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# The diet of dingoes, feral cats and eastern barn owl on Pullen Pullen Reserve, southwest Queensland.

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## Summary text

We compare the diet of dingo, feral cat and eastern barn owl using scat, stomach and pellets collected from a significant conservation reserve in southwest Queensland. We found that dingo diet was dominated by macropods, while the diet of feral cat and barn owl was dominated by small mammals. We found no remains of threatened species but recommend continued monitoring of predator diet as a tool to assist management.

## Key words

*Canis lupus dingo*, conservation, diet, dingo, eastern barn owl, *Felis catus*, feral cat, macropods, night parrot, *Pezoporus occidentalis*, predation, scat, threatened species, *Tyto delicatula*.

**Abstract**

Predator diet can provide important data to inform management actions as well as an enhanced understanding of the fauna of a region. The diet of dingo (*Canis lupus dingo*), feral cat (*Felis catus*) and eastern barn owl (*Tyto delicatula*) were compared using scat, stomach and pellets from a significant conservation reserve in southwest Queensland. Dingo diet was dominated by macropods, while the diet of feral cat and barn owl was dominated by small mammals. We found no remains of threatened species but recommend continued monitoring of predator diet as a tool to assist management.

## Introduction

Native and introduced predators consume billions of animals every year across Australia (Woinarski *et al.*, 2017a; Woinarski *et al.*, 2018; Doherty *et al.*, 2019; Murphy *et al.*, 2019; Woolley *et al.*, 2020). Introduced predators in particular have had, and continue to have, a catastrophic impact on native species (Woinarski *et al.*, 2015; Woinarski *et al.*, 2019); and dietary analysis can provide important data on prey preferences, regional variation, the scale of impact and the need for management intervention (Woinarski *et al.*, 2017a, 2017b; Murphy *et al.*, 2019).

At a property scale, monitoring the diet of predators can provide conservation land managers with information on what species are more frequently preyed upon, the need for intervention and appropriate control methods (Augusteyn *et al.*, 2020; McGregor *et al.*, 2020). Furthermore, predator diet can provide improved insight into the faunal assemblage of an area, especially for cryptic and rare species (Kutt e*t al.,* 2020). These methods can provide spatial and temporal data regarding predator and prey patterns, and their functional roles, critical to more cost-effective and targeted management (Linley *et al.*, 2020).

This study examined the diet of three predators (dingo (*Canis lupus dingo*), feral cat (*Felis catus*) and eastern barn owl (*Tyto delicatula*)) from scats, stomachs and pellets collected at an arid conservation reserve in Queensland's Channel Country. Although management of feral species on this reserve is a high priority due to the presence of endangered species such as the Night Parrot (*Pezoporus occidentalis*), there is uncertainty about which predators might prey on species of conservation significance. We compared the diet of each predator, the relative importance of prey items, and compared that data with concurrent fauna surveys on the reserve.

## Method

Predator diet samples were collected from Bush Heritage Australia's 56,000 ha Pullen Pullen Reserve (Fig. 1, -23°S, 142°E) between December 2017 and November 2019. Refer to Kutt *et al.* (2021) for a description of the reserve, its climate and vegetation.

Dingo and cat scats were collected, mostly opportunistically, across the reserve from July 2018 to August 2019 and analysed by Scats About Ecological (Majors Creek, NSW, Australia). Prey items in scats were identified to the lowest possible taxonomic class through comparison of remains with reference material or the literature (Watts and Aslin, 1981; Triggs and Brunner, 2002). Hair was identified using the technique described by Brunner and Coman (1974). Carrion was assumed if maggots co-occurred with individual samples.

Cat stomachs were collected during feral predator management on the reserve and neighbouring properties from December 2017 to November 2019. These were frozen and sent to Queensland Museum for content identification (by HJ and SGK). Prey items in cat stomachs were compared with reference material and identification keys (Van Dyck *et al.*, 2013). Hair analysis was not used to identify prey items in cat stomachs. Given the small number of cat scats, they were combined with the stomach samples for data presentation.

Barn owl pellets were collected from roosts in August and October 2019. Pellet age indicated the accumulation of weeks to months of prey items which likely covered the period of the other predator diet collection, and coincident with vertebrate fauna surveys carried out on the reserve (Kearney *et al.*, 2020). Prey identification (by SGK) was achieved through consultation of taxonomic literature (Archer, 1976, 1977, 1981; Watts and Aslin, 1981; Van Dyck *et al.*, 2013), museum reference specimens and relevant experts (Queensland Museum and Queensland University of Technology).

Index of relative importance (IRI) was calculated as: (numerical percentage + biomass percentage) x frequency of occurrence percentage (Hart *et al.*, 2002); where numerical percentage is the percentage of the total prey items for that predator; biomass percentage is the percentage of the total biomass; and frequency of occurrence percentage is the percentage of the total diet samples that the prey item was recorded in. Species biomass (mean weight) were taken from reference literature (Higgins and Davies, 1996; Higgins, 1999; Higgins *et al.*, 2001; Higgins *et al.*, 2006; Kutt, 2011; Van Dyck *et al.*, 2013; Kutt *et al.*, 2020). For prey items that were too large to be consumed by a predator in a day (e.g. macropods), biomass values were altered to reflect this. We follow Paltridge (2002) and assign a value of 500 g for these large prey items if consumed by cats and 1000 g for these prey items if consumed by dingoes. Mammal data from the fauna surveys (two surveys of 22 sites; Kearney *et al.*, 2020) were used for comparison with the species recorded in predator diets.

**Results and Discussion**

From 63 dingo scats, 12 cat scats, 38 cat stomachs and 156 barn owl pellets, 697 prey items were identified (Table 1). Fauna surveys recorded 38 individuals from 10 mammal species (Table 1; Kearney *et al.*, 2020). In each predator's diet, mammals were the most common prey, although percentages varied (Fig. 2). Mammals accounted for over two-thirds of the total prey items for dingoes and barn owl, but less than a half for cats (Fig. 2). Cats had the highest percentage of reptiles and birds, with each group accounting for over 20% of prey (Fig. 2). The diets of all predators were broadly like those reported in other studies in the region and throughout arid Australia (Kutt, 2011; Murphy *et al.*, 2018; Kutt *et al.*, 2020).

The diet of dingoes contained the fewest total species (n=8; Table 1) and had the lowest richness of mammals (Table 1). Macropods were by far the most important dietary item for dingoes, although birds ranked third (Table 1). For cats, *Sminthopsis macroura* ranked as the most important dietary items (Table 1), although beetles and birds were also important (ranking two and three, respectively; Table 1). Cats and barn owl had the highest richness of mammals, both containing 15 species (Table 1). For barn owl, *Leggadina forresti* and *Sminthopsis macroura* ranked one and two, respectively, with invertebrates ranking third (Table 1).

Ten mammal species, 40% of all of those recorded in this study, were recorded during fauna surveys (Table 1), with the additional 15 mammal species only recorded in dietary remains (Table 1). For example, *Rattus villosissimus* and *Antechinomys laniger* were only recorded in barn owl pellets, while cf. *Zyzomys* sp. was only recorded in a cat stomach. Additionally, amphibians were only recorded in barn owl diet, although it is likely due to sampling bias as frogs of the region are most active soon after rainfall events (Roberts and Edwards, 2018). The owl pellet samples represent prey available over wet and dry seasons, whereas the scat and stomach collections occurred only when the property was trafficable, that is the dry season when amphibians are not active.

*Pseudomys desertor, L. forresti* and *S. macroura* were recorded in every predator's diet, potentially indicating higher abundance of these species as available prey, which was supported by *P. desertor* and *S. macroura* being the mammals most commonly recorded during fauna surveys (Kearney *et al.*, 2020). Consistent with barn owl diet studies in the area (Palmer, 2001; Debus *et al.*, 2008, 2010), birds were a more important component of the diet here compared to other regions (Morton and Martin, 1979; McDowell and Medlin, 2009; Kutt *et al.*, 2020). This highlights the importance of continued monitoring of the diet of barn owl on the reserve due to the potential of predation of birds of conservation significance.

The consumption of macropods by cats provides a useful insight for potential management interventions. As recorded elsewhere in arid Australia, cats increase consumption of carrion (Catling, 1988) and novel foods (McGregor *et al*., 2020) when typical prey items become scarce. Further research is needed to better understand if and when carrion becomes an important component of the diet of cats on the reserve (e.g., seasonally), which may help inform opportunities for management approaches that are often considered ineffective, such as dead meat baits.

There are four important conclusions from this short study: (i) no threatened species were recorded in the diet of any predators; however the presence of many small mammals, including genera with threatened species (e.g. *Notomys*) and many birds suggest that the prospect of threatened species predation is real; (ii) the consumption of macropods by cats potentially indicates a degree of diet shifting from live prey to carrion at certain times and may provide useful pathways to management; (iii) traditional fauna survey methods used to inventory species on conservation reserves should be complemented by other methods that might reveal cryptic species and (iv) feral predator management on conservation reserves needs to involve not just regular control but the integration of a process of data collection and analysis to inform management approaches.

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**Conflicts of interest**

The authors declare no conflicts of interest.

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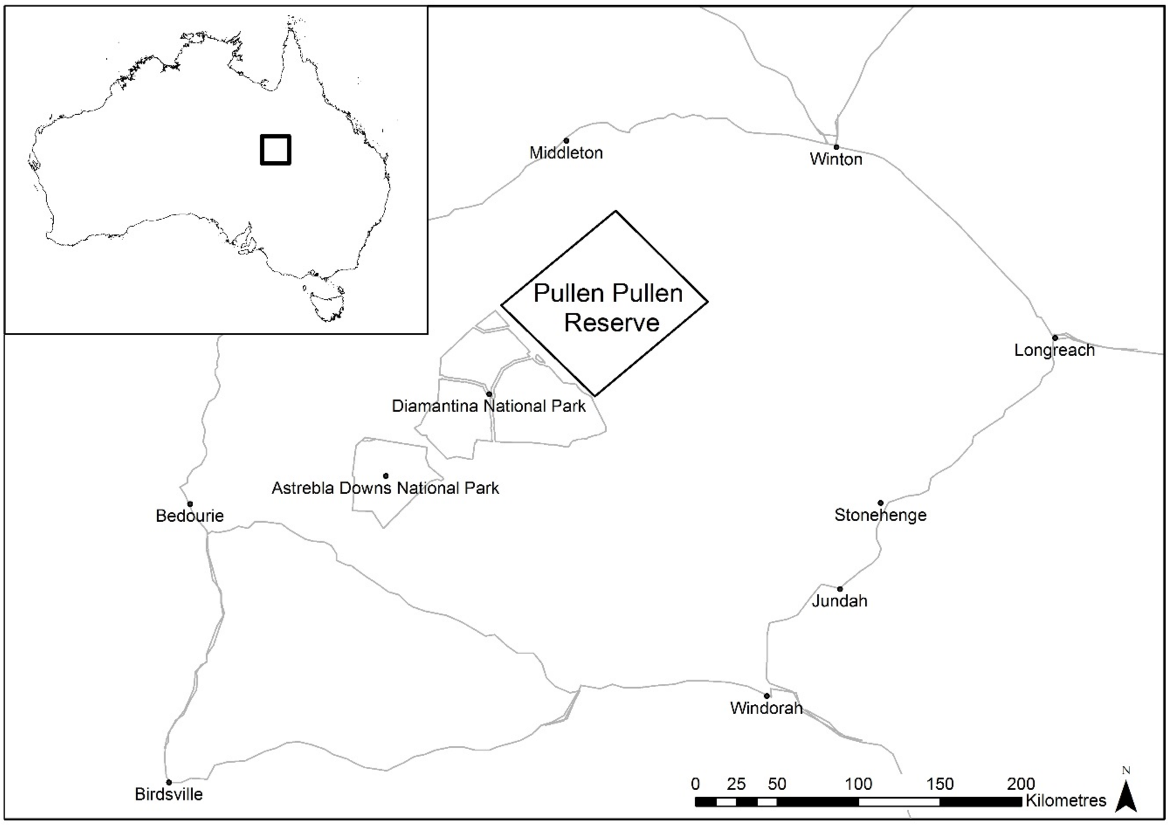


**Fig. 1.** The general location of Pullen Pullen Reserve in south-west Queensland. The exact location of the reserve is not shown, due to concerns of human disturbance on the night parrot.

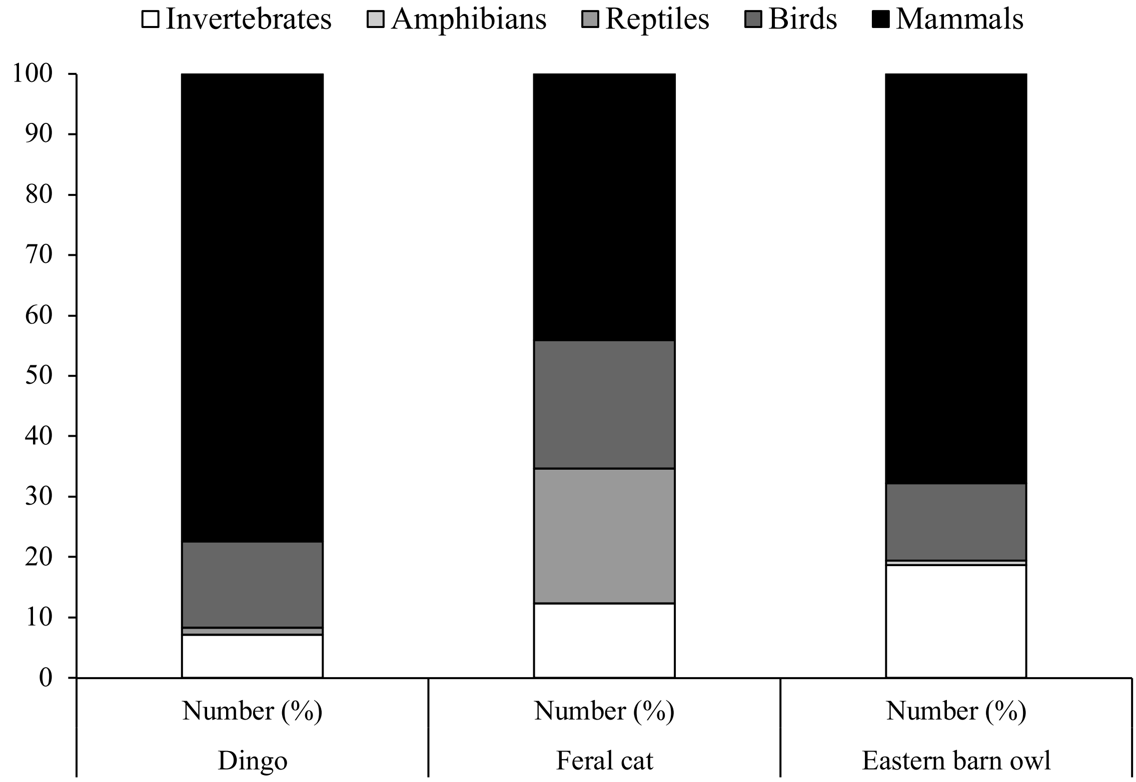


**Fig. 2.** The percentage of total distinguishable prey items (dingo n=84, feral cat n=211, eastern barn owl n=401) from each prey class in the diet of predators on Pullen Pullen Reserve.

**Table 1.** The importance of prey items for dingo, feral cat, and eastern barn owl on Pullen Pullen Reserve. **No.** is the total number of individuals in each prey category and **Freq.** is the total number of each predator's diet samples (scats, stomachs, or pellets) from which the prey was recorded. Where No. and Freq. were the same, the single value is shown; where No. and Freq. differed, Freq. is shown in square brackets. The No. and Freq. percentage are shown in the round brackets, respectively. **IRI** is the index of relative importance (see method). For IRI calculations, individuals identified as cf. species were combined with confirmed congeneric species. **Rank** is the order of importance. Rank values shown in bold are the top 10 ranked prey items for that predator. The Freq. percentage for the mammals recorded during fauna surveys are shown to provide a comparison with the mammals recorded in each predator's diet. **The unidentified parrots in the diet of the dingo and feral cat were not Night Parrot.

| | | **Dingo** | | | **Feral cat** | | | **Eastern barn owl** | | | **Fauna survey** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **No. & Freq. (%)** | **IRI** | **Rank** | **No. & Freq. (%)** | **IRI** | **Rank** | **No. & Freq. (%)** | **IRI** | **Rank** | **Freq. (%)** |
| **Invertebrates** | | | | | | | | | | | |
| Unidentified invertebrate | | - | - | - | - | - | - | 75 (18.7, 48.1) | 947.2 | **3** | n/a |
| Centipede | Chilopoda | - | - | - | 2 (0.9, 4.0) | 3.8 | 24 | - | - | - | n/a |
| Beetle | Coleoptera/Orthoptera | 4 (4.8, 6.3) | 30.3 | **5** | 24 (11.3, 48.0) | 545.8 | **2** | - | - | - | n/a |
| Crayfish | Parastacidae | 2 (2.4, 3.2) | 8.1 | **9** | - | - | - | - | - | - | n/a |
| **Amphibians** | | | | | | | | | | | |
| Amphibian sp. | | - | - | - | - | - | - | 3 (0.7, 1.9) | 2.2 | 17 | n/a |
| **Birds** | | | | | | | | | | | |
| Unidentified bird | Aves | 10 (11.9, 14.3) | 178.2 | **3** | 19 [17] (9.0, 34.0) | 326.6 | **3** | 13 (3.2, 8.3) | 55.9 | **7** | n/a |
| Unidentified parrot** | Aves | 2 (2.4, 3.2) | 8.1 | **10** | 3 (1.4, 6.0) | 9.3 | 13 | - | - | - | n/a |
| Peaceful Dove | *Geopelia cuneata* | - | - | - | 7 [4] (3.3, 8.0) | 28.3 | **9** | - | - | - | n/a |
| Budgerigar | *Melopsittacus undulatus* | - | - | - | 3 [2] (1.4, 4.0) | 6.0 | 21 | 7 (1.7, 4.5) | 20.4 | 12 | n/a |
| Variegated Fairy-wren | *Malurus lamberti* | - | - | - | 1 (0.5, 2.0) | 1.0 | 34 | - | - | - | n/a |
| Possible Grey Butcherbird | cf. *Cracticus torquatus* | - | - | - | 1 (0.5, 2.0) | 1.1 | 27 | - | - | - | n/a |
| Zebra Finch | *Taeniopygia guttata* | - | - | - | 10 [5] (4.7, 10.0) | 48.4 | **6** | 31 [13] (7.7, 8.3) | 105.7 | **5** | n/a |
| Australasian Pipit | *Anthus novaeseelandiae* | - | - | - | 1 (0.5, 2.0) | 1.0 | 31 | - | - | - | n/a |
| **Reptiles** | | | | | | | | | | | |
| Unidentified lizard | Squamata | - | - | - | 2 (0.9, 4.0) | 3.9 | 23 | - | - | - | n/a |
| Unidentified reptile | Squamata | - | - | - | 1 (0.5, 2.0) | 1.0 | 33 | - | - | - | n/a |
| Unidentified snake | Squamata | - | - | - | 4 [3] (1.9, 6.0) | 11.8 | 12 | - | - | - | n/a |
| Unidentified blind snake | *Anilios* sp. (probable) | - | - | - | 1 (0.5, 2.0) | 0.9 | 37 | - | - | - | n/a |
| Unidentified dragon | Agamidae | - | - | - | 4 (1.9, 8.0) | 15.4 | 11 | - | - | - | n/a |
| Unidentified gecko | Gekkonidae | - | - | - | 1 (0.5, 2.0) | 0.9 | 35 | - | - | - | n/a |
| Gecko | *Gehyra* sp. | - | - | - | 4 [2] (1.9, 4.0) | 7.6 | 20 | - | - | - | n/a |
| Variegated gecko | *Gehyra versicolor* | - | - | - | 1 (0.5, 2.0) | 0.9 | 35 | - | - | - | n/a |
| Unidentified skink | Scincidae | 1 (1.2, 1.6) | 1.9 | 13 | 7 [6] (3.3, 12.0) | 40.9 | **7** | - | - | - | n/a |
| Unidentified ctenotus | *Ctenotus* sp. | - | - | - | 20 [2] (9.4, 4.0) | 38.9 | **8** | - | - | - | n/a |
| Unidentified varanid | Varanidae | - | - | - | 1 (0.5, 2.0) | 1.0 | 28 | - | - | - | n/a |
| Varanidae | *Varanus acanthurus* | - | - | - | 1 (0.5, 2.0) | 1.6 | 26 | - | - | - | n/a |
| **Mammals** | | | | | | | | | | | |

| | | Dingo | | | Feral cat | | | Eastern barn owl | | | Fauna survey |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. & Freq. (%) | IRI | Rank | No. & Freq. (%) | IRI | Rank | No. & Freq. (%) | IRI | Rank | Freq. (%) |
| Unidentified mammal | Mammalia | - | - | - | 3 (1.4, 6.0) | 8.8 | 15 | - | - | - | - |
| Short-beaked Echidna | *Tachyglossus aculeatus* | 2 (2.4, 3.2) | 18.6 | **6** | - | - | - | - | - | - | 9 (40.9) |
| Unidentified macropod | Macropodidae | 11 (13.1, 17.5) | 561.4 | **2** | - | - | - | - | - | - | - |
| Common Wallaroo | *Osphranter robustus* | 4 (4.8, 6.3) | 74.2 | **4** | 2 (0.9, 4.0) | 7.8 | 19 | - | - | - | 1 (4.5) |
| Red kangaroo | *Osphranter rufus* | 39 (46.4, 61.9) | 7057.0 | **1** | 1 (0.5, 2.0) | 2.0 | 25 | - | - | - | 1 (4.5) |
| Unidentified dasyurid | Dasyuridae | - | - | - | - | - | - | 1 (0.2, 0.6) | 0.3 | 20 | - |
| Kultarr | *Antechinomys laniger* | - | - | - | - | - | - | 2 (0.5, 1.3) | 1.5 | 18 | - |
| Unidentified planigale | *Planigale* sp. | - | - | - | 5 (2.4, 10.0) | 23.9 | 10 | 10 (2.5, 6.4) | 21.1 | 11 | - |
| Narrow-nosed planigale | *Planigale tenuirostris* | - | - | - | - | - | - | - | - | - | 6 (27.3) |
| Unidentified dunnart | *Sminthopsis* sp. | - | - | - | 1 (0.5, 2.0) | 1.0 | 32 | 7 (1.7, 4.5) | 15.4 | 14 | - |
| Fat-tailed dunnart | *Sminthopsis crassicaudata* | - | - | - | 3 (1.4, 6.0) | 8.8 | 16 | 13 [11] (3.2, 7.1) | 41.2 | **8** | - |
| Stripe-faced dunnart | *Sminthopsis macroura* | 3 (3.6, 4.8) | 17.5 | **8** | 29 [22] (13.7, 44.0) | 628.1 | **1** | 81 [61] (20.2, 39.1) | 1633.6 | **2** | 5 (22.7) |
| Unidentified rodent | Muridae | - | - | - | 18 [7] (8.5, 14.0) | 125.3 | **5** | 10 (2.5, 6.4) | 36.5 | **9** | - |
| Unidentified rock-rat | cf. *Zyzomys* sp | - | - | - | 1 (0.5, 2.0) | 1.0 | 29 | | | | - |
| Desert short-tailed mouse | *Leggadina forresti* | 2 (2.4, 3.2) | 7.8 | 11 | 18 [14] (8.5, 28.0) | 248.1 | **4** | 78 [67] (19.5, 42.9) | 1727.8 | **1** | - |
| House mouse | Mus musculus | - | - | - | 2 (0.9, 4.0) | 3.9 | 22 | 6 [5] (1.5, 3.2) | 9.9 | 15 | - |
| Unidentified hopping-mouse | *Notomys* sp. | - | - | - | 1 (0.5, 2) | 1.0 | 30 | 6 (1.5, 3.8) | 16.2 | 13 | - |
| Fawn hopping-mouse | *Notomys cervinus* | - | - | - | 4 [2] (1.9, 4.0) | 8.1 | 18 | 31 [28] (7.7, 17.9) | 398.1 | **4** | - |
| Dusky hopping-mouse | *Notomys fuscus* | - | - | - | - | - | - | - | - | **-** | 2 (9.1) |
| Desert Mouse | *Pseudomys desertor* | 3 (3.6, 4.8) | 17.6 | **7** | 3 (1.4, 6) | 8.9 | 14 | 2 (0.5, 1.3) | 1.5 | 19 | 5 (22.7) |
| Sandy inland mouse | *Pseudomys hermannsburgensis* | - | - | - | 3 (1.4, 6) | 8.7 | 17 | 12 [11] (3.0, 7.1) | 34.6 | **10** | 5 (22.7) |
| Unidentified mouse | *Pseudomys* sp. | - | - | - | - | - | - | 5 [4] (1.2, 2.6) | 6.4 | 16 | - |
| Long-haired rat | *Rattus villosissimus* | - | - | - | - | - | - | 8 (2, 5.1) | 78 | **6** | - |
| Unidentified canid | *Canid* sp. | 1 (1.2, 1.6) | 4.6 | 12 | - | - | - | - | - | - | 3 (13.6) |
| Feral cat | *Felis catus* | - | - | - | - | - | - | - | - | - | 1 (4.5) |
| **Mammal richness** | | | | | | | | | | | |
| Total mammal species | | 8 | | | 15 | | | 15 | | | 10 |
| Unique mammal species | | | | | 1 | | | 2 | | | 1 |
| % of all mammal species / groups recorded | | 32% | | | 60% | | | 60% | | | 40% |