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CAMERA TRAPPING AS A MONITORING METHOD OF THE RED-BACKED SHRIKE (*LANIUS COLLURIO*) IN ITALY

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Abstract.

In Italian mountain areas, the recolonization of the meadows led by the forests is a factor that explains the decrease of some passerine birds, as well as the Red-Backed Shrike. The project aims to manage a meadow area of northern Apennine (Dynamo Oasis – Pistoia – Italy), testing a new method to monitor the species breeding population. Since 2019, we scheduled wintering shredding of meadows, keeping spontaneous shrubs in order to provide natural perches to Shrikes; at the same time, a study was carried out to monitor the breeding population of the species, collecting color-ringed data and resightings obtained through camera traps combined with artificial perches. The first four years of activity show that the species that mainly used the artificial perches was the Red Backed Shrike; the quality of collected images allows us to read the ring code and recognize the taxonomy of caught prey. Using the same data to evaluate the annual return rate and the distribution of the species along the study area, we considered both the ringing and photo-trapping one; overall, this last was the most representative. The first results obtained by the use of the camera traps led to remarkable results that may be useful for the conservation of the species, also linked to the use of the images for educational purposes, to raise awareness among the general public about the conservation of grasslands and of the Red Backed Shrike.

Key words: *Red-Backed Shrike, camera traps, color-ring banding, artificial perches*

Introduction

Wooded areas cover 38% of Italy and have increased by almost seven percent compared to 1990 in response to a transition process due to abandoned agricultural land by humans and environmental disasters, leading to forest regeneration (de Panizza, 2020). Passeriformes are considered bioindicators for changes in environmental biodiversity, particularly for changing agricultural landscapes. Many species related to mosaic landscapes, resulting from traditional agropastoral activities, are now rare, protected, and included in European laws. Red-backed Shrike (*Lanius collurio*, family Laniidae) is a predatory passerine that prefers open farm areas, surrounded by woods and fragmented by hedges and bushes; it has shown a demographic and distribution contraction because of the landscape changes. The Red-Backed Shrike is listed in the Annexes of the EU Birds Directive (EU 2009), emphasizing conservation responsibilities in the European Union. In mountain areas, the leading intensive agriculture, the abandonment of traditional mowing and grazing activities, with consequent invasion and colonization of grasslands by forests, has led to a remarkable loss of suitable habitats for the species and a consequent decrease of its presence (Casale and Pirocchi, 2005; Laiolo et al., 2004).

After implementing environment management plans in Italy, the Red-Backed Shrike has responded positively and the breeding population has increased in recent decades (Casale and Radames 2004; Brambilla et al., 2007). To implement effective conservation measures, a better understanding of its breeding biology, life history parameters, and population trends is crucial (Cox et al., 2014; Greenwood, 2007; Pedersen et al., 2018). Mapping and distance sampling methods are globally applied in bird survey techniques, including for shrikes (Gottschalk and Huettmann, 2011; Hidalgo et al., 2023). In recent years, using automated cameras to detect wildlife has become an essential tool for researchers worldwide. The last 20 years have also seen a marked improvement in automated cameras' reliability, portability, and technological advancement. Indeed, the use of camera traps has grown exponentially amongst researchers in more recent times, becoming a mainstream tool in conservation and ecology (Rowcliffe and Carbone, 2008). Camera traps provide multiple benefits, including unobtrusiveness, low cost, and the ability to conduct studies over large geographical scales and long observation periods, reducing survey efforts (Caravaggi et al., 2017; Chalmers et al., 2023). Camera traps also monitor secretive ground-dwelling birds (Znidersic, 2017).

Researchers have recently begun using camera traps to record perch visits, especially for raptors (Wong and Kross, 2018). Camera traps are also used to identify individual color-marked birds (Brides et al., 2018) or to record predatory birds in farmlands, collecting many pictures of shrikes (Hong et al., 2022). Performances about the combined use of artificial perch with camera traps have already been evaluated and confirmed, also within our study area, providing information about Red-backed Shrike diet composition (Giannerini et al. 2019; Giannerini et al. 2020); the same method was applied to the resighting of colored rings (Nannelli et al., 2021). In this paper, we aim to summarizing the results of camera-trap monitoring of Red-Backed Shrike and discuss the reliability of this method to estimate population parameters.

Figure 1. Artificial perch combined with a camera trap. In addition to the perch, the image shows the outer battery pack (6v) and stainless-steel bollards for birds to avoid landing outside the perch zone.

Methods

We studied in the central Italian Apennines (Podere Nappo, Oasi Dynamo, Pistoia, Italy - 44.037205°N, 10.797657°E; 1100 m asl; about 10 ha). The area consists mainly of permanent meadows (30.7%) and woods with thorny shrubs (67.7%); 14% of the surface of both environments is occupied by Bracken Fern (*Pteridium aquilinum* (L.) Kuhn). Winter shredding of meadows is conducted once every four years to prevent forest regeneration; within this area, spontaneous shrubs with a buffer zone of 2 m are kept at distances of about 30 m from each other. We built a 2 m high artificial perch and a camera trap to monitor the Red-backed Shrike. Although several studies have used camera traps to record birds on perches, methods differ for target species, camera trap model used, or other specific needs (Hong et al., 2022). After several attempts involving different ways to set the camera trap and the perch (Giannerini et al. 2019), since 2019, both camera trap and perch have been installed on unique wooden supporting poles (Ø 8 cm). The perch (square wooden pole with a side of 3 cm) has a length of 30 cm. The structure for housing the camera trap consists of a solid iron "S" shaped section (1x1cm) fixed to the supporting pole with three screws. A stainless-steel angle bracket (2 mm thick) was screwed to the end of the profile, onto which the camera trap was installed with a ¼-inch screw with a UNC (Unified National Coarse) thread. The steel bracket allows minor position corrections during the alignment of the camera trap with the perch. In order to prevent birds from landing on the profile, thus collecting blurry images, we installed stainless-steel bollards for birds (Fig.1).

Because the distance between the camera trap and the birds on the perch is close, we contacted the dealer (Boly Media Communication Co. Ltd, 3235 Kifer Rd., Suite 260, Santa Clara, CA 95051, USA) to adjust the focal length to 50 cm. Although recent studies have shown that biased and imprecise results can be obtained when detection probabilities are low (Hofmeester et al. 2017; Kays et al. 2010), concerning the interaction between the probability of fast activation and camera trap model, the Scout Guard is one of the best camera traps that work on a short distance, especially with medium size birds (0-2.5 meters) (Palencia et al., 2022). The camera trap model was selected based on various parameters, including the angle of the detection zone (57°), focus distance (50 cm), sensor activation speed (<1 sec), and image quality (36MP), which allowed us to obtain sharp images even at multiple zoom levels. Perches were installed maintaining a consecutive distance between 58 m and 112 m; this sampling procedure ensures that each perch falls at least within a territory of Red-backed shrike couple. The average home range extension was considered to be about one hectare (Cramp and Perrins 1993; Brambilla et al. 2007), the minimum and average distance among nests equal to 58 m and 108 m, respectively (Paci et al. 2011), and the average distance between hunting perches and nest areas as 84.3 m (Meschini et al., 2011). Larger prey are often carried up to a perch before being killed and consumed (Cramp and Perrins, 1993; Lefranc, 2004), with maximum flights of 25 m for being captured in flight (Solari and Schudel, 1998). Artificial perches have been placed between 20 and 30 m from the ecotonal edge to limit the combined use of natural perches in the woods. Every year, were scheduled a ringing session during the first ten days of June to mark birds with colored rings. Red-Backed Shrikes captured were marked with both metal and colored rings (www.cr-birding.org/node/5127). Ornithologists and entomologists checked every collected photo. Collected data included perch identification number, date and time, bird species, age and sex, ring code, and taxonomy of captured prey (Figure 2).

Figure 2. Example of image collected by a camera trap. A colored engraved plastic plate provided the information on the perch identification number, and the date and time were automatically obtained by free software (Directory List & Print, Infonautics GmbH, Switzerland). The information on bird species, age and sex, ring code, and taxonomy of prey are evaluated by the ornithologist and entomologist.

Statistical analyses were conducted with the open-source R-studio program (Version 1.4.1564, Inc., Boston, Massachusetts) and used Chi-square comparison tests. Summarized results are presented as mean ± SD unless otherwise indicated. We calculated absolute and relative frequencies (in percentage) of perch use by each bird during the two study years. The hypothesis that the same individual used a single perch was tested to analyze the distribution of a breeding couple within the study area and the level of fidelity to the home range. The time series was shown based on ten-day periods (decades), from 11-20 May (decade 14) and 3-12 September (decade 25). The annual return rate was defined as the proportion of birds ringed in the previous year that returned to the same site the following year (Latta and Faaborg, 2001).

Results

In the four study years, we captured and ringed 41 Red-Backed Shrikes (26 males, 15 females born before the calendar year of capture; year of birth unknown).

Between 2019 and 2022, from the 15th of May to the 15th of September, we obtained 70,270 camera events, showing 26 species from the camera traps. Red-Backed Shrike (94%) used the artificial perches the most. Only 0.10% of the images portrayed birds on the bollards set on the supporting pole, therefore at a distance that cannot guarantee a clear image. To show the use of perches by shrikes, we considered only the data concerning 2021 and 2022, when all the camera traps worked continuously. For the target species, 74.11% of pictures show adult males, 19.12% adult females, and 6.75% juveniles. Five percent of the pictures were until decade 18, 91% between decades 19 and 23, and 4% in decades 24 and 25. The absolute frequencies of pictures showed that males tend to use the perches to a lesser extent until decade 18 (6.7%), 92% between decades 19-23, and 1.3% in decade 24. No record was taken during decade 25. Females (1%) were detected until decade 18, 95% between decades 19-23, and 4% in decade 24; no record was taken during decade 25. Juveniles were recorded between decades 20 and 25 (Figure 3).

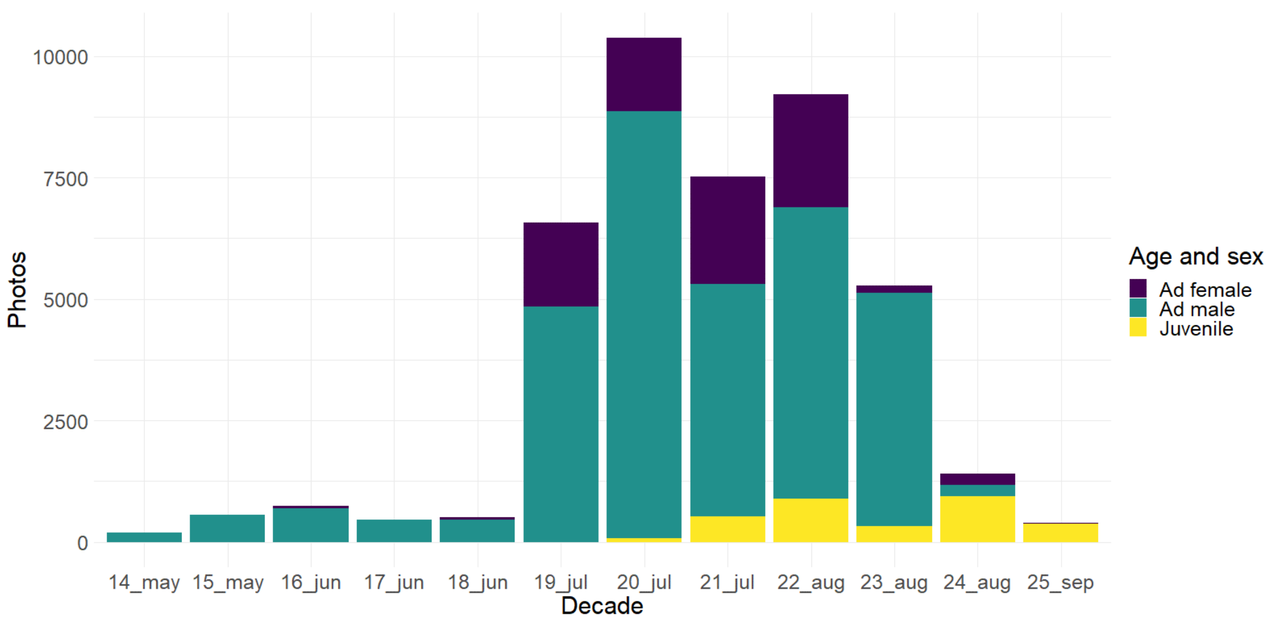

Figure 3.Absolute cumulative frequencies of pictures of Red-Backed Shrike obtained by camera traps mounted on artificial perches. This data concerns the last two years of monitoring (2021, 2022) and is divided by sex. Adult males comprised 74.11% of pictures, 19.12% of adult females, and 6.75% of juveniles. Five percent of pictures were until decade 18, 91% between decade 19 and 23, and 4% in decades 24 and 25.

Using the ringing and camera-trapping data, the return rate was 47.92% ± 8.24 for males and 32.11% ± 1.05 for females. Using only camera traps, the re-sighting rate was 62%. In 90% of the cases, each bird used a single perch, 48.14% exclusively, and 51.86% preferentially ($p>0.001$). The number of males that occupied the same perch was 3±0.43. Of the ten birds whose annual preferred perch was identified, five came back in subsequent years to the same perch (50%). Among all the images of the Red-Backed Shrike, it was possible to recognize the prey in 3,448 images, i.e., 4.9% of total. Over 96% of prey were insects: Orthoptera (41%), Coleoptera (12%), Hymenoptera (11%), Lepidoptera (4,3%), Diptera (1,6%), Hemiptera (0,3%), Dermaptera (0,2%), Heteroptera (0,1%), Mantodea (0,1%), Homoptera (0,1%), Mecoptera (0,1%), Neuroptera (0,1%), Odonata (0,1%), unidentified insects (25%); and 4% of the prey were Aranea.

Discussion and Conclusion

In the first four years of Red-Backed Shrike population monitoring in the Dynamo Oasis using colored rings, artificial perches, and camera traps, we obtained 70,270 images. The low percentage of the images on the bollards confirms that the perch design is adequate for the project. The perch dispersal in the study area provided a homogeneous sampling coverage in accordance with the biological pattern described in the literature, such as home range size during the breeding season and the distance between nest sites (Cramp and Perrins 1993; Brambilla et al., 2007; Paci et al., 2011). Our results showed that all the perches were used by Red-backed shrikes, confirming a continuous distribution of the species in the study area. Perch use, expressed by the number of pictures, increased from early July. This probably followed the intensification of food needed for fledglings, especially for females, who spent most of their time in the nest until late June. The range of each bird, identified by the color ring, was linked to a single perch in 46% of cases exclusively and in 54% of cases preferentially. This displayed a strong fidelity to the feeding site, probably related to the nest site, during the breeding season. The first data of interannual resighting shows a high fidelity to the breeding site. Perches used by more than one adult highlight the overlap of different home ranges. We checked the interannual site-fidelity in five males that returned to the territory occupied in the preceding year, suggesting probable fitness benefits. The initial results with camera traps have led to intriguing results, which can be helpful for species conservation. Concurrently, the images were also used for educational purposes, to raise awareness among the general public about the conservation of grasslands in general and of the Red-Backed Shrike in particular. Although increasing the number of perches requires more significant effort, this may increase the number of individuals at the study site (Yosef and Grubb 1994), their resightings, and better our knowledge of the species' biology. Our camera-trapping method can be used to optimize the perch density in managed habitats. So far an optimal density was documented in southern Belgium based upon classic observations during a limited time period of the breeding season (Van Nieuwenhuyse et al., 1995, Van Nieuwenhuyse, 1998). Research during all phases of the breeding cycle and in function of local landscape paramerters could be optimized with automatic data collection. Hence, combining camera-trapping with other classic methods, such as direct observation or radio-telemetry, would allow us to understand how effective and reliable the camera-trap data is in studying the biology of the Red-Backed Shrike.

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