

THE USE OF HAIR TRAPPING AND CAMERA TRAPS FOR MONITORING THE EUROPEAN WILDCAT (*Felis silvestris silvestris* Schreber, 1777) IN THE EASTERN VENETIAN PREALPS (ITALY)

USO DI TRAPPOLE PER LA CATTURA DI PELI E TRAPPOLAGGIO FOTOGRAFICO PER MONITORARE IL GATTO SELVATICO EUROPEO (*Felis silvestris silvestris* Schreber, 1777) NELLE PREALPI ORIENTALI VENETE

MARCO CATELLO^{1*}, GIUSEPPE TORMEN², RICCARDO DEON² & CHRISTIAN LOSSO³

¹ Progetto Lince Italia - Università di Torino *marcocatello@gmx.de

² Associazione Faunisti Veneti

³ Christian Losso, Amministrazione Provinciale di Belluno

Abstract. In this pilot project two non-invasive techniques, hair trapping and camera trapping, were tested at the same time to monitor the European wildcat in a study area in the Eastern Veneto Prealps. Between December 2018 and March 2019, 10 rough-sawn spruce sticks matching 10 cameras were used. The objectives of the project were: to verify the effectiveness of valerian tincture as an attractant, both on wildcats and other animal species, to increase our knowledge about the species in an anthropized area with high presence of free-ranging domestic cats and to combine the two investigative methods, to improve the reliability of taxonomic diagnosis based on phenotype. Valerian tincture has proved to be an effective olfactory attractant for the wildcat, obtaining in all documented cases an interaction with the stick. Our results demonstrated the high potential of hair trapping, when combined with genetic analysis and camera traps. The simultaneous use of these methods not only allowed to detect the presence of wildcats in low density and recently colonized areas, but also enabled individual identification, associating the genetic data to the distinctive traits of the specimen's coat. Finally, our survey also significantly facilitated the collection of hair samples, providing evidences to immediately discard those of non-target species.

Riassunto. In questo progetto pilota sono state testate contemporaneamente due tecniche non-invasive, trappolaggio di pelo (hair trapping) e fototrappolaggio, per monitorare il Gatto selvatico europeo in un'area di studio nelle Prealpi Venete orientali. Tra dicembre 2018 e marzo 2019 sono stati utilizzati 10 paletti di abete abbinando ad ognuno di essi una fototrappola. Gli obiettivi del progetto erano poter verificare l'efficacia della tintura di valeriana come attrattivo, sia sul gatto selvatico che su altre specie animali, incrementare le nostre conoscenze sulla specie in un'area antropizzata con elevata presenza di gatti domestici e infine, combinando i due metodi investigativi, migliorare l'affidabilità della diagnosi tassonomica basata sul fenotipo. La tintura di valeriana ha dimostrato di essere un efficace attrattivo olfattivo per il gatto selvatico, ottenendo in tutti i casi documentati un'interazione con il paletto. I nostri risultati hanno provato l'alto potenziale del trappolaggio di pelo, se combinato con l'analisi genetica e le fototrappole. L'utilizzo simultaneo di questi metodi non solo ha permesso di rilevare la presenza del gatto selvatico in un'area a bassa densità recentemente colonizzata, ma ha consentito pure l'identificazione individuale, associando il dato genetico ai caratteri distintivi del mantello dell'esemplare. La nostra indagine è stata infine notevolmente agevolata durante la raccolta dei campioni di pelo, potendo scartare immediatamente i campioni delle specie non-target.

INTRODUCTION

The European wildcat *Felis silvestris* has a wide and fragmented distribution in Europe and occupies a variety of very different habitats (DRISCOLL & NOWELL 2010, LOZANO 2010). In Italy, the Cispadana population ranges from the Tuscan-Emilian Apennines to Calabria, but also in Sicily (RAGNI *et al.* 2014). The species is well documented also in north-eastern Italy and it is connected with the Dinaric-Balkan population (MATTUCCI *et al.* 2015). Recent observations have also documented the presence of the felid in Liguria (GAVAGNIN 2020 pers. comm.).

From the most recent researches carried out

in north-eastern Italy, it seems that the westernmost margin of the distribution area of the species is located in the southern part of the province of Belluno and along the pre-Alpine ridge of the province of Treviso (CATELLO *et al.* 2022 (a), Catello *et al.*, this volume).

Within the Felidae family, small species, such as the European wildcat, are relatively poorly studied.

In the last years, however, the implementation of numerous targeted researches has significantly improved our knowledge on this carnivore. A remarkable contribution to level the gap with larger species, such as the Eurasian lynx (*Lynx lynx*) or the Iberian lynx (*Lynx pardinus*), has been given

mainly by the use of the camera traps, a method that can successfully monitor carnivores with nocturnal, elusive and low-density habits.

Camera trapping, although it has significantly increased our data collection capabilities, requires to provide reliable, good quality images. However, there is always the possibility of incorrect taxonomic analysis, given the potential similarity of the characters with domestic cats with striped-tabby pelage.

The simultaneous application of several investigative techniques (e.g. camera trapping and genetics) can reduce this bias and improve the reliability of the taxonomic diagnosis based on distinctive traits of the specimen's coat visible from the picture.

Considering the results of previous surveys carried out in Italy (ANILE *et al.* 2012, VELLI *et al.* 2015), we wanted to test the effectiveness of hair trapping in the Eastern Prealps of Veneto, where the European wildcat population shows medium-low density (CATELLO *et al.* 2021). A pilot project was then started, using lure sticks and camera traps at each station at the same time. The objectives were to increase the knowledge of the species in Veneto Region and to verify the response to the attractant for each detected species.

MATERIALS AND METHODS

Between 01.12.2018 and 31.03.2019 in a study area located in the Eastern Veneto Prealps (Fig. 1), a research of hair trapping was conducted by matching each stick with a camera trap. The study area is located within the municipality of Limana, on the edge of the small plateau of Valpiana, at an average height of 756 m above sea level (range: 650-900). There are some artificial plants of larch (*Larix decidua*), spruce (*Picea abies*), beech (*Fagus sylvatica*) and a widespread renewal of

ash (*Fraxinus spp.*) with sporadic sycamore (*Acer pseudoplatanus*). The extensive lawn areas are interrupted by birches (*Betula spp.*). Along the edges of the plateau there are numerous limestone outcrops. In the area, the wildcat had already been documented in the past, as the presence of numerous free-ranging domestic cats. These characteristics and the fact that almost all the stations are well accessible, even during the winter period, make this area in the Belluno Prealps extremely interesting for an investigation.

A total of 9 sticks with 9 camera traps were used in the study area. A tenth stick with a camera, was positioned inside the municipality of Lentiai (Stabie), also in the eastern Prealps of Veneto. The sticks were made of rough-sawn spruce of 70 cm in height and 5 X 3 cm and have been buried in a vertical position for 20 cm and positioned at a distance of $618 \text{ m} \pm 248.6$ (range: 250-1100) meters from each other. Each stick was identified with a code and geo-localized. As lure has been used valerian (*Valeriana officinalis*) root extracted into ethanol 70% (Dronania pharmaceuticals GmbH) which has been shown to have a good effectiveness in attracting the wildcat (HUPE & SIMON 2007, STEYER *et al.* 2013) and get a good rubbing response on the stick (MONTERROSO *et al.* 2011). The sticks were sprayed with valerian tincture on all four sides. In an attempt to achieve a more lasting effect, a hole of 1.5 cm of diameter and 5 cm of depth was drilled in the apex of the stick, which was filled with valerian-impregnated sawdust. The hole was then plugged with a piece of wood. On the sides were also made holes with a diameter of 0.4 cm to facilitate the exit of the valerian essence. In order to optimize the capture of the hair, numerous cuts were also made along the four edges of the stick (STEYER *et al.* 2013).

The stick inspection was done every 7-10

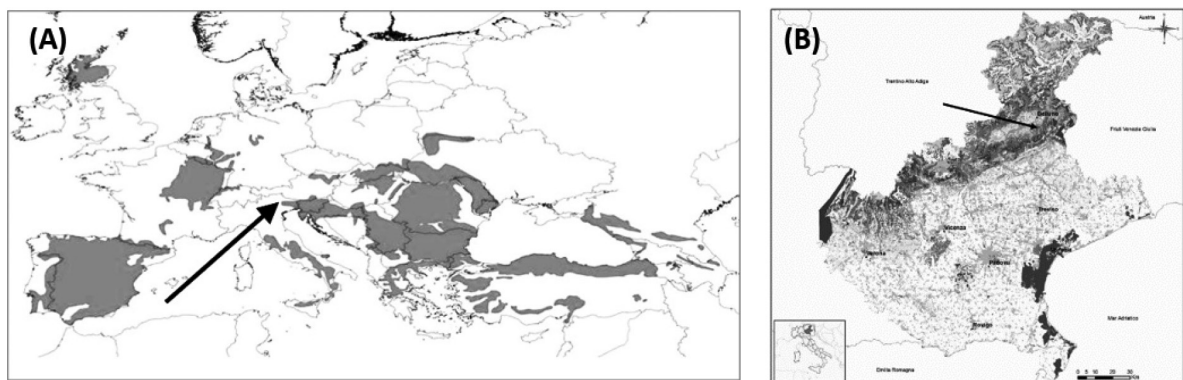


Fig. 1 - Distribution ranges of the European wildcat *Felis silvestris* (A) and the Veneto Region (Italy) (B), where we conducted our research in 2018-2019

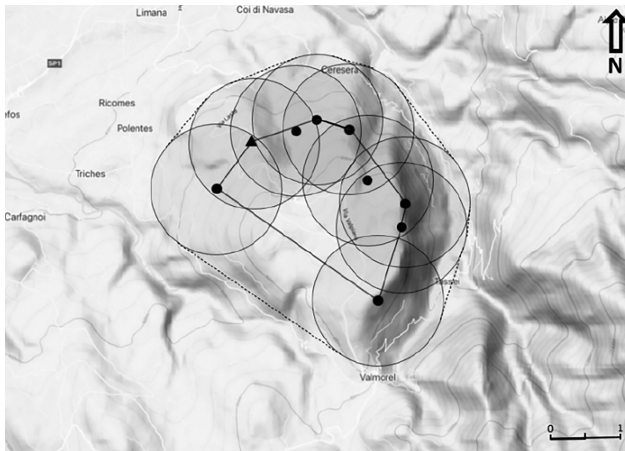


Fig. 2 - Study area (Valpiana) with the minimum convex polygon (continuous line) and the additional buffer strip (dotted line). ▲ Hair trap/camera trap with wildcat capture event (46,084 N 12, 2052 E). ● hair trap/camera trap without wildcat capture event

days. The camera traps were checked on site to immediately ascertain which animals rubbed themselves on the stick. The hairs were collected with forceps and placed in plastic envelopes, and then stored in the dark with silica gel in a non-humid environment away from heat sources to avoid degradation of DNA. After each sampling event, the stick was then cleaned with a brush with metal bristles to remove any unseen organic hair or remains. The valerian tincture was renewed by spraying the stick with a nebulizer and drenching the sawdust present in the apical hole again. The cameras were placed at a height of 40-70 cm and at a distance of 2-3 meters from the stick.

The traced minimum convex polygon, obtained considering the outermost nine stations in our study's area (Valpiana) is 4 km². Considering that our study's area, although in the Alpine environment, develops at a low mountain altitude with little difference in altitude and that the smallest known home ranges for the species vary considerably from 1.5 km² (GERMAIN 2008) to 2.7 Km² (BIZZARRI *et al.* 2010), we further created a buffer strip of 900 m to the MCP, thus obtaining an area of 12.2 km² (Fig. 2).

From the collected images, on the basis of phenotype analysis (RAGNI & POSSENTI 1996) it was possible to select the hair samples belonging to the European wildcat and subsequently extracted and analysed their DNA using 10 species-specific autosomal microsatellites markers as described in Mattucci *et al.* (2013).

All the videos collected by the cameras were examined to evaluate the behaviour of each single animal in the presence of the valerian-impregnated stick. To standardize the analysis an ethogram (VELLI *et al.* 2015) was used, where its possible reactions are indicated (Tab. 1). The data collected from Stabie's stick are part of the ethological analysis, but not in the calculation of the other parameters (e.g. capture success rate etc.), since it is not part of the Valpiana study area.

RESULTS

Ten sticks were used during the survey, nine were placed in the municipality of Limana (Valpiana) at an average height of 756 m above sea level, while the tenth stick was placed in the

Tab. 1 - Ethogram of the reactions at the sticks recorded by the camera traps (from VELLI *et al.* 2015). The percentage of occurrence concerns only the reactions of domestic cats and the wildcat specimen.

| Label | Name | Behaviour | Percentage of occurrence |
|-------|--------------------|--|--------------------------|
| I | Indifference | The individual shows no interest in the lure | 9 |
| C | Curiosity | The individual is somehow attracted by the lure. It sniffs and remains next to the picket for a while. It does not touch the trap | 5 |
| FM | Facial marking | The individual shows a typical facial marking behaviour rubbing the cheeks and the forehead on the picket | 32 |
| SM | Spray marking | The individual marks the picket by spraying on the trap | 9 |
| SI | Strong interaction | The individual strongly interacts with the lure by rubbing the face and the body, sitting by the picket and scratching it with the nails | 45 |
| D | Diffidence | The individual looks at the lure appearing suspicious and insecure. It does not get too close to the pickets | 0 |
| F | Fear | The individual reacts suddenly leaving the sampling station. | 0 |

municipality of Lentiai (Stabie) at an altitude of 310 m above sea level.

The sampling events were 79, with an average control every 9 days (9.4). The total hair trap-days were 727, average 72.7, while for the camera traps they were 641, average 64.1. This difference is explained by the fact that one camera was stolen and others (3) were recovered earlier than expected to avoid further thefts. Altogether on the stations (Valpiana and Stabie), only one was positive for the wildcat, both for camera trapping and hair trapping, while in 6 stations the domestic cat was documented.

A total of 13 hair samples were collected in the study area of Valpiana, but only 6 have been genetically analysed. Examining the videos, we were able to discard the samples of the non-target species, only selecting the 5 hair samples, where the rubbing of the wildcat on the stick had been documented by the camera, plus a sixth hair sampled, where the camera had not worked. Of the six samples, one was successfully genotyped with a capture success rate of 0.14 genotyped hair samples per 100 trap-days.

The cameras have documented within the study area of Valpiana 5 subjects of domestic cat and one of wildcat. From the characteristics of the coat, it can be seen that all five captures are from the same specimen. The rate of capture success was 0.78 ind./100 trap-days, slightly higher than the one found in a neighbouring area during a 3-year survey of 0.5 ind./100 trap-days (CATELLO *et al.* 2021).

Overall there were 85 captures of 9 different species during the study period: fox (*Vulpes vulpes*) 5, beech marten (*Martes foina*) 7, badger (*Meles*

meles) 15, domestic cat (*Felis catus*) 17, wild cat (*Felis silvestris*) 5, red deer (*Cervus elaphus*) 5, roe deer (*Capreolus capreolus*) 16, brown hare (*Lepus europaeus*) 6, red squirrel (*Sciurus vulgaris*) 9. Among the documented species, the reaction to the lure was very different (Fig. 3). A strong interaction was recorded only for the felids. In the 5 documented occasions on the wildcat, 4 happened at night and only one during the day and occurred in December (2) and January (3). The 17 domestic cat captures are distributed over the entire research period December (2), January (3), February (6) and March (6). In 45% of the cases where the felids were documented, a strong interaction (FI) was recorded (Tab. 1). For the wildcat, this type of interaction occurred in 80 % of cases (4 out of 5) (Fig. 3).

DISCUSSION

The data collected in the Valpiana study area, with the simultaneous use of the two survey systems, made it possible to identify an European wildcat density of 0.08 ind./1Km², a slightly lower value than that found in a three-year survey of the Eastern Veneto Prealps, 0.12 ind./1Km² (CATELLO *et al.* 2021a). From the pictures we identified 5 different domestic cats, 0.4 ind./1Km², therefore a higher presence than the already mentioned three-year survey carried out about 3 Km away from Valpiana with 0.04 ind./Km². Although considering the limits of the pilot project, its results document the constant presence of the wildcat, recorded in the area since June 2018, in

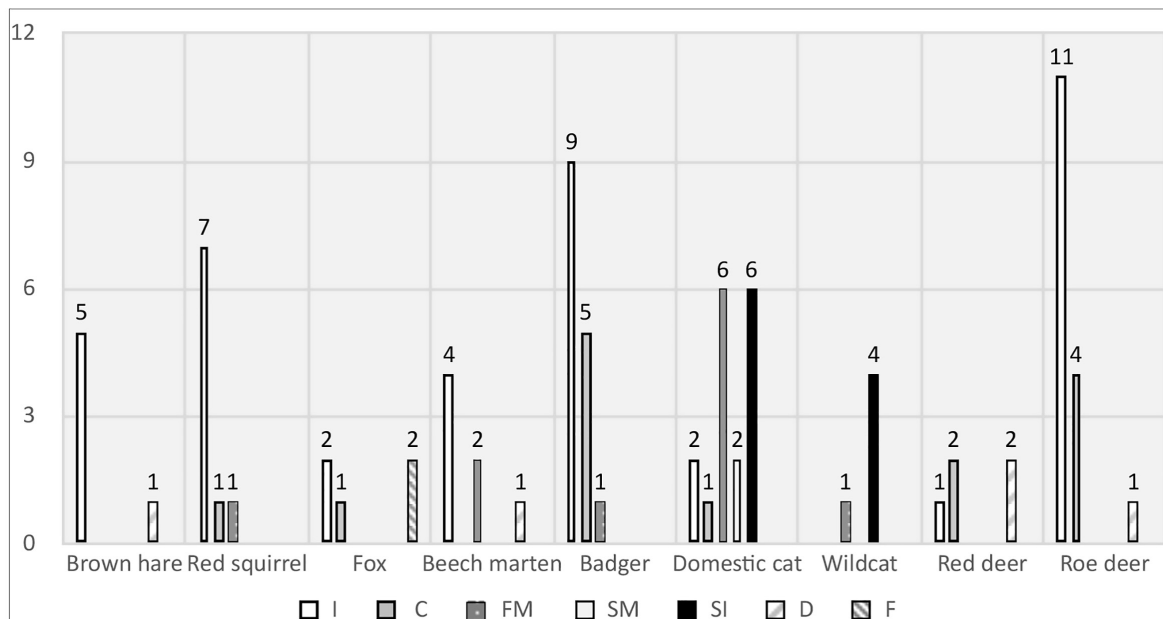


Fig. 3 - Ethogram of the behaviours detected by the camera traps. I = Indifference, C = Curiosity, FM = Facial marking, SM = Spray marking, SI = Strong interaction, D = Diffidence, F = Fear

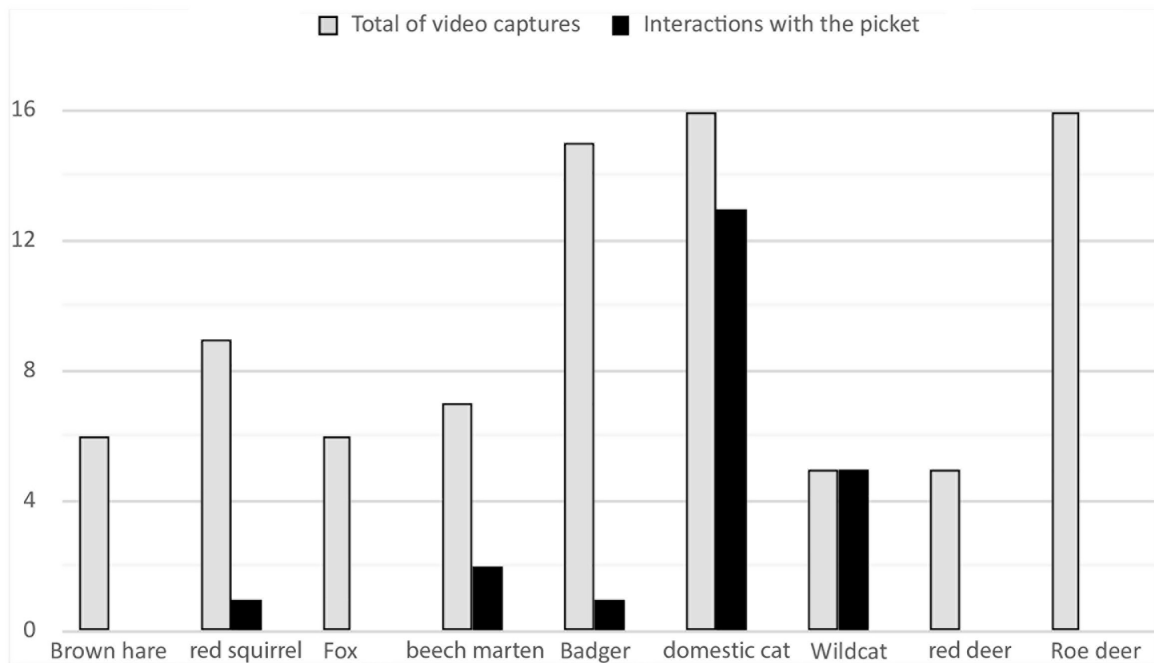


Fig. 4 – Species that have had an interaction with the picket: FM+SM+SI

an anthropized area with a high presence of free-ranging domestic cats. Both were recorded on two occasions on the same site a few hours apart from each other.

The hair trapping success rate (0.14/100 trap days) was slightly higher than other studies (0.07/100 trap days STEYER *et al.* 2013, 0.08/100 trap days VELLI *et al.* 2015). This parameter is related to the behaviour of wildcats towards sticks, in our study there were always interactions (Fig. 4), but Monterroso *et al.* (2011) found that only 11.5% showed investigative behaviour.

A research by Anile *et al.* (2012) in Sicily documented the total lack of interest of wildcats in valerian, while in Velli *et al.* (2015), this has been documented in 51,7 % of cases. There were positive results, however, both in Switzerland Kéry *et al.* (2011) and in Germany Steyer *et al.* (2013). This variation in the response to valerian may have genetic bases.

In the present pilot project only one hair sample out of five (20%) provided reliable individual genotypes. This is mainly related to DNA degradation caused by weathering exposure. Other studies showed lower results (10% MONTERROSO *et al.* 2014, 11% VELLI *et al.* 2015). However, despite the few samples collected, it was possible to associate the genetic data with the picture of only one individual (Fig. 5). A similar result, but with a higher research effort, was obtained in the survey of Velli *et al.* (2015).

The analysis of the ethogram shows that only 5 species had contact with the stick impregnated with valerian, red squirrel, badger, beech marten, domestic cat and wildcat, but only with the last two there was a strong interaction. The wildcat specimen rubbed itself on the stick in two cases for more than 6 minutes, covering a large surface of the body. However, still underlining the limited case history of our pilot project, we can say that the wildcat



Fig. 5 - The genotyped wildcat by the picket

specimen had 100% of the capture events a contact with the stick. Velli *et al.* (2015) found that 44.4% of the subjects documented in a study area in the Foreste Casentinesi National Park left hair on the sticks.

CONCLUSION

In this study we have integrated two research systems, hair trapping and camera trapping to document the presence of the European wildcat in an anthropized area of the Veneto pre-Alps in the province of Belluno. Valerian tincture has proved to be an excellent attractant for the target species, allowing to capture several times a specimen and the collection of 6 hair samples that enabled to characterize the genetic profile, confirming in this way the initial taxonomic analysis and the belonging to the species *Felis silvestris*. Our investigation was also significantly facilitated during the collection of hair samples, being able to immediately discard those of non-target species.

The knowledge about the European wildcat in Veneto is still very limited, due to the objective difficulties of obtaining data, given its presence at low densities and its extremely elusive habits. For this reason, new genetic, morphological and ecological data are very important, especially in areas where the felid has been recently confirmed.

Further investigations are therefore hoped for,

in order to better understand the dynamics of the species in an area so highly frequented by domestic cats and possibly implement conservation measures.

The pilot project, while demonstrating the validity of the method, has presented some limitations.

The first is the limited use of sticks. Weber and Hintermann (2008) recommend using 3 of them for each square kilometre in order to have in this way a good chance of capture.

Second, Valpiana is a very anthropized area, with a large presence of hikers, hunters etc. The monitoring stations, composed of rough-sawn spruce sticks and cameras, can sometimes be very visible and lead to vandalism or theft, thus limiting the sampling effort.

ACKNOWLEDGMENTS

We would like to thank the Provincial Administration of Belluno for having supported us in every phase of our project and ISPRA (Institute for Environmental Protection and Research) for carrying out the genetic analysis.

We thank for the support in the field and for useful suggestions: De Faveri Adriano, Catello Luca, Faller Mathias and Nussberger Beatrice. Gratitude also goes to Streif Sabrina and Tripke Henriette that helped us to develop the methodology applied in this project.

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