague to re-survey	
Frankland River, approximately	1912	Location too vague to re-survey	
Cranbrook area	1954	Location too vague to re-survey	
Rocky Gully area	1954	Location too vague to re-survey	
Tenterden Nature Reserve	1970	Yes	Yes
Yellerup Nature Reserve	1983	Hard to access, not surveyed	
South Jingalup Nature Reserve	1984, 2005	Yes	Yes
Warrenup Nature Reserve	1986	No	No
Jingalup Nature Reserve	1989	No	No cameras
Mongelup Nature Reserve	1990	No	No cameras

Rock Hole Dam Nature Reserve	1993	Yes (fresh)	Yes
Water Reserve 39621 (Wandoo Rd.)	2005	Not surveyed	
Mondurup Views	2007	Not surveyed- Black-gloved Wallaby's still present (landholder)	
New sites assessed – Black-gloved Wallaby detected			
Chininup NR	NA	Yes	Yes
L-shaped-Site 1	NA	Yes	No
L-shaped-Site 2	NA	Yes	Yes
L-shaped-Site 3	NA	Yes	No
Stockyard Rd WR-Site 1	NA	Yes	No
Stockyard Rd WR-Site 2	NA	Yes	Yes
Nunijup WR	NA	Yes (fresh)	Yes
Tenterden NR	NA	Yes	Yes
James S Tohl, Overidge Rd	NA	Yes	No
Murray P Gibbs, Shamrock Rd	NA	Yes	No
B & T Smith, Private property – adjacent to Rockhole Dam reserve	NA	Landholder report Black-gloved Wallaby using remnant, not surveyed	
Quindinup NR-Site 1	NA	Yes	Yes
Quindinup NR-Site 2	NA	Yes	Yes
New sites assessed – Black-gloved Wallaby not detected			
Lake Nunijup	NA	No	No cameras
Reserve 1km north of Tenterden adjacent to railway line - -Crown Reserve 686	NA	No	No cameras
Shire Reserve south of Tenterden on Albany Hwy - Crown Reserve 25763	NA	No	No cameras
Orchid NR	NA	No	No cameras
Remnant on corner of Yerreminup Rd and Frankland-Cranbrook Rd	NA	No	No cameras
Mongellup NR	NA	No	No cameras
Geekabee Hill	NA	No	No cameras
Brian C Bunker, Westcup Farm, Stockyard Rd	NA	No	No cameras
Corbellup NR	NA	No	No cameras
Geekabee Hill, northern edge farm boundary	NA	No	No cameras
Andrew K Toovey, Boyacup Farm, Boyacup Rd	NA	No	No cameras
Tootenellup NR	NA	No	No cameras
Alan Hordacre, Ballijup Farm, Nunijup Rd, NE cnr block	NA	No	No cameras
Noobijup NR	NA	No	No cameras

Remote Camera

At the sites where Black-gloved Wallaby photos were obtained the average number of camera trapnights ranged from 14-49, and the number of trapnights it took to obtain a photo (minimum trapping effort) ranged from 2 to 28. Based on this, sites where no photos were obtained with trapping efforts above at least 49 may have been expected to obtain a photo if Black-gloved wallabies were currently using the site. For those below 49 trapnights, it is assumed that further trapping would possibly return a positive result.

Photographic rate can be used in some instances to give a relative index of abundance or activity, provided only independent images are counted (i.e. images that can be assumed to be of different individuals). The definition of independence can be quite subjective. Here independent images are classed as those that are certainly different individuals (male vs female) or are different “captures” (separated by 15 minutes, different camera or different night). Differences in photographic rate should be interpreted with caution and act only as a possible guide to areas with more or less abundance or activity.

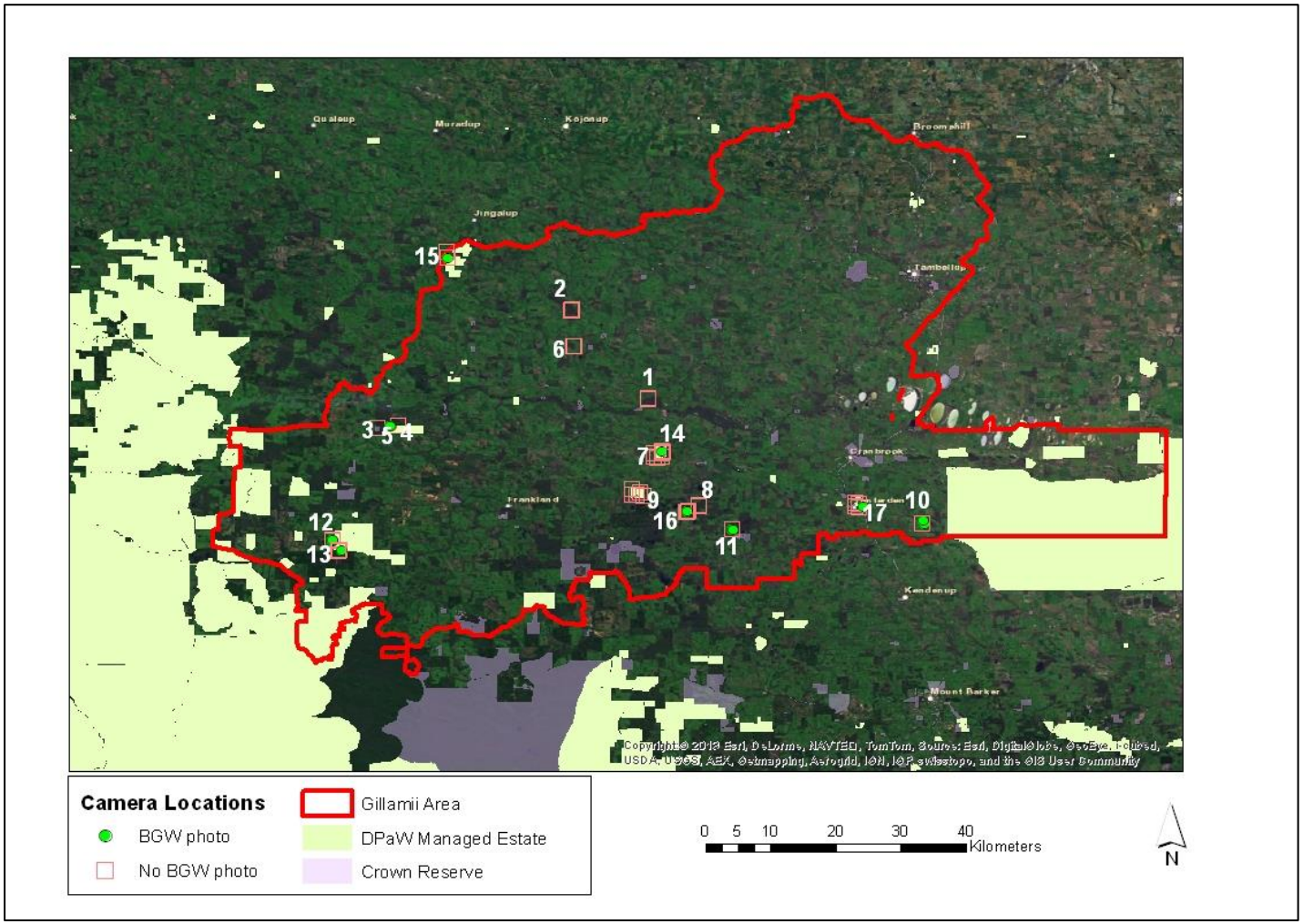


Figure 17: Locations of cameras installed to detect Black-gloved wallabies and photo results for each camera site. *Site numbers refer to those in Table 2.*

Table 2: Results from remote camera trapping. *Number of camera trapnights = no. nights set X no. of cameras; Independent images are those that are certainly different individuals (male vs female) or are different "captures" (separated by 15 minutes, different camera or different night); Minimum trapping effort = no.cameras set X no. nights to first detection (>X then more trapping effort may have resulted in a photo); photographic rate = no. independent images/no. camera trapnights.*

Site	Site number	Number of nights cameras set	Number of cameras set	Number of camera trapnights	Black-gloved Wallaby detected?	First night Black-gloved Wallaby detected	Number of nights Black-gloved Wallaby detected on	Number of cameras Black-gloved Wallaby detected on	Number of images of Black-gloved Wallaby	Number of independent images of Black-gloved Wallaby	Minimum trapping effort	Photographic rate
Andrew K Toovey, Boyacup Farm, Boyacup Rd	**1**	8	3	24	n						>24	0
James S Tohl, Overidge Rd	**2**	7	6	42	n						>42	0
L-shapedS1	**3**	7	3	21	n						>21	0
L-shapedS3	**4**	7	2	14	n						>14	0
Murray P Gibbs, Shamrock Rd	**6**	18	5	90	n						>90	0
Rockhole Dam_Site 1	**7**	10	5	50	n						>50	0
StockyardRd_S1_1	**8**	5	4	20	n						>20	0
StockyardRd_S1_2	**8**	9	6	54	n						>54	0
StockyardRd_S1_3	**8**	8	3	24	n						>24	0
Warrenup NR	**9**	5	10	50	n						>50	0
Chininup NR	**10**	6	3	18	y	1	1	1	2	1	3	0.05
L-shapedS2	**5**	7	2	14	Y	1	5	2	37	11	2	0.78
Nunijup WR	**11**	9	3	27	y	3	4	2	13	4	9	0.15
Quindinup NR_site 1	**12**	7	6	42	y	4	4	5	10	7	24	0.16
Quindinup NR_site 2	**13**	7	4	28	y	2	4	1	33	4	6	0.02
Rockhole Dam_Site 2	**14**	7	4	28	y	7	1	1	2	2	28	0.07
South Jingalup NR Site2	**15**	5	4	20	y	5	1	1	7	1	20	0.05
StockyardRd_S2_1	**16**	7	7	49	y	2	2	1	3	2	14	0.04
Tenterden NR	**17**	6	5	30	y	2	1	1	1	1	10	0.03

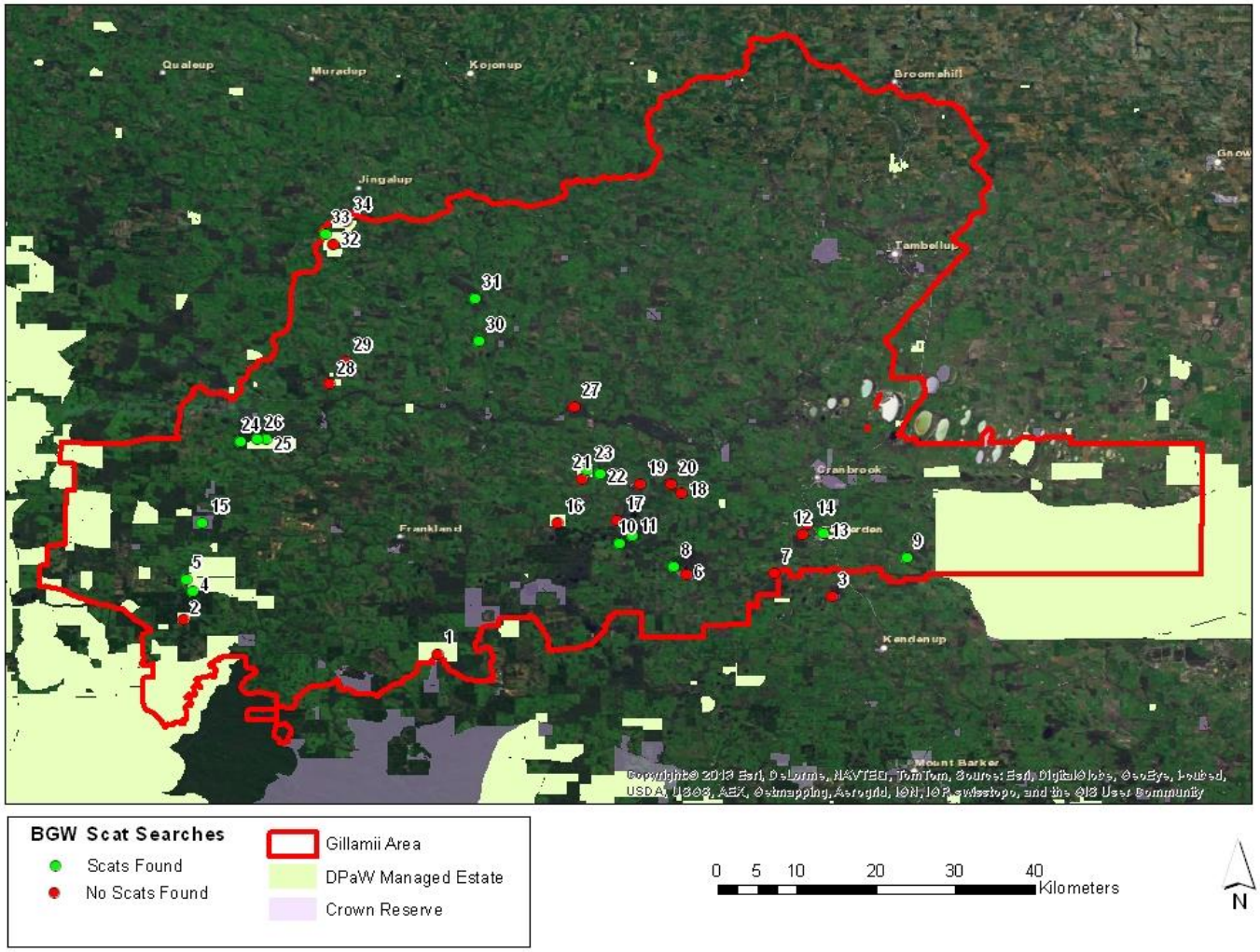


Figure 18: Sites searched for Black-gloved Wallaby scats and results of search. *Numbers correspond to numbers in Appendix 2.*

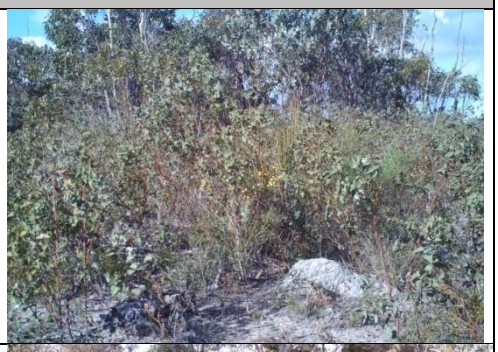
Black-gloved Wallaby presence and vegetation type

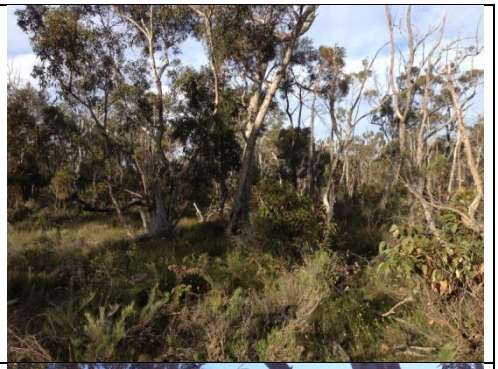
The very broad vegetation type of the site where Black-gloved Wallabies were caught on camera is shown in Table 3. Animals were recorded in a variety of broad vegetation types from Mallee-Heath close to the Stirling Range NP to Jarrah/Wandoo woodland in the centre of the Gillamii Area and Jarrah/ Marri Forest closer to the forested regions.

A more detailed vegetation survey of two of these sites (Tenterden NR and Rock Hole Dam NR) is currently underway to determine more fine scaled vegetation mapping at these sites and to inform vegetation species mix and spacing for revegetation works (Sandiford 2014). This survey indicates that vegetation types where Black-gloved Wallabies occur are quite varied, providing both dense areas for sheltering and more open areas for feeding.

In addition to vegetation type other factors which are associated with Black-gloved wallaby presence and would contribute to an understanding of how Black-gloved Wallabies are using the landscape are remnant size, remnant isolation/connectivity and fire history.

Table 3: Sites where Black-gloved Wallaby's were caught on camera and broad vegetation types.

Site	Vegetation type	
Chininup	**Mallee-heath**	
StockyardRd_Site 2 **L-shaped_Site 2** **Quindinnup NR_site 1** **Quindinnup NR_site 2**	**Medium forest; jarrah-marri**	

Nunijup WR **Jingalup South NR** **Tenterden NR**	**Medium forest; jarrah-marri and wandoo**	
Rockhole Dam_Site 2	**Medium woodland; wandoo, jarrah & yate**	

Recommendations

A number of actions are recommended to further knowledge on distribution, connectivity requirements and habitat associations of the targeted fauna within the Gillamii Area. This will aid in the management of the Area to benefit these species plus other species with similar requirements.

- Carry out further survey for Black-gloved wallabies particularly along major linkages e.g. Gordon and Frankland Rivers, in order to determine if there is any exchange of Black-gloved Wallaby's between remnants. Encourage landholder sightings along these corridors.

- Determine vegetation associations of Black-gloved Wallabies to inform revegetation practice.

- Determine correlations between remnant size and isolation/connectivity, fire age and presence of Black-gloved wallabies.

- Carry out a scat decay trial for Black-gloved wallabies to assist with identifying current use based on scat observations.

- Determine detection probabilities using remote cameras for Black-gloved Wallabies within the Gillamii Area.

- Set up monitoring sites at selected locations for Black-gloved Wallabies to assess effectiveness of revegtation and fencing on Black-gloved Wallaby use of remnants, using monitoring protocols developed for Restoring Gondwana.

- Using the distributional data collected in the project, perform a strategic assessment of how best to increase connectivity for Black-gloved Wallabies within the Gillamii Area. For example carry out an MCAS analysis to prioritise areas for revegetation that will provide the most benefit to Black-gloved Wallabies.

- Investigate translocation of Red-tailed Phascogales into Tambellup WR. This should involve a more extensive survey of the reserve, liaison with Tambellup Shire about current management of the reserve and close collaboration with DPaW with regard to any potential translocation proposal.

- Determine the extent of the outlying Bandicoot population, and encourage fox baiting by landholders within the area and surrounds.

- Encourage landholders and the community to report any sightings of the mammals discussed in the report, particularly Bandicoots, Red-tailed Phascogales and Numbats.

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APPENDICES

APPENDIX 1: Location of cameras deployed for the detection of Black-gloved Wallaby's and Quendas, and camera results.

Location	Site	camera	latitude	longitude	date set	date retrieved	no. nights	Target species detected?
Quendas								
Brickhouse Rd		RECONYX 1, 2 and 3	-34.25615	117.66018	01-Nov-13	07-Nov-2013	6	n
Brickhouse Rd		RECONYX 1	-34.25762	117.65953	07-Nov-13	19-Nov-2013	12	n
Brickhouse Rd		BHA 010	-34.25773	117.65925	07-Nov-13	19-Nov-2013	12	n
Brickhouse Rd		UQ 010	-34.25773	117.65910	07-Nov-13	19-Nov-2013	12	n
Brickhouse Rd		RECONYX 3	-34.25760	117.65908	07-Nov-13	19-Nov-2013	12	not working
Brickhouse Rd		RECONYX 2	-34.25772	117.65960	07-Nov-13	19-Nov-2013	12	not working
Brickhouse Rd		BHA 011	-34.25772	117.65968	07-Nov-13	19-Nov-2013	12	n
Brickhouse Rd		BHA 17	-34.25785	117.65977	07-Nov-13	19-Nov-2013	12	n
Brickhouse Rd		BHA 02	-34.25788	117.65955	07-Nov-13	19-Nov-2013	12	n
Brickhouse Rd		BHA 01	-34.25793	117.65940	07-Nov-13	19-Nov-2013	12	n
Brickhouse Rd		BHA 04	-34.25798	117.65940	07-Nov-13	19-Nov-2013	12	n
Lehmans		RECONYX 1	-34.24754	117.68053	03-Dec-13	13-Dec-13	10	n
Lehmans		RECONYX 2	-34.24746	117.68064	03-Dec-13	13-Dec-13	10	n
Lehmans		RECONYX 3	-34.24744	117.68057	03-Dec-13	13-Dec-13	10	n
Black-gloved Wallaby								
Chininup Rd. Reserve		BHA16	-34.38635	117.65338	03-Jul-13	9-Jul-13	6	y
Chininup Rd. Reserve		RECONYX 2	-34.38236	117.65318	03-Jul-13	9-Jul-13	6	y
Chininup Rd. Reserve		UQ011	-34.38683	117.65154	03-Jul-13	9-Jul-13	6	n
Jingalup Sth NR		BHA03	-34.01816	116.99371	18-Jul-13	23-Jul-13	5	n
Jingalup Sth NR		BHA05	-34.01826	116.99379	18-Jul-13	23-Jul-13	5	n

Jingalup Sth NR		BHA16	-34.01089	116.99285	18-Jul-13	23-Jul-13	5	n
Jingalup Sth NR		BHA19	-34.01820	116.99448	18-Jul-13	23-Jul-13	5	y
L-Shaped Reserve	Site 1	RECONYX 1	-34.25436	116.89761	17-Apr-13	24-Apr-13	7	n
L-Shaped Reserve	Site 1	RECONYX 3	-34.25413	116.89728	17-Apr-13	24-Apr-13	7	n
L-Shaped Reserve	Site 1	UQ008	-34.25423	116.89727	17-Apr-13	24-Apr-13	7	n
L-Shaped Reserve	Site 3	UQ007	-34.25171	116.92585	17-Apr-13	24-Apr-13	7	n
L-Shaped Reserve	Site 3	UQ014	-34.25146	116.92651	17-Apr-13	24-Apr-13	7	n
L-Shaped Reserve	Site 2	RECONYX 2	-34.25104	116.91547	17-Apr-13	24-Apr-13	7	y
L-Shaped Reserve	Site 2	UQ011	-34.25098	116.91496	17-Apr-13	24-Apr-13	7	y
Rockhole Dam NR		BHA15	-34.29608	117.28472	05-Mar-13	15-Mar-13	10	n
Rockhole Dam NR		PIXCONTROLOR	-34.28913	117.28020	05-Mar-13	15-Mar-13	10	n
Rockhole Dam NR		RECONYX 1	-34.29389	117.28006	05-Mar-13	15-Mar-13	10	n
Rockhole Dam NR		UQ008	-34.29517	117.29025	05-Mar-13	15-Mar-13	10	n
Rockhole Dam NR		UQ014	-34.28926	117.29051	05-Mar-13	15-Mar-13	10	n
Stockyard Rd WR	Site 1	Reconyx 1	-34.36172	117.34135	18-Jul-13	23-Jul-13	5	n
Stockyard Rd WR	Site 1	Reconyx 2	-34.36188	117.34101	18-Jul-13	23-Jul-13	5	n
Stockyard Rd WR	Site 1	Reconyx 3	-34.36194	117.34125	18-Jul-13	23-Jul-13	5	n
Stockyard Rd WR	Site 1	UQ008	-34.36150	117.34172	18-Jul-13	23-Jul-13	5	n
Stockyard Rd WR	Site 1	UQ011	-34.36161	117.34146	18-Jul-13	23-Jul-13	5	n
Tenterden NR		BHA04	-34.35828	117.55879	15-Mar-13	21-Mar-13	6	n
Tenterden NR		BHA05	-34.36417	117.56288	15-Mar-13	21-Mar-13	6	n
Tenterden NR		RECONYX 2	-34.36272	117.55773	15-Mar-13	21-Mar-13	6	n
Tenterden NR		UQ011	-34.35981	117.56387	15-Mar-13	21-Mar-13	6	n
Tenterden NR		UQ014	-34.36372	117.56922	15-Mar-13	21-Mar-13	6	y
Warenup NR		BHA04	-34.33927	117.24869	05-Mar-13	15-Mar-13	10	n
Warenup NR		BHA06	-34.34778	117.24915	05-Mar-13	15-Mar-13	10	n
Warenup NR		RECONYX 2	-34.34633	117.25613	05-Mar-13	15-Mar-13	10	n
Warenup NR		RECONYX 3	-34.34402	117.26064	05-Mar-13	15-Mar-13	10	n
Warenup NR		UQ011	-34.34919	117.26457	05-Mar-13	15-Mar-13	10	n

Water Reserve Nunijup		UQ011	-34.39541	117.38846	09-Jul-13	18-Jul-13	9	y
Water Reserve Nunijup		UQ014	-34.39532	117.38855	09-Jul-13	18-Jul-13	9	n
Water Reserve Nunijup		UQ016	-34.39563	117.38881	09-Jul-13	18-Jul-13	9	y
Stockyard Rd WR	Site 1	BHA19	-34.36128	117.34174	09-Jul-13	18-Jul-13	9	n
Stockyard Rd WR	Site 1	RECONYX 3	-34.36255	117.34124	09-Jul-13	18-Jul-13	9	n
Stockyard Rd WR	Site 1	RECONYX 3	-34.36166	117.34140	09-Jul-13	18-Jul-13	9	n
Stockyard Rd WR	Site 1	UQ007	-34.36223	117.34138	09-Jul-13	18-Jul-13	9	n
Stockyard Rd WR	Site 1	UQ007	-34.36137	117.34154	09-Jul-13	18-Jul-13	9	n
Stockyard Rd WR	Site 1	UQ008	-34.36164	117.34128	09-Jul-13	18-Jul-13	9	n
Rockhole Dam NR	Site 2	UQ010	-34.28706	117.29073	19-Sep-13	26-Sep-13	7	n
Rockhole Dam NR	Site 2	UQ090	-34.28715	117.29104	19-Sep-13	26-Sep-13	7	y
Rockhole Dam NR	Site 2	Reconyx 1	-34.28691	117.29149	19-Sep-13	26-Sep-13	7	n
Rockhole Dam NR	Site 2	Reconyx 2	-34.28798	117.29167	19-Sep-13	26-Sep-13	7	n
Stockyard Rd WR	Site 1	Reconyx 3	-34.36265	117.34124	03-Jul-13	9-Jul-13	8	n
Stockyard Rd WR	Site 1	UQ008	-34.36164	117.34128	03-Jul-13	9-Jul-13	8	n
Stockyard Rd WR	Site 1	UQ007	-34.36223	117.34138	03-Jul-13	9-Jul-13	8	n
Stockyard Rd WR	Site 2	Reconyx 1	-34.36942	117.32672	26-Sep-13	2-Oct-13	6	n
Stockyard Rd WR	Site 2	Reconyx 2	-34.37091	117.32427	26-Sep-13	2-Oct-13	6	n
Stockyard Rd WR	Site 2	Reconyx 3	-34.36987	117.32629	26-Sep-13	2-Oct-13	6	y
Stockyard Rd WR	Site 2	UQ007	-34.37027	117.32658	26-Sep-13	2-Oct-13	6	n
Stockyard Rd WR	Site 2	UQ008	-34.37074	117.32509	26-Sep-13	2-Oct-13	6	n
Stockyard Rd WR	Site 2	UQ009	-34.37140	117.32496	26-Sep-13	2-Oct-13	6	n
Stockyard Rd WR	Site 2	UQ011	-34.37061	117.32517	26-Sep-13	2-Oct-13	6	n
Tooveys	Site 1	Reconyx 1	-34.21447	117.27141	2-Oct-13	10-Oct-13	7	n
Tooveys	Site 1	Reconyx 2	-34.21401	117.27164	2-Oct-13	10-Oct-13	7	n
Tooveys	Site 1	Reconyx 3	-34.21425	117.27161	2-Oct-13	10-Oct-13	7	n
Tohls - Overidge Rd.		UQ008	-34.09023	117.16668	10-Oct-13	16-Oct-13	6	n
Tohls - Overidge Rd.		Reconyx 2	-34.09084	117.16590	10-Oct-13	16-Oct-13	6	n
Tohls - Overidge Rd.		UQ011	-34.09145	117.16559	10-Oct-13	16-Oct-13	6	n

Tohls - Overidge Rd.		Reconyx 1	-34.09183	117.16537	10-Oct-13	16-Oct-13	6	n
Tohls - Overidge Rd.		PixController	-34.09143	117.16697	10-Oct-13	16-Oct-13	6	n
Tohls - Overidge Rd.		UQXXX	-34.09176	117.16658	10-Oct-13	16-Oct-13	6	n
Tohls - Overidge Rd.		UQ007	-34.09183	117.16613	10-Oct-13	16-Oct-13	6	n
Gibbs		UQ009	-34.14091	117.16850	16-Oct-13	07-Nov-13	18	n
Gibbs		Reconyx 2	-34.14077	117.16842	16-Oct-13	07-Nov-13	18	n
Gibbs		Reconyx 3	-34.14089	117.16879	16-Oct-13	07-Nov-13	18	n
Gibbs		UQ011	-34.14103	117.16930	16-Oct-13	07-Nov-13	18	n
Gibbs		Reconyx 1	-34.14117	117.16965	16-Oct-13	07-Nov-13	18	n
Quindinup NR	Site 1	BHA010	-34.41035	116.83467	26-Nov-13	3-Dec-13	7	y
Quindinup NR	Site 1	Reconyx 1	-34.41065	116.83539	26-Nov-13	3-Dec-13	7	n
Quindinup NR	Site 1	BHA02	-34.41117	116.83564	26-Nov-13	3-Dec-13	7	y
Quindinup NR	Site 1	Reconyx 2	-34.40915	116.83481	26-Nov-13	3-Dec-13	7	y
Quindinup NR	Site 1	BHA 17	-34.40928	116.83514	26-Nov-13	3-Dec-13	7	y
Quindinup NR	Site 1	UQ008	-34.40982	116.83495	26-Nov-13	3-Dec-13	7	n
Quindinup NR	Site 2	UQ011	-34.42465	116.84331	26-Nov-13	3-Dec-13	7	n
Quindinup NR	Site 2	UQ007	-34.42413	116.84476	26-Nov-13	3-Dec-13	7	n
Quindinup NR	Site 2	UQ010	-34.42420	116.84744	26-Nov-13	3-Dec-13	7	y
Quindinup NR	Site 2	Reconyx 3	-34.42437	116.84224	26-Nov-13	3-Dec-13	7	n

Appendix 2: All sites searched for Black-gloved Wallabies

Scat search site	Scat search_site_no	Latitude	longitude	scats found?
Tootenellup NR	1	-34.49526	117.12037	N
Corbellup NR	2	-34.45594	116.83218	N
Shire Reserve S of Tenterden on Albany Hwy- Crown Reserve 25763	3	-34.4297	117.56871	N
Quindinup NR_ Site 1	4	-34.42465	116.84331	Y
Quindinup NR_Site 2	5	-34.41035	116.83467	Y

Lake Nunijup Reserve (Crown Reserve 29175)	6	-34.40558	117.40349	N
Ballijup NE Cnr block	7	-34.40336	117.503293	N
Nunijup Water Reserve, Stockyard Rd.	8	-34.39563	117.38881	Y
Chininup NR	9	-34.38635	117.65338	Y
Stockyard Rd. Water Reserve Site 2	10	-34.36942	117.32672	Y
Stockyard Rd. Water Reserve Site 1	11	-34.36128	117.34174	Y
Orchid NR	12	-34.35957	117.5359	N
Tenterden NR	13	-34.35828	117.55879	Y
Reserve just north of Tenterden adj railway line-Crown Reserve 686	14	-34.34796	117.54174	N
Crown Reserve 35307	15	-34.34666	116.85362	Y
Warrenup NR	16	-34.34636	117.25701	N
Bunkers	17	-34.342879	117.32496	N
Geekabee Hill Nature Reserve and SE corner	18	-34.31276	117.39725	N
Remnant on corner of Yerreminup Rd and Frankland-Cranbrook Rd	19	-34.30249	117.35021	N
Geekabee Hill, northern edge farm boundary	20	-34.3024	117.386	N
Rockhole Dam	21	-34.29608	117.28472	N
Smith, Private property – adjacent to Rockhole Dam reserve	22	-34.290759	117.3052	Y
Rockhole Dam- Hill	23	-34.28706	117.29073	Y
L-shaped Reserve Site 1	24	-34.25436	116.89761	Y
L-shaped Reserve Site 3	25	-34.25171	116.92585	Y
L-shaped Reserve Site 2	26	-34.25104	116.91547	Y
Tooveys	27	-34.21417	117.27569	N
Yellerup	28	-34.18841	116.9976	N
Mongellup NR	29	-34.163754	117.01648	N
Gibbs	30	-34.14016	117.16762	Y
Tohls	31	-34.091177	117.163065	Y
Jingalup Sth NR Site 1	32	-34.03022	117.00237	N
Jingalup Sth NR Site 2	33	-34.01816	116.99371	Y
Jingalup NR	34	-34.004	117.01709	N