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Trappability of rodents in single-capture and multiple capture traps in arid and open environments: Why don't Ugglan traps work?

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Obtaining reliable data on small mammal population structure and numbers requires efficient traps that trap all functional categories of the population. We compared three types of live-traps (Ugglan, Sherman, Longworth) in a pairwise comparison in two arid environments, the Negev Desert in Israel and in south-eastern Australia. Ugglan traps did not capture a single gerbil in the Negev whereas Sherman traps captured probably all resident gerbils in the trapping grid in ten trap nights. Significantly more mice were captured with Longworth traps than with Ugglans in arid and open Australian grain-growing area. Ugglan traps have a very high trapping efficiency in boreal habitats with a dense undercover, but seem to be inefficient in arid and open environments.

Introduction

Many techniques which estimate the numbers and structure of small mammal populations and communities rely on capture-mark-recapture methods. Following individually marked individuals over a period of time, e.g. over the breeding season or over winter, typically requires an effective live-trapping protocol. Traps should reliably capture individuals of different species and different age and sex cohorts of populations (Krebs & Boonstra 1984). Trapping efficiency is dependent on the trap type chosen (Wiener & Smith 1972), type of bait and prebaiting method (Chitty & Kempson 1949), social interactions between individuals (Ylönen *et al*. 1990) and on effects of recent trapping efforts. The latter include the effects of odours of previously trapped conspecifics (Krebs & Boonstra 1984), competitors or predators (Stoddart 1982) and the previous experience of being caught in a trap (Tanaka 1963).

A number of single-capture and multiple-capture traps are used by researchers in different habitats, often based on the traditions of experienced researchers in the area. Single-capture traps have the advantage of often being simpler and easier to carry between study sites. They normally trap a single individual at a time (but *see* Australian house mouse trapping efficiency with single capture traps, e.g. Singleton *et al.* (2001)). Multiple-capture traps are usually more complicated in structure, often heavier and non-collapsible. However, the advantage to their use is that they allow several individuals to enter the trap during a single trapping occasion. This can result in greatly improved trap success during periods of high rodent densities when the number of traps is limited (Andrzejewski *et al.* 1966, Krebs & Boonstra 1984). Furthermore, multiple-capture traps facilitate the collection of valuable information on social interactions between individuals of different sexes and age groups, such as if certain individuals are more likely to be found in a single trap together and if others avoid each other (Ylönen *et al.* 1990).

We studied the relative trapping efficiency of two single capture traps versus that of a multiple capture trap in pair-wise comparisons in two arid or semi-arid regions. In the Negev Desert in Israel trappability of gerbils (*Gerbillus* sp.) was compared between single-capture Sherman traps and Ugglan Special multiple-capture traps. These data were compared with data from a study in the semi-arid Australian grain-growing area of North Victoria, where we compared trapping efficiency of single-capture Longworth traps against that of an Ugglan trap (Jacob *et al.* 2002). We conducted the study during average spring densities of gerbils in the Negev Desert and during period of high mouse density in the Victorian Mallee.

The Sherman traps have been widely used in studies of desert rodents both in the old and new world (Kotler 1984) and also in small rodent (*Microtus, Peromyscus*) research in North America (Slade *et al.* 1993). Longworth traps have been used in an 18-year long-term study of the Australian house mouse (e.g. Bomford & Redhead 1987, Singleton *et al.* 2001) and in a variety of other studies in Australia. Ugglan traps have been favoured in studies of boreal rodent communities e.g. in central and northern Europe both in enclosures (e.g. Ylönen *et al.* 1990, Andreassen *et al.* 1996) and in open areas (Henttonen 2000, Sundell 2003). Our study aimed to determine the usefulness of Ugglan traps in two arid or semi-arid environments for two reasons: (1) to obtain more information on social relationships between individuals in gerbil and house mouse populations by allowing multiple captures of several individuals, and (2) because Ugglan traps avoid trap saturation during high densities, their use should provide a more accurate estimate of population density and population structure. The latter point applies for high and outbreak densities of Australian house mouse (Singleton *et al.* 2001), but not for desert rodents which are not known to reach very high densities.

Material and methods

Traps, study sites and trapping

The Ugglan Special trap (Type #3; Grahnab AB, Hillerstorp, Sweden) is a multiple capture livetrap constructed from galvanised wire mesh and covered with a lid of sheet metal. The lid covers the wire mesh wall on both sides of the 24 × 8 × 6 cm trap, allowing a partial air circulation through the trap. Animals enter via an unbaited entrance compartment that is connected to a baited capture compartment by a whip door, which closes after an animal has entered the trap.

The Sherman trap (type SFA, H.B. Sherman Traps, Inc., Tallahassee, USA) is a light and foldable aluminum trap of 5.5 × 7 × 18 cm in size. It does not have a separate entrance tunnel but the door forms after closing one end wall of the trap. Multiple captures in Sherman traps are uncommon.

Longworth traps (Longworth Scientific Instruments, Abingdon, UK) consist of a nest box (14 × 6.5 × 9 cm) connected to a metal entrance tunnel (13 × 4.5 × 4.5 cm). When an animal enters the nest box a treadle mechanism closes the entrance (Chitty & Kempson 1949).

Negev Desert, Israel

Bir Asluj (31°01´N, 34°45´E), our study site in March 1996, is some 35 km south of Beer-Sheva in the northwestern Negev Desert, Israel. It receives an annual average of 108 mm rain during winter. Dunes in Bir Asluj vary from well stabilized to semi-stabilized. Various species of small shrubs grew on the dunes, although the vegetation was dominated by *Retama retam* and *Artemisia monosperma* (Danin 1978).

We conducted live trapping on two permanently marked study grids. The grids, ca. 150 m apart, were set up in an area containing semi-stabilized dunes, rocky slopes and loess. Each grid measured 60 × 360 m and contained 120 trap stations arrayed 15 × 15 metres and marked with numbered wooden sticks. Two trappings were conducted, first with Ugglan multiple-capture traps and then with Sherman traps. We trapped for ten nights using 60 traps in each second trap station the first five nights (600 trap nights per grid, 1200 in total for each trap type). After that traps were moved to half-way between the original lengthwise trapping points to cover all points in a grid of 15 × 15 m.

Unhusked millet seeds were used as bait. The traps were checked early every morning but re-baited every afternoon, because ants tended to remove the seeds during the day. Animals caught for the first time were individually marked by toe-clipping. Weight and site were recorded for all animals trapped before release at the point of capture.

In the first trapping session the 60 Ugglan multiple capture traps in each grid were covered with a small curved metal trap cover and buried in the sand, so that the opening appeared to be a small tunnel in the sand. The second trapping session was conducted identically, except that the Sherman traps substituted each Ugglan trap.

Victoria Mallee, Australia

We compared the trapping efficiency of Ugglan and Longworth traps on four farms located at Walpeup in north-eastern Victoria (35°08´S, 142°02´E) in summer 2000–2001. The weather during December was warm and dry and during later summer very hot and dry. Mouse densities at the study sites were increasing dramatically (Ylönen *et al*. 2002). Wheat harvest occurred in early December 2000, two weeks prior to the first trapping session. The study design and the results of this substudy are published by Jacob *et al*. (2002). We had three trapping sessions in 4-week intervals starting in December 2000. For Ugglans there were 432 trap nights and for Longworths 422 trap nights after excluding phantom traps, which were closed in the morning but without a mouse inside.

Results

Ugglan traps did not capture a single gerbil or jird in our Bir Asluj study area in the Negev desert.

In contrast, Sherman traps recorded 31 captures of four species (*Gerbillus dasyurus, G. andersoni allenbyi, G. henleyi* and *Meriones crassus*) on one grid and 41 captures of two species (*G. dasyurus* and *G. a. allenbyi*) on the other. The small *G. henleyi* did not survive in the traps. The trappability for the common species on the two grids was 4.16 for *G. a. allenbyi* and 1.25 for *G. dasyurus* in 100 trap nights, respectively. In total 29 individuals were captured, 16 (= 55%) of them more than once (range 2–5 times in ten nights of trapping). Of the 21 individuals of the most common species, *G. a. allenbyi*, ten were females and 11 males.

We recorded 122 captures with Longworth traps and 32 captures with Ugglan traps in Victoria Mallee. Throughout the study, the number of mice caught and recapture rates in Longworth traps were greater than in Ugglan traps (for details *see* Jacob *et al*. 2002).

Discussion

We had two reasons to investigate the use of Ugglan Special multiple capture traps in arid and semi-arid regions: (1) to check if multiple-capture traps provide more information on social relationships of desert rodents, and (2) to avoid trap saturation at high densities of mice during incipient plague densities in the Australian grain-growing areas. Both objectives were ultimately unsuccessful. Contrary to our expectation, Ugglan traps did not capture gerbils in the desert habitat in the Negev and proved to be much less effective in capturing house mice in Australia than were Longworth traps.

In the Negev Sherman traps had a trapping efficiency of 6.4 ind./100 trap nights, which resembles the average trappability of gerbils during spring (B. P. Kotler pers. obs.). About half of the individuals of the two common species *G. a. allenbyi* and *G. dasyurus* were recaptured frequently and appeared to be resident in our study sites. These frequently captured individuals were probably socially dominant, as dominance is often reflected in higher trappability e.g. in bank voles (Ylönen *et al.* 1990). The other half was caught only once. These gerbils were probably either subordinate residents or visitors from outside of the trapping grid.

In Ugglan traps, no gerbils were captured in the three nights just following a full moon, but there were also no captures in seven trap nights during the subsequent dark moon phase. Otherwise the climatic or environmental circumstances between the trapping sessions with Ugglan and Sherman traps did not differ. Therefore, we conclude that Ugglan traps are not suitable for trapping gerbils in open desert habitat.

Similarly, lower trappability in Ugglan than Longworth traps was evident for the house mouse in the grain-growing area of the Victorian Mallee. Three out of four multiple captures recorded occurred in Longworth traps and only one in a "multiple-capture" Ugglan trap (Jacob *et al.* 2002). Mouse densities were increasing in our study area and had already reached trap saturation in some of the trap lines in March 2001 (Ylönen *et al.* 2002). However, high densities did not enhance the trapping efficiency of Ugglan traps. If there was cover available in the fence row or in crop, both Ugglan and Longworth traps were placed under this often scanty cover. However, this did not increase trappability in Ugglan traps. Around human dwellings with a more complex man-made habitat trappability of mice might in general be higher in traps like Ugglan. We trapped mice in a piggery and immediately captured several mice in a single Ugglan trap (G. Singleton unpubl. data). However, our field study sites were on average 1–2 km away from farm houses, habitat was open and very uniform and provided only little cover for the traps.

Reasons for the inefficiency of multiple capture Ugglan traps could include features of the study habitat, behaviour of rodents, trap construction or a combination of these factors. Ugglan traps are very effective in trapping voles and mice in boreal habitats, both in agro-ecosystems (Nemirov *et al.* 1999, Jacob & Halle 2001), forests and northern taiga (Henttonen 2000, Sundell 2003) and in experimental populations in enclosures (e.g Andreassen *et al.* 1996). They are widely used in European small mammal research and are regarded as more effective than Longworth traps for voles and shrews (Lambin & MacKinnon 1997).

Boreal habitats with a dense layer of ground cover might provide voles and shrews with a complex habitat of holes and burrows. The mosaic of branches, twigs, stones and forbs might force individuals to climb and face different types of hindrances and barriers. This could affect individual behaviour and make these species more likely to enter the complicated entrance structure of Ugglan traps. Sufficient cover may also allow individuals more time to decide whether or not to enter a trap (to gain the bait reward). In open arid habitats exposure to predators might force a rapid decision that reduces the effectiveness of complicated traps like Ugglans, as compared with traps like Sherman and Longworth with simple entrances. This suggests that behavioural differences of mice living in more or less complex habitats may have an effect on the trappability with Ugglan traps.

Ugglan traps are specifically designed to allow multiple captures. However, despite using them we were not able to gain information on social interactions between individuals in either study due to low or very low trappability, and to low recapture rates with virtually no multiple captures.

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