Rodent trapping in the Saja/Umm Ar-Rimth Protected Area of Saudi Arabia using two different trap types

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Abstract. Small mammal trapping was carried out in the Saja/Umm Ar-Rimth Protected Area to determine the species composition and to compare standard-length Sherman and commonly available cage traps. Five rodent species were captured from December 2002 to December 2003. The cage traps consistently trapped more rodents than the Sherman traps and the Baluchistan Gerbil, Gerbillus nanus, showed a clear preference for the cage traps. There was no marked difference in the failure rates of the two trap types. Seasonally, the trapping frequencies were not randomly distributed, with higher capture rates for most species during the cool season. Significant differences were recorded in the mean weights of the five rodent species captured, but no significant difference existed between the mean weights of the rodents successfully captured in either trap type. We conclude that both trap types were successful in trapping rodents in the observed weight range, and that species-specific behavioral differences and/or differences in trap design could affect trap efficiency. Consequently it is advisable to use a combination of trap types when studying rodent ecology. It is also strongly recommended that pilot studies be conducted to help identify any potential shortcomings in study design and field procedures.

Key words. Gerbil, jerboa, pilot study, small mammal, monitoring, Sherman traps, Saudi Arabia, Middle East.

Introduction

Desert ecosystems have a high diversity of rodents (KOTLER & BROWN 1988) and, excluding the Sciuridae and the Hystricidae, there are 46 known rodent, or small mammal species in the Arabian Peninsula (HARRISON & BATES 1991). This is in part because of their specialisation on seed-producing plants, as has also been documented in the deserts of North America (MUNGER & BROWN 1981, KOTLER & BROWN 1988). Consequently OLFERMANN et al. (1993) suggested that rodents could serve as indicator species for the restoration of vegetation, as they should be sensitive to changes in their food base and ultimately to changes in vegetation density, structure and diversity.

Trapping is a technique often used in small mammal ecology and monitoring, and in general the trapping techniques either capture the animals alive or kill them in the process. Live traps that are commonly used include the Sherman trap (O'FARRELL et al. 1994, DRICKAMER 1995) and the Longworth trap (FLOWERDEW et al. 2004), while kill-trapping is often done with Victor traps (DRICKAMER & MIKESIC 1993), Museum Specials (FRANCL et al. 2002) or other snap traps such as the "Ezeset" traps (WEIHONG et al. 1999). However, it has long been known that different trap types are more successful at capturing some species than others, thereby introducing bias in determining both the species composition and population density estimates in any given area (SEALANDER & JAMES 1958). Although a variety of studies as-
sessing the relative efficiency of different trap types (e.g. MANVILLE 1950, SEALANDER & JAMES 1958, RANA 1982, DRICKAMER & MIKESIC 1993, FRANCL et al. 2002) have been carried out, no such work has, to the best of our knowledge, been published from the Arabian Peninsula using the trap types from this study.

This paper reports on a pilot study that was undertaken at the outset of a monitoring programme aimed at documenting potential changes in small mammal species composition and abundance with vegetation recovery. In particular, we set out to determine which small mammal species were present in the Saja/Umm Ar-Rimth Protected Area and in so doing we tested the hypothesis that small mammals were equally likely to be captured in one of two trap types. In addition, tests were done to assess the effects of species, body mass, previous capture, habitat and season on the proportion of captures, while the failure rates of the two traps were also compared.

**Study area**

The Saja/UmmAr-Rimth Protected Area of 6,000 km² lies on an open plain of sand and gravel on the eastern edge of the Najd pediplain, in the Arabian hinterland (CHILD & GRAINGER 1990) (Fig. 1). According to IUCN terminology, Saja/Umm Ar-Rimth was designated as a Multiple Use Management Area in 2001 and, with the exception of a 400 km² fenced core area, the entire protected area remains accessible to Bedouin and their livestock. Vegetation in the area consists of associations of *Acacia tortilis* and *Panicum turgidum* and is dominated by *Haloxylon salicornicum*, *Fogonia indica*, and some Graminaceae such as *Centropodia forskali* and *Stipagrostis hirtulguma*. The vegetation in the area is degraded due to over-utilisation (ROBINSON 2001). The climate of the area is tropical and arid. Rainfall is scant and erratic with c. 50-100 mm of rainfall per year, with mean daily temperatures of 21.1±6.4°C and 27.8±8.4°C during the cool (November to April) and hot (May to October) seasons respectively.

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Fig. 1. The location of the Saja/Umm Ar-Rimth Protected Area in west-central Saudi Arabia.
Fig. 2. The Sherman (front) and cage (back) traps used for rodent trapping in the Saja/Umm Ar-Rimth Protected Area in the present study. Note the triggering mechanism on top of the cage trap and the plastic sheeting to provide cover to trapped animals.

Methods

Trapping and handling

Trapping sessions were carried out in the Saja/Umm Ar-Rimth Protected Area from December 2002 to December 2003, thereby covering both the cool and the hot seasons. In so doing, a standard-length collapsible Sherman trap (23x9x8 cm) and a Thailand-made cage trap (32x12.8x13 cm) commonly available in markets in Saudi Arabia (and herein referred to as cage traps) were placed 1 m apart at 100 m intervals, along a randomly selected 4 km transect line that bisected a gravel plain and a wadi. This resulted in 20 trap stations being set in both the wadi and the gravel plain habitats during each 4-night trapping period. To provide shade for captured animals, half the length of all the cage traps was covered with plastic (Fig. 2), leaving the ends uncovered so that animals could still see into and through the trap upon entry. No modifications were made to the Sherman traps. All traps were baited with a mixture of bread and peanut butter during late afternoon and checked early the next morning. All traps remained closed during the day and were only opened in the afternoon at the time of baiting. No pre-baiting was done and no attempts were made to channel rodents towards the traps.

Upon capture, all rodents were identified to species level, sexed and weighed, and their general condition was determined. Before release at the original site of capture, each rodent was dorsally marked with a small amount of spray paint to facilitate determination of its status during a trapping period.
Data analyses
We followed two approaches in the data analyses. Firstly, we aimed at testing for trap preference. For this purpose we used a subset of the database, which included only those trapping stations where a rodent was successfully trapped in one of the paired traps while the other remained active with bait in place throughout the night. Due to inconsistencies in data collection, this subset only included data from three of the five trapping periods, namely December 2002, August 2003 and December 2003. Due to the small sample sizes, these data were pooled for analysis. Secondly, we used the entire dataset to compare overall trapping frequencies of the two trap types, with reference to species, weight, capture/recapture, habitat and season.

Where appropriate, we have used Chi-square, the t-test or ANOVA to analyse the data. Tukey's post-hoc test was used to determine where significant differences occurred following ANOVA. Where necessary, data were visually inspected for normality of distribution. All analyses were done using SYSTAT 10 and the confidence interval was set at 95%.

Results
During the study period 174 rodents, representing five different species, were successfully captured in the Saja/Um Ar-Rinth Protected Area. These were Sundevall's Jird, Meriones crassus Sundevall, 1842, Baluchistan Gerbil, Gerbillus nanus Blanford, 1875, Cheesman's Gerbil, G. cheesmani Thomas, 1919, Lesser Jerboa, Jaculus jaculus (Linnaeus, 1758), and Libyan Jird, Meriones libycus Lichtenstein, 1823. Meriones crassus and Gerbillus nanus were the species most frequently caught, while Meriones libycus was the least caught species (Table 1). When considering only active, paired traps (i.e. trap preference), three of the five rodent species were captured more often in the cage traps than in the Sherman traps. Only Gerbillus nanus was trapped significantly more often (Pearson $\chi^2 = 4.80$, d.f. = 1, $P = 0.028$) in the cage traps. Captures of Jaculus jaculus and Meriones libycus were too infrequent to warrant statistical analysis. Furthermore, our capture rates were too low to test for possible trap preference by the different species on a seasonal basis. There was no significant difference ($\chi^2 = 0.720$, d.f. = 1, $P = 0.396$) in the failure rates of the two trap types.

Overall, four of the five species were captured more often in the cage traps than in the Sherman traps, with only Jaculus jaculus being captured significantly more often (Pearson $\chi^2 = 7.364$, d.f. = 1, $P = 0.007$) in the cage traps. Only two Meriones libycus specimens were captured during the entire study period; one in each trap type. Trapping the five species was not randomly distributed on a seasonal basis (Pearson $\chi^2 = 12.971$, d.f. = 3, $P < 0.01$), with Meriones crassus being captured significantly more often (Pearson $\chi^2 = 26.614$, d.f. = 1, $P < 0.01$) than expected during the cool season. None of the other species showed any significant differences in trapping frequency between seasons.

Both Gerbillus nanus and Gerbillus cheesmani were trapped significantly more often in the wadi than on the plain (Table 2), while Jaculus jaculus and Meriones crassus were caught on the plain more often than in the wadi, but not significantly so. Both captures of Meriones libycus were in the wadi. With the exception of Meriones libycus, all species were captured significantly more often than recaptured (Table 2). While both trap types were more successful at first captures than at recaptures, no significant (Pearson $\chi^2 = 0.150$, d.f. = 1, $P = 0.698$) difference could be found between the traps.

Significant ($F = 409.151$, d.f. = 4, $P < 0.01$) differences were found in the mean weights of the five rodent species captured (Fig. 3). Tukey's post-hoc test showed that both Gerbillus

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Table 1. The number of captures of different rodent species in cage traps and Sherman live traps. The Chi-square ($\chi^2$) values and probability values (P) are also given (d.f. = 1). * = Trapping frequencies too small for Chi-square analysis.

<table>
<thead>
<tr>
<th>Species</th>
<th>Cage trap</th>
<th>Sherman</th>
<th>$\chi^2$</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active paired traps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gerbillus nanus</td>
<td>21</td>
<td>9</td>
<td>4.800</td>
<td>0.028</td>
</tr>
<tr>
<td>Gerbillus cheesmani</td>
<td>5</td>
<td>5</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Meriones crassus</td>
<td>11</td>
<td>7</td>
<td>0.889</td>
<td>0.346</td>
</tr>
<tr>
<td>Meriones libycus*</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jaculus jaculus*</td>
<td>1</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Overall</td>
<td>31</td>
<td>23</td>
<td>1.185</td>
<td>0.276</td>
</tr>
</tbody>
</table>

Table 2. The effect of habitat and capture history on the capture probabilities of five rodent species in the Saja/Umm Ar-Rimth Protected Area of Saudi Arabia (d.f. = 1). * = Trapping frequencies too small for Chi-square analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Species</th>
<th>Pearson $\chi^2$</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: wadi vs. gravel plain</td>
<td>Gerbillus nanus</td>
<td>50.074</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Gerbillus cheesmani</td>
<td>16.667</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Jaculus jaculus</td>
<td>0.818</td>
<td>0.366</td>
</tr>
<tr>
<td></td>
<td>Meriones crassus</td>
<td>0.976</td>
<td>0.323</td>
</tr>
<tr>
<td></td>
<td>Meriones libycus*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Capture vs. recapture</td>
<td>Gerbillus nanus</td>
<td>10.667</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Gerbillus cheesmani</td>
<td>13.500</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Jaculus jaculus</td>
<td>7.364</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>Meriones crassus</td>
<td>6.373</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>Meriones libycus*</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

G. nanus and G. cheesmani were significantly lighter than the remaining three species caught, while Meriones libycus was also significantly heavier than both Meriones crassus and Jaculus jaculus. We found no significant ($t = 0.404, d.f. = 168, P = 0.688$) difference between the mean weights of the rodents successfully captured in either the cage traps or the Sherman traps.

Non-target species were captured during both the hot and the cool seasons and in both trap types. The non-target species captured included two Arabian Babblers Turdoides squamiceps (one each in the cage and Sherman traps), a Hoopoe Lark Alauda arvensis and an Ethiopian Hedgehog Paraechinus aethiopicus (Ehrenberg, 1833) (both in the cage traps), and an unidentified beetle in a Sherman trap.
In assessing trap preference, 60% of rodent species were caught more often in the cage traps than in the Sherman traps, although both trap types successfully caught all five species. However, clear preference was shown by only one of the species, *Gerbillus namus*, with more than twice the number of captures of this species made in the cage traps than in the Sherman traps. We cannot, however, reject our hypothesis that small mammals are equally likely to be captured in the two trap types used in this study (Table 1). The ambiguous nature of this result could be attributed to our low capture rates and the further constraint of using a subset of the data, thereby weakening our ability to test for trap preference. Using a subset of the data was essential however, as a valid comparison of trap efficiency can only be made when the animal makes a choice before entering the trap, while entering traps at random at any one location would remove the element of selectivity (Sealander & James 1958). Our low capture rates could be attributed to a combination of the degraded nature of the habitat (Robinson 2001) and to a high predator density, which has been estimated as up to 0.63 Rüppell’s Foxes/km² in the protected area (NWRC unpublished). In the Mahazat As-Sayd Protected Area of Saudi Arabia, rodent abundance was significantly lower in areas with mammalian predators than in areas without such predators (Wells 1999). Similar conclusions were reached in the Americas (Taitt & Krebs 1983, Meserve et al. 1993). Moreover, the importance of cover in avoiding predators has also been previously established (Wells 1999).

When looking at the entire dataset, our results suggest that the cage traps were more effective at trapping rodents in the Saja/Umm Ar-Rimth Protected Area than were the Sherman traps, as three of the five species, notably *Gerbillus namus*, *Meriones crassus* and *Jaculus jaculus* were more frequently captured in the former than in the latter, while *Gerbillus cheesmani* and *Meriones libycus* were captured the same number of times in both trap types. Our results also indicate that Sherman traps are ineffective in capturing *Jaculus jaculus*. This finding is supported by Wells (1999) who did not trap a single *Jaculus jaculus* specimen in

Discussion

![Graph showing mean weights of five rodent species](image)

Fig. 3. The mean weights (±SE) of the five rodent species caught in the Saja/Umm Ar-Rimth Protected Area, Saudi Arabia, from December 2002 to December 2003 (all seasons are combined).
such traps in more than 5,900 trap nights, despite observing their presence in the trapping areas. The higher frequency of rodent captures in the cage traps could be due to differences in trap design. The Sherman traps work with a treadle on which a rodent must step to spring the trap door. SLADE et al. (1993) have indicated that it was not possible to place bedding material and bait beyond the treadle of standard length Sherman traps, thereby increasing the probability of treadle movement being obstructed. Furthermore, SLADE et al. (1993) also suggested that some rodents might be able to back out of a standard length Sherman trap when struck by the door (which opens to the inside), as has also been observed for voles in Longworth traps (BOONSTRA & ROOD 1982). While no observations of rodents backing out of a Sherman trap have been made in the present study, it remains a possible explanation for the lower capture rates in these traps, especially since the fate of only a small number of unsuccessful traps (i.e. those not catching a rodent) have been recorded in the field. In contrast to the Sherman traps, the cage traps we used do not have a treadle, but rather a baited hook that is suspended from the roof of the trap, and which acts as a trigger to spring the door when a feeding rodent moves the hook. A pair of springs, one on each side of the door, which opens to the outside, jams it shut when the trap is sprung, thereby making it nearly impossible for any rodent to back out of the trap. Finally, rodents might have been more inclined to enter the cage traps through which they could see, than a solid Sherman trap with no view of their surroundings, a conclusion shared by O’FARRELL et al. (1994) when comparing Sherman and mesh traps.

Nevertheless both trap types were found to be successful in capturing rodents ranging from c. 20-140 g. Despite the differences in trap design, particularly with regards to trigger mechanism, no differences were found in the mean weights of rodents successfully captured by the two trap types, suggesting that species-specific behavioural differences and/or other design features (e.g. visibility) were more important in determining successful capture than rodent weights.

The seasonal variation in Meriones crassus capture rates could possibly be explained by our cool season trapping sessions, inadvertently following soon after the breeding season, as almost half (46.2%) of the specimens captured during the cool season were considered to be juvenile animals. According to KRASNOV et al. (1996), Meriones crassus in the Negev desert were in reproductive condition from January to September. Furthermore, WELLS (1999) suggested that although this species was particularly susceptible to predation pressure, it had the potential to recover quickly from predation-induced depletion. The potential effects of disease in the fox population (such as mange or rabies) and a resulting decrease in predation pressure could therefore also have contributed to the perceived sudden increase in Meriones crassus numbers and therefore captures, especially since some fox mortalities in the area were attributed to mange during the study period (NWRC unpublished).

The fact that Gerbillus namus and Gerbillus cheesmani were mostly captured in the wadi suggests that suitably different microhabitats were available for both these species within the larger wadi system. Meriones crassus, however, is regarded as a habitat generalist (WELLS 1999) and, based on a similar diet, it seems likely that Jaculus jaculus might also be a generalist, thereby possibly explaining the absence of any significant relationship between captures and habitat for these two species. It is, however, premature to speculate further on the habitat preferences of the rodent species in the Saja/Umm Ar-Rimth Protected Area because we did not aim to elucidate habitat preferences and because trapping is not necessarily the ideal way to study rodent habitat preferences (PRICE 1978).

Recapturing rodents during a particular 4-night trapping period proved to be unlikely (Table 2), with the ratio of captures to recaptures ranging from 1.8:1 for Meriones crassus to
for Jaculus jaculus, with the exception of Meriones libycus where the only individual trapped successfully in a cage trap was recaptured in a Sherman trap. It is not clear whether the latter species is rare in the area or whether neither trap was suitable at successfully capturing it. In the event of Meriones libycus or another species being rare, the traditional trap line might not be suitable for determining its presence (BROWN et al. 1996). The generally low incidences of recapture could possibly be attributed to the relatively large ranges that the rodents must occupy in such an arid environment, coupled with a relatively small proportion of the microhabitats used by the rodents being covered by the single trap line.

In conclusion, this pilot study showed that there are at least five rodent species present in the Saja/Um Ar-Rimth Protected Area in its current degraded condition. It is possible, however, that other subordinate and rare species have not been sampled by our single transect line. The use of trapping grids could solve this problem by removing more of the dominant species, thereby increasing the likelihood of trapping rare specimens while also increasing sample sizes. Alternatively, shorter, replicate transect lines would allow sampling along more habitat types while the potential problem of small sample sizes (low capture rates) could be addressed by increasing the number of trapping periods and/or trap nights. We have used two different trap types and, despite our data suggesting that the cage traps are more efficient than the Sherman traps, we have been unable to prove this statistically for more than a single species. Nevertheless, we strongly recommend pilot studies involving more than one trap type before embarking on ecological studies based on trapping, because rodent community composition may be inaccurately portrayed based on the trap type used (SLADE et al. 1993; O'FARRELL et al. 1994). Moreover, rodent monitoring through live trapping allows the collection of a range of information that other, indirect means, cannot supply (FLOWERDEW et al. 2004). We therefore urge others to plan their studies carefully, to test their methods in a pilot study, and to follow judiciously project protocols once established, in order to ensure consistency in data collection, sample sizes suitable for stringent statistical analyses and the drawing of unambiguous conclusions.

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References


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