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Short Note

Evaluation of three indirect methods for surveying European pine marten in a forested area of central Italy

Paola Bartolommei[a,*], Emiliano Manzo[a], Roberto Cozzolino[a]
[a] *Fondazione Ethoikos, Convento dell'Osservanza, 53030 Radicondoli, Siena, Italy*

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Abstract

Although small carnivore distribution has been widely studied in several countries, not all techniques used for mustelids survey can be efficiently applied in every area and scarce information exists on the effectiveness of different techniques. For this reason we tested three different methods to detect presence and abundance of European pine marten in a forested area of central Italy. Considering the naturally low density of this species and its nocturnal and elusive habits, the choice was addressed to indirect methods: camera trapping, hair tubes, and scats survey. Data were collected from March to June 2009 in 18 km^2 study area, where 90 camera traps and 90 hair tubes were positioned as well as 30 transect lines. Although all these methods are used in mustelids surveys, including pine marten, our results suggest that camera trapping is the only effective method to assess the presence and estimate population density of European pine marten in our study area. We stress the need to test different survey methods before starting species monitoring in a new study area.

Monitoring the abundance and distribution of species is essential for devising management and conservation actions. In the absence of reliable data on these topics, it is impossible to draw conclusions regarding population status, habitat requirements and anthropogenic impacts (Williams et al., 2002). Although small carnivore distribution has been widely studied in several countries, not all techniques used for mustelids surveys can be efficiently applied in every area and data are scarce about the effectiveness of different techniques. The choice of method to estimate the presence and abundance of a species depends on the goal of the study, the habitat characteristics of the study area, the budget and the personnel involved in the study, and the etho-ecological traits of the species (Silveira et al., 2003).

The European pine marten *Martes martes* is widely distributed in Europe, but data on abundance and spread of this species are mainly referred to central and north Europe (e.g. in Switzerland Marchesi 1989, in Poland Zielinski et al. 1995). In Italy the only estimation of population density was reported by Manzo et al. (2011). This lack of information is mainly due to the elusive behaviour of this species. For this reasons we carried out a study aimed to identify a reliable and efficient method to assess pine marten presence and abundance in a forested area of central Italy. Considering the naturally low density of this species and its nocturnal and elusive habits, we applied three indirect methods: camera trapping, hair tubes, and scats survey. All these methods are already being used for surveys of mustelids, including pine marten (e.g. Balestrieri et al. 2009; Manzo et al. 2011; Roche 2008).

This study was carried out in La Selva Forest (43° 13' N, 11° 4' E), in Tuscany. The study area covers 18 km^2, mainly consisting of deciduous forest of the middle European or sub-Mediterranean zone, with slight anthropic alterations. The altitude ranges from 350 to 700 m a.s.l.. The climate is Mediterranean, with warm dry summers and cool wet winters. Other meso-mammals in the study area are stone marten (*Martes foina*), polecat (*Mustela putorius*),

*Corresponding author
Email address: paola.bartolommei@ethoikos.it (Paola Bartolommei)

fox (*Vulpes vulpes*) and badger (*Meles meles*).

We divided the area into six 3 km^2 units and within each unit we selected 15 points spaced 400 m apart. In each point we placed one camera trap and one hair tube at a distance of 100 m from the camera. To determine spacing between cameras, the density of placements was calculated as the ratio between the number of camera positions (90) and the size of the entire study area (18 km^2), and the inverse of the square root of this was used to give an approximate distance between placements (0.44 km). We then set placements out on the study site, drawn on a digital map of the habitats based on an aerial photo (1:50000, CGR 2001) and from a vegetation map (1:15000, 1997). Six main habitat types were recognised: (1) oak woodland (67.5%) – *Quercus cerris* and *Quercus pubescens* - with abundant scrub cover; (2) scrub (7.2%) – mainly *Rubus* sp., blackthorn *Prunus spinosa* and hawthorn *Crataegus monogyna*, constituting hedges between fields and along roads, or covering uncultivated fields; (3) human-made woodland (11%) – plantations dominated by *Pinus* sp. and *Castanea sativa*; (4) cultivated fields (13.3%) – mainly sowed with cereals (mostly wheat) and legumes (mostly broad beans); (5) anthropic areas (0.7%) – areas usually or occasionally occupied by human; (6) artificial lakes (0.3%) – small artificial lakes used for irrigation. In each unit area cameras were positioned following a stratified procedure. First the area of every habitat type inside each unit was calculated, and the number of placements in each habitat type (excluding lakes) was then allocated proportionally to habitat area. Camera positions were initially localized randomly inside each habitat type, using a georeferenced aerial photo (UTM–WGS 84), respecting the distance between cameras necessary to obtain maximum coverage area. Then the points were downloaded into a GPS receiver for positioning in field. When cameras positions previously chosen were not suitable for the right location in the field we tried to find the nearest suitable camera location, maintaining 0.44 km spacing between cameras stations. We defined an unsuitable position as a location where vertical structure (e.g. tree or wooded pole) was absent for fixing camera at 50 cm above ground. Whereas camera traps must be randomly spaced to follow the random encounter model (REM, Rowcliffe et al. 2008), hair tubes has been placed in a "suitable" way follow the sampling protocol reported by Roche (2008) in Ireland. Camera traps (Cuddeback Capture 3.0®) were placed on trees at a height of approximately 0-50 cm above ground and were set to take pictures 24-h per day, with a delay of 5 min between photographs. Following Rowcliffe et al. (2008) we did not bait the cameras (for details see Manzo et al. 2011). Hair tubes (plastic tubes of 25 cm length and 118 mm diameter) were wired at 1 to 1.5 m up, vertically, against the trunk. An open section, 3 cm wide, had been made for the entire length of the tube on the side in contact with the trunk, to make the apparatus more stable and to ensure the pine marten a better grip for access into the tube. Sticky patches provided with glue rodenticide (Alt®) were fixed inside the tubes, at the top of the entrance, to collecting hair samples. Chicken baits were placed in small metal cages, in the upper part of the tubes. All the devices were active for 15 days within each unit between 2 March and 2 June 2009, giving a total of 1334 trap days for cameras and 1350 trap days for tubes. At the same time, in each unit area, we carried out the count of scats along five parallel transect lines, spaced 400 m apart, for a total of 30 transects. Two trained field operators conducted the survey simultaneously by walking along a line and searching for the faeces up to 2 m from the transect line.

The presence of pine marten was recorded in all of the six sampling units by 22 of 90 camera traps (24%). Using random encounter method (Rowcliffe et al., 2008) it was possible to estimate population density as 0.34 individuals/km^2 (see Manzo et al. 2011). The REM is a technique for calculating animal densities from camera trapping rates by modelling the underlying detection process that allows the estimation of population density without the need for individual recognition. Three scats probably of pine marten were collected but, due to the small sample size, the genetic analysis for species determination was not conducted. No hair samples were collected by the hair tubes method. Our results suggest that camera trapping is the only effective method to assess the presence and estimate population density of European pine marten in our study area. One of the major problems in research on martens is to distinguish pine marten from stone marten, both of which occur at our study site, although stone martens appear to be much less common. Twenty nine out of 32 martens found dead and caught since 2005 were pine martens. By examining animals found dead and caught, we have found that the two species appear to be distinguishable from external shape and markings in this area of Central Italy. In all cases, we were able to identify corpses by superficial examination, confirmed by detailed examination of internal morphology and genetic analysis (Natali et al., 2010). This, combined with the relative scarcity of stone martens, gives us confidence that misidentification of species was not a serious problem in this study.

Although Balestrieri et al. (2009) used successfully scat survey to assess the spread of the pine marten in plain areas of northern Italy, in our study area this method was ineffective. Lynch et al. (2006) highlighted some limiting factors in using scat counts along transects for surveying pine marten population. They noted that 1) the ability to locate faeces when pine marten density is low may decrease, 2) the loss of scat from the transect line trough the removal by other species, (e.g. red fox), wet weather or being covered up by leaf litter, 3) faeces deposition may depend on position within a pine marten's home range (core or edge) and 4) the ability of researcher to identify pine marten scat correctly. We think that the failure of this method in our study is mainly related to the presence of the leaf litter on the ground that makes difficult to see the excrements. According to Lynch et al. (2006) hair traps may provide a real alternative for pine marten survey, overcoming many disadvantages associated with scat location. However, although we used the sampling protocol reported by Roche (2008) in Ireland, where the method has been successfully used, in our study hair tubes were ineffective to detect the presence of pine marten. We do not know the reason for this failure. Assuming that the failure was related to the type of bait used, a year later, we replicated the survey using the same bait that we use successfully for the live-trapping of marten in the same study area (i.e. eggs), but also in this case the hair tubes did not work.

Future studies should be addressed to find other indirect methods to detect presence and population density of European pine marten in a forested area. We suggest, however, a pilot study to test the most effective survey method before starting the monitoring of a species in a new study area.

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