Notes on....

Capture rates of small vertebrates decrease as the pit-trapping effort increases at Ora Banda

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Abstract. Based on 27216 pit-trap nights, we measured catch rates for reptiles and mammals using bucket and pipe pit-traps over seven consecutive days for nine sites for eight trips over two years in the Ora Banda region of Western Australia. The number of individuals captured was highest for both mammals and reptiles on the first day that pit-traps were open. For mammals, catch rates declined over a period of four consecutive days and then remained at that level. All species were likely to be captured in the first two days of trapping days with the trapping strategy that we used. For reptiles, catch rates declined for the first four days then increased to a level similar to days 2 and 3. New species of reptiles were captured after the fourth day of trapping, so extended periods of pit-trapping increases the proportion of species in the assemblage that are captured, although the return on trapping effort declines.

Keywords: pit-trap, trap effort, reptile, mammal

Introduction

Moseby & Read (2001) reported that for a 10 day survey the last night of pit-trapping typically captured between one third and one half of the first night's catch. Their first full day of trapping yielded the highest number of captures, and nights 1–3 captured significantly more than nights 6–10. We examined whether capture rates for mammals and reptiles changed with successive trapping days, and whether these changes were influenced by using buckets or pipes as pit-traps for an intensive survey of the Ora Banda region, Western Australia.

Materials and methods

Study sites

We surveyed nine relatively undisturbed sites (Gimlet, Palace, Rose, Wendy Gully, Salmon Gums, Spinifex, Davyhurst, Security and Crossroads) in the gold mining region of Ora Banda (30° 27' S, 121° 4' E; approximately 50 km north of Kalgoorlie), Western Australia over a two year period. Ora Banda lies on Archaen granites that underlie lateritic gravel soils. The vegetation was heterogenous, ranging from Eucalypt-Casuarina-Mulga woodlands interspersed with *Acacia*, to sparsely distributed spinifex (*Triodia* spp) and shrubs (*Acacia* spp) to dense shrubs (*Acacia* spp, *Atriplex* spp, *Allocasuarina* spp). Each of the nine sites represented a different vegetation type and was typical of the area (Mattiske Consulting Pty Ltd 1995).

Pit-trapping

All sites were pit-trapped on eight occasions between Sept 2000 and Apr 2002 (Sept and Dec 2000; Jan, Apr, Sept and Dec 2001; Jan and Apr 2002) using alternating 20 L PVC buckets and 150 mm PVC pipes (600 mm deep) with a 250 mm high x 30 m long fly-wire drift fences. Each site had eight rows of six pit-traps. All pit-traps were prepared before the study in June–July 2000. During each survey period, pit-traps were opened for seven consecutive days and cleared daily. In Sept, Dec and Jan survey periods, study sites were divided into two groups and surveyed in successive weeks. Most individuals were identified before immediately being released adjacent to their point of capture; a few specimens were vouchered with the Western Australian Museum. Recaptures have been included in the analysis. We report 27216 pit-trap nights of data.

Data analysis

We combined data for eight survey periods and used a repeated measures ANOVA, with days nested in seasons, which were nested within years with buckets and pipes as factors to determine significant differences among years, seasons, days and trap type for individuals and species. A post hoc Tukey test was used to examine differences among days.

We used a species accumulation curve for the January 2001 survey period to illustrate the capture rate of additional species of reptiles and mammals over seven days of surveying. More reptile individuals and species were captured during the Jan 2001 seven day survey than any other survey period, therefore these data represent the best possible capture rate for species in the area. The Beta-P non-linear regression model was then used to calculate a species accumulation curve from the data (Thompson *et al.* 2003).

Results

For mammal abundance there was no significant difference between buckets and pipes ($F_{1,16}$ = 3.04, P = 0.10), years ($F_{1,16}$ = 0.04, P = 0.84) or seasons ($F_{3,48}$ = 0.08, P = 0.97), but there was a significant difference among days ($F_{6,96}$ = 11.47, P < 0.001). For mammal species richness there also was no significant difference between buckets and pipes ($F_{1,16}$ = 2.17, P = 0.16), years ($F_{1,16}$ = 0.01, P = 0.91) or seasons ($F_{3,48}$ = 0.68, P = 0.57), but there was a significant difference among days ($F_{6,96}$ = 10.14, P < 0.001).

For reptile abundance there was a significant difference between buckets and pipes ($F_{1,16}$ = 34.74, P < 0.001), years ($F_{1,16}$ < 44.0, P < 0.001), seasons ($F_{3,48}$ = 40.7, P = 0.001) and days ($F_{6,96}$ = 14.06, P < 0.001). For reptile species there also was a significant difference between buckets and pipes ($F_{1,16}$ = 11.3, P < 0.001), years ($F_{1,16}$ = 36.4, P < 0.001), seasons ($F_{3,48}$ = 58.3, P < 0.001) and among days ($F_{6,96}$ = 15.1, P < 0.001).

Table 1

P-values from a post-hoc Tukey test of the differences in catch rates among consecutive pit-trapping nights. P-values in bold are significant at a < 0.05.

	Days					
Mammal abundance						
Days	2	3	4	5	6	7
1	0.460	**0.018**	**0.001**	**0.001**	**0.001**	**0.001**
2		0.780	**0.001**	0.086	**0.049**	**0.005**
3			**0.007**	0.819	0.695	0.222
4				0.255	0.371	0.853
5					1.000	0.952
6						0.985
Mammal species						
1	0.961	**0.043**	**0.001**	**0.004**	**0.001**	**0.001**
2		0.356	**0.001**	**0.071**	**0.019**	**0.001**
3			0.043	0.988	0.874	0.211
4				0.254	0.537	0.994
5					0.999	0.663
6						0.910
Reptile abundance						
1	**0.001**	**0.001**	**0.001**	**0.001**	**0.016**	**0.001**
2		0.909	**0.040**	1.000	0.503	0.999
3			0.462	0.897	**0.048**	0.991
4				**0.037**	**0.001**	0.122
5					0.523	0.999
6						0.250
Reptile species						
1	**0.001**	**0.001**	**0.001**	**0.001**	**0.021**	**0.001**
2		0.443	**0.030**	1.000	0.443	1.000
3			0.879	0.516	**0.003**	0.310
4				**0.041**	**0.001**	**0.015**
5					0.374	1.000
6						0.591

The catch rates for mammals for day 1 differed significantly from catch rates for most successive trapping days, for both abundance and the number of species captured (Table 1). Similarly, the catch rate for reptiles for day 1 differed significantly from subsequent days for both abundance and number of species captured. Day 4 generally had the lowest catch rates for both mammals and reptiles (Figs 1, 2). A significantly lower number of reptile individuals and species were captured on day 4 than days 1 and 2, and day 5 (Fig 2), and day 6 for reptile species (Table 1).

The species accumulation curve for the January 2001 survey period for reptiles (Fig 3) shows that most, but not all species, were captured in the first two days of trapping. All six species of mammals were captured on the first day during this January survey period.

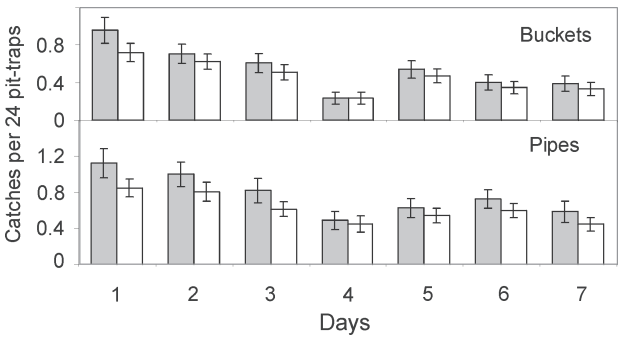

Figure 1. Catch rates for mammals for consecutive nights at Ora Banda using buckets and pipes. Abundance in grey fill and species in clear fill; values are mean with one se.

Discussion

Moseby & Read (2001) reported for three sites in the arid interior of northern South Australia that for reptiles day 6 in the grazed area was the first day in which catch rates were significantly lower than day 1, compared to day 5 for pastoral areas, and day 2 for mined areas. Their catch rates continued to decline over 10 days of trapping. The pattern for reptile captures in natural habitats at Ora Banda differed among consecutive days. Day 1 captured the highest number of reptiles, with a progressive decline to day 4, after which the catch rate increased. The pattern was the same for buckets and pipes. Why there was a decline and a subsequent increase was not obvious. Some species of reptiles are attracted to freshly dug soil (e.g. *Varanus eremius*, pers. obs), and this might account for the higher initial catch rate (e.g. day 1). This is an obvious reason for leaving a period between when pit-traps are

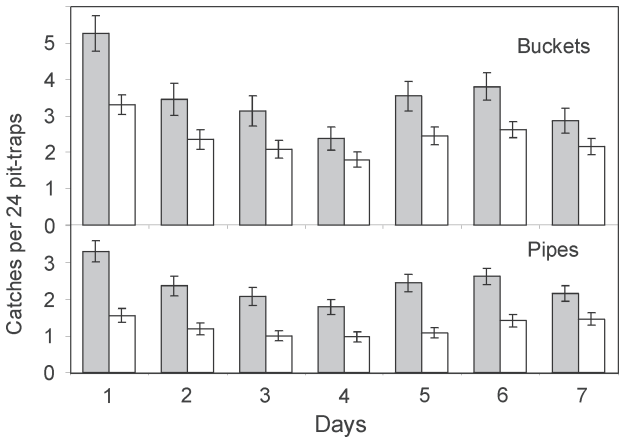

Figure 2. Catch rates for reptiles for consecutive nights at Ora Banda using buckets and pipes. Abundance in grey fill and species in clear fill, values are means with one se.

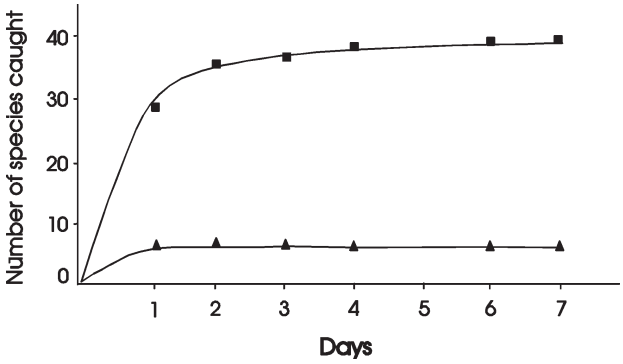

Figure 3. Species accumulation curves for Jan 2001 survey period over seven consecutive days. Squares (reptiles) and triangles (mammals) are actual data points; reptile species accumulation curve is calculated using the Beta P model.

dug into the ground and when they are first opened for the purposes of sampling the reptile assemblage.

Mammal captures declined progressively for the first four days, increased a little and remained at that rate thereafter. As for reptiles, there was no difference in the pattern between buckets and pipes. These data suggest that mammals are either learning to avoid pit-traps, are moving away from the area, or are dying as a result of being captured.

Although catch rates generally declined over the first four days, new reptile species were still being captured after day 4. We have captured 51 species of reptiles around Ora Banda (9 sites), although we only captured 39 species during Jan 2001. With lower captures during other survey periods, additional trapping effort would be required to catch the same number of species. Our survey data indicate that unless intensive surveys are carried out or surveys are undertaken during spring, summer and autumn, then all species will not be captured within seven days using our trapping strategy (also see Thompson *et al.* 2003). Therefore, if the objective of the terrestrial fauna survey is to record all available species in the area, a much greater trapping effort than was applied here is required. It was evident that at least for the first seven days of a survey, both mammal and reptile catches will decline for the first four days. Mammal catches will stay low after the fourth day, around 40–50% of the first days catch, but reptile catch rates will increase to a level similar to day 2, at least at Ora Banda.

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