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**Home range size and use by long-nosed bandicoot (*Perameles nasuta*) following fire**

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**Running heading:** Home range size and use of long-nosed bandicoot

17 **Abstract**

18 Understanding how animals use available habitat and how disturbance events such as  
19 fire influence habitat use is crucial to wildlife management. We explored relationships  
20 between home range size of long-nosed bandicoots (*Perameles nasuta*) and vegetation  
21 type and fire effects on food availability and vegetation cover. We mapped home ranges  
22 and movement of *P. nasuta* in burnt and unburnt vegetation using radio-tracking, and  
23 used compositional analysis to study their habitat associations. In 2004, six months after  
24 wildfire, we found no significant relationships between home range size and vegetation  
25 type. In 2005, there was a preference for dry and wet forest over heath and disturbed  
26 areas. In both years, in ranges that contained both burnt and unburnt vegetation, there  
27 was a preference for unburnt vegetation. Home range size was positively related to the  
28 body weight of individuals. Fire did not significantly alter home range size, but did  
29 influence the way animals used their home range. Dense understorey might provide  
30 vital shelter from predators, and may be particularly important after fire. Wildfire and  
31 prescribed burning are major forms of disturbance in many natural areas and our work  
32 suggests the importance to *P. nasuta* of retaining unburnt patches when conducting  
33 hazard reduction burning.

34 **Additional keywords**

35 Peramelidae, ecology, habitat modification, habitat preference

36 **Introduction**

37 An animal's territory can be defined as 'an area occupied more or less exclusively by an  
38 animal or group of animals by means of repulsion through overt defence or  
39 advertisement' (Wilson 1975). Optimisation models described by Dill (1978) and  
40 Kodric-Brown and Brown (1978) and then built upon work by Hixon (1980; 1982;  
41 1987) and Schoener (1983) all suggest that the territory of an individual animal is  
42 regulated to maximise access to resources while minimising the cost of obtaining and  
43 defending those resources (Stamps 1994; Adams 2001). In many studies, those  
44 resources are food supplies (Brown 1964; Scott *et al.* 1999), although they also may be  
45 nesting sites or mates (Hixon 1987).

46 Home range is defined by (Burt 1943) as the area an animal traverses carrying out  
47 its normal activities of food gathering, seeking refugia and mating. Home range size  
48 may vary in response to an array of factors that influence territory size. For example,

49 traditional assumptions about territorial animals (as reviewed by Stamps 1994) suggest  
50 that territory location, size and shape is a function of access to key resources such as  
51 food, but offset by the cost of defending those resources. If food resources vary  
52 temporally such as through the impacts of a disturbance, then animals should increase  
53 their home range size if the availability of food resources is reduced. Conversely, home  
54 range size should decrease if the availability of food resources increases and animals no  
55 longer need to expend as much energy in the search for them (Adams 2001). Similarly,  
56 home range size may vary in response to population density. As population density  
57 increases, greater competitive pressure is applied to conspecifics to defend resources  
58 (Fretwell and Lucas 1970).

59 In this paper, we examine relationships between home range size, habitat  
60 association and; (1) attributes at the individual level (gender and body weight), (2)  
61 habitat characteristics – as reflected by vegetation type, and (3) natural disturbance; in  
62 this case wildfire. Our study species was a population of the long-nosed bandicoot  
63 (*Perameles nasuta*) at Booderee National Park in south-eastern Australia. The study  
64 area is valuable for examining differences in home range size of this species for a suite  
65 of reasons. First, following extensive baiting for the introduced Red Fox (*Vulpes*  
66 *vulpes*), there is a large population of *P. nasuta* in Booderee National Park  
67 (Lindenmayer *et al.* 2008; Dexter *et al.* 2011) which enable questions about  
68 relationships between home range size and characteristics of individuals to be  
69 addressed. Second, Booderee National Park is characterised by considerable  
70 heterogeneity of vegetation types (from dry heath to rainforest) (Taws 1998) that vary  
71 spatially often across short distances and hence within the typical size of *P. nasuta*  
72 home range. Third, in late December 2003, a wildfire spread eastward and northward  
73 from approximately the centre of Booderee National Park, burning most of the eastern  
74 half of the park. Some areas of shrubland, wet forest and rainforest remained unburnt  
75 (Lindenmayer *et al.* 2008) this enabled us to quantify the effects of disturbance on home  
76 range size in *P. nasuta*.

77 In relation to several assumptions underpinning the optimisation model of home  
78 range (*sensu* Dill 1978), we posed the following questions:

- 79 1. Are there relationships between body mass and home range size? If a  
80 measure of an animal's fitness is its relative weight, we would expect

81 heavier animals to occupy larger home ranges or home ranges with the most  
82 food resources (Harestad and Bunnell 1979; Swihart *et al.* 1988). Indeed, a  
83 study of the southern brown bandicoot *Isoodon obesulus* by Broughton and  
84 Dickman (1991) identified a significant positive relationship between body  
85 weight and home range area and we sought to determine if a similar pattern  
86 occurred for *P. nasuta*.

87 2. Is home range size influenced by gender? Scott *et al.* (1999) reported that in  
88 an urban population of *P. nasuta*, males had significantly larger overall  
89 home ranges than females. We hypothesised that if the population at  
90 Booderee National Park showed similar sexual dimorphism, we also would  
91 observe larger home ranges in male bandicoots inhabiting a natural  
92 environment.

93 3. Is an animal's home range size influenced by the size of its neighbours? We  
94 would expect an animal with relatively larger heavy neighbours to have a  
95 smaller home range than an animal with smaller lighter neighbours.

96 4. Does home range size change with an increase in population density?  
97 During a long term monitoring project at Booderee National Park in south-  
98 eastern Australia, we captured 72 *P. nasuta* in 2004 (1980 trap nights) and  
99 216 individuals in 2005 (2844 trap nights). This is a density of 2.71 per ha  
100 in 2004 and 5.71 per ha in 2005 (Lindenmayer *et al.* 2008). This large  
101 increase in population density between years allowed us to examine changes  
102 in home range size and overlaps between *P. nasuta* as density increased. We  
103 predicted that home range size should decrease with an increase in  
104 population density and the number of overlaps in home range should also  
105 increase as animals compete for food resources.

106 5. Does home range size differ between vegetation types and, in turn, potential  
107 available food between and within vegetation types? *P. nasuta* is an  
108 omnivore and its diet consists primarily of invertebrates, invertebrate larvae  
109 and hypogean fungi (Moyle *et al.* 1995; Scott *et al.* 1999; Thums *et al.*  
110 2005). Scott *et al.* (1999) and Thums *et al.* (2005) found that invertebrates  
111 comprised more than 50% and 70% of the volume of faecal samples  
112 respectively. Thums *et al.* (2005) also found invertebrates were recorded in

113 100% of faecal pellets. Dexter *et al.* (2011) showed that mean invertebrate  
114 biomass differed between vegetation types and that mean body weights of  
115 *P. nasuta* were higher in vegetation types with the highest mean invertebrate  
116 biomass (forest then woodland) and lower in vegetation with lower mean  
117 invertebrate biomass (heath). Scott *et al.* (1999) consistently found that  
118 swamp and heath had lower invertebrate availability than open lawns, forest  
119 and scrub. As territory sizes are usually negatively related to the abundance  
120 of naturally-available food resources (Seastedt and MacLean 1979;  
121 Broughton and Dickman 1991; Chambers and Dickman 2002) and given  
122 likely differences in food availability between vegetation types at Booderee  
123 National Park, we therefore forecast home range size in *P. nasuta* would be  
124 smallest in home ranges dominated by forest and larger in woodland.

125 6. Do animals preferentially use particular vegetation types within their home  
126 range? If an animal's home range encompasses several vegetation types, we  
127 predict that vegetation types with higher abundance of food resources  
128 (forest and woodland) will be preferentially selected.

129 7. Does the size of a home range and home range use differ between disturbed  
130 (burnt) and undisturbed (unburnt) vegetation? If food resources vary  
131 temporally as a result of fire, animals should increase their home range size  
132 if the availability of food resources is reduced. Conversely, they should  
133 decrease home range size if the availability of food resources increase and  
134 animals no longer need to expend as much energy in the search for food  
135 (Adams 2001). If fire influences food availability within a bandicoot home  
136 range, we would expect bandicoots to associate more with areas of their  
137 home range with higher food availability. Shelter or nest sites may also be  
138 reduced by fire; animals may associate more with unburnt vegetation within  
139 their home range.

140 Fire is a major form of natural disturbance in Australia. Fires directly affect fauna,  
141 causing death, and indirectly by depriving survivors of food resources and cover from  
142 predators (Gill and Catling 2002; Whelan *et al.* 2002). Fire is also a widely used tool by  
143 forest management agencies to manage a variety of products while protecting human  
144 life and property particularly at the urban-bushland interface (Gill 2012). The long-

145 nosed bandicoot is an animal that persists at this interface with urban areas (Scott *et al.*  
146 1999; Chambers and Dickman 2002; Hughes and Banks 2010). Therefore it is important  
147 land managers are aware of the response of animals to fire induced changes to  
148 vegetation and food resources, so they can protect important habitat areas when  
149 planning fire regimes or manage the recovery of threatened populations following  
150 wildfire.

## 151 **Methods**

### 152 ***Study species***

153 The long-nosed bandicoot (*Perameles nasuta*) is a nocturnal terrestrial marsupial,  
154 distributed widely along the east coast of Australia. While once regarded as common  
155 throughout most of its range, *P. nasuta* has become locally extinct in areas where its  
156 habitat has been cleared (Scott *et al.* 1999). The species is found in a wide range of  
157 habitats from rainforest to dry grassy woodland (Opie *et al.* 1990; Stodart 1995). Like  
158 other bandicoot species, *P. nasuta* has been observed displaying territorial behaviour in  
159 captivity (Stodart 1966) and in the wild (Scott *et al.* 1999).

160 *P. nasuta* is defined as a ‘Critical Weight Range’ species (35 g – 5500 g) because  
161 it is among those animals most sensitive to predation by introduced predators such as  
162 the Red Fox (*Vulpes vulpes*). There is evidence that foxes may be a contributing factor  
163 to the decline in populations of small to medium sized mammals in south-eastern  
164 Australia (Claridge *et al.* 1991).

### 165 ***Study region***

166 We conducted this study between 2004 and 2005 at Booderee National Park in south-  
167 eastern Australia. The study area is a ~7500 ha area owned by the Wreck Bay  
168 Aboriginal Community and jointly managed by the Community and the Australian  
169 Government Department of Sustainability, Environment, Water, Population and  
170 Communities. Booderee National Park is located on the southern peninsula of Jervis  
171 Bay, 200 km south of Sydney on the south coast of New South Wales, south-eastern  
172 Australia (approximate midpoint is 35°10'S latitude, 150° 40'E longitude). The area has  
173 a temperate climate with an average rainfall of 1242 mm per annum spread relatively  
174 evenly over the year. Average minimum and maximum air temperatures for February  
175 (summer) are 18-24°C and for July (winter) 9.2-15°C (Bureau of Meteorology 2009).

176 The geology of the study area is dominated by Permian (~260 million year old)  
177 sandstone sequences that form part of the southern boundary of the Sydney Basin.  
178 Pleistocene (< 1.6 million year old) windblown sand dune systems cover the Permian  
179 sandstones in parts of Booderee National Park. Other geological formations include  
180 siltstones and Tertiary-aged alluvial deposits (Cho 1995).

### 181 ***Site selection***

182 In 2004, Lindenmayer *et al.* (2008) found the highest capture rates per site at Booderee  
183 National Park of *P. nasuta* occurred in forest (0.96 bandicoots per site), shrubland (0.75  
184 bandicoots per site) and woodland (0.63 bandicoots per site). The majority of shrubland  
185 did not burn in 2003; we therefore dropped it from our site selection for the  
186 investigation we report here. We selected seven sites previously trapped by  
187 Lindenmayer *et al.* (2008), where we were most likely to capture *P. nasuta*, four were in  
188 burnt and three in unburnt forest and woodland.

### 189 ***Trapping and radio tracking***

190 We captured *P. nasuta* in wire cage traps 500 x 200 x 170 mm (RE Walters (1899) Pty  
191 Ltd, Sunshine, Victoria) in 2004 and 2005. The traps were baited with peanut butter and  
192 rolled oats and checked at first light on three consecutive mornings; in 2004 we  
193 completed 594 trap nights across seven sites, while in 2005 there were 322 trap nights  
194 completed across three sites (two forest and one woodland). *Perameles nasuta* were  
195 weighed, sexed, and the pouch condition and reproductive status of females was  
196 recorded. Each animal was permanently marked with a uniquely numbered Trovan  
197 ID100<sup>®</sup> microchip transponder inserted subcutaneously at the back of the neck of each  
198 animal. We classified females as adult if they had previously had young as determined  
199 by pouch and teat condition. We classified males as adults on the basis of body weight  
200 (> 650g; see Lyne 1964).

201 We attached a 5 g single stage transmitter (Titley Electronics, Ballina, NSW) to  
202 the tail of each adult and subadult animal with a minimum tail length of 75 mm (*see*  
203 (Moseby and E. 2003)). We shaved hair from the upper tail, then wrapped one layer of  
204 elastic adhesive bandage (Askina Plast E, Braun) around the tail. The transmitter was  
205 then placed on the upper surface of the tail so that the antennae followed the tail bone,  
206 before a second layer of adhesive bandage was wrapped over the transmitter to hold it in  
207 place. We placed a strip of reflective tape between two layers of the adhesive bandage,

208 to assist the identification of the tracked individual. The total weight of the transmitter  
209 and bandage was 9g.

210 In 2004 we trapped 23 *P. nasuta* and commenced tracking 22 animals. One  
211 animal died prior to release, a necropsy revealed parasitisation by lung worm. In 2005  
212 we trapped 18 animals, and tracked 16, one animal was too small to fit the transmitter,  
213 the other had no tail.

214 We tracked *P. nasuta* using a Yagi antenna attached to an Australis receiver  
215 (Titley Electronics, Ballina, NSW) on foot until they were sighted using a spotlight with  
216 a red filter. This method did not seem to disturb the animals, which often continued  
217 digging or feeding while being observed. If animals were not seen, an approximate  
218 location of the tagged individual was determined using triangulation from three points  
219 within 5 minutes. An interval of at least one hour was kept between radio location fixes  
220 of individual *P. nasuta*. This interval was shown by Scott *et al.* (1999) and Chambers  
221 and Dickman (2002) to be sufficient to avoid autocorrelation of successive fixes. We  
222 obtained 85% of our radio locations between sunset and midnight. In 2004, we tracked  
223 *P. nasuta* on all seven sites. In 2005, we concentrated nocturnal tracking in one forest  
224 site, principally to gather nest location and data on interactions between individual *P.*  
225 *nasuta*.

#### 226 ***Vegetation data***

227 We used surveys conducted by Lindenmayer *et al.* (2008) to quantify the composition  
228 and structure of the different key kinds of vegetation in each of the areas where we  
229 studied *P. nasuta*. There were at least two vegetation measurement plots (each  
230 measuring 20 m × 20 m), in each area where we conducted radio tracking. However, we  
231 have used the entire vegetation dataset for the region as although bandicoots were  
232 trapped in forest and woodland their home ranges also comprised other vegetation  
233 types. We gathered ground cover measurements at eight 1 m x 1 m plots at each site.  
234 We measured vegetation covariates in 2004 (immediately after the December 2003  
235 fires) and again in late 2005 early 2006. We analysed percentage cover of the midstorey,  
236 understorey and grasses to generate an index of cover from potential predators. We  
237 analysed counts of plant species to provide an indication of plant species diversity and  
238 the structural complexity of the vegetation. We provide the vegetation measurement  
239 protocols in Appendix 1. We transformed the measurements to stabilise the variance of



240 the means. Count data was transformed using ARCSINH (as there were some zero  
241 counts) and per cent coverage data using ARCSIN.

242 We examined differences in the means of vegetation covariates measured within  
243 the 20 m x 20 m plots on burnt and unburnt forest, woodland, shrubland, heathland and  
244 rainforest. Only two wet forest plots from eight were not burnt in the 2003 wildfire, we  
245 therefore combined wet forest with dry forest prior to analysing the vegetation  
246 covariates.

### 247 ***Invertebrate data***

248 In a parallel study on habitat-dependent population regulation by *Perameles nasuta* at  
249 Booderee National Park, Dexter *et al.* (2011) established invertebrate pitfall traps at 500  
250 m intervals throughout the park. Each pitfall consisted of a 11.5 cm diameter by 8 cm  
251 plastic container bisected by a 1 m by 35 cm drift fence. In total, 100 traps were  
252 established and have been opened for three days on a quarterly basis each year since  
253 2003. Traps were removed after three days, and invertebrates dried and weighed. We  
254 have used data from periods in February 2004 until May 2005 that correspond to the  
255 periods immediately prior to, and during, when we completed radio tracking of *P.*  
256 *nasuta*. We analysed the biomass data by vegetation type (dry forest, wet forest,  
257 woodland and heath). Only three pitfalls were established in shrubland so this  
258 vegetation type was omitted from our analysis. We also divided the vegetation types  
259 into burnt and unburnt classes. Biomass data was measured in grams per metre, and we  
260 transformed it using ARCSINH as there were some zero counts.

### 261 **Data analysis**

262 We conducted incremental area analysis (*sensu* Kenward 2001) to determine the  
263 minimum number of radio-locations required to calculate a home range. We treated nest  
264 (diurnal refugia) locations as single points when calculating the minimum number of  
265 radio-locations because they were often used multiple times. This revealed a minimum  
266 of 15 to 18 radio-locations were required to define 80% of the home range. We  
267 therefore used data only for the 20 *P. nasuta* which had a minimum of 18 radio-  
268 locations in our detailed analyses. Of these 20 animals, three (2 males and 1 female)  
269 were tracked in both 2004 and 2005. For the purposes of our home range analyses, we  
270 have treated the ranges of these three animals separately in each year and have used  
271 only those data gathered in 2004 to avoid pseudo-replication.

272 We transformed home range area data using the natural logarithm to stabilise the  
273 variance and then conducted two-sample t-tests to compare differences between mean  
274 home range area of male and female *P. nasuta* and between mean home range area of  
275 adult and sub-adult *P. nasuta*. We used linear regression to model the log of area against  
276 gender and body weight. We used the term ‘focal animal’ to differentiate between the  
277 home range of a specific animal and the home ranges of its neighbours.

278 We examined the proportion of location fixes for a given individual that occurred  
279 within the home range of a neighbouring animal (i.e. within the overlap area). We  
280 transformed the proportion of points within the overlapping area using an arcsine  
281 transformation because over 50% of observations were between 0 and 0.2.

282 We used compositional analysis to study habitat association (*sensu* Aebischer *et*  
283 *al.* 1993). We examined the availability of habitats for *P. nasuta* with > 18 radio-  
284 locations in both 2004 and 2005 at two scales: **(i)** outside range to measure range  
285 selection and **(ii)** within the Minimum Convex Polygon (MCP) home range (Johnson  
286 1980).

287 We defined available habitat ‘Outside’ the MCP home range separately for each  
288 animal (*sensu* Arthur *et al.* 1996) as a circle centred on the harmonic mean centre of  
289 each range. We based the radius of the ‘availability circle’ on the maximum movement  
290 between consecutive radio-locations with approximately 24hrs between them. This was  
291 repeated for both sexes. The maximum movement by a male and female *P. nasuta*  
292 during a single interval of 26 hrs was 456 m and 262 m respectively. We determined  
293 ‘Within’ home range area by using 95% Minimum Convex Polygons.

294 We compared the proportion of radio-locations within a vegetation type to the  
295 proportion of the vegetation type available to each *P. nasuta* ‘within’ its home range. As  
296 each of these proportions lacked independence due to the ‘unit sum constraint’  
297 (Aebischer *et al.* 1993), we converted them to log ratios (Aitchison 1986).

298 We used ARCGIS to analyse a digitised vegetation map of Booderee National  
299 Park created by Taws (1998) to determine the proportions of vegetation types available  
300 and used by each individual. We mapped the radio-locations within each MCP home  
301 range using ARCGIS. We then related home range use to the vegetation types  
302 summarised in Table 1.

303

304 <<Insert Table 1 here>>

305

306 Where a vegetation type was available but was not used by an individual *P.*  
307 *nasuta*, we substituted a measure equivalent to an order of magnitude less than the  
308 minimum proportional use by any other *P. nasuta* (as  $\ln(0)$  cannot be calculated). In  
309 2004, this value was 0.002, and in 2005 it was 0.003 (*sensu* Aebischer *et al.* 1993). Not  
310 all vegetation types were available to all individuals. We therefore replaced missing  
311 values in the log ratio with the mean of all remaining values for that log ratio  
312 (Aebischer *et al.* 1993).

313 We calculated a ‘log difference’ matrix for each *P. nasuta* to rank ‘preferred’  
314 vegetation types in the ‘availability circle’ and in its home range. A value of 0 was  
315 scored if an animal had a similar association with both the numerator and denominator  
316 vegetation types. If the log ratio was positive, this indicated that a preference was  
317 shown for the numerator vegetation type over the denominator vegetation type. If the  
318 log ratio was negative, the reverse was true. The greater the log ratio was from 0, the  
319 greater the association (Kenward 2001). We used the matrix ratios for all *P. nasuta* to  
320 produce a table of mean log ratios and standard errors. We calculated t-values by  
321 dividing the mean by the standard error for each element of the matrix. The pattern of  
322 the t-values in the matrix enabled us to rank vegetation types. Comparing the t-value  
323 with the table value indicated the level of reliability of the ranking (Aebischer *et al.*  
324 1993).

325 We examined the proportion of location fixes for a given individual that occurred  
326 within the home range of a neighbouring animal (i.e. within the overlap area). We  
327 transformed the proportion of points within the overlapping area using an arcsine  
328 transformation because over 50% of observations were between 0 and 0.2.

## 329 **Results**

330 We first present results of the vegetation analysis as an index of the cover available to  
331 *P. nasuta*. Second, we present the analysis of invertebrate biomass as an index of food  
332 availability to *P. nasuta* in different vegetation types. Third, we present the results of  
333 our analysis of home range size and habitat associations of *P. nasuta*

### 334 ***Differences between burnt and unburnt vegetation cover***

335 Vegetation surveys at the forest, woodland and heathland plots showed similar  
336 significant differences in understorey cover between unburnt and burnt vegetation  
337 variables (Table 2). However, in 2004 there were no significant differences in the means  
338 of the above variables in shrubland or rainforest between burnt and unburnt plots.

339 As seen from the data we present in Table 3, by January 2006, percentage cover of  
340 the midstorey, understorey and grass layer had recovered in burnt areas and previous  
341 significant differences in mean values for the majority of key measured covariates in  
342 2004 no longer occurred.

343

344 <<Insert Tables 2 and 3 here>>

345

### 346 *Vegetation type, fire and between year differences in invertebrate biomass*

347 In 2004 there was no significant difference in mean invertebrate biomass between forest  
348 and woodland ( $t=0.16$ ,  $P=0.87$ ,  $df=39$ ), forest and heath ( $t=1.42$ ,  $P=0.156$ ,  $df=199$ ),  
349 between heath and woodland ( $t=-0.83$ ,  $P=0.41$ ,  $df=56$ ), nor between dry and wet forest  
350 ( $t=-1.74$ ,  $P=0.08$ ,  $df=172$ ).

351 Mean invertebrate biomass was significantly higher in burnt forest than unburnt  
352 forest ( $t=-2.04$ ,  $P=0.04$ ,  $df=174$ ). The 95% confidence interval for the difference in the  
353 means was  $-0.94 - -0.01$ . Mean invertebrate biomass was significantly higher in burnt  
354 dry forest than unburnt dry forest ( $t=2.29$ ,  $P=0.02$ ,  $df=150$ ). There was no significant  
355 difference between the mean biomass of invertebrates in burnt and unburnt wet forest  
356 ( $t=0.45$ ,  $P=0.65$ ,  $df=20$ ), woodland ( $t=0.35$ ,  $P=0.73$ ,  $df=31$ ) or between the means in  
357 unburnt and burnt heath ( $t=-0.13$ ,  $P=0.89$ ,  $df=23$ ).

358 We found a highly significant difference between the mean biomass of  
359 invertebrates in forest in 2004 and 2005 ( $t=-3.79$ ,  $P<0.001$ ,  $df=338$ ). The 95%  
360 confidence interval for the difference in the means was  $-0.80 - -0.23$ . We found a  
361 significant increase in invertebrate biomass in unburnt dry forest between years ( $t=-$   
362  $3.63$ ,  $P<0.001$ ,  $df=201$ ). The 95% confidence interval for the difference in the means  
363 was  $-1.11 - -0.28$ . There was no significant difference in the mean invertebrate biomass  
364 in burnt dry forest between 2004 and 2005 ( $t=-0.96$ ,  $P=0.341$ ,  $df=102$ ). The 95%  
365 confidence interval for the difference in the means was  $-0.77 - 0.25$ . We found no  
366 significant between year difference in mean invertebrate biomass for heath ( $t=-0.34$ ,

367 P=0.74, df=48). The 95% confidence interval for the difference in the means was -0.98  
368 – 0.66 nor did we find any significant between year difference in mean invertebrate  
369 biomass for woodland (t=-0.09, P=0.93, df=57). The 95% confidence interval for the  
370 difference in the means was -0.81 – 0.73.

371 In 2005 we found a significant difference in the mean invertebrate biomass  
372 between forest and woodland (t=2.53, P=0.01, df=216), and a significant difference  
373 between forest and heath (t=3.34, P<0.001, df=204). There was no significant difference  
374 found between woodland and heath (t=0.90, P=0.37, df=60). There was a significant  
375 difference in mean invertebrate biomass between dry forest and wet forest (t=-2.27,  
376 P=0.03, df=39). We found no significant difference in the mean invertebrate biomass of  
377 unburnt and burnt forest (t=-1.19, P=0.23, df=180), woodland (t=-0.24, P=0.81, df=26),  
378 heath (t=-1.23, P=0.23, df=23).

### 379 ***Individual attributes and home range size***

380 In 2004, we captured 23 *P. nasuta* and attached transmitters to them (Table 4). We  
381 obtained sufficient data from 11 of them to enable their home ranges to be calculated. In  
382 2005 we captured 16 *P. nasuta*, and gathered sufficient data for nine of them to enable  
383 home ranges to be calculated.

384

385 <<***Insert Table 4 here***>>

386

387 We found significant differences in the weights of male and female *P. nasuta* (t=  
388 2.73, P = 0.014, df=18) the 95% confidence interval for the ratio was 53.46 – 409.2  
389 (Table 5). We found no significant difference in mean weight of either sex between  
390 years (males: t= -0.60, P=0.56, df=12 the 95% confidence interval for difference in  
391 means was: (-420.3 – 238.3) and females: t= -0.80, P=0.46, df=4). The 95% confidence  
392 interval for the difference in means was: (-319.0 – 175.7). We therefore pooled data on  
393 body weights for both sexes across years.

394

395 <<***Insert Table 5 here***>>

396

397 We found that the Log of home range area was positively related to body weight  
398 (r=0.6589, n=20, P=0.0016) (Fig. 1).

399

400 <<Insert Fig. 1 here>>

401

402 Using 95% Minimum Convex Polygons (MCP), we found that the mean home  
403 range sizes of *P. nasuta* were 3.58ha  $\pm$  0.79 ha for males and 1.62ha  $\pm$  0.20 ha for  
404 females. At 100% MCP, mean home range sizes were 4.55ha  $\pm$  0.92ha for males and  
405 1.91ha  $\pm$  0.22ha for females.

406 We show in Table 6 the mean home range sizes for animals tracked in 2004 and  
407 2005, respectively. We found no significant difference between years for males (t=0.01,  
408 P=0.99, df=12) with 95% confidence interval for the ratio being (0.41 – 2.46) and for  
409 females (t=-0.77, P=0.49, df=4) with 95% confidence interval for the ratio being (0.37 –  
410 1.74). At 95% MCP, we found the mean home range size for males (3.58ha  $\pm$  0.79 ha)  
411 was not significantly larger than for females (1.62ha  $\pm$  0.20 ha) (t=1.86, P =0.08, df=18)  
412 with the 95% confidence interval for the ratio being (0.46 – 3.48). The difference in  
413 mean home range size between adult (n=14) and sub-adult (n=6) age classes was not  
414 statistically significant (t=1.92, P=0.07, df=18). The 95% confidence interval for the  
415 ratio was (0.95 – 3.52). There was a significant difference between the home range sizes  
416 of adult (n=10) and sub-adult (n=4) male *P. nasuta*. (t=2.15, P=0.05, df=12). The 95%  
417 confidence interval for the ratio was (0.99 – 5.25). There was no significant difference  
418 in the home ranges of adult (n=4) and sub-adult (n=2) female *P. nasuta*, however our  
419 sample size for this comparison was small (see Table 6).

420

421 <<Insert Table 6 here>>

422

423 We examined home range relationships for the mean body weight of an individual  
424 and the body weight of neighbouring *P. nasuta*. Mean weight of neighbours included  
425 the weight of all *P. nasuta* with a range known to abut or intersect with a particular  
426 focal individual's home range (including animals that did not have sufficient radio  
427 locations to include in the calculation of home range size). We found that the log of  
428 home range area of a given focal animal was significantly positively related to the ratio  
429 of the focal animal body weight to mean body weight of neighbouring *P. nasuta*

430 (r=0.6994, P=0.0012, n=18). Thus, the heavier the mean weight of neighbours, the  
431 smaller the home range of an individual.

### 432 ***Increasing population density and home range size***

433 In 2004, using 95% Harmonic centred peeled polygons, we found that the mean number  
434 of home range overlaps was  $1.0 \pm 0.19$  (based on data for 21 *P. nasuta*). Notably, six  
435 animals (one male and five female) exhibited no home range overlap with any other  
436 radio tracked *P. nasuta*. In 2004, we found no female *P. nasuta* overlapped with other  
437 females (at either 95% or 100% Harmonic centred peeled MCP). We show the  
438 difference in the number of overlaps between years in Table 7.

439

440 <<***Insert Table 7 here***>>

441

442 We observed a greater number of home range overlaps in 2005 than in 2004, the  
443 mean number of overlaps per *P. nasuta* was  $3.2 \pm 0.61$  (based on data for 10 *P. nasuta*).  
444 This was significant at both 95% MCP (t=-3.55 at P=0.001, df=29) and 100% MCP  
445 (t=-2.98 at P=0.005, df=29). We also found a significant increase in the number of  
446 overlaps for both sexes (Table 8). All male *P. nasuta* (n=6) overlapped with at least one  
447 other male and three males overlapped with at least two female *P. nasuta*.

448

449 <<***Insert Table 8 here***>>

450

451 Each overlap can be measured as a proportion of each home range. We calculated  
452 the mean overlap proportion for the heavier and lighter individual for each pair of  
453 animals and for each sex within the pair (Table 9). We found that a heavy animal takes  
454 up a greater percentage of a lower body weight neighbour's home range than did a low  
455 body weight animal.

456

457 <<***Insert Table 9 here***>>

458

459 The mean percentage of heavier *P. nasuta* home range overlapped by a  
460 neighbour's home range was 12.8%, irrespective of sex. While the mean percentage of

461 lighter *P. nasuta* home range overlapped by a neighbour's home range irrespective of  
462 sex was 22.2%. We found no female/female overlaps in 2004.  
463 We found only one female/female home range overlap in 2005. We found two instances  
464 where a heavier female overlapped its home range with a lighter (subadult) male. The  
465 mean overlap was 13.6% of the home range of the female and 11.0% of the home range  
466 of the male.

467 We indirectly examined the amount of time a given animal potentially had to  
468 defend its territory against, or interact with, a neighbour. We did this by dividing the  
469 number of radio-locations for a given animal that occurred in the overlap area with a  
470 neighbour, by the total number of radio-locations for that animal (Table 10). We  
471 identified no significant between-year or within-year differences in the mean number of  
472 points located within neighbouring home ranges.

473

474 <<Insert Table 10 here>>

475

#### 476 ***Vegetation type differences in home range size and use***

477 We found no significant difference between the mean home range size of *P. nasuta*  
478 captured in forest in 2004 (n=15) with those captured in woodland in 2004 (n=5)  
479 ( $t=-0.57$ ,  $P=0.57$ ,  $df=18$ ). The 95% confidence interval of the ratio is (0.35 – 1.81).

#### 480 ***Selection of home range from the total area available in 2004***

481 We found *P. nasuta* showed no significant preference for any of the vegetation types  
482 available to it when selecting a home range (Table 11) ( all t ratios < 2.228,  $P=0.05$ ,  
483  $df=10$ ). As rainforest and heath were unavailable to 90% of *P. nasuta* we tracked, we  
484 dropped these vegetation types from subsequent 'within range' habitat analysis.

485

486 <<Insert Table 11 here>>

487

#### 488 ***Vegetation associations within home ranges in 2004***

489 When we compared the proportion of radio-locations to the available vegetation types  
490 within home ranges, we found no significant difference in the use of the top three  
491 ranked vegetation types, indicating that their ranking was interchangeable. However



492 shrubland was, significantly preferred to woodland ( $t$  ratio=2.289 > 2.228,  $P=0.05$ ,  
493  $df=10$ ) (Table 12).

494

495 <<*Insert Table 12 here*>>

496

#### 497 ***Selection of home range from the total area available in 2005***

498 We found that home range locations were significantly associated with dry forest and  
499 wet forest in 2005. However, there was no significant difference between dry and wet  
500 forest and their preference rankings were interchangeable ( $t$  ratio=0.612<2.31,  $P=0.05$ ,  
501  $df=8$ ). Each showed significantly greater use than the other vegetation types, and both  
502 were significantly preferred to heath and shrubland, which in turn were significantly  
503 preferred to the ‘vegetated carpark’ and woodland (Table 13).

504

505 <<*Insert Table 13 here*>>

506

507 Areas of shrubland and woodland were within the ‘availability circle’ of each  
508 animal but they were not selected by *P. nasuta*. Hence, we dropped these vegetation  
509 types from the subsequent ‘within range’ analysis.

#### 510 ***Vegetation associations within home ranges in 2005***

511 We found that in 2005, *P. nasuta* exhibited a significant preference for dry and wet  
512 forest, and both these vegetation types were significantly preferred to the vegetated  
513 carpark habitat and heath. There was no significant difference between vegetated  
514 carpark habitat and heath (Table 14).

515

516 <<*Insert Table 14 here*>>

517

#### 518 ***Differences in home range size and use between burnt and unburnt vegetation***

519 We found no significant difference between the mean home range size of *P. nasuta*  
520 radio-tracked in vegetation that was burnt in 2003 ( $n=11$ ) and those radio-tracked in  
521 vegetation that was not burnt in 2003 ( $n=9$ ), ( $t= 0.81$ ,  $P=0.428$ ,  $df=18$ ).

#### 522 ***Selection of home range from the total area available in 2004***

523 We analysed the home ranges of eight *P. nasuta* whose home ranges spanned both burnt  
524 and unburnt vegetation. In 2004 we found no significant difference in preference for  
525 burnt or unburnt vegetation. We found the ‘mean log ratio difference’ of burnt/unburnt  
526 vegetation was  $-0.37 \pm 1.01$  with a range of  $-5.27 - 4.53$ ,  $t$  ratio =  $-0.37 < 2.365$  at  
527  $P=0.05$ . This analysis included one *P. nasuta* with 100% of its home range entirely  
528 within burnt vegetation and another with 100% of its home range entirely in unburnt  
529 vegetation; we therefore excluded these animals from the analysis of vegetation type  
530 selection within home ranges.

#### 531 ***Burnt and unburnt vegetation associations within home ranges in 2004***

532 We found all six *P. nasuta* with home ranges that spanned both burnt and unburnt  
533 vegetation showed significantly greater association with unburnt vegetation within their  
534 home range ( $t$  ratio =  $3.73 > 2.571$  at  $P=0.05$ ). The ‘mean log ratio difference’ of  
535 burnt/unburnt vegetation was  $-1.38 \pm 0.37$ . The range was  $-2.52$  to  $-0.38$ .

#### 536 ***Burnt and unburnt vegetation associations within home ranges in 2005***

537 In 2005, four *P. nasuta* had home ranges that spanned both burnt and unburnt  
538 vegetation. All four *P. nasuta* showed significant association with unburnt vegetation ( $t$   
539 ratio =  $4.23 > 3.182$  at  $P=0.05$ ). However, this association was less pronounced than it  
540 was in 2004. The mean log ratio difference of burnt/unburnt vegetation was  $-1.12 \pm$   
541  $0.26$ . The range was  $-1.87$  to  $-0.67$ . We found no significant difference in the mean log  
542 ratio difference between years ( $t=-0.52 < 2.306$ ,  $df=8$ , at  $P=0.05$ ).

#### 543 **Discussion**

544 We have examined several key questions associated with home range size and use  
545 following major wildfire, using investigations of *P. nasuta* as a case study. We  
546 identified a range of unexpected findings that contrasted markedly with those that we  
547 predicted would occur at the outset of this investigation. Four of these were that: (1) the  
548 home range size of an individual may be dependent on that of a neighbouring animal  
549 and, in turn, the body mass of that neighbouring animal, (2) there was an absence of  
550 vegetation type effects on home range size, (3) there was a preferential selection of  
551 unburnt areas within the home ranges of animals where fire was patchy and  
552 heterogeneous, and, (4) there was a general paucity of fire effects on home range size.  
553 We discuss these and other key findings in the remainder of the Discussion.

#### 554 ***Individual attributes and home range size***

555 We found home range size was positively related to body weight, irrespective of gender.  
556 This finding is consistent with our expectation and is broadly consistent with the results  
557 of other studies of home range size in an array of different taxa (Schoener 1968;  
558 Harestad and Bunnell 1979; Jenkins 1981). Broughton and Dickman (1991) found that  
559 *Isoodon obesulus* that received supplementary feeding gained weight and increased their  
560 home range relative to control animals that did not receive additional food.

561 We found no significant difference in the home range size of male and females  
562 despite the significant difference in the mean weights. This finding was consistent with  
563 the findings of Scott *et al.* (1999) who found female home ranges of an urban  
564 population of *P. nasuta* were larger during non-breeding months while those of males  
565 were smallest at this time.

566 We also found the ratio of the mean weight of neighbouring animals to that of the  
567 focal animal to be a slightly better predictor of home range size than the weight of the  
568 focal animal alone. This result was surprising given the already strong relationship we  
569 detected between body weight of the focal animal and home range size (see Fig. 1).  
570 Adams (2001) observed that a few studies show that the relative body size of  
571 neighbouring residents is a better predictor of territory area than absolute body size of  
572 each resident. For example, our result was consistent with the findings of Petrie (1984)  
573 who found that the ratio of weight of males of the moorhen (*Gallinula chloropus*) to the  
574 weight of their male neighbours was strongly related to territory size. While Schradin *et*  
575 *al.* (2004; 2010) recognised the relative body mass of neighbours as important in  
576 contests between animals and therefore important in the determination of home range  
577 size, many models of territoriality assume that territories are not contiguous and  
578 examine home range size in isolation of neighbours (Hixon 1980; Schoener T.W. 1983).  
579 As recognised by Adams (2001), this is a limitation of the optimality model of territory  
580 size and use, and our findings further underscore this limitation.

#### 581 ***Influence of increased population density on home range size***

582 Despite a substantial increase in population density in *P. nasuta* between 2004 and  
583 2005, we found no significant difference in home range size between years or in mean  
584 body weight between years. This result was surprising as we expected home range size  
585 to decline with increased population density as animals competed for food resources.  
586 According to various studies (Seastedt and MacLean 1979; Broughton and Dickman

587 1991; Chambers and Dickman 2002; Hayward *et al.* 2004), if food availability remains  
588 stable and the density of animals expressing territorial behaviour increases over time,  
589 the size of home ranges should contract. The significant increase in invertebrate  
590 biomass in forest between 2004 and 2005 may have allowed *P. nasuta* to tolerate  
591 greater intrusion into their home ranges (as evidenced by the increased number of home  
592 range overlaps) and still maintain access to sufficient food resources to maintain body  
593 weight.

594 The increase in the number of overlaps in home range among females from 2004  
595 to 2005 did not match that observed for males. As food resources were stable or  
596 increased, males may have been more tolerant of intruding male conspecifics while  
597 females may have been less tolerant of same-sex intruders because of the need to spend  
598 a smaller proportion of their energy on defence and more energy on reproduction  
599 (Ostfeld 1985). A study of *P. nasuta* in a semi-urban area (North Head) by Scott *et al.*  
600 (1999) does not support this model. Ostfeld (1985) suggests that the existence of  
601 territoriality in female voles is related to the micro-distribution and renewability of their  
602 food resources. He predicted that female territoriality is least pronounced when food is  
603 dense, evenly distributed, and quickly renewable and when population density is high.

#### 604 ***Influence of vegetation type on home range size***

605 We hypothesised at the outset of our study that home range size should differ between  
606 vegetation types as a result of differing food resource availability. Despite Dexter *et al.*  
607 (2011) finding an overall difference in mean invertebrate biomass between vegetation  
608 types, we found no significant differences between forest, woodland and heath in 2004  
609 and we identified no significant vegetation type effects. In 2005, invertebrate biomass  
610 was significantly higher in forest than in woodland and heath. However, we still found  
611 no significant difference between the mean home range size of *P. nasuta* radio-tracked  
612 in forest to those radio-tracked in woodland. Nor was there a significant difference in  
613 home range size between years. In our investigation, a lack of vegetation type  
614 relationships with home range size of *P. nasuta* would indicate that vegetation type as a  
615 surrogate for invertebrate biomass did not influence home range size.

#### 616 ***Influence of vegetation type on habitat associations***

617 In 2004, at the 'home range selection level', our findings were not consistent with our  
618 initial predictions that animals would show a preference for particular vegetation types

619 based on differing availability of food resources (Harestad and Bunnell 1979) in our  
620 case invertebrates (Dexter *et al.* 2011). However, when the invertebrate data were  
621 analysed, for 2004 we found no significant difference in biomass between vegetation  
622 types. Care must be taken when interpreting this result as we cannot be certain that  
623 semi-gregarious behaviour in *P. nasuta* (Scott *et al.* 1999) did not influence the location  
624 of home ranges. We speculate that if the relative weight of neighbouring *P. nasuta* can  
625 influence home range size it might also influence home range location. In addition, the  
626 proportion of different vegetation types within a given home range was not significantly  
627 different from the proportion of different habitats that was available.

628         Despite the lack of significant difference in invertebrate biomass, at the ‘within  
629 home range level’ in 2004, our findings were consistent with the above prediction.  
630 Within the home range of a given individual, *P. nasuta* showed a preference for wet  
631 forest or shrubland over dry forest. While the associations were not strong, it is  
632 important to note that the areas of wet forest and the majority of shrubland accessible  
633 within the home ranges of the *P. nasuta* tracked in 2004 were not burnt in the 2003  
634 wildfire.

635         Contrary to our results in 2004, in 2005, we found evidence that home range  
636 selection was influenced by vegetation type. Animals exhibited a preference for dry and  
637 wet forest over heath, vegetated carpark, shrubland and woodland. This pattern of usage  
638 was mirrored by the results of analyses of usage of vegetation types within the home  
639 ranges. While shrubland and heath was not available within the home range of *P. nasuta*  
640 radio-tracked in 2005, the patterns of home range selection and usage are explained by  
641 the significant between vegetation-type differences in the availability of invertebrates.  
642 Dry and Wet forest supported the highest abundance of invertebrates in 2005. In  
643 addition there was a significant increase in the mean dry weight of invertebrates  
644 captured in forest between 2004 and 2005 (Dexter *et al.* 2011).

645         We suggest that in 2004, home range selection in *P. nasuta* was more strongly  
646 influenced by access to cover provided by unburnt vegetation than the availability of  
647 food alone. Our analyses of vegetation cover showed that in 2004, unburnt forest and  
648 woodland had significantly greater mid-storey and understorey cover than burnt forest  
649 (Table 2). Dense ground cover has been shown to be important habitat for *P. nasuta*  
650 (Claridge *et al.* 1991; Claridge and Barry 2000; Chambers and Dickman 2002), most

651 probably because of the shelter it provides from potential predators. Cover is likely to  
652 be important because analysis of scats of the Red Fox (*Vulpes vulpes*) at Booderee  
653 National Park indicate that *P. nasuta* is a common prey item (Roberts *et al.* 2006).

#### 654 ***Influence of fire on home range size and vegetation associations***

655 We found no significant difference between the mean home range sizes of *P. nasuta*  
656 captured and tracked in vegetation burnt in the 2003 wildfire and those captured and  
657 tracked in unburnt vegetation. This is consistent with findings of Christensen (1980) and  
658 Vernes and Pope (2001), neither of whom found any significant fire-related change in  
659 home range size of the potoroid marsupials, *Bettongia penicillata* and *Bettongia tropica*  
660 respectively.

661 We found significantly higher mean dry weight of invertebrates in burnt forest  
662 than unburnt forest. We therefore expected home ranges of animals in burnt forest to be  
663 smaller than those in unburnt forest and our results are not consistent with the theory  
664 that home range size should be inversely related to food production (Hixon 1980). We  
665 speculate that *P. nasuta* in burnt forest could not reduce the size of their home ranges  
666 because of their need to access shelter provided by areas of adjacent unburnt forest or  
667 woodland.

668 Our data suggest that *P. nasuta* may be able to alter its habitat selection strategy.  
669 In 2004, six months after the 2003 wildfire, most individuals were strongly associated  
670 with areas of unburnt vegetation within their home range. In 2005, *P. nasuta* appeared  
671 to have selected areas to optimise access to food resources by associating with the  
672 vegetation types with higher levels of invertebrate abundance. Our vegetation surveys in  
673 early 2006 showed that the burnt forest understorey had recovered to the extent that  
674 both the number of understorey species and the percentage cover were significantly  
675 higher than forest which remained unburnt in 2003.

676 For animals with a home range comprising both burnt and unburnt vegetation, we  
677 identified a significant preference for unburnt vegetation. We have observed that *P.*  
678 *nasuta* often takes diurnal refuge under unburnt clumps of vegetation such as *Lomandra*  
679 *longifolia* (MacGregor *et al.* unpublished data). We suggest that *P. nasuta* select  
680 unburnt areas because of the greater availability of potential refuge sites, rather than for  
681 access to food resources. Our findings are consistent with those of Chambers and  
682 Dickman (2002) who found *P. nasuta* nests in areas with dense understorey. They are

683 also congruent with the results of investigations by Heinsohn (1966) and Dufty (1994)  
684 who reported that the eastern barred bandicoot (*Perameles gunnii*) nests in areas of high  
685 structural complexity.

## 686 **Conclusion**

687 Our results indicate that the home range size of individuals was not significantly related  
688 to vegetation type, fire or the abundance of food resources but was strongly influenced  
689 by both focal animal body weight and the weight (and hence the home range size) of  
690 neighbouring animals.

691 While fire did not affect the size of home range used by *P. nasuta*, it did affect the  
692 way animals used their home range. Home range use was a function of disturbance,  
693 with dense unburnt understorey vegetation providing shelter from predators, especially  
694 after fire when other parts of the home range have been burnt.

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850

851 **Table 1. Vegetation types in which *P. nasuta* was tracked**

<b>Vegetation type</b>	<b>Area of Booderee NP (%)</b>	<b>Dominant species</b>
Wet Forest	47	<i>Eucalyptus pilularis</i>
		<i>Eucalyptus botryoides</i>
		<i>Lomandra longifolia</i>
Dry Forest	47	<i>Eucalyptus pilularis</i>
		<i>Corymbia gummifera</i>
		<i>Pteridium esculentum</i>
Rainforest	0.9	<i>Eucalyptus pilularis</i>
		<i>Acmena smithii</i>
		<i>Cissus hypoglauca</i>
Woodland	14	<i>Corymbia gummifera</i>
		<i>Eucalyptus sclerophylla</i>
		<i>Pteridium esculentum</i>
Dry Heath	15	<i>Banksia ericifolia</i>
		<i>Allocasuarina distyla</i>
		<i>Leptospermum laevigatum</i>
Shrubland	9.4	<i>Banksia serrata</i>
		<i>Acacia sophorae</i>
		<i>Chrysanthemoides molinifera*</i>
Vegetated carpark	0.04	<i>Casuarina glauca</i>
		<i>Eucalyptus pilularis</i>
		<i>Lomandra longifolia</i>

852 \* exotic plant species

853

854 **Table 2. Comparison of unburnt vegetation to burnt vegetation in 2004**

2004 Vegetation Survey	Unburn		t value*	2 sided P=0.05	df
	t mean	Burnt mean			
<b>Forest</b>					
# of mid storey species	4.50	2.00	4.30	< 0.001	36
% cover of mid storey	43.33	20.92	3.51	0.001	36
# of understorey species	8.67	10.69	-1.89	0.07	36
% understorey cover	62.92	46.73	2.09	0.04	36
% cover of grasses	18.19	6.88	2.74	0.01	15
<b>Woodland</b>					
# of mid storey species	4.15	2.77	2.20	0.03	44
% cover of mid storey	39.75	22.96	3.02	< 0.01	44
# of understorey species	14.85	14.00	0.31	0.76	44
% understorey cover	76.35	54.81	3.68	<0.001	44
% cover of grasses	31.36	12.92	3.83	<0.001	26
<b>Heathland</b>					
# of mid storey species	2.50	0.88	2.12	0.04	36
% cover of mid storey	10.83	7.50	0.96	0.34	36
# of understorey species	13.17	13.56	-0.29	0.77	36
% understorey cover	97.50	70.94	3.78	< 0.001	36
% cover of grasses	48.96	19.29	4.30	< 0.01	6
* using transformed data					

855

856

857 **Table 3. Comparison of unburnt vegetation to burnt vegetation in 2006**

<b>2006 Vegetation Survey</b>	<b>Unburnt mean</b>	<b>Burnt mean</b>	<b>t value*</b>	<b>2 sided P=0.05</b>	<b>df</b>
<b>Forest</b>					
# of mid storey species	1.75	1.54	1.49	0.145	36
% cover of mid storey	38.33	9.61	4.07	0.001	14
# of understorey species	10.08	14.31	-3.67	< 0.001	36
% understorey cover	36.25	56.15	-2.72	0.010	36
% cover of grasses	14.71	13.04	0.64	0.524	36
<b>Woodland</b>					
# of mid storey species	1.8	1.58	0.69	0.495	44
% cover of mid storey	20.5	14.15	1.08	0.286	44
# of understorey species	12.15	15.31	-2.83	0.007	44
% understorey cover	71	63.85	1.60	0.117	44
% cover of grasses	25.81	17.46	1.72	0.093	44
<b>Shrubland</b>					
# of mid storey species	1.78	3.17	-1.83	0.083	18
% cover of mid storey	30.36	24.17	0.11	0.910	18
# of understorey species	10.86	10.17	0.13	0.899	18
% understorey cover	39.64	66.67	-2.12	0.048	18
% cover of grasses	20.09	37.91	-1.66	0.114	18
<b>Heathland</b>					
# of mid storey species	2	0.72	1.39	0.172	36
% cover of mid storey	35	4.84	1.62	0.164	5
# of understorey species	7.83	11.94	-2.84	0.007	36
% understorey cover	76.67	81.09	-0.43	0.669	36
% cover of grasses	54.58	47.50	0.66	0.510	36
<b>Rainforest</b>					
# of mid storey species	1.20	1.50	-0.93	0.367	14
% cover of mid storey	20.20	27.50	-0.66	0.517	14
# of understorey species	8.80	14.33	-2.42	0.029	14
% understorey cover	54	43.33	0.69	0.50	14

% cover of grasses	11.12	13.96	-0.86	0.41	14
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\* using transformed data

858

859 **Table 4. Captures of *Perameles nasuta* in 2004**

Vegetation type	Recent fire history	Number of sites	No. of tagged <i>P. nasuta</i> (2004)	No. of <i>P. nasuta</i> With $\geq 18$ radio locn.	No. of sites Tracked
Forest	Burnt	3	11	4	1
Forest	Unburnt	2	6	2	2
Woodland	Burnt	1	3	2	1
Woodland	Unburnt	1	3	3	1

860

861 **Table 5. Mean weight of *Perameles nasuta***

Year	Sex	No.	Mean weight (g)	S.E.(g)
2004	Male	8	953.125	$\pm 82.7$
	Female	3	725	$\pm 75$
2005	Male	6	1044.167	$\pm 136.22$
	Female	3	796.6667	$\pm 48.07$

862

863 **Table 6. Home range areas for *P. nasuta* in Booderee NP, using 95% MCP**

Year	Sex	No.	Mean $\pm$ s.e. (ha)	Range (ha)
2004	Male	8	$3.3 \pm 0.71$	1.05–6.45
	Female	3	$1.48 \pm 0.38$	0.99–2.22
2005	Male	6	$3.9 \pm 1.67$	0.80–12.08
	Female	3	$1.75 \pm 0.22$	1.32–2.08

864

865 **Table 7. Number of bandicoots with overlapping home ranges, and the number of**  
 866 **overlaps in parentheses using 95% harmonic centred peeled polygons**



	2004		2005	
	Male	Female	Male	Female
Male	10 (7)	5 (5)	6 (7)	4 (8)
Female	3 (5)	0	3 (8)	2 (1)

867

868 **Table 8. Mean number of overlaps by sex using 95% minimum convex polygons**

	2004	2005	t value	2 sided at P=0.05	df
Male	1.28± 0.22	3.5± 0.81	-3.06	0.006	18
Female	0.42± 0.29	2.75± 1.03	-2.42	0.04	9

869

870

871 **Table 9: Percentage of home range area falling within an overlap area in 2004 and**  
872 **in (2005)**

2004					
Interaction	# of <i>P. nasuta</i> with overlaps	# of overlaps	Mean % of home range area	Mean % of heavier <i>P. nasuta</i> home range area	Mean % of lighter <i>P. nasuta</i> home range area
male/male	10 (6)	7 (7)	17.97(29.00)	15.66(12.04)	20.30(45.96)
male/female	8 (7)	5(8)	17.37(28.78)	7.90(18.31)	24.96(39.25)
female/female	0 (2)	0 (1)	(12.50)	(12.00)	(13.00)

873

874 **Table 10: Proportion of points in the overlapping area**

		2004 mean	2005 mean	2 sided at P=0.05	t value*	df
female	male	3.83	4.63	0.970	2.179	12
female	female		2.75			
male	female	2.80	3.60	0.885	2.160	13

male            male                            3.70            8.00            0.068            2.042            32

875 \*using transformed data

876

877 **Table 11. 2004 MCP v Total area available as defined by animal movement**

878 Ranking from 5 – most preferred to 0 – least preferred.  $t=2.228$ ,  $P<0.05$ ,  $df=10$ .

				Woodla	Rainfor		
	Dry	Wet	Shrub	nd	est	Heath	Rank
Dry							
Forest		-0.496	-0.153	0.239	0.893	0.658	3
Wet							
Forest	0.496		0.594	1.225	2.098	1.320	5
Shrubland	0.153	-0.594		0.515	1.153	1.148	4
Woodland	-0.239	-1.225	-0.515		0.882	0.555	2
Rainforest	-0.893	-2.098	-1.153	-0.882		-0.564	0
Heath	-0.658	-1.320	-1.148	-0.555	0.564		1

879

880 **Table 12. 2004 within range radio fixes v available vegetation types within home**

881 **range**

882 Ranking from 3 – most preferred to 0 – least preferred.  $t=2.228$   $P<0.05$ ,  $df=10$ .

	Dry	Wet	Shrubland	Woodland	Rank
Dry forest		-0.663	-0.711	0.885	1
Wet forest	0.663		0.060	1.652	3
Shrubland	0.711	-0.060		2.289	2
Woodland	-0.885	-1.652	-2.289		0

883

884 **Table 13. 2005 MCP v Total area available defined by animal movement**

885 Ranking from 5 – most preferred to 0 – least preferred.  $t=2.306$ ,  $P<0.05$   $df=8$ . The

886 Disturbed habitat used here was a large vegetated carpark.

			Veg		Shrubla	Woodla	
	Dry	Wet	Cpk	Heath	nd	nd	Rank
Dry forest		0.612	2.785	2.628	2.680	4.332	5
Wet	-0.612		3.302	1.300	2.527	4.353	4

forest							
Veg Cpk	-2.785	-3.302		-1.097	-0.374	1.698	1
Heath	-2.628	-1.300	1.097		1.201	3.795	3
Shrubland	-2.680	-2.527	0.374	-1.201		4.365	2
Woodland	-4.332	-4.353	-1.698	-3.795	-4.365		0

887

888 **Table 14. 2005 within range radio fixes v available vegetation types.**

889 Ranking from 3 – most preferred to 0 – least preferred.  $t=2.365$ ,  $P<0.05$   $df=7$ .

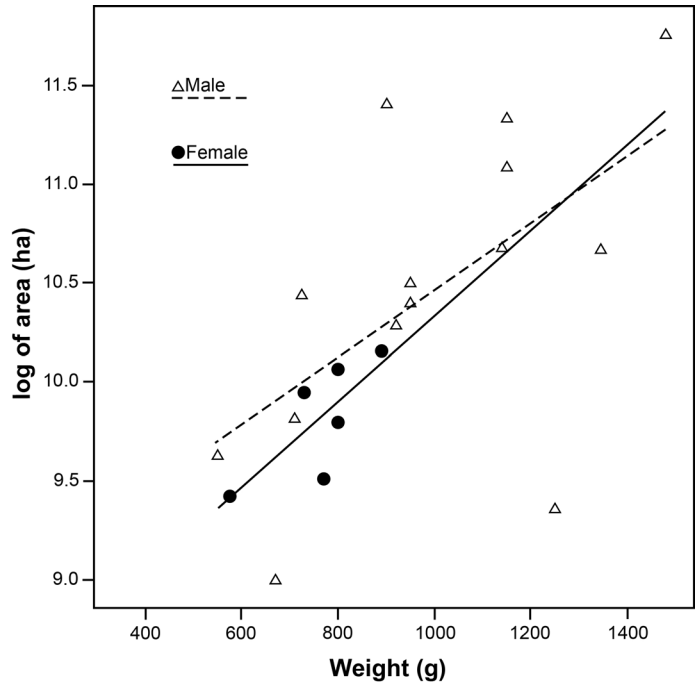
	<b>Dry</b>	<b>Wet</b>	<b>Veg Cpk</b>	<b>Heath</b>	<b>Rank</b>
Dry forest		1.299	5.317	2.480	3
Wet forest	-1.299		4.299	0.909	2
Veg Cpk	-5.317	-4.299		-1.043	0
Heath	-2.480	-0.909	1.043		1

890

891

892 **Fig. 1: Relationship between weight of *P. nasuta* in grams and home range area**  
893 **(ha), using 100% MCP**

894



895  
896