

Evaluation of three indirect methods for surveying the distribution of the Least Weasel *Mustela nivalis* in a Mediterranean area

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Abstract

The Least Weasel *Mustela nivalis* occurs in a large circumboreal range and seems to be declining in some localities. However, methods used for surveying the species vary highly between studies and data are scarce about the effectiveness of different techniques. Three indirect methods frequently used for carnivore inventories (hair-traps, track census and faeces sampling) were tested for surveying the distribution of this species in a Mediterranean area, central Spain. Hair-traps recorded the highest proportion of sites occupied (30.8%), whereas the other methods provided values <10%, with differences statistically significant among these techniques. The probability of detection also shows that hair-trapping works significantly better than sign surveys (0.56 with hair-trap opposed to 0.20 and 0.28 with signs). The hair-trap method can be a powerful and useful technique for surveying the Least Weasel but further research is needed to improve the method and increase probability of detection.

Keywords: central Spain, faeces sampling, hair-trap, Mustelidae, track survey

Evaluación de tres métodos indirectos para el muestreo de la distribución de la Comadreja *Mustela nivalis* en un área Mediterránea

Resumen

La Comadreja *Mustela nivalis* está presente en un área circunboreal extensa y parece que está declinando en algunas localidades. Sin embargo, los métodos empleados para muestrear a la especie son muy variables entre los estudios y los datos sobre la efectividad de las diferentes técnicas son escasos. Tres métodos indirectos usados frecuentemente en los inventarios de carnívoros (trampas de pelo, censos de huellas y muestreos de excrementos) fueron testados para muestrear la distribución de la especie en un área Mediterránea de España central. Las trampas de pelo registraron la mayor proporción de sitios ocupados (30.8%), mientras que los otros métodos proporcionaron valores <10%, con diferencias estadísticamente significativas entre estas técnicas. La probabilidad de detección también mostró que las trampas de pelo funcionaban significativamente mejor que las prospecciones de indicios (0.56 para las trampas de pelo en contraposición a un 0.20 y 0.28 de los indicios). El método de las trampas de pelo puede ser una técnica adecuada para muestrear a la Comadreja, pero es necesario investigar para mejorar el método e incrementar las probabilidades de detección.

Palabras clave: España central, muestreo de huellas, Mustelidae, prospección de excrementos, trampa de pelo

Introduction

The Least Weasel *Mustela nivalis* is broadly distributed throughout the northern hemisphere (Sheffield & King 1994). Particularly in Europe, it seems one of the commonest carnivores (Mitchell-Jones *et al.* 1999), but some recent evidence (McDonald & Harris 1999, Battersby 2005, Palomo *et al.* 2007) suggests population declines.

For this species, specific sampling protocols have not been developed and typical methods used for surveying carnivores, such as faeces sampling, camera-trapping and direct observations, do not work well (Millán *et al.* 2001, Torre *et al.* 2003, González-Esteban *et al.* 2004, Virgós & Travaini 2005, Gompper *et al.* 2006, Barea-Azcón *et al.* 2007, Reid 2007, Mangas *et al.* 2008). Further, monitoring programmes are usually based on track surveys (Korpimäki *et al.* 1991, Aunapuu & Oksanen 2003 Gehring & Swihart 2003, Gompper *et al.* 2006, Hellsted *et al.* 2006, Oksanen *et al.* 2006, Reid 2007), indirect data derived from trapping (McDonald & Harris 1999, 2002, McDonald 2000, de Marinis & Masseti 2003, Lischka *et al.* 2006, Reid 2007), enquiries (McDonald & Harris 1999, de Marinis & Masseti 2003, Richter & Schaubert 2006, Reid 2007) or actual field-based observations (de Marinis & Masseti 2003, Reid 2007). Thus, estimations of occurrence, range

shifts or habitat preferences are rarely robust enough for statistical analysis.

Dirks *et al.* (1996) designed a funnel trap for Stoats *Mustela erminea* that could also be potentially powerful method for surveys of the Least Weasel. However, González-Esteban & Villate (2005) using such hair-traps in northern Spain achieved poor results on Least Weasel distribution, but considered this a reflection of low abundance of the species in their study site. Our objective was to compare the effectiveness of hair-traps, track census and faeces sampling for detection of Least Weasel.

Materials and methods

Study area

The study was carried out in a suburban area of central Spain, around Salamanca and near villages (Coordinates of a central point: 40°57'24"N, 5°39'27"W; general altitude 800 m for the study area). Sampling was focused on the riparian habitats adjacent to the river Tormes, because during the last decade all observations and data obtained in the study area about the species came from this zone.

Climax vegetation of the riparian strip consists of a gallery forest dominated by willows (e.g. *Salix fragilis* and *S. alba*) but

including European Alder *Alnus glutinosa* and various poplars *Populus sp(p)*. The shrub stratum is represented by the rose family: brambles *Rubus sp(p)*., roses *Rosa sp(p)*., and Common Hawthorn *Crataegus monogyna*. Some grassland are present around this forest. Helophytic vegetation (*Typha latifolia*, *T. domingensis*, *Phragmites australis*, *Sparganium erectum*, *Juncus sp(p)*. and *Scirpus sp(p)*.) is well developed, covering sometimes >10% of the water's surface in dense aggregations.

Given the close proximity to the city, some of the riverine habitat is currently used intensively for recreation, thereby modifying forest structure and dynamics.

Some other carnivore species such as the Red Fox *Vulpes vulpes*, the Common Genet *Genetta genetta* and the American Mink *Neovison vison* were also detected in Salamanca during the study.

Sampling design

The design of the survey is based on the minimum home range of a single Least Weasel (Wilson *et al.* 1996, Zielinski & Stauffer 1996), ensuring at least one trap and survey per potential territory. Home range data of adult Least Weasel is scarce, but published data indicates a minimum home range of about 0.25 km² (King 1975, Sheffield & King 1994, Erlinge 1995, Jedrzejewski *et al.* 1995, Brandt & Lambin 2007).

Given the human pressure described, the natural vegetation around the study area extends 200–500 meters from the banks. Thus, the entire river and closely related stream length (13 kilometers) was divided into one-kilometer stretches, creating plots of about 0.25 km², with both banks considered independent from the plot on the opposite side of the main river. For defining this surface area, in some sites it was necessary to enlarge or reduce by some meters (never more than 100) the length of the station surveyed. Tributaries were divided equally into one-kilometer length stations with 500 m width, but in this case we included both banks because of high connectivity (many bridges, and some stretches with the bed usually dry). This design gave 26 sampling stations (Fig. 1) in which the above protocols were used.

Fieldwork was conducted in April and May 2008 to avoid biases due to seasonal variations in population abundance (see King 1980, Sheffield & King 1994, Erlinge 1995, McDonald & Harris 2002).

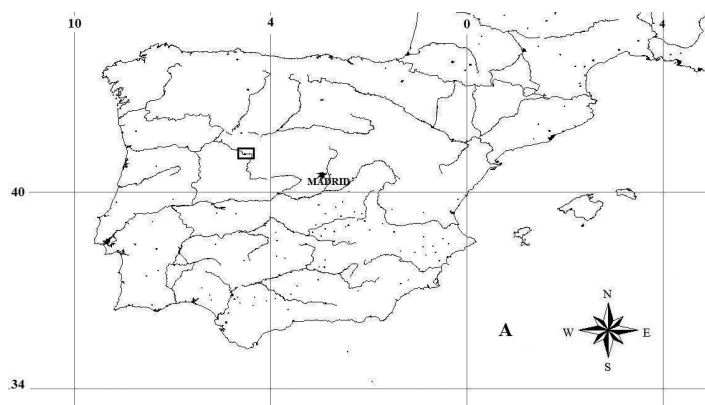


Fig. 1. A: Geographical location of the study area (black rectangle). B: Results of the survey with each method (division in one-kilometer long stations superimposed). Black dots: station positive; open dots: station negative.

Faeces sampling

Faeces sampling is one of the most used techniques for surveying carnivores (Wilson *et al.* 1996, Birks *et al.* 2005, Gompper *et al.* 2006, Barea-Azcón *et al.* 2007). Least Weasel faeces are small (<3 cm long), thin and often rolled in appearance, and are differentiable from those of the few other species of carnivores (see above) in the study area (Sanz *et al.* 2004). Faeces were intensively sought (more than two hours per station per surveyor) in ways, trunks, rocks, among the vegetation, etc. with the help of a portable torch by walking the entire 0.25 km² area of each station.

Track sampling

Searches for footprints are much used in carnivore studies (Palomares *et al.* 1996, Wilson *et al.* 1996), but rely on a good substrate for imprinting the tracks. In each 0.25 km² station, tracks were searched by walking in all areas where their occurrence was potentially likely, as in mud or sand, abundant in the banks of the river after flooding. Sampling effort was as that during faeces surveys (more than two hours per observer). Least Weasel tracks are of typical mustelid form, but smaller in size than any congeners (less than 2 cm) and frequently in groups of four, representing all the limbs of an animal (Sanz *et al.* 2004). Taking into account the identities of the few other carnivore species in Salamanca, tracks with these attributes must belong to a Least Weasel, but such cannot be extrapolated throughout the species's range.

Hair-traps

Several different types of hair-traps, depending on the target species, have been designed to retain a sample of hairs to be identified to species through microscopic preparation (Belant 2003, Lynch *et al.* 2006). This study adopted the design of González-Esteban & Villate (2005), of two overlapped wire mesh pieces, one baited with fresh chicken wing and another provided with an adhesive tape. The trap was placed on shrubs or trees at 20–30 cm high (Fig. 2). One hair-trap was placed at the centre of each sampling station for seven consecutive nights (as with sampling for Pine

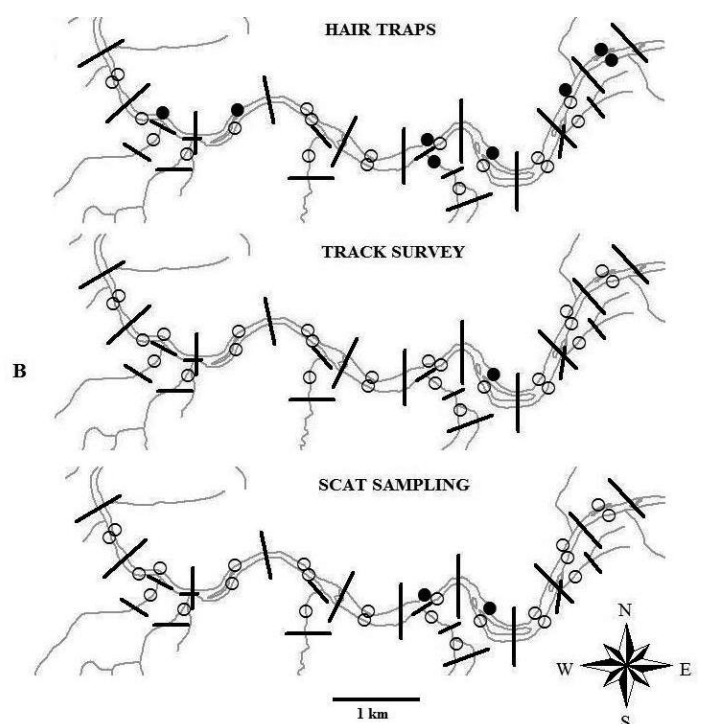




Fig. 2. Design of the hair-trap used in this study placed in a tree trunk. The adhesive tape was partially removed to allow observation of the structure; it usually covers the entire surface of the larger wire mesh piece.

Marten *Martes martes*; Lynch *et al.* 2006) trying to ensure that if a Least Weasel is present, it will come some times around the trap (King 1975, Sheffield & King 1994, Erlinge 1995, Jedrzejewski *et al.* 1995, Brandt & Lambin 2007). The hairs collected in the traps were processed following the procedures of Teerink (1991) and identified using Faliu *et al.* (1980), Teerink (1991) and Toth (2002).

In all three procedures, when hair, faeces, or track of Least Weasel was found, the point was considered positive, if not, or if signs were unclear the point was considered negative.

Effectiveness of the methods and statistical analysis

The results obtained from the 26 different sampling stations allowed a matrix of detection data gained with each method to be built. Occurrence determined with these methods was compared with a non-parametric paired McNemar test (Sprent 1989). The probability of detection is a basic feature in animal surveys (Borchers *et al.* 2002). Optimal detection probability is 1, but is rarely achieved (MacKenzie *et al.* 2002). Those methods that provide a better estimation of this parameter (closer to 1) appear, other factors being equal, to be more suitable for surveying a species.

With the same matrix used in the statistical analysis, the probability of detection of the Least Weasel using the three different methods was estimated following MacKenzie *et al.* (2002) and using program PRESENCE (at <http://www.proteus.co.nz/home.html>). Finally the probability of Least Weasel detection using each method was compared using a χ^2 test for proportions. Statistical measurements were carried out in S-PLUS 8.0.

Results and discussion

The Least Weasel was widely distributed in the study area (Fig. 1). Hair-traps had a higher overall rate of detection (30.8 % of stations), whereas faeces and track sampling provided positive results at <10 % of sampling points (7.8% and 3.9%, respectively). More sites were positive using hair-traps than with the other two methods (McNemar test faeces–hair-traps: 135.26, *d.f.* = 25, $P < 0.01$; McNemar test track survey–hair-traps: 124.32, *d.f.* = 25, $P < 0.01$), but comparison between these latter two methods did not

reveal differences (McNemar test faeces sampling–track census: 1.00, *d.f.* = 25, $P = 0.32$). Besides this, in stations where faeces or tracks were found, hair samples were always collected (Fig. 1).

Probabilities of detection estimated with these methods also differed greatly ($\chi^2 = 32.16$, *d.f.* = 2, $P < 0.01$), confirming that hair-trapping offers a higher probability of detection (0.56) than do faeces or track surveys (0.28 and 0.20, respectively). Both proportion of occupied sites and probability of detection suggests that faeces and track surveys may underestimate occupation of the area by the Least Weasel by comparison with results from hair-traps.

Despite these results, a previous study using hair-traps in Atlantic areas of the Iberian peninsula (González-Esteban & Villate 2005) indicated rather low rates of Least Weasel detections (less than 20%) but this may have reflected poor habitat quality (i.e., genuinely low numbers) as opposed to inefficiencies in the technique. Night-time direct observations (Millán *et al.* 2001), photo-trapping (Guzmán *et al.* 2002, Torre *et al.* 2003, González-Esteban *et al.* 2004, González-Esteban & Villate 2005, Gompper *et al.* 2006, Barea-Azcón *et al.* 2007), sign surveys (Gil-Sánchez *et al.* 2001, Gehring & Swihart 2003, Virgós & Travaini 2005, Gompper *et al.* 2006, Mangas *et al.* 2008) or accidental trapping (McDonald & Harris 1999, 2002, McDonald 2000, Lischka *et al.* 2006) showed lower detection rates compared with hair-traps, ranging from 2% to 18%.

Previous data on detection probability for Least Weasels using these methods are unavailable; thus, no comparisons can be made. Although hair-traps provided the best results in the number of occupied stations and also in the probability of detection, the estimation of the last parameter suggests that the method could potentially be improved and that about 40% of the sites with Least Weasel remain not detected. However, the track and faeces methods had 70–80% underestimation.

Data from this study indicate that hair-trapping is a good method to assess distribution of the Least Weasel, at least in the Mediterranean basin, providing better results than the other methods tested herein; and it is less invasive than live-trapping. Hair and faeces samples are also suitable for various genetic studies (Wang *et al.* 2002, Fernandes *et al.* 2008). Monitoring schemes for the Least Weasel should therefore consider use of hair-traps, providing a tool for objective assessment of Least Weasel status rather than basing conservation strategies upon a range of opinions of people (as in Palomo *et al.* 2007). However, further investigations are needed to evaluate the efficacy of hair-trapping as an abundance indicator and the power to reveal the natural variations in the abundance of populations of the Least Weasel.

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