Mammal assemblages in Boonanarring Nature Reserve, Dandaragan Plateau, Western Australia from 1986 and 2012

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ABSTRACT

Although long term monitoring can provide land managers and researchers with insights into faunal changes there are few such programmes in Australia, and many conservation actions are implemented without assessment of their biodiversity benefits or costs. This study investigated the current status of native small mammals in the Boonanarring Nature Reserve (BNR), Western Australia, aiming to compare the contemporary distribution of mammals to those recorded 26 years ago.

Of particular importance is the evidence that no small mammal species have been lost from the reserve in the last 26 years; *Pseudomys albocinereus*, *Tarsipes rostratus* and *Sminthopsis* (sp)p. were recorded in both years' surveys. Records of *P. albocinereus* in this study are significant as they confirm the persistence of the species on the Dandaragan Plateau, whereas on the adjacent Swan Coastal Plain the species has not been recorded since 1987.

Overall, the persistence of small mammals in this reserve, unlike the nearby reserves on the Swan Coastal Plain (SCP), could be attributed to the mix of vegetation types within the reserve and the larger size of Boonanarring Nature Reserve. However, deficiencies in the monitoring programme were identified. There is a need to improve the long-term monitoring of small mammals within the BNR with long-term, repeat-measures, analysis and reporting.

KEYWORDS: Swan Coastal Plain, *Pseudomys albocinereus, Tarsipes rostratus, Sminthopsis*, ash grey mouse, monitoring

INTRODUCTION

Long term studies can provide researchers and land managers with insights into faunal changes over time, often in association with abiotic and biotic variables of change. However, biodiversity monitoring in Australia is limited and poorly coordinated (Natural Resource Management Ministerial Council 2010, Lindenmayer & Gibbons 2012, Lindenmayer *et al.* 2012). Managers and researchers who have worked in conservation biology in Australia are often disappointed by the absence of effective biodiversity monitoring that allows evaluation of how well Australia's natural heritage is managed (Garkaklis 2014). There are few long-term programmes, and many conservation actions are implemented without assessment of their biodiversity benefits or costs. Ultimately, a management decision must be made, but a manager needs to feel confident in making management intervention decisions (Varcoe 2012). There is a need to improve this with long-term, repeat-measures data, followed by its analysis and reporting. This is particularly relevant given Australia's significant extinction rate since European settlement (Woinarski *et al.* 2015).

Mammal extinctions and declines have occurred across the continent (McKenzie *et al.* 2007). Australian mammals, including those in the biodiversity hotspot of south-west Western Australia, have seen some of the highest extinction rates and include 50% of the world's extinction events since European settlement (Short & Smith 1994, Woinarski *et al.* 2015). Many factors have been implicated in these declines including climate change and a lack of rainfall, introduced predators, introduced herbivores and habitat modification (Burbidge & McKenzie 1989, McKenzie *et al.* 2007, Wilson *et al.* 2012, Woinarski *et al.* 2015). To conserve mammals, quantifying population trends over time in relation to management practices such as prescribed burning, predator control and abiotic changes such as habitat and climate change factors are pivotal in predicting populations in current and future conditions. This study employed sampling at two time points, 1986 and 2012, in Boonanarring Nature Reserve (BNR) in the south-west of Western Australia to examine changes in the species richness and abundances of mammals over recent decades.

Faunal declines in small isolated reserves are not unexpected (Fahrig 2002, Henle *et al.* 2004, Fischer & Lindenmayer 2006) but fauna populations in larger reserves may also be at risk. Boonanarring Nature

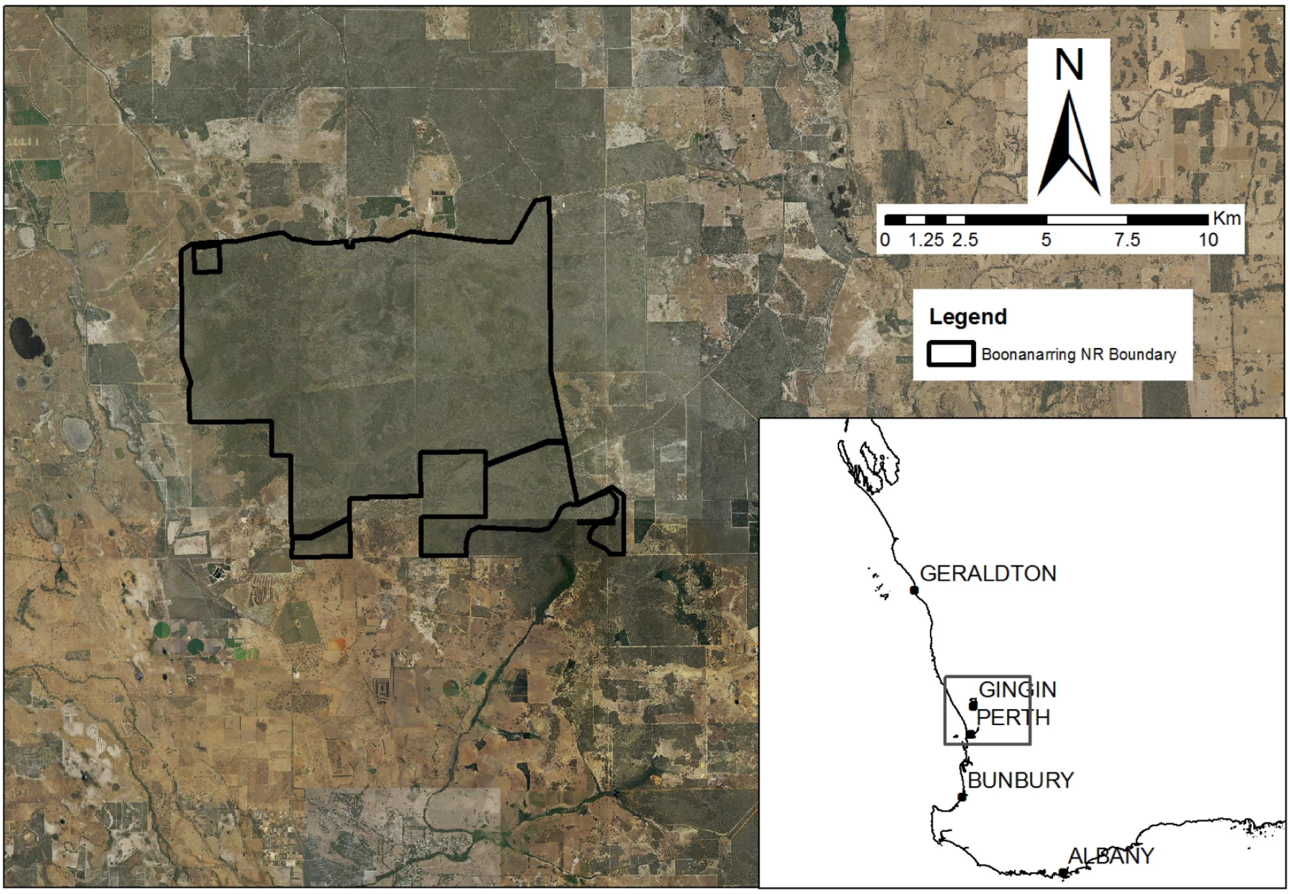

Figure 1. Location of Boonanarring Nature Reserve on the Swan Coastal Plain, Western Australia.

Reserve is located on the Dandaragan Plateau, which borders the Swan Coastal Plain (SCP) and Darling Scarp, near Gingin, Western Australia. Much of the Dandaragan Plateau has been extensively cleared and the dominant land use is dry-land agriculture (92.6%). Only 6.8% is remnant vegetation under conservation management and much of this is present in isolated patches (Department of Conservation and Environment 1983). Despite its isolation BNR has special significance, not only because it is one of the larger nature reserves covering >9000 ha with a level of connectivity to areas of surrounding natural vegetation totalling approximately 10, 000 ha. It contains the highest quality and most extensive example of conserved *Banksia* woodlands on Dandaragan soils with unique flora and fauna (Burbidge *et al*. 1996). It was surveyed in 1986 for vegetation and fauna (Burbidge *et al.* 1996) and broad scale vegetation mapping was conducted by Beard (1979) and Heddle *et al*. (1980), but no other biological surveys have been conducted in the reserve. Fauna surveys were thus carried out in 2012 to determine the current status of vertebrate fauna and mammal populations in the reserve.

Burbidge *et al*. (1996) captured three significant native small mammal species (*Pseudomys albocinereus* (ash grey mouse), *Tarsipes rostratus* (honey possum) and *Sminthopsis griseoventer* (grey bellied dunnart) in BNR, and identified fire and introduced predators as likely threats to native mammals. Within conservation lands, fire management by the Department of Parks and Wildlife aims to protect human life and property, and to a lesser degree biological diversity by reducing fuel loads that could lead to large wild fires. Prescribed burning occurs in BNR but planning for such burns is currently not focused on biological diversity or conservation of native species. Feral predators and weed invasion are other management issues across reserves in south-western Australia but currently no feral predator or weed control occurs in BNR. There are additional, potentially deleterious activities occurring within and surrounding the reserve, including gravel extraction and exploration for oil and gas (Coffey Natural Systems Pty Ltd. 2008; unpublished data).

The objectives of this paper were thus to (i) assess the current status of small mammals (abundance and species richness) in BNR, (ii) compare the current status of mammals to that described 26 years ago, and (iii) evaluate any problems associated with long term monitoring.

METHODS

Site description

Boonanarring Nature Reserve is a 'C' class reserve of 9250 ha, 15 km north of Gingin, with connections to 10,000 ha of protected remnant vegetation in Moore River Nature Reserve. It is situated to the southern

Table 1. Fire history and description of each site from the 2012 surveys at Boonanarring Nature Reserve, AB indicates that the site associated with the grid has PVC pit traps. FERA is a fire reference exclusion area. Vegetation data originate from Burbidge *et al*., (1986).

Site Number	Fire age (years)	Vegetation type
1	14	*Corymbia calophylla* over heath
2 and AB1	14	Banksia woodland
3 and AB2	14	*Eucalyptus wandoo* woodland
4	3	*Eucalyptus marginata* and *Corymbia calophylla* woodland
5 and AB3	5	Banksia woodland
6	8	*Eucalyptus marginata* and *Corymbia calophylla* woodland
7	14 (FERA)	Heathland
8	14 (FERA)	Heathland
9	8	Heathland
10	14	Breakaway- low vegetation
11	14	Unusual tall heath on slope with *Eucalyptus* sp. woodland

end of the Dandaragan Plateau and is bordered by the SCP to the west and the Darling Scarp to the east (Figure 1). The biological significance of the area was first assessed in 1971 (N. McKenzie pers. comm.) and on the basis of this report it was later recommended that the then unallocated Crown land be combined with smaller reserves and an area of 400 ha of private land along Gingin Brook to form the BNR (Department of Conservation and Environment 1983). The reserve was gazetted as a 'C' class reserve in 1991, and vested in the National Parks and Nature Conservation Authority. Boonanarring Nature Reserve has a range of soil types (mostly lateritic, but also with white, grey or yellow sands) supporting over 570 plant species, 13% of which are recorded as being of special interest. The reserve supports a mix of vegetation types including banksia (*Banksia grandis*, *B. attenuata* and *B. menziesii*), *Corymbia calophylla* (marri), *Eucalyptus marginata* (jarrah), and *E. wandoo* (wandoo) woodlands (Table 1). The reserve is significant as it is rich in flora and vegetation types not present together on any other conservation reserves and being large enough to provide some protection from degradation owing to edge effects. It has a Mediterranean climate of wet winters and dry, hot summers (Burbidge *et al.* 1996, Coffey Natural Systems Pty Ltd. 2008).

At the time of the 2012 survey, the majority of the fauna survey sites had been burnt within the last 14 years (Table 1). The reserve contains a centrally located Fire Exclusion Reference Area (FERA) of 845 hectares for breeding and resting sites of the endangered Carnaby's black-cockatoo (*Calyptorhynchus latirostris*). Prescribed burns are planned for this reserve but a lack of optimal burning conditions had restricted implementation in the previous six years.

Monitoring surveys

1986 survey

Seven (2 ha) sites were trapped from the 17th to the 23rd of March 1986 (Table 2). Pitfall traps (12.5 x 60 cm) were employed at sites one to four and seven, and Elliot traps at sites five and six. Sites one to four had three lines of pitfall traps, sites five and six had three lines of Elliot traps and site seven had two lines of pitfall traps. Trap nights equated to 600 nights (Burbidge *et al.* 1996).

2012 survey

Trapping sites were established in the reserve in autumn and spring 2012. The sites were located in similar positions as those in the 1986 surveys in order to document any changes in mammal faunal assemblages. An additional five sites (7–11) were located in different vegetation types (heathland, breakaway and unusually tall heath) and/or fuel age in spring 2012 in an attempt to survey as many different habitats as possible. The trap efforts for each year are detailed in Table 2.

During two survey periods in 2012, in autumn (15th–23rd April) and spring (15th to the 22nd November), pitfall, Elliott and funnel traps were employed. Autumn surveys monitored six pitfall sites and in spring an additional five sites were surveyed. In autumn each pitfall site had 10 buckets connected by drift fences in a Y formation with two funnel traps at the end of each arm and five Elliott traps distributed within approximately 30m of the pitfall buckets. In spring the same set up was used, except that funnel and Elliot traps were not used. Three additional sites (AB 1, 2 and 3), closely connected to the other trapping locations (details in Table 2), consisting of only pitfall traps (12.5 x 60 cm) were established for the spring survey with a total of six traps per site as it was suspected that *Pseudomys albocinereus* could jump out of the 20L buckets. All pitfall and funnel traps were opened for eight nights and Elliot traps were open for six nights (for capture of mammals, amphibians and reptiles; however we only report on the mammals in this paper). In autumn and spring, trapping was conducted over 948 and 1084 trap nights respectively.

Table 2. Trap nights and survey effort of the 2012 and 1986 surveys in Boonanarring Nature Reserve.

Survey Method	Trap nights in 1986	Trap nights in 2012 Autumn	Spring
Pitfall traps (20L buckets)	0	480	880
Funnel traps	0	288	0
PVC pitfall traps	300	0	144
Elliot traps	300	180	60
Total trap nights	600	948	1084

ANALYSIS

As the trapping effort differed between years the mean mammal abundance, species richness and individual mammal species' abundances (as defined by mammal captures) were standardised to ten trap nights using data from all pitfall, Elliot and funnel traps (e.g. mean mammal abundance per ten trap nights at each site). Individual species were only analysed if their captures were above 20 individuals. In 2012 three individuals of *Sminthopsis* were captured but not identified to species. Captures of *Sminthopsis* were added irrespective of the initial species identification, as identification of animals from this genus in the field can be problematic (Kemper *et al.* 2011) and these individuals are herein termed *Sminthopsis* sp(p).

A direct comparison of 1986 and 2012 may be influenced by the season in which the survey was completed. Surveys were conducted in autumn in 1986 and 2012, and in spring 2012. One-way ANOVAs (Inc 2007) were thus performed at the site level to determine: 1) the relationship between mean mammal abundance, mammal species richness and individual mammal species' abundance and the season of trapping (autumn and spring) in 2012, and 2) relationships between mammal abundance, mammal species richness and individual mammal species' abundance and the year (1986 and 2012) and 3) relationships between mammal abundance, mammal species richness and individual mammal species' abundance in 1986 and 2012 using only autumn data.

Capture data were compiled for four species, *T. rostratus*, *M. musculus*, *P. albocinereus* and *Sminthopsis* sp(p). (*Sminthopsis griseoventer* in 1986), including capture numbers, sex ratio and body weights. Weight data for 2012 included mean, standard deviation and range for each species, whereas the weight data for 1986 were less detailed and only included the weight range for each species.

RESULTS

1986 survey

Four mammal species including one introduced species, *Mus musculus,* and three native species, *Pseudomys albocinereus*, *Sminthopsis griseoventer* and *Tarsipes rostratus,* were captured in 1986 (Burbidge *et al.* 1996).

2012 survey

Four small mammal species were captured during the 2012 surveys including one introduced species, *M. musculus* and three native species, *P. albocinereus*, *Sminthopsis* sp(p). and *T. rostratus.*

Mus musculus abundance was significantly different between the autumn and spring 2012 surveys with more *M. musculus* captured in autumn than spring (Table 3 and Figure 2). Total mammal abundance, species richness and abundances of the other individual mammals did not differ between the autumn and spring 2012 surveys (Table 3).

Capture data for individual mammal species

Body weights for both sexes and sex ratios between 2012 and 1986 for all species were similar (Table 4; no statistical analysis has been performed). There were some differences in the numbers of *P. albocinereus* of each sex captured. Male *P. albocinereus* captures were higher in spring 2012 (10), than females (5). In autumn 1986 and 2012 similar numbers of each sex were caught (1986: 10 males and 13 females; 2012 one male and female; Table 4).

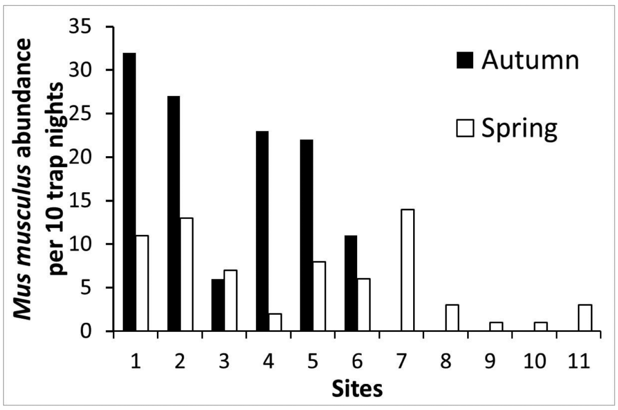

Figure 2. *Mus musculus* abundance in autumn and spring 2012. Only sites one to six were trapped in autumn and all 11 sites were trapped in spring 2012.

Table 3. Relationships between total mammal abundance, mammal species richness and individual mammal species' abundance, and the season of trapping (autumn and spring) in 2012, the year (1986 and 2012) and in autumn only in 1986 and 2012 (excluding the spring 2012 survey data) using a one way ANOVA (*F* and *P* values in bold are significant).

	Autumn and Spring 2012	**1986 and 2012**	**Autumn only 2012 and 1986**
Dependant Variables	***F* and *P* values**	***F* and *P* values**	***F* and *P* values**
Total mammal abundance	2.74, 0.11	0.70, 0.41	3.61, 0.08
Mammal species richness	0.436, 0.51	**9.733, 0.007**	1.103, 0.316
Mus musculus abundance	**10.05, 0.006**	**4.78, 0.04**	3.49, 0.08
Pseudomys albocinereus abundance	2.13, 0.16	**11.81, 0.003**	**8.645, 0.01**
Sminthopsis sp(p). abundance	1.951, 0.183	0.025, 0.877	0.923, 0.357
Tarsipes rostratus abundance	4.01, 0.06	**4.58, 0.04**	4.04, 0.06

Comparison of 1986 and 2012

Mammal species richness in 1986 was statistically higher than in 2012 (Table 3; Figure 3a). The abundance of *Mus musculus* was significantly higher in 2012 than 1986 (Table 3; Figure 3b). The abundance of *Pseudomys albocinereus* and *Tarsipes rostratus* were significantly lower in 2012 than 1986 (Table 3; Figure 3c and d). Mammal abundance and *Sminthopsis* sp(p). abundance were unchanged between the two survey years (Table 3).

When examining the differences between the autumn surveys in 1986 and 2012 (excluding spring 2012 surveys to account for the effect of seasonality on trapping results) there was a significant difference between the years for *P. albocinereus* (Table 3). There were less *P. albocinereus* in autumn 2012, similar to the results using both 2012 surveys (autumn and spring; Figure 4). Mean mammal abundance, mammal species richness and *M. musculus*, *Sminthopsis* sp(p). and *T. rostratus* abundances were unchanged between the two surveys (Table 3).

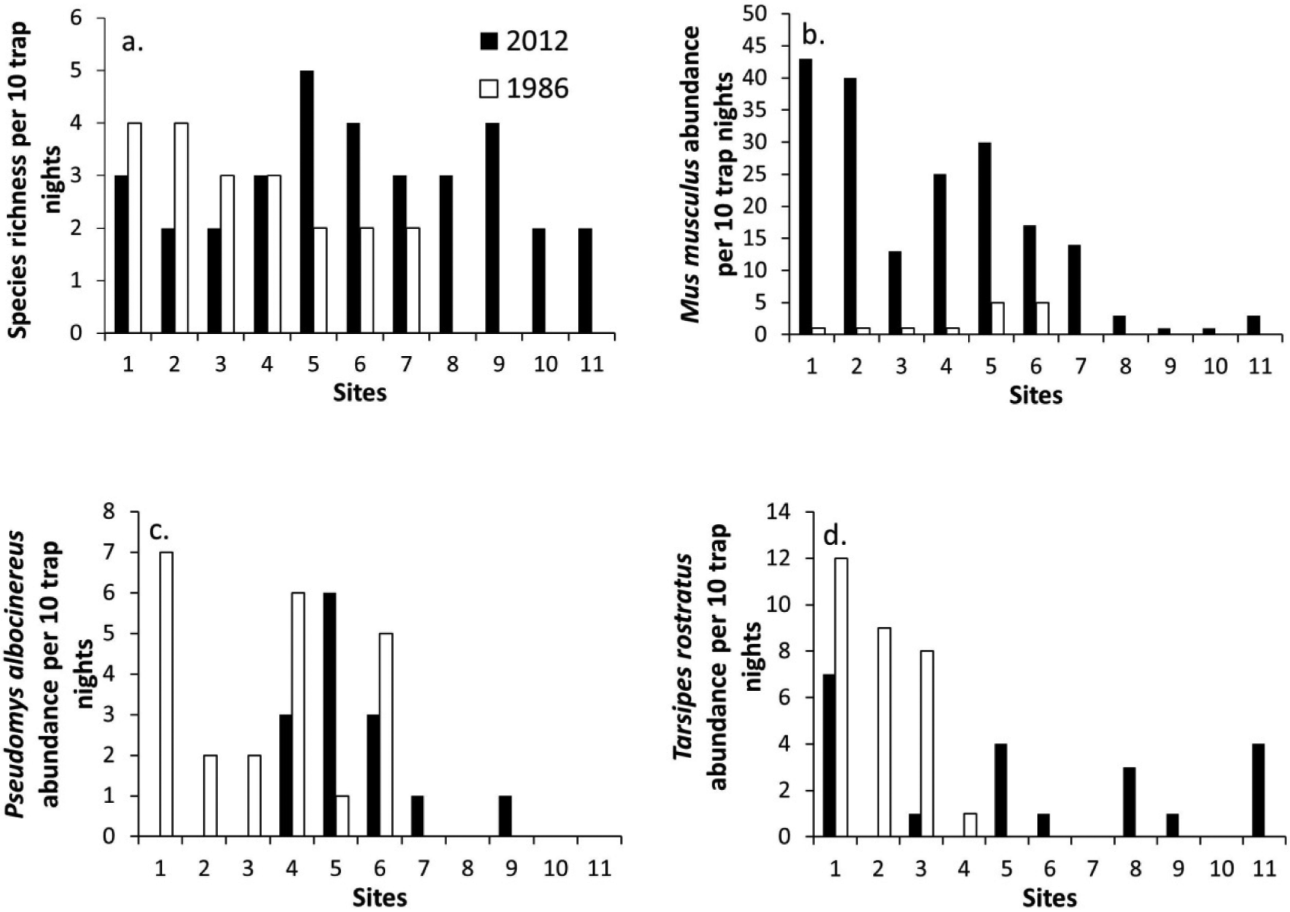

Figure 3. Mammal species richness (a), and the abundances of *Mus musculus* (b), *Pseudomys albocinereus* (c), and *Tarsipes rostratus* (d) at each site in 1986 and 2012.

Table 4. Capture data for *Tarsipes rostratus*, *Mus musculus*, *Pseudomys albocinereus* and *Sminthopsis* sp(p)., including the number of captures, sex ratio and body weights of males and females in 1986 (range) and 2012 (± SD, range); 1986 data taken from Burbidge *et al*. (1996).

Species	Captures in 1986	Captures in 2012	Sex ratio (M:F) 1986	Sex ratio (M:F) 2012	Body weight males 1986	Body weight males 2012	Body weight females 1986	Body weight females 2012
Tarsipes rostratus	30	24	14:16	12:10	5.3–7.0	6.78 ± 4.19 (3.1–17.5)	6.0–11.3	7.5 ± 3.92 (2–12)
Mus musculus	14	234	9:5	67:97	8–17.5	11 ± 4.14 (4–32)	8.5–14.5	9.54 ± 2.62 (3–19)
Pseudomys albocinereus	23	17	10:13	11:6	16.2–32	17.93 ± 6.45 (10–28)	15.5–28	20.4 ± 6.78 (10.5–25.5)
Sminthopsis sp(p).	7	29	5:2	14:12 (3 unknown sex)	9.5–11.5	8.25 ± 4.43 (5–19)	9.5–13.5	10.4 ± 4.87 (4.1–18)

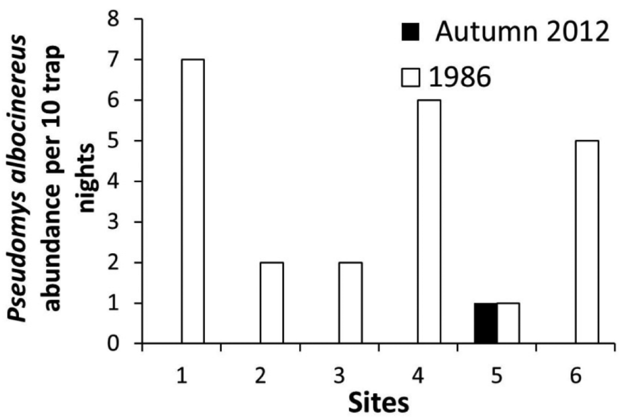

Figure 4. *Pseudomys albocinereus* abundance in 1986 and autumn 2012 at each of the six sites.

DISCUSSION

Current status of small mammals in Boonanarring Nature Reserve

Ecosystems on the Dandaragan Plateau and northern SCP, including BNR, have been severely impacted by clearing, fragmentation, and decreasing rainfall over the last 40 years but there is little knowledge of the significant impacts on mammal fauna and their habitats (Wilson *et al*. 2012, Woinarski *et al*. 2015). This study has contributed important information to the knowledge of the distribution and abundance of native small mammal species in BNR, a significant and large reserve on the southern Dandaragan Plateau (Burbidge *et al*. 1996).

Of particular importance is the information obtained on *P. albocinereus*, for which records have been infrequent over the last few decades. This native rodent has a broad distribution over coastal and inland areas of Western Australia, ranging from Bernier Island in the north-west to Israelite Bay in the south-east (Van Dyck & Strahan 2008). While it was trapped at a range of sites in woodland and heath habitats on the northern SCP by Kitchener *et al*. (1978) it has not been recorded there since 1978. The records in this study are significant as they confirm the presence of the species at least on the Dandaragan plateau, some 26 years after previous studies (Bamford 1986; Burbidge *et al.* 1996).

Pseudomys albocinereus is classified as Least Concern on the IUCN Red List (Morris *et al.* 2008), and not listed under the Western Australian Wildlife Conservation Act 1950 (Department of Parks and Wildlife 2014), even though its former range has been reduced by clearing for agriculture and infrastructure (Bleby *et al.* 2009). Recent work on *P. albocinereus* showed a preference for relatively dense vegetation cover at ground level compared to available microhabitat and suggested that the species may compete with *Mus* in some habitats. Home range size was estimated to be ca. 1.7 ha and most shelters were in burrows or grass trees (*Xanthorrhoea* sp.) (Smith 2015). Up until this study and Smith's (2015) there was a lack of knowledge about the habitat selection and behaviour of *P. albocincereus* (Bamford 1986). However, more data and information are required to develop a detailed understanding of the relationship of *P. albocinereus* with habitat complexity and fire age, as well as nesting and habitat use behaviour, in order to facilitate informed management. This is particularly important as ongoing habitat fragmentation, decreasing rainfall and inappropriate fire regimes endanger the current range of this species, therefore putting local populations at risk (Bleby *et al.* 2009, Wilson *et al.* 2014, Woinarski *et al.* 2014).

One interesting piece of information on *P. albocinereus*' ecology that was noted, was the slightly higher number of captures of males in spring. In the 2012 trapping, twice as many males were caught as females. In 2014 trapping of the same sites, again more males were captured than females (Smith 2015). Yet in autumn 1986 and 2012 surveys similar numbers of each sex were caught. This suggests that males are more mobile in spring, presumably searching for mates, but during non-breeding seasons (autumn) do not disperse as far. However, more research is required to test this hypothesis.

Captures of *T. rostratus* at eight sites scattered across the reserve in 2012 were indicative of long term persistence of the species in BNR some 26 years after the Burbidge *et al*. (1996) study. *Tarsipes rostratus* is endemic to the south-west of Western Australia. Although the species is not considered to be threatened, it is noteworthy taxonomically as it is the only species in the Family Tarsipedidae. The species is restricted to coastal sandplain heaths and low open woodlands with healthy understorey (Wooller *et al.* 2004, Bradshaw *et al.* 2007). Most studies of the species have been conducted in a cool climate in continuous habitats across the south-coast of Western Australia and may not be representative of much of the range of this species, which is distributed from Shark Bay to the edge of the Nullarbor Plain (Garavanta *et al.* 2000, Wooller *et al.* 2004, Bradshaw *et al.* 2007, Dundas *et al.* 2013). It is also commonly captured in studies on the northern SCP, where the habitat is more open and lacks the connectivity of the south-coast habitat, often being surrounded and fragmented by pine plantations (Clancy 2011, Wilson *et al.* 2012). *Tarsipes rostratus* is evidently an adaptable species found in a range of vegetation types, from those with a dense, flowering understorey to open woodlands, both of which are found in Boonanarring Nature Reserve on the Dandaragan Plateau.

In 1986 *S. griseoventer* was captured at only two sites in BNR, whereas in the 2012 survey, individuals of *Sminthopsis* were captured at all sites except for two. Only one individual (considered likely to have been *S. griseoventer*) has been recorded recently on the SCP in 2007–08 (Wilson *et al.* 2012) indicating that at least one *Sminthopsis* taxon is still extant, albeit in small numbers. The confirmation of the presence of a considerable *Sminthopsis* sp(p) population in BNR is important as there is evidence that other vegetation remnants on the SCP are largely devoid of the species.

Status of mammals in 2012 compared to 26 years previously

Species richness (overall number of species) of small mammals in BNR was maintained between the two survey years (1986 and 2012) with four mammal species recorded: *M. musculus*, *P. albocinereus*, *Sminthopsis* sp(p)

(*S. griseoventer* in 1986) and *T. rostratus*. The significant difference in the mean species richness between autumn 2012 and 1986 surveys is most likely a reflection of differences in captures at the site level. There is therefore no evidence that any small mammal species has been lost from the reserve in the last 26 years.

Overall, the trapping revealed more *M. musculus* captures in 2012 than 1986, with the majority of the 2012 captures being in autumn. The results are consistent with the findings of Bamford's (1986) study at a nearby reserve where *M. musculus* was captured more commonly in autumn than any other time of year. Autumn provides optimal resources for breeding and survival for this introduced rodent (Brown & Singleton 1999). Increased presence of *M. musculus* is particularly concerning as the species may compete with native rodents for nesting and shelter sites as well as food resources (Smith & Quin 1996).

In contrast to *Mus*, the abundance of *P. albocinereus* and *T. rostratus* appeared to be lower in 2012 than 1986. There is a need to confirm if these differences are the result of a declining population trend, by undertaking more repeat measure monitoring. If these differences reflect a decline, they could be a result of many factors including inappropriate fire regimes, changes in water availability, introduced weeds and predators (Torre & Diaz 2004, Bleby *et al.* 2009, Craig *et al.* 2010, Wilson *et al.* 2014). Several studies in the northern SCP and the south-coast of Western Australia demonstrate that higher abundances of *T. rostratus* are found in complex habitat with a fire age of 15–20 years (Bamford 1992, Garavanta *et al.* 2000, Friend & Wayne 2003, Clancy 2011). Future studies should measure habitat complexity (as well as fuel age) to determine the habitat requirements of *T. rostratus* and *P. albocinereus* present in the reserve. Water is required for plants and shrubs to provide food (flowers or seeds) for *T. rostratus* and/or *P. albocinereus* (Wilson *et al.* 2012); with declining rainfall in this area over multiple decades, such factors may be playing a role in the declining abundance of these small mammals. Lastly, although our traps were not appropriate for capturing introduced predators, passive sampling methods did reveal the presence of *Felis catus* and *Vulpes vulpes* in both 1986 and 2012, and *Canis familiaris* in 1986 (Burbidge *et al.* 1996; unpublished data), all of which are predators of small native mammals (Doherty *et al.* 2015). Future work should expand on the knowledge of *T. rostratus* and *P. albocinereus* in BNR and their habitat requirements.

Evaluation of problems associated with long term monitoring in this project

For many long term studies, trap design, location and effort are difficult to replicate. In this study there were minor differences in the 2012 surveys compared to the 1986 surveys. In 2012 it was difficult to determine the exact location of the traps from the 1986 survey using only GPS coordinates, so the traps were located as close as possible. Positions of the trap arrays may have differed by tens of metres between 1986 and autumn 2012, and it is likely that different microhabitats were sampled, and the differences in trap array design (lines vs Y-shapes) would have meant that, for animals with small home ranges, different numbers of home ranges would have been intersected, and different proportions of dispersing animals might encounter a trap (Friend *et al*. 1989). The number of survey nights also varied, with six nights in autumn 1986 and eight nights each in autumn and spring 2012 (Table 2). The number and types of traps used also differed between the two surveys (Table 2). With these caveats in mind we chose to compare trapping rates as captures/trap nights. Taking these caveats into consideration is also important when assessing any statistical differences identified (Friend *et al.* 1989, Rolfe & McKenzie 2000, Garden *et al.* 2007, Environmental Protection Authority & Department of Environment and Conservation 2010).

CONCLUSION

Boonanarring Nature Reserve to date has provided a sustainable habitat for small native mammals including *P. albocinereus*, *Sminthopsis* sp(p). and *T. rostratus*, most likely due to its large area of remanent vegetation encompassing many habitat types. The continued presence of these species requires active management actions such as appropriate burning regimes and predator control, followed by evaluation of population trends.

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