Do possum (*Pseudocheirus occidentalis; Trichosurus vulpecula hypoleucus*) counts vary with the time of the survey?

S A Thompson [1] & G G Thompson [1,2]

[1] Terrestrial Ecosystems, 10 Houston Place, Mt Claremont, WA, 6010

✉ scott@terrestrialecosystems.com

[2] Edith Cowan University, Joondalup Drive, Joondalup, WA, 6027

✉ graham@terrestrialecosystems.com

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Abstract

Western Ringtail Possums (*Pseudocheirus occidentalis*) are listed as conservation significant species with both State and Commonwealth governments. As a consequence any areas proposed for development that potentially support these possums are surveyed to determine their abundance. Here we report a decline in the number of *P. occidentalis* recorded for successive surveys during the same night suggesting that some individuals either retreat to areas where they are not visible or observer fatigue results in fewer possums being detected. In contrast, there was no difference in the number of Common Brushtail Possums (*Trichosurus vulpecula hypoleucus*) observed during the same surveys. This finding has important consequences for environmental consultants or researchers that are undertaking multiple surveys during a night to record local population sizes for Western Ringtail Possums in Western Australia.

Keywords: Western Australia, fauna surveys

Introduction

Western Ringtail Possums *(Pseudocheirus occidentalis)* are listed as vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act (1999) and as a Schedule 1 species (Fauna that is rare or is likely to become extinct) under the Wildlife Conservation Act (1950), with the consequence that land developers that may impact on these possums are required to survey the site prior to a development to estimate the population.

Pseudocheirus occidentalis is most abundant along the coastal strip of vegetation between Yalgorup and Dunsborough (Jones *et al.* 1994b; de Tores 2008; DEWHA 2008), but scattered populations also exist throughout the south-west of Western Australia as far east as Two Peoples Bay near Albany with some isolated inland populations at Collie, Yendicaup and Moradalup (Jones *et al.* 2007). *Pseudocheirus occidentalis* is nocturnal and usually shelters by day in a drey (bird-like nest) or tree hollow. Dreys are typically located in the crown of Peppermint trees (*Agonis flexuosa)*, but may be constructed in other tree species, such as Melaleuca, Banksia, Marri, Tuart and Jarrah trees (Thompson & Thompson 2009). But they can also be found in dense sword grass, grass trees, reeds, sedges, blackberry thickets, fallen logs and disused rabbit warrens or use tree hollows as retreats (de Tores 2008; Harewood 2008; Jones *et al.* 1994a).

Because of its conservation status, all areas that support native vegetation or peppermint trees that are proposed for development in the coastal strip between Bunbury and Dunsborough should be searched for *P. occidentalis* and their dreys counted as part of the fauna assessment to support an environmental impact assessment or native vegetation clearing permit application. Being nocturnal requires that the counting of *P. occidentalis* must be done at night. Where multiple areas are to be surveyed at the same time, environmental consultants will frequently survey multiple sites in one night. Searches are typically undertaken using a head torch and walking through an area counting the number of *P. occidentalis* seen.

Lindenmayer *et al*. (2001) and Goldingay & Sharpe (2004) concluded from their review of the effectiveness of spotlighting to count arboreal mammals that this technique was being used more frequently in environmental assessments and additional research was required to determine whether spotlighting counts can be calibrated and used for population estimates.

Davey (1990) reported spotlighting to be an effective method for surveying nocturnal marsupials, however, Lindenmayer *et al*. (2001) reported that spotlighting significantly underestimated the population size for greater gliders (*Petauroides volans*). Wayne *et al*. (2005) suggested that there was variability in the different methods of counting *P. occidentalis*, and best results were obtained from scat surveys and spotlighting using a 50-W hand-held spotlight. They also noted significant differences among observers in spotlighting counts. Our experience using head torches while walking and

searching trees during repeated surveys of *P. occidentalis* at the same site also indicated that counts varied, suggesting that not all *P. occidentalis* were being detected during a single survey. Wayne *et al*. (2005) reported that heavy rain, wind, cloud cover and vegetation structure affected counts of *P. occidentalis* and the Common Brushtail Possum (*T. v. hypoleucus*), however, start time after sunset did not affect detection rates for either of these species. Contrary to the data presented by Wayne *et al*. (2005), our anecdotal records from repeated surveys of the same site suggested that survey period might be affecting detection rates. Our objective for this study was to determine whether the number of *P. occidentalis* being detected varied with successive surveys on the same night. As our survey area also contained a population of *T. v. hypoleucus,* we included this species in the survey.

Methods

The study site consisted of a rectangular 5.3 ha isolated patch of Peppermint (*Agonis flexuosa*) woodland approximately four kilometres from the Busselton town centre (33.66 °S, 115.39 °E). The area outside of the isolated patch of Peppermint trees was grassed open pasture, a bitumen road and school playing fields, and a partially developed housing estate. The area contained a series of parallel black plastic irrigation pipes that were approximately 9m apart which were used as transects.

Possums were located by two observers using head torches while walking along every second irrigation pipe on two consecutive nights (22nd and 23rd December 2008). Generally, one observer would walk along the irrigation pipe and the other to the eastern side of the irrigation pipe. The search focussed on the area approximately 10–15 m either side of the irrigation pipe. The two observers were experienced in spotlighting *P. occidentalis* and were familiar with this site as it had been surveyed on multiple previous occasions.

Surveys commenced after dark at about 22:45 hr, 01:15 hr and 4:00 hr on both nights. Possums did not flee when they were detected and therefore double counting of individuals was unlikely, although possible. The location of each possum was recorded using a GPS, along with the tree species and the height of each possum in the tree. It was not practical to measure the height of the possum in a tree, so the height of each possum was estimated.

Data analysis

Multiple surveys on the same night and repeated again on a subsequent night would generally require a repeated measures approach to analysing the data. However, this is not possible in this circumstance as repeated measures ANOVA requires more subjects than repeats which we do not have for the number of observations of either species of possum. We did not record each individual possum's height in a tree for subsequent surveys, as there was no way of identifying individual possums.

We used a goodness-of-fit measure to examine the extent to which the number of observed possums deviated from the average number of possums observed for the six periods of observation. As there was a significant difference in these data, we then combined the number of observations for the first, second and third periods on each night and tested for a temporal difference in observations against the average number of observations over the entire night. A significant difference would indicate there was a temporal variation in the number of observations. A two factor ANOVA was used to test for difference in the height of possums in trees. A Tukey post-hoc test was used to examine differences between survey periods. A level $\alpha = 0.05$ was used in all analysis to determine if differences were significant.

Results

There were clear skies with almost no wind on both evenings the surveys were undertaken. The survey site has a tree canopy that ranges from 5–20m with little vegetation other than tree trunks to 3m above ground level. Visibility with head torches in locating possums was generally good.

There was a significant difference between the number of *P. occidentalis* observed over the six survey periods ($\chi = 12.4$, df = 5, $P = 0.03$) and a significant difference among the three survey periods ($\chi = 11.1$, df = 2, $P = 0.004$) indicating a significant and declining temporal difference in the number of *P. occidentalis* counted (Fig. 1). The pattern was the same for *T. v. hypoleucus* for the second to the third period but it was not true for the first to the second period (Fig. 2; $\chi = 4.8$, df = 5, $P = 0.44$).

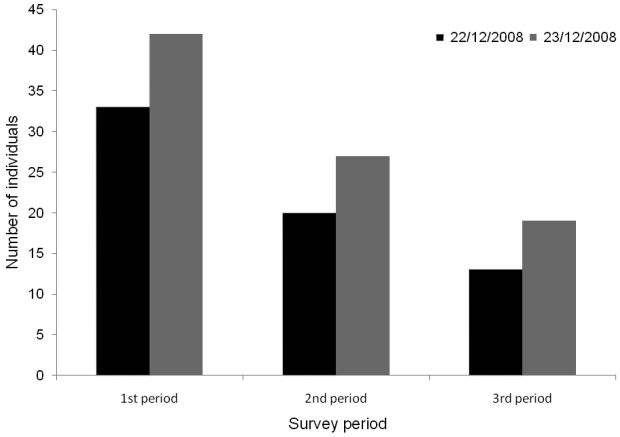

Figure 1. Number of *Pseudocheirus occidentalis* seen during three successive surveys on two nights.

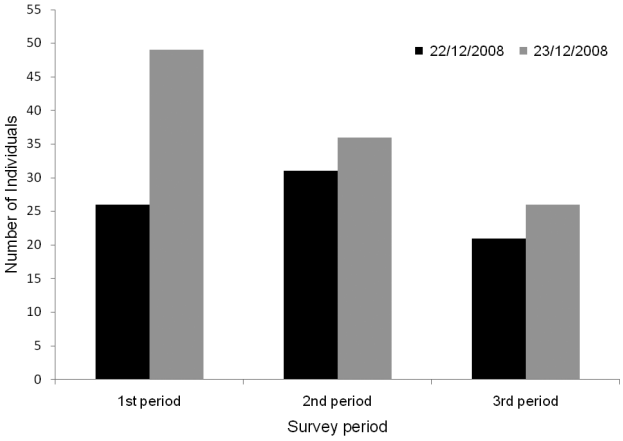

Figure 2. Number of *Trichosurus vulpecula hypoleucus* seen during three successive surveys on two nights.

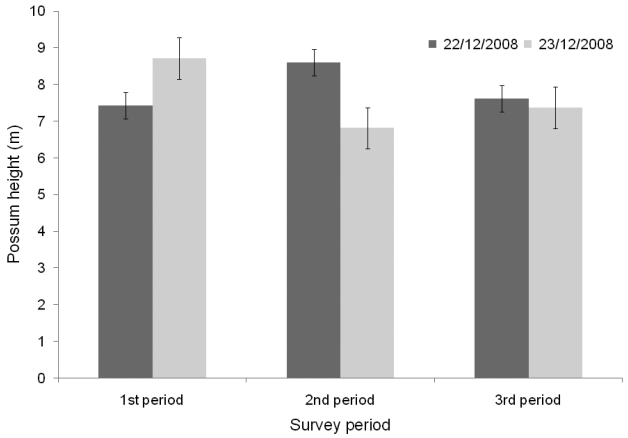

Figure 3. Height of *Pseudocheirus occidentalis* in trees during three successive surveys on two nights (1 se bars).

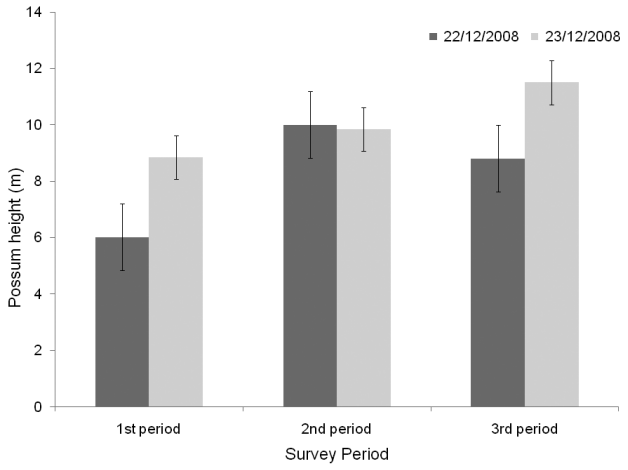

Figure 4. Height of *Trichosurus vulpecula hypoleucus* in trees during three successive surveys on two nights (1 se bars).

The estimated height of *P. occidentalis* varied significantly among survey periods ($F_{1,2}$ = 15.5, P < 0.01; Fig. 3) and there was a significant interaction between night and survey period ($F_{1,2}$ = 4.1, P = 0.02; Fig. 3). The post-hoc test indicated significant differences between the first and second, and first and third surveys. Similarly, for *T. v. hypoleucus*, there was significant difference in the height they were observed in the tree ($F_{1,2}$ = 127.6, P < 0.01; Fig. 4), a significant interaction between night and survey period and again the post-hoc test indicated significant differences between the first and second, and first and third surveys.

Discussion

Difference in the number of possums counted during successive surveys on the same night can be attributed to one of three reasons: a) possums moved out of the survey area; b) possums were not be detected as they had not emerged or have returned to their retreats, were higher in the canopy and could not be seen or had turned their heads away from the light so that their eye shine was not evident (Davey & Robinson 1986; Lindenmayer *et al.* 2001); or c) observers were less vigilant, became fatigued and tired, or changed their behaviour in some way during subsequent surveys each night and missed seeing individuals as the night progressed (Lindenmayer *et al.* 2001).

A few possums occasionally moved in and out of the study area. We know that this occurs as dead possums have been recorded on roads in the adjacent area and a night security guard for the nearby housing estate has occasionally seen possums running across the road at night. We believe the number of possums that moved out of our survey area on any one night would have been low, and it is likely that a similar number of possums moved into and out of the survey area as our long term data for the site suggested the population was relatively stable.

Lindenmayer *et al*. (1991) reported emergence times from dens varied for arboreal marsupials and differences were correlated with body mass, field and standard metabolic rate. MacLennan (1984) reported that for the first two hours after sunset, *T. vulpecula* spent most of the time in dens grooming, moving around or sitting, and feeding did not commence until the second hour after sunset. MacLennen (1984) reported *T. v. hypoleucus* mostly foraged between the fourth and eight hour after sunset and returned to their den 8.98hrs (± 0.96) after sunset. Sunset was about 19:05hr and we commenced our survey at about 21:45hr (corrected for daylight saving) which was greater than two hours after sunset. Based on the observations of MacLennan (1984) some *T. v. hypoleucus* may have still been in the den or were preparing to come out and forage. Similar data on emergence times are not available for *P. occidentalis*.

The height of possums in trees varied significantly, but they were not significantly higher in the last survey each night compared with the earlier surveys (Figs 3 and 4) suggesting that the difference in the number of individuals observed was not due to more individuals being higher in the tree canopy and more difficult to observe.

In summary, we counted more *P. occidentalis* during the first survey of the night, and this number decreased on both nights during the second and third surveys. The pattern was different for *T. v. hypoleucus*, with a decrease on both evenings between the second and third surveys, but with a difference between the two nights for the first survey. We consistently observed more possums of both species during the second night survey. There are two possible reasons for the variation in the number of possums recorded. *Pseudocheirus occidentalis* either shifted their position so that they were difficult to observe (*e.g.* moved into a tree hollow, moved higher in the canopy, looked away from the light) or observer fatigue meant that fewer possums were recorded. There is no evidence to suggest these possums moved higher in the canopy between successive surveys each night but it is possible that *P. occidentalis* returned to their retreats and could not be seen. If *T. v. hypoleucus* were slower to emerge on the second night, then both reasons outlined above could have contributed to the reduced number of possums being observed during the second and third survey periods each night. We presumed that the difference in the number of possums recorded between the two nights reflected the difference in the number of possums that were active and out of their retreats.

Whatever the reason for the lower number of *P. occidentalis* being observed during the second and third surveys each night, it is evident that observations during the early part of the evening record a higher number of individuals than those later. In addition, the number of possums observed varied significantly between the two successive nights. These findings have important implications for future *P. occidentalis* surveys that are used to record the number of individuals in a particular site or are used as part of an ongoing monitoring program. Our recommendations are that surveys should be concluded by midnight and a minimum of two surveys should be undertaken to record the population of possums in an area.

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