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USE OF WOMBAT GATES BY WOMBATS AND OTHER MAMMALS ON A FARM

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Cover photo: Wombat using a wombat gate at Swanmoor.

Summary

The effectiveness of wombat gates to allow passage of wombats whilst excluding other browsing mammals was investigated on a 300 ha property on the Tasman Peninsula. The use of 17 wombat gates and two fence holes by mammals was monitored for two weeks using cameras. Four mammal species were recorded pushing open and passing through the gates. The wombat was the most common species passing through the 17 gates (613 passes) followed by the rufous-bellied pademelon (33), Bennett's wallaby (4) and Tasmanian devil (2). Only wombats (45 passes) and rufous-bellied pademelons (45) were recorded passing through the two fence holes. The wombat gates were effective in providing passage for wombats and restricting passage by browsing macropods and in reducing damage to fences. It is suggested that the number of macropods using wombat gates in this study could be reduced if the gates were made heavier.

Introduction

Exclusion fences are installed by landowners or land managers for a range of reasons including protection of agricultural and silvicultural assets (Di Stefano 2005), and safeguarding vulnerable wildlife populations (Moseby and Read 2006). Common wombats (*Vombatus ursinus*) are capable of breaching most exclusion fences established in their territories and "wombat gates" are promoted as a method to reduce their impact on exclusion fences (Statham and Statham 2009).

The effectiveness of wombat gates to allow passage of wombats whilst excluding other species of target wildlife has been investigated in two previous studies. Using camera-traps, Borchard and Wright (2010) monitored six wombat gates on the interface between natural riparian vegetation and a 22-ha blueberry (*Vaccinium corymbosum*) orchard in southeastern Australia. They found that wombats regularly used the gates but foxes (*Vulpes vulpes*) and swamp wallabies (*Wallabia bicolor*) rarely breached the gates during the nine month monitoring period. Also using camera-traps, Coates (2013) monitored ten custom-designed wombat gates installed in a fence designed to exclude predators, particularly foxes. They found that wombats and echidnas (*Tachyglossus aculeatus*) frequently passed through the gates while foxes and swamp wallabies were unable or unwilling to pass through them.

Here the use of wombat gates by wombats and other mammals was investigated on the interface between Tasmanian native forest and farmland.

Methods

The study was conducted on the property "Swanmoor" located near Saltwater River on the Tasman Peninsula, southeast Tasmania. Swanmoor is approximately 300 ha comprising 100 ha of native forest and 200 ha of pasture. The main stock on the property is sheep but also includes some cattle.

Between 2012 and 2017, wallaby-proof fences with a 30 cm apron (Statham and Statham 2009) were erected to exclude Bennett's wallabies (*Macropus rufogriseus*) and rufous-bellied pademelons (*Thylogale billardierii*). Wombats were allowed to breach the fences for a period of approximately three months before gates were installed at the breach locations. The gates were installed in the fences between 2016 and 2017 and were tied open for two week to allow the wombats to become accustomed to them. The wombat gate design was a modification of that described by Statham and Statham (2009) in that the Swanmoor gates did not have a steel plate added at the bottom. Subsequent to gate operation an electric wire was installed on the inside of some fences to prevent wombats from digging out from inside the fenced areas. These wires were removed when the wombats became more accustomed with using the gates.

Cameras were set on 17 wombat gates and 2 fence holes (Figs 1-2). Two types of gates that differed in their weights were compared; one had a hollow metal bar at the bottom ("light gate") and the other had a solid metal bar at the bottom ("heavy gate"). An index of the "swing resistance" of the gates was determined by holding the gate open at right angles to the fence using a spring balance. Mean weights were 1.9 kg (range: 1.7–2.3 kg) for the heavy gates and 1.2 kg (range: 1.1–1.4 kg) for the light gates. The actual weight of the gates was approximately 4.5 kg, with the bar on the solid gate weighing 2 kg (G. Dobner, owner of Swanmoor, pers. comm.). Mean height and width for the seven heavy gates were 38 by 31 cm (range: 38–40 by 30–35 cm) and the 10 light gates were 39 by 33 cm (range: 35–40 by 30–40 cm). The sizes of the two holes under the fences were 20 by 40 and 20 by 30 cm.

Three types of camera were used: Keep Guard 680V (n = 12), Scout Guard 560K-8MHD (n = 5) and Reconyx H600 (n = 2). The Scout Guard and Keep Guard cameras were set to record in video mode for 15 minutes each time the sensor was triggered. Reconyx do not have a video mode and recorded still images every time the sensor was triggered, with a 30 second delay between images. Sensitivities on all cameras were set to medium. Cameras were set on 29 November 2017 and removed 14 days later on 13 December 2017. Cameras were mounted on a wooden stake, 30–50 cm above the ground and 2-4 m in front of the gates. The three camera models have been shown to detect similar numbers of small–medium-sized mammals (Driessen *et al.* 2017); however, whether detection of visits differs between cameras set to take stills and cameras set to take videos is not known.

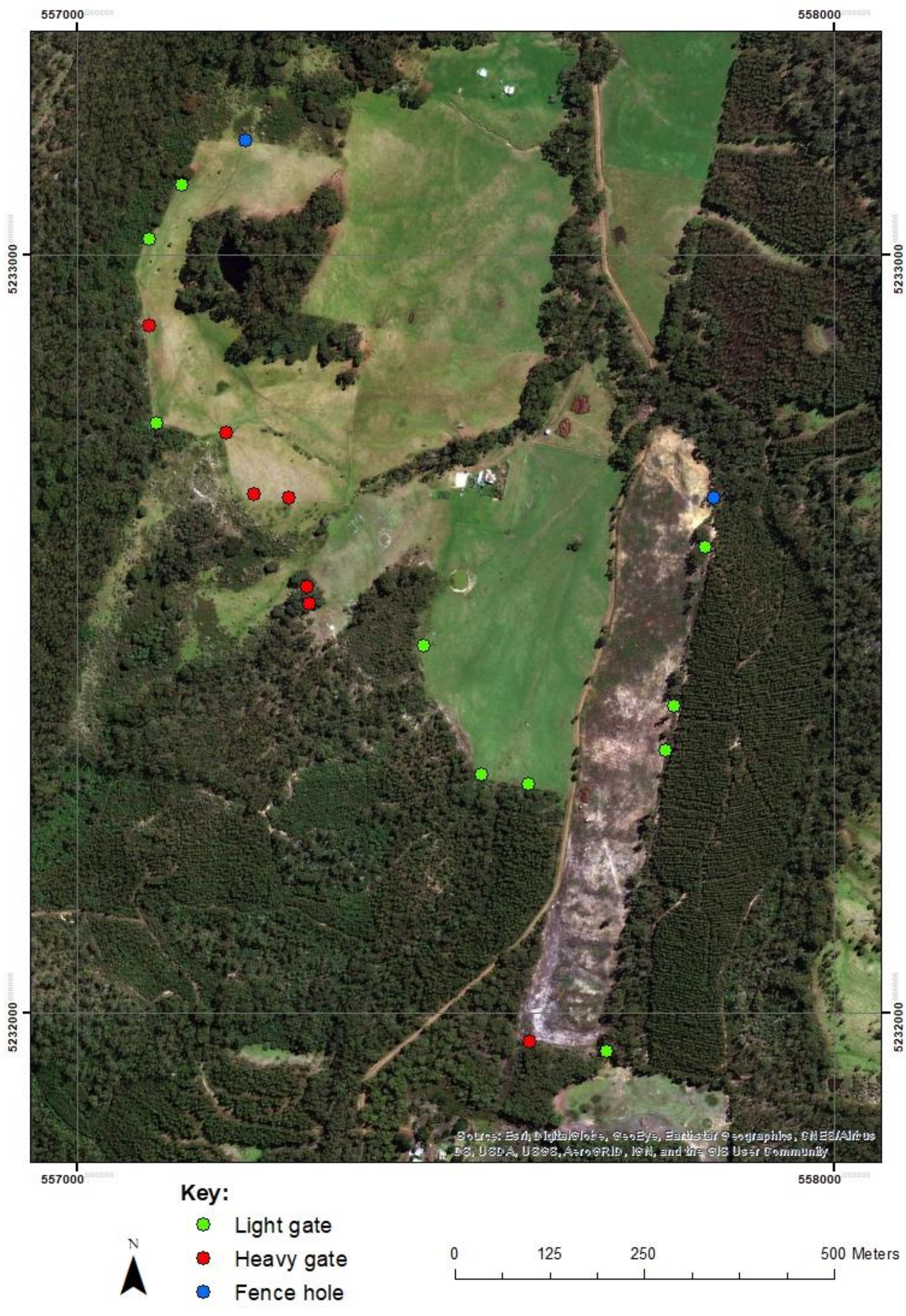

Fig. 1 Study area and position of wombat gates and fence holes.

Light gate with hollow base bar

Heavy gate with solid base bar

Fence hole

Fig. 2 Examples of wombat gates and fence holes monitored.

All images recorded by cameras were assessed for the presence of an animal and wherever possible the animal was identified to species level. Sometimes the animals were too close to the camera or only part of an animal was observed preventing species identification. The number of visits by each species to the camera detection zone was counted rather than the number of images. Visits indicate independence between successive images made by animals spending long periods of time in front of a camera (Jarman and Driessen 2018). Five minutes was chosen as the interval to separate visits. Thus a visit is defined as one trigger or sequence of triggers containing one or more images of a single species with no interval between animal images greater than five minutes. The number of times a species passed through a gate or fence hole was also recorded. This was usually easy to assess on video, although occasionally an animal was assumed to have passed through a gate if it was observed moving away from a gate and the gate was swinging. For still images, an animal was deemed to have passed through a gate/hole if part of its body crossed the line of the fence. It is likely that cameras that recorded still images underestimated the number of passes.

Due to disturbances and instances of poor camera performance not all cameras operated over the full 14 days of survey. To standardise across cameras, the number of animal visits and number of animal passes through the gate per 24 hour period of functional camera operation (12 noon to 12 noon) was calculated.

One-way ANOVA was used to test for differences in the number of wombat visits to, and the number of wombat passes through, light gates, heavy gates and fence holes. Because rufous-bellied pademelon and Bennett's wallaby data departed to a large degree from normality, a non-parametric test, the Kruskal-Wallace, was used with adjustment for ties. There were too few data for other species to analyse statistically.

Images of wombats were assessed for visible signs of mange using the Department's mange scoring guidelines (DPIPWE 2017). Tasmanian devil (*Sarcophilus harrisii*) images were assessed for visual presence of devil facial tumour disease.

Results

Twelve mammal species were detected on cameras, comprising nine native species and three non-native species (Table 1). Wombats were the most commonly recorded mammal, accounting for 50% of visits, followed by rufous-bellied pademelons (32%) and Bennett's wallabies (10%). Seven bird species, a snake and a lizard were also detected, with forest ravens, native hens and superb blue wrens the most commonly detected birds (Table 2).

Four mammal species were recorded pushing open and passing through the wombat gates: wombat, rufous-bellied pademelon, Bennett's wallaby and Tasmanian devil. Several other mammal species such as the eastern barred bandicoot (*Perameles gunnii*), brush-tailed possum (*Trichosurus vulpecula*) and rabbit (*Oryctolagus cuniculus*) were small enough to pass through gaps within the wombat gates. One of the two videos of a short-beaked echidna (*Tachyglossus aculeatus*) showed an individual attempting to pass through.

Wombat

Wombats were recorded passing through the gates more often than any other species both in terms of total number of passes (93% of all passes by mammals) and as a proportion of the total number of wombat visits (57%, Table 1). Wombats were the second most common mammal recorded using the two fence holes (31.5% of all mammal visits, Table 1). There was no significant difference in the number of visits to gates or holes ($F_{(2, 16)} = 0.71$, $P = 0.51$) or the number of passes through gates and holes ($F_{(2, 16)} = 0.71$, $P = 0.51$) (Fig. 3).

Rive instances were observed where a female wombat passed through the gate but her young at foot did not traverse through the gate at the same time and the two became separated either side of the gate. It was able to be determined from one set of videos that the two re-joined after 30 s, but the final outcome for the other four was unknown. Eight instances were also observed of both mother and young-at-foot passing through gates together.

Of the 1177 wombat visits, 845 were of sufficient quality to assess for the visual presence of mange. Of these, 833 (99%) wombat visits showed no visible signs of mange and the remaining 12 wombat visits had ambiguous signs (i.e. possible hair thinning/skin reddening, likely healthy).

Rufous-bellied pademelon

Rufous-bellied pademelons accounted for 5% of all passes through the gates by mammals and 6% of all visits by this species (Table 1). Pademelons were the most commonly recorded mammal using the two fence holes, accounting for 65% of all mammal visits (Table 1).

There was no significant difference in the number of visits by pademelons to gates or holes (H = 2.56, df = 2, *P* = 0.28, Fig. 3). There was little evidence to suggest that there was difference in use of light and heavy gates by pademelons (Fig. 3). Rufous-bellied pademelons passed through the two fence holes almost three times as much as the wombat gates and this difference tended toward statistical significance (H = 3.35, df = 1, *P* = 0.07).

Bennett's wallaby

There was no significant difference in the number of visits by Bennett's wallabies to gates or holes (H = 2.22, df = 2, *P* = 0.33, Fig. 3). Only four gate passes were detected for Bennett's wallaby out of 238 visits (1.7%), with three of the four passes occurring though the light gates (Table 1). Only one visit by a Bennett's wallaby was recorded at the two fence holes.

Tasmanian devil

Only four visits of Tasmanian devils were recorded during the survey and all were associated with heavy gates (Table 1). Three of those four visits involved devils passing through the gates. No instances of devils with visible facial tumour disease were recorded.

Comparison of visits to and passes through gates between species

The average number of visits per night to the gates by wombats was more than twice the number of visits by pademelons or wallabies (H = 11.20, df = 2, *P* = 0.004, Fig. 4). However, the average number of passes through gates per night by wombats was 14 times greater than pademelons and 37 times greater than Bennett's wallabies. (H = 33.89, df = 2, *P* = 0.000, Fig 4).

Table 1 The number of visits by mammals species recorded by camera set in front of wombat gates and fence holes in fences and the number of passes through the gates/holes. Data has been combined across all camera-traps.

Mammals	Light gate		Heavy gate		Fence hole		Total number of visits
	Number of visits	Number of gate passes	Number of visits	Number of gate passes	Number of visits	Number of passes	
Wombat	463	222	604	391	110	45	1177
Pademelon	97	10	432	23	228	45	757
Bennett's wallaby	104	3	134	1	1	0	239
Sheep	22	0	22	0	9	0	53
Rabbit*	25	0	26	0	0		51
Brushtail possum*	4	1	20	8	1	0	25
Barred bandicoot*	1	0	17	0	0		18
Tasmanian devil	0		4	3	0		4
Short-beaked echidnas	0		2	0	0		2
Eastern bettong	2	0	0		0		2
Long-nosed potoroo	1	0	0		0		1
Cat	0		1	0	0		1
Unidentified macropod	12	0	9	0	0		21
Unidentified mammal	20	0	6	0	0		26
All mammals	751	236	1277	426	349	90	2377
No. of cameras set	10		7		2		19
No. of camera nights	65		65		19		149

*these species did not push open the gates; they were small enough to pass through holes in the gates.

Table 2 The number of visits by birds and reptiles detected by camera traps set in front of wombat gates and fence holes. Data has been combined across all camera-traps.

Variable	Light	Heavy	Hole	Total observed
	Number observed	Number observed	Number observed	
Forest Raven	7	3	1	11
Native hen	6	1	3	10
Superb blue wren	6	1	0	7
Grey currawong	1	2	0	3
Masked lapwing	2	0	0	2
Starling	1	0	0	1
Bronzewing pigeon	0	1	0	1
Unid. bird	1	0	0	1
Lizard	1	0	0	1
Snake	1	0	0	1
Unknown	9	0	30	39
All animals	35	8	34	77
No. of cameras set	10	7	2	19
No. of camera nights	65	65	19	149

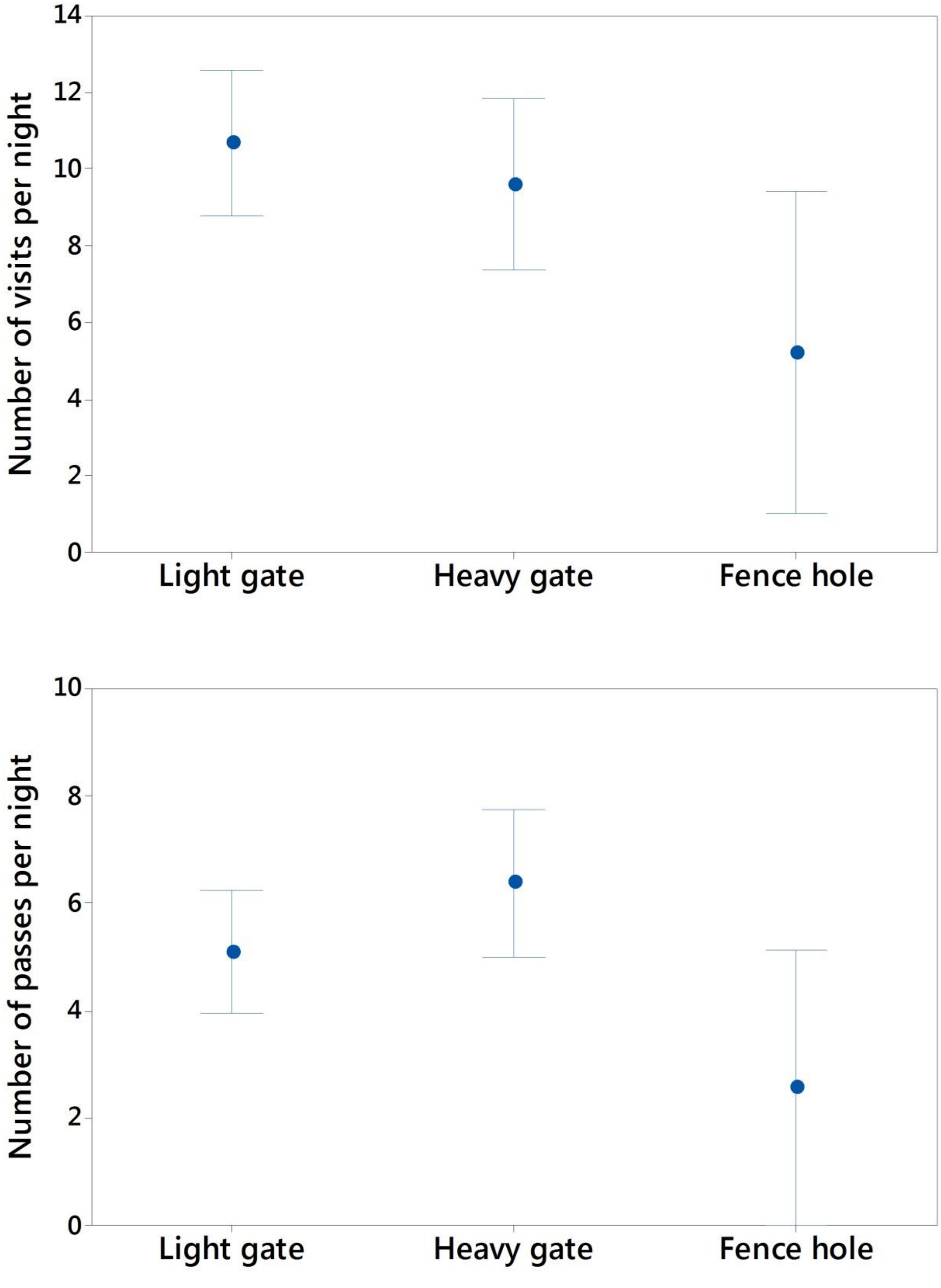

Fig. 3 Comparison of the number of wombat visits (top) and number of wombat passes through gates/holes (bottom) between light gates (n = 10), heavy gates (n = 7) and fence holes (n = 2). Standard error bars pooled across groups are shown.

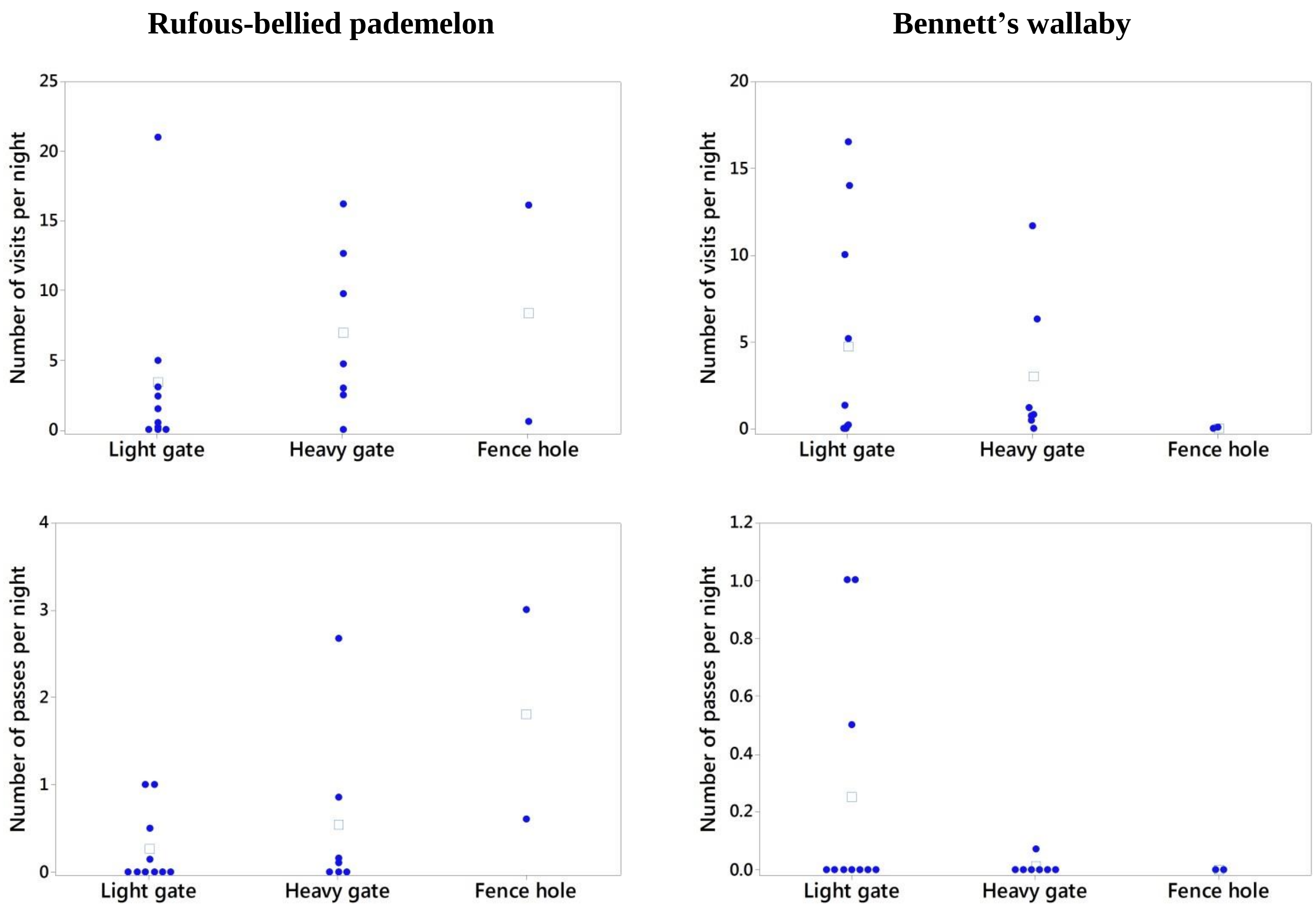

Fig.4 Individual value plots of number of visits and number of passes through gates/holes between light gates (10), heavy gates (7) and fence holes (2) for rufous-bellied pademelons and Bennett's wallabies. Dots are values for individual cameras, which have been offset to display all. Square symbols are the mean values.

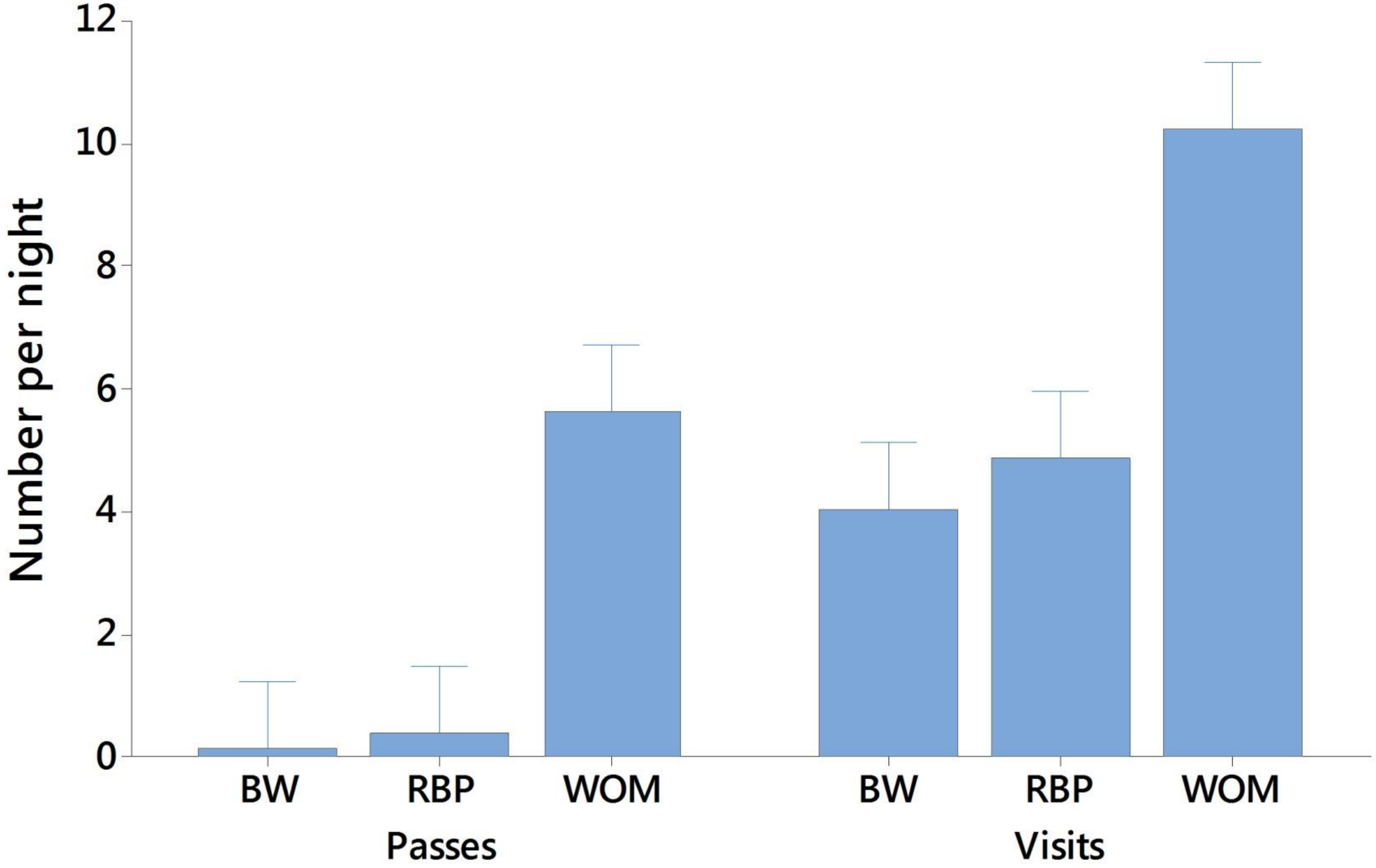

Fig. 5 Comparison between species of the number of visits to, and number of passes through, wombat gates. BW = Bennett's wallaby, RBP = rufous-bellied pademelon, WOM = wombat. Standard error bars pooled across groups are shown.

Discussion

The results of this survey of wombat gates are comparable to two previous studies (Borchard and Wright 2010; Coates 2013) conducted on mainland Australia which have shown that wombats quickly adapt to using gates. The wombat gates were installed at Swanmoor to allow wombats to pass through fences without damaging them and whilst also preventing wallabies and pademelons access to pasture and crops. This goal was largely achieved with wombats frequently using all gates whilst largely precluding use by pademelons and wallabies. It is suggested that if the wombat gates are made a little heavier at the base, then this could further reduce access by macropods. Gates with a 3 kg weight added to the base have previously been recommended (Borchard and Wright 2010; Statham and Statham 2009). Why pademelons were more successful than wallabies at passing through the gates is not known but may be partly due to their smaller size. Both previous studies investigating use of wombat gates found that the swamp wallaby, a species of comparable size to Bennett's wallaby, also rarely used wombat gates (Borchard and Wright 2010; Coates 2013). Some pademelons were observed pushing open the gates by going through gaps between the gate and the supporting frame. Decreasing this gap may also further reduce access by pademelons and potentially other macropods.

One issue that has not previously been raised in relation to the use of wombat gates is the potential for separation of mothers and their young-at-foot. Five instances were observed where an adult female wombat passed through the gate but her young at foot did not traverse through the gate at the same time and the two became separated either side of the gate. It was determined from one set of videos that the two re-joined after 30 seconds, but the final outcome for the other four was unknown. Eight instances of both mother and young-at-foot passing through gates together were also observed. Possible modifications to the gate that may improve unimpeded passage by young-at-foot include; (1) "taller gates" so that the gate is open for a longer period allowing more time for the young at foot to traverse the gate with the mother, and/or (2) a solid barrier on the bottom approximately 10 cm of the gate so that the head of the young wombat does not go through the gate grill while pushing the gate open, which appears to impede passage. Both options will require further investigation.

Our study is the first to record Tasmanian devils using wombat gates. Although echidnas were not recorded going through the wombat gates on the two occasions they were recorded, they were regularly recorded using gates by Coates (2013).

The small number of fence holes used in our study limited our comparison of fence hole use with wombat gate use. Nevertheless, it was clear that fence holes were an important access point for pademelons into paddocks.

This study has shown that wombat gates, in combination with wallaby-proof fencing, are effective in restricting access to pastures by wallabies and pademelons whilst allowing access to wombats, and thus avoiding damage to fences by wombats. The gates therefore represent an effective option to managing wildlife on farms. Further investigation of design features is warranted as the efficacy of the gates can likely be increased.

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