Mammal Review

Mammal Rev. 2012, Volume 42, No. 4, 314–318. *Printed in Singapore*.

SHORT COMMUNICATION

New trapping method to survey for presence of the Etruscan shrew *Suncus etruscus*, the smallest mammal

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ABSTRACT

The presence of the Etruscan shrew *Suncus etruscus* is hard to prove where its predator, the barn owl *Tyto alba*, is absent, because most live traps are not triggered by it. I therefore developed a new trapping method involving a feeding period of 1 week followed by one night of trapping using modified Trip Trap traps. I show here in detail how I caught four Etruscan shrews in 2010 with 24 traps in the Valley of Dora Baltea (Piemonte, Italy). In 2011, another 11 Etruscan shrews were caught in Piemonte and Lombardia, Italy, and Ticino, Switzerland. The proposed new method is useful for establishing the presence of the species.

Keywords: census techniques, distribution range, owl pellets, Soricidae, Trip Trap

Mammal Review (2012), **42**, 314–318
doi: 10.1111/j.1365-2907.2012.00215.x

INTRODUCTION

The Etruscan shrew *Suncus etruscus* is the world's smallest mammal, a position held jointly with the bumblebee bat *Craseonycteris thonglongyai* from Thailand. The shrew's body mass of only 1.8 g (range 1.2–2.3 g, $n = 38$; Fons 1970) makes it almost impossible to catch in small mammal traps such as the American Sherman or the English Longworth traps. However, in the centre of its occurrence around the Mediterranean Sea, the shrew's presence is easily detectable thanks to the barn owl *Tyto alba*. The pellets of this owl provide rich material for mammalogists and are used for the census of the distribution of many shrew and rodent species, e.g. for the atlas of wild mammals of France (Fayard et al. 1984).

In regions where the barn owl is absent, information on the distribution of small mammals must be based on trapping, indirect signs or on fortuitous encounters with live or dead specimens. Therefore, at the northern limit of this tiny shrew's geographical range, towards the southern slope of the Alps where the barn owl is absent (Osieck & Shawyer 1997), shrew populations are patchy and density is low, it is hard to investigate its presence. Its apparent absence over wide areas (Libois & Fons 1999) north of 45°20′N latitude may simply be an artefact of the shrew's untrappability. The possible occurrence of *Suncus etruscus* in Switzerland illustrates this. The species was found only once in Lugano in 1895. According to Ghidini (1911), who obtained one specimen at Porlezza, on the Italian shore of Lake Lugano, this proved the existence of a local population. This interpretation was rejected by Genoud (1995), who assumed an accidental introduction from Italy. Without new data in 116 years, the question of the occurrence in Switzerland remains open-ended and a specific investigation without an efficient search system seems hopeless.

Morris and Harper (1965) introduced a new approach to checking small mammal distributions: the examination of discarded bottles for the skeletons of perished mammals. Since its introduction, this technique has been widely used (Pagels & French 1987, Taulman et al. 1992, Debernardi et al. 1997, Benedict & Billeter 2004). However, discarded bottles are rarely found in habitats suitable for the Etruscan shrew.

I therefore developed a new trapping method suitable for surveys for the possible presence of *Suncus etruscus* in optimal habitats at the northern limits of its distribution. Before applying the method in Switzerland it was important to test the system in a region where the occurrence of the Etruscan shrew had been shown by using the bottle technique. Here I present the method, and the first results from Ivrea, in the Valley of Dora Baltea, Canavesana, Piemonte, Italy, from Lombardia, Italy, and from Ticino, Switzerland.

MATERIAL AND METHODS

The only type of trap that is sensitive enough to catch *Suncus etruscus* is the Trip Trap (Trixie Heimtierbedarf, Tarp, Germany); on the Island of Pantelleria, Italy, one Etruscan shrew was trapped in a Trip Trap (Vogel et al. 1992). So that the trap would fit in small holes in dry-stone walls, an optimal habitat for this shrew (Fons 1975), I used the smallest model (Fig. 1a) with dimensions of $18 \times 5 \times 4$ cm. This model, which was developed for house mice *Mus musculus*, is recommended by the manufacturer only for use inside buildings and should be checked every two hours. The nest-box is so small that mice or shrews which urinate inside the trap, may get wet and die within a few hours. Moreover, the trigger system is easily blocked by mealworms (larvae of the beetle *Tenebrio molitor*, used as bait) and nest material. During the course of one night, house mice are able to gnaw through the plastic material of the Trip Trap and destroy the locking system between trigger-tunnel and nest-box.

In order to avoid the disadvantages, I

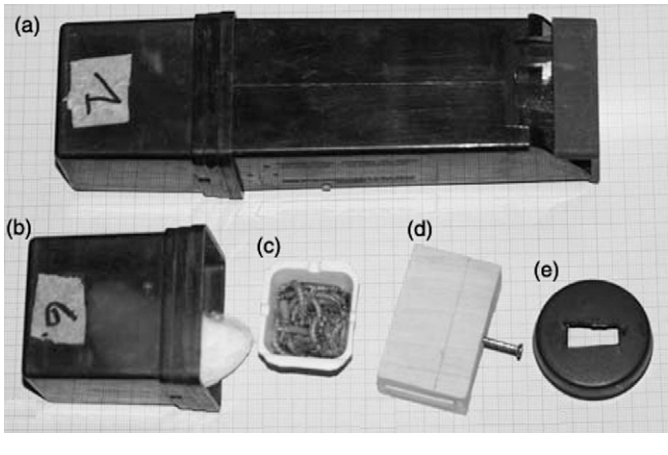

Fig. 1. Equipment used in the new trapping method: (a) Trip Trap live trap; (b) nest-box with cotton wool bedding; (c) tray of mealworm bait; (d) wooden block with a slot to allow Etruscan shrews to enter, used as a mouse excluder in the trap entrance; (e) lid of feeder bottle with slot to allow Etruscan shrews to enter and exit.

1. only used clean traps to avoid problems with the trigger;
2. used living mealworms confined in a small tray as bait and provided water (Fig. 1c);
3. used a small pad of cotton wool, squeezed into the nest-box, to avoid nest material getting caught under the trigger (Fig. 1b);
4. used a mouse excluder (to avoid trap destruction and mortality). This consisted of a wooden block (Fig. 1d) with a slot below big enough to allow an Etruscan shrew to enter (15 × 5 mm). This block, if pushed towards the nest-box, blocks the trigger but allows shrews to enter and to leave (prebaiting position, although in fact bottles were used, see further). If pulled towards the entrance, mice are excluded, but the trigger works and the trap closes if shrews enter.

Experience of trapping built up over 30 years has shown that one week of prebaiting increases trapping success. As the sensitive Trip Trap gets dirty when small mammals enter, I replaced the traps with a feeding bottle during the prebaiting period: a 250 mL plastic fruit juice bottle filled with 30 g of mealworms and closed by a lid with a small slot (Fig. 1e). The bottles were set horizontally in exactly the future trapping positions and held in place by flat stones or wedged into horizontal holes in dry-stone walls, so that Etruscan shrews could enter and exit the bottles through the slots. Moreover, some mealworms were scattered nearby to attract shrews towards the feeding bottles.

In 2010, I set four lines of six feeding bottles in Piemonte, each replaced after one week by two Trip Traps (12 per line) and one Longworth trap. In order to have an idea of the rodent numbers per line, I placed one further similar rodent feeder and replaced it by four Longworth traps, resulting in a total of 10 Longworth traps per line. For the trap lines, I selected places that seemed to represent good habitats for Etruscan shrews (Fons 1975): sun-exposed dry-stone walls. Two lines in Chiaverano were very close together; one more northern line was at Tavagnasco (western bank of Dora Baltea River) and one at Plan du Brun, north of Pont Saint-Martin. In 2011, I trapped north of 45°20′N (in Piemonte and Lombardia, Italy, and Ticino, Switzerland) using the same method but with just one trap per feeder, in 17 trap lines (in total 142 feeders and traps). The traps replacing the bottles were set in the late afternoon, checked at 2300 h and 0700 h, and then removed.

RESULTS

Table 1 shows that with this combined feeding and trapping system in this type of habitat, the most frequently caught mammal was *Crocidura suaveolens* (10

Table 1. Animals caught in 2010, in traps on four trap lines, open for one or two nights

	Plan du Brun, two nights		Tavagnasco, first night		Tavagnasco, second night		Chiaverano 1, one night		Chiaverano 2, one night		
Species	L	T	L	T	L	T	L	T	L	T	Total
Suncus etruscus	0	0	0	1	0	2	0	0	0	1	4
Crocidura suaveolens	0	0	1	2	1	2	2	0	2	0	10
Crocidura leucodon	0	0	0	0	0	0	0	0	1	0	1
Apodemus flavicollis	0	0	0	0	0	0	0	0	2	0	2

Types of traps: L, Longworth; T, Trip Trap.

captures), followed by *Suncus etruscus* (four captures). Moreover, one *Crocidura leucodon* and only two *Apodemus flavicollis* entered Longworth traps. All shrews and mice were in good condition and were released at the trapping place. Two Etruscan shrews showed signs of light reversible hypothermia, an energy saving strategy in case of food shortage (Vogel 1974).

Four individuals of *Crocidura suaveolens* were caught in Trip Traps, six in Longworth traps. The mealworm feeding station was accessible and therefore very attractive to this species. The slot in the wooden mouse excluder on the Trip Traps, which was supposed to exclude species other than *Suncus etruscus*, was slightly too large. In 2010, in Trip Traps (68 trap nights), trapping success of all shrews was 16% and that of *Suncus etruscus* was 6%. In 2011, I captured 11 Etruscan shrews (7.7% trap success) in five trap lines.

DISCUSSION AND CONCLUSION

The aim of this study was to develop an adapted strategy to reveal the presence of the Etruscan shrew in its marginal range and in the absence of barn owl pellets. Two other methods have been used to survey this species. The first, the search for discarded bottles (Morris & Harper 1965) was used in the Aosta Valley, in Lombardia and in Piemonte (Debernardi et al. 1997). In 195 bottles, the remains of 904 small mammals of 14 species were found. Although *Suncus etruscus* was not found, three specimens were found in bottles later, between the small lakes of Ivrea (E Patriarca & P Debernardi, personal communication).

The second method, pitfall trapping, has often been applied. For instance, Vogel (1970) trapped five Etruscan shrews in two nights, in the Camargue region (France), in 14 metal 1 L food cans containing bait and nesting material. Such a high score (18% success) reveals an optimal habitat with high density, confirmed also by the prey frequency of 7% in barn owl pellets there. In the region of Banyuls, France, where the Etruscan shrew is found, Fons (1975) trapped this species in five lines of 20–25 pitfall traps along walls, carrying out daily checks for over four and a half years. In the best habitat, abandoned vineyards, he caught 89 Etruscan shrews in 31025 trap nights, equivalent to a trap success of 0.3%. Extrapolated to the present field sites and assuming the same trapping efficiency and population density as in Banyuls, 1394 trap nights instead of 68 would have been needed to catch four individual Etruscan shrews. Moreover, mortality in pitfall traps is very high (Fons 1974). For surveys at the limit of the shrew's distribution, pitfall trapping is therefore unsuitable.

The trapping method presented here, a one-week period of feeding followed by just one night of trapping, seems to be the most promising and economical technique. Mealworms are very resistant and are much appreciated by the Etruscan shrew (Vogel 1970). The feeding bottle method is derived from a study of a small mammal feeder (containing seeds and mealworms) used on a wild population of greater white-toothed shrews *Crocidura russula* and wood mice *Apodemus sylvaticus* tagged with passive induced transponders (Vogel & Ravasi 2003). The feeder was set every month for a 48-hour period. Once discovered by the shrews and mice, the feeder was visited by several individuals: the best score was observed in January with 59 visits by seven shrews, which spent 5 hours 42 minutes inside the feeder, and 294 visits by six mice, which spent 4 hours 30 minutes. Trapping results show that this feeder technique also works well for the Etruscan shrew.

Prebaiting is not suitable for population studies, because this method changes the behaviour of the shrews on a social and spatial level. In some habitats in summer, prebaiting is impossible because ants eat all the bait within a few hours. Trapping should therefore be carried out during spring or autumn.

The proposed new trapping method is suitable for surveys of promising areas and can help to prove the presence of the Etruscan shrew. A similar technique could be applied to capture other small mammals selectively, e.g. the smallest marsupial (*Planigale ingrami*), tenrec (*Geogale aurita*) and soricine shrew (*Sorex minutissimus*).

ACKNOWLEDGEMENTS

I thank Elena Patriarca for fruitful discussions, Charlotte Vogel and Christine Sanz for their help in the field, J Hausser for comments on the manuscript, and H Brünner for valuable technical suggestions.

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Submitted 16 December 2011; returned for revision 21 March 2012; revision accepted 14 May 2012
Editor: KH