

Black Mountain Symposium 2018 Background Paper No. 7

The mammal fauna of Black Mountain

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Abstract. This paper provides a brief review of the mammal fauna of Black Mountain in Canberra, Australian Capital Territory. Information was sourced from fauna surveys and records held in various wildlife databases. The mammal fauna of the area is reasonably diverse and typical of the fauna of the woodlands and forests in the north of the ACT, with at least 26 native mammal species and 10 introduced mammal species having been recorded. Since gazetted as a nature reserve in 1970, it is apparent that Black Mountain still conserves a diversity of mammals, with arboreal species being particularly abundant. A conspicuous exception is the loss of small ground-dwelling native mammals from the area.

1. Introduction

The ACT encompasses a broad range of habitats for fauna, from the high elevation montane forests in the south of the territory, to the lower elevation woodlands, forests and grasslands in the north where Black Mountain is located. As a result of fauna surveys, specimen collections and opportunistic observations by scientists and the public, the mammalian fauna of the north of the ACT is reasonably well known. It is moderately diverse, and includes a range of native mammals together with more recently introduced species such as rodents that are commensal with humans.

Although Black Mountain is located in the heart of Canberra, there have been surprisingly few systematic fauna surveys of the site since the mid 1970s, when Tidemann (1980) in 1974–75 undertook what appears to be the first fauna survey as part of an ecological impact assessment for an extension of the Australian National Botanic Gardens into Black Mountain Reserve. Since then two other significant fauna surveys of the reserve have involved mammals, one undertaken shortly after Tidemann in 1975–76 (Kukolic 1990) and another three decades later in 2005 (Buckmaster 2005; Buckmaster et al. 2010).

This paper provides a brief review of the accumulated data on the presence, absence, and where possible abundance, of mammals on Black Mountain since those first surveys four decades ago.

2. Methods

2.1 Study Area

The study area encompasses all parts of Black Mountain that have natural vegetation, including the nature reserve and parts of the Australian National Botanic Gardens.

2.2 Sources of information

Information on the historic and current mammalian fauna of Black Mountain was sourced from the results of fauna surveys and research studies, and from records held in databases such as the ACT Wildlife Atlas (ACT Government), Atlas of Living Australia (Commonwealth Government), the Australian Wildlife Collection (CSIRO) and Canberra Nature Map.

2.2.1 Surveys and research studies

Tidemann (1980) undertook trapping in 1974–75 on Black Mountain for small ground-dwelling mammals, spotlighting for nocturnal mammals and opportunistic observations, though specific details of the methods (number of traps, locations etc) are not mentioned.

The ACT Parks and Conservation Service carried out a more comprehensive fauna survey in 1975–76 (Kukolic 1990) that encompassed amphibians, reptiles, birds and mammals. Small ground-dwelling mammals were surveyed using the standard method of Elliot traps (small metal tunnel traps) baited with a peanut butter–rolled oats mixture. The traps were laid out along a transect line (about 100–200 m long), each line containing about 20 traps spaced at approximately 10 m intervals. Twelve transect lines were located across a broad range of aspect and vegetation types on Black Mountain. The traps were set for four nights and checked early each morning. Spotlighting was used to survey for nocturnal terrestrial and arboreal mammals. The survey also involved opportunistic observations and identification of faecal pellets. As bats were not surveyed, and information on them was obtained from existing records and expert knowledge, those recorded in Kukolic (1990) have not been included in this review.

Dickman (1980) surveyed for *Antechinus* species at various sites in the Canberra region, including Black Mountain, in 1978–79. Standard Elliot trapping methods were used, with between 45 and 200 traps placed at each site (the specific trapping details are not given for individual sites).

Martin (1995) surveyed fox abundance in urban Canberra (mostly through opportunistic sightings reported by the public and roadkills) for an Honours thesis.

Buckmaster et al. (2010) surveyed for small ground-dwelling mammals in 2005 at several locations in the ACT region, including Black Mountain, for an Honours thesis (Buckmaster 2005). The survey used Elliot traps baited with a standard mix of rolled oats, peanut butter and honey, together with foot-print tracking tunnels and hair-tubes (using the same bait as the Elliot traps). Sampling occurred along five transects that were distributed broadly across Black Mountain and located where Kukolic sampled in 1975–76 to provide a direct comparison. Approximately 25 Elliot traps were placed along each 250 m transect at about 10 m spacing. A foot print tunnel and a hair-tube were also placed near each Elliot trap.

Treadwell (2009) surveyed for microbats in eight urban reserves in Canberra, including Aranda and adjacent parts of Black Mountain, as part of a Masters thesis. Harp traps and ultrasound recording devices were placed in each reserve for between two and eight nights between 27 October and 21 December 2008.

The Conservation Research section of the ACT Government undertook a survey of small ground-dwelling mammals on Black Mountain in 2009 using 75 footprint tunnels baited with peanut butter and rolled oats, and left in the field for four nights. The footprint tunnels were placed at the same locations surveyed by Kukolic (1990) to provide a comparison.

Citizen science projects that have involved surveys for mammals on Black Mountain include Batwatch in 2013 (ultrasound surveys for bats in bushland adjacent to Black Mountain) (Pennay 2013) and the Centenary BioBlitz program undertaken in the same year (see Purdie 2018).

2.2.2 Museum and other miscellaneous records

Four databases were searched for mammal records from Black Mountain; they include species found in fauna surveys and opportunistic sightings. The ACT Wildlife Atlas is an ACT Government database that holds records of opportunistic sightings and records from fauna and flora surveys undertaken by the ACT Government and in some cases by other research institutions. The Australian Wildlife Collection is a CSIRO database that holds specimens and records of fauna from all over Australia. Canberra Nature Map contains citizen science records that, where possible, are verified by expert moderators (see Purdie 2018). The Atlas of Living Australia is an amalgamation of biological datasets from various sources, and sightings from citizen science projects and from the general public. Species identification (such as for bats) may not be accurate for Atlas records that are not specimen-backed; doubtful records of this type have not been included in this review.

Miscellaneous records of mammals on Black Mountain include opportunistic observations by ACT Government staff (mainly researchers and rangers) of live animals and road-killed

individuals, and a recent movement study (radio-tracking) of Eastern Grey Kangaroos on Black Mountain (ACT Government unpublished–a).

3. Results

A list of fauna recorded or observed on Black Mountain is provided in Table 1. They comprise one monotreme, 10 marsupials, 15 bats and 10 introduced mammals. The results of individual surveys are outlined below.

3.1 Survey by Tidemann 1974–75

Tidemann (1980) reports 26 mammal species having been recorded from two study areas on Black Mountain, comprising 19 native and seven introduced species. Native mammals include five ground-dwelling species, three arboreal species and 11 bat species. Tidemann (1980) compiled these records from his 1974–75 survey and other sources including the 1975–76 survey by Kukolic.

3.2 Survey by Kukolic 1975–76

Yellow-footed Antechinus (*Antechinus flavipes*) was the only native small ground-dwelling mammal detected in the survey by Kukolic (1990). The non-native small ground-dwelling mammals were Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*). Brushtail Possums (*Trichosurus vulpecula*) and Ringtail Possums (*Pseudocheirus peregrinus*) were frequently observed, and Sugar Gliders (*Petaurus breviceps*) were recorded only twice. Two of the four species of macropods occurring in the ACT were observed on Black Mountain: Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby (*Wallabia bicolor*). Kukolic (1990) did not observe Red-necked Wallabies (*Macropus rufogriseus*) but mentioned a record of a juvenile killed on Tuggeranong Parkway at the base of Black Mountain. No Common Wombats (*Vombatus ursinus*) or their burrows were observed on Black Mountain, though they were known to occur in the north of the ACT. Cats were occasionally seen though Kukolic (1990) was unable to determine if they were roaming domestic cats or feral/stray cats.

3.3 Antechinus survey by Dickman 1978–79

Yellow-footed Antechinus (*Antechinus flavipes*) and Agile Antechinus (*Antechinus agilis*) were both trapped on Black Mountain, and this remains the only record of sympatry for these species in the ACT (Dickman 1980). The number of individuals trapped of each species is not given for Black Mountain.

3.4 Ecology of foxes by Martin 1995

Martin (1995) observed foxes and a den on Black Mountain and road-killed foxes were found on the roads bordering the area.

3.5 Small mammal survey by Buckmaster 2005

The small ground-dwelling mammals detected at Black Mountain during the 2005 survey were all exotic (House Mouse and Black Rat); no native species were recorded (Buckmaster 2005; Buckmaster et al. 2010). However, small native ground-dwelling mammals were recorded at sites in NSW close to the ACT.

3.6 Microbat survey by Treadwell 2008

From a combination of trapping and ultrasound recording, Treadwell (2009) confirmed the presence of seven species of microbats in the Aranda–Black Mountain area. The trapping and ultrasound data collected during the study are more suitable for determining species richness than species abundance.

3.7 Survey by the ACT Government 2009

A survey for small ground-dwelling mammals using footprint tunnels in 2009 failed to detect any small mammals (either native or introduced species) on Black Mountain (ACT Government unpublished–b). Several of the footprint tunnels were disturbed by possums or foxes.

Table 1. Mammals recorded on Black Mountain, ACT

Scientific Name	Common Name	Source ^a
Monotremes		
<i>Tachyglossus aculeatus</i>	Echidna	CT, KK, WA, AL, NM
Marsupials		
<i>Antechinus agilis</i> ^b	Agile Antechinus	KK [#] , CD,
<i>Antechinus flavipes</i>	Yellow-footed Antechinus	KK, CD, CC
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	CT, KK, WA, CC, NM
<i>Macropus robustus</i>	Wallaroo	WA, NM
<i>Macropus rufogriseus</i>	Red-necked Wallaby	KK [#] ,
<i>Petaurus breviceps</i>	Sugar Glider	CT KK, WA, AL
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	CT, KK,
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	CT KK, WA, AL
<i>Vombatus ursinus</i>	Common Wombat	CT, WA, NM
<i>Wallabia bicolor</i>	Swamp Wallaby	KK, WA, AL, NM
Introduced species		
<i>Capra hircus</i>	Goat	WA
<i>Dama dama</i>	Fallow Deer	WA
<i>Cervus unicolor</i>	Sambar Deer	WA
<i>Felis catus</i>	Cat	CT, KK, AL
<i>Lepus europaeus</i>	European Brown Hare	CT
<i>Mus musculus</i>	House Mouse	CT, KK, AB,
<i>Oryctolagus cuniculus</i>	European Rabbit	CT, KK, WA, NM
<i>Rattus rattus</i>	Black Rat	CT, KK, AB, CC
<i>Sus scrofa</i>	Feral Pig	CT
<i>Vulpes vulpes</i>	European Fox	CT, KK, JM, WA, NM
Bats		
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	CT, MT, MP, WA, CC
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	CT, MT, MP, AL
<i>Miniopterus schreibersii oceanus</i>	Eastern Bent-winged Bat	AL
<i>Mormopterus</i> sp.3	Inland Free-tailed bat	CT
<i>Mormopterus</i> sp.4	South-eastern Free-tailed Bat	MT
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	CT, MT, CC
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	CC
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	CT, MP,
<i>Pteropus scapulatus</i>	Little Red Flying-fox	CT
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	WA
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	CT

<i>Tadarida australis</i>	White-striped Free-tailed Bat	CT, MT, MP, AL
<i>Vespadelus darlingtoni</i>	Large Forest Bat	MT, MP, CC, AL
<i>Vespadelus regulus</i>	Southern Forest Bat	CT, MP, CC
<i>Vespadelus vulturnus</i>	Little Forest Bat	CT, MT, MP

^a AB = Buckmaster (2010); AL = Atlas of Living Australia; CC = CSIRO wildlife collection; CD = Dickman (1980); CT = Tidemann (1980); JM = Martin (1995); KK = Kukolic (1990); KK# = reference to another source reported in Kukolic (1990); MP = Pennay (1013); MT = Treadwell (2009); NM = Canberra Nature Map; WA = ACT Government records (including Wildlife Atlas).

^b This species is referred to as *Antechinus stuartii* in ACT records prior to the late 1990s, when taxonomic revision split the species into *A. agilis* in the southern part of the distribution (which includes the ACT) and retained *A. stuartii* in the northern part of the distribution.

3.8 Museum and miscellaneous records

Six species not recorded in the preceding fauna surveys have been reported on Black Mountain in the ACT Government Wildlife Atlas, the Australian Wildlife Collection and/or Canberra Nature Map, namely, Wallaroo (*Macropus robustus*), Gould's Long-eared Bat (*Nyctophilus gouldi*), Eastern Horseshoe Bat (*Rhinolophus megaphyllus*), Goat (*Capra hircus*), Fallow Deer (*Dama dama*) and Sambar Deer (*Cervus unicolor*).

Microbats are highly mobile, and have been recorded foraging more than 1 kilometre (and up to 12 km for some species) from their roost site (Van Dyke and Strahan 2008), and so microbats recorded from bushland adjacent to Black Mountain (Aranda Nature Reserve, Bruce/O'Connor Ridge Nature Reserve) during surveys such as Batwatch are considered in this review to also be present (foraging and/or roosting) in Black Mountain Nature Reserve. The Canberra Nature Park Management Plan (1999) (ACT Government 1999) lists Common Dunnart (*Sminthopsis murina*) as being present on Black Mountain, though the source of this record was unable to be verified and so has not been included in Table 1. This species has been recorded from the north of the ACT, including Mulligans Flat Woodland Sanctuary (ACT Government unpublished–c).

3.9 Mammals 'missing' from Black Mountain

Mammals that have been recorded from the north of the ACT but not on Black Mountain include Spotted-tailed Quoll (*Dasyurus maculatus*), Common Dunnart (*Sminthopsis murina*) (though there is an unconfirmed record from Black Mountain), Koala (*Phascolarctos cinereus*) and Eastern Pygmy Possum (*Cercartetus nanus*). Records of these species occurring in the north of the ACT are from surveys and wildlife datasets such as the ACT Wildlife Atlas (ACT Government) and the Australian Wildlife Collection (CSIRO).

4. Discussion

The mammalian fauna of Black Mountain is reasonably diverse and typical of the fauna of the woodlands and forests in the north of the ACT. Four mammalian species recorded in the broader area that have not been recorded from Black Mountain are all species that are rare or uncommon in this landscape.

The five large native grazers that occur in the ACT (Eastern Grey Kangaroo, Wallaroo, Red-necked Wallaby, Swamp Wallaby and Common Wombat) have all been recorded on Black Mountain. Its forests and woodlands support populations of all three arboreal species that occur in the north of the ACT (Brushtail Possum, Ringtail Possum and Sugar Glider). Two of the three small native ground-dwelling mammals recorded in the north of the ACT have also been recorded on Black Mountain (Agile Antechinus and Yellow-footed Antechinus), with an unconfirmed report of the third species (Common Dunnart) from the site. All microbat species known to occur in the north of the ACT have been recorded from Black Mountain (or in bushland adjacent to it), either flying (ultrasound identification) or as hand-collected specimens. The two Flying-fox species present in the ACT (Grey-headed Flying-fox and Little Red Flying-fox) have their

daytime roosting camp in Commonwealth Park next to Lake Burley Griffin, but have been recorded flying in the vicinity of, or over, Black Mountain; it is likely that any eucalypts flowering on the mountain would be visited by these large bats. No threatened mammal species have been recorded from Black Mountain (with the exception of Grey-headed Flying-foxes flying in the vicinity).

Introduced mammals that are commensal with humans and common in Canberra suburbs (House Mouse, Black Rat) are present on Black Mountain, together with introduced species more typical of the surrounding rural or bushland landscape (Rabbit, European Red Fox and cat).

Surveys for mammals on Black Mountain have been largely aimed at detecting the presence or absence of species rather than determining abundance. Results of these surveys therefore do not lend themselves to assessing changes in abundance of mammal species over time. Nevertheless, it is apparent that some arboreal species have remained common (Brushtailed Possum, Ringtailed Possum) whereas small ground-dwelling mammals have not fared well over the past few decades. Both species of *Antechinus* appear to have disappeared from Black Mountain since the 1970s, a trend for these species that is reflected in the broader landscape including other nature reserves (Buckmaster et al. 2010; ACT Government unpublished–d). The 2009 survey by Conservation Research (ACT Government) using footprint tunnels did not detect any small ground-dwelling mammals, suggesting that both native and introduced small ground-dwelling mammals were rare or absent on Black Mountain at that time.

Buckmaster et al. (2010) concluded that the apparent local extinction of both species of *Antechinus* on Black Mountain is mainly due to a combination of habitat simplification and increased predation from introduced predators (foxes and cats). These researchers found *Antechinus* to be present in non-urban areas outside the ACT that had a higher abundance of leaf litter and logs. More frequent fire in urban ACT reserves, including Black Mountain, tend to result in fewer logs and less leaf litter. A reduction in this ground shelter for small mammals is likely to increase their susceptibility to predators such as owls, foxes and cats. Higher levels of illumination at night in urban reserves may also increase the susceptibility of small mammals to predation. Populations of introduced mammals such as the House Mouse and Black Rat, are likely to be able to sustain relatively high levels of predation on Black Mountain because individuals can immigrate from the adjacent urban matrix. Conversely, the urban matrix is likely to be a barrier to *Antechinus* and thus once the population on Black Mountain has been extirpated, there may be little chance of recolonization.

5. Implications for conservation of mammals

The 400 ha forest and woodland reserve of Black Mountain supports moderate densities of the two arboreal mammal species and of Eastern Grey Kangaroos (population of at least 100 individuals). Swamp wallabies and echidnas appear to be reasonably abundant, whereas the other macropods (wallaroos and red-necked wallabies) are uncommon and wombats are observed only rarely, suggesting there may be limited habitat available for these species in the reserve. Bat diversity is high and reflects the species present in the wider landscape. Native ground-dwelling mammals have apparently become locally extinct in the reserve.

Black Mountain is largely surrounded by urban areas and bounded by major roads that separate it from the adjacent smaller reserves of Bruce/O'Connor Ridge to the north and Aranda Bushland to the west. The roads and urban areas are likely to be barriers to movement (and a source of mortality) for mammals to varying extents depending on species. Barriers to movement have implications for recolonization following local extinction and for maintaining biodiversity and genetic diversity. Eastern Grey Kangaroos are known to move between Black Mountain and adjacent bushlands (as evidenced by opportunistic observations, radio-tracking and road-killed kangaroos), and it is likely that there is also some emigration and immigration of the other three macropod species between Black Mountain and adjacent bushland. The extent of movement of arboreal mammals between Black Mountain and adjacent habitat is uncertain, but may be

sufficient to maintain genetic diversity of the Black Mountain populations (i.e. immigration of one breeding individual per generation).

The presence of introduced predators (foxes and roaming domestic or feral cats) combined with habitat simplification (frequent burns), habitat fragmentation (major roads) and possibly other factors such as night time illumination from the urban area, pose a significant challenge for conserving small native ground-dwelling mammals in Canberra's urban reserves, including Black Mountain.

6. References

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