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Short note

Jumping on the trails: European hare's (Lepus europaeus Pallas, 1778) activity in near-natural habitat in Bulgaria

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Abstract. European hare (*Lepus europaeus*) is among the most common game species and is a part of the medium-sized mammals and raptors diets. In Bulgaria, information for its activity lacks, mostly under scarce human influenced conditions. Hare's daily activity was established by camera trapping in mountainous habitat in Central Bulgaria. The species demonstrated unimodal activity, peaking at night during cold season. Bimodal activity during the warm season was registered, peaking around dawn and dusk.

Key words: *Lepus europaeus*, activity pattern, nocturnal, mountainous.

Introduction

European hare (*Lepus europaeus*) is among the most common game species, being preferable prey for the medium-sized carnivores and raptors. Most of the studies on species activity were conducted in agricultural regions by GPS- and radiotelemetry (Pepin & Cargnelutti, 1994; Reitz & Leonard, 1994; Rühe & Hohmann, 2004). Recently, camera trapping has been used to establish spatiotemporal overlap between hare and its potential predators (Viviano et al., 2021). It is considered 30-100 independent camera trap registrations for a particular species per season/year as sufficient in its activity defining with results comparable to these from GPS- and radiotelemetry (Lashley et al., 2018).

European hare is the only one lagomorph species inhabiting Bulgaria. It is widespread throughout the country (Popov & Sedefchev, 2003). However, information for the species activity under scarce human disturbance conditions lacks. It is universally acknowledged activity cycle undergoes geographical changes. For this reason, it is intriguing when hare chooses to move among the local predator community in near-natural habitat in Bulgaria.

Material and Methods

The study was conducted during the period September 2021-September 2022 in the area of Central Stara Planina Mts. A total of 30 camera traps were placed on trees along animal paths with obvious runs, following the instructions for detection of medium sized animals (Ancrenaz et al., 2012). No bites or lures were used.

The vegetation was represented by oak (*Quercus* spp.) up to 800 m a.s.l. and by beech (*Fagus sylvatica*) mixed with European hornbeam (*Carpinus betulus*) and *Quercus dalechampii* at higher elevations, primarily on the south slopes (Jurukov & Zhelev, 2001). In the area the most common predators concerning hare were jackals (*Canis aureus*), foxes (*Vulpes vulpes*) and stone martens (*Martes foina*).

Wolves (*Canis lupus*) and pine martens (*Martes martes*) presented at higher elevations as well. The raptors were represented by common buzards (*Buteo buteo*), northern goshawks (*Accipiter gentilis*), golden eagles (*Aquila chrysaetos*) and common ravens (*Corvus corax*). No agricultural activities were carried out in the area, while human presence came down to hunt and tourism.

Elevational positioning of camera traps on northern and southern slopes ranged from 400 to 1300 m a.s.l. with a 200 m setback between the levels. The devices were placed of three per level, at about 500 m distance between. Keep Guard Cam (KG690NV) and LTL Acorn (6310 – 3G) camera traps were used. The operation mode was set to take three photos with five minutes' delay to the next detection. Independent registrations of the target species with 30 minutes' interval between were treated as a single event. During study period, a total of 167 photos of European hares were obtained distributed as follows: 76 photos (45.51%) in warm season and 91 photos (54.5%) in cold season, as per the accepted astronomical ones.

The relative abundance index (RAI or TS – trap success) was calculated to test whether the obtained photos were sufficient for further analysis using the equation (Ogurtsov et al., 2018):

$$\text{RAI} = \frac{\sum TE}{\sum TCD} * 100,$$

where TE (trap events) is the number of animal registrations and TCD is the number of camera days. Ogurtsov et al. (2018) considered when the success of capturing (RAI) exceeds 1 the results are proper for investigation of a species activity. The RAI for hare in the present study valued 1.53.

Dawn and dusk were defined as ± 1 hour from sunrise and sunset (Eggermann et al., 2009; Gerber et al., 2012).

Results and Discussion

During cold season hare exhibited unimodal activity peaking between 02:00 and 04:00 h. (Fig. 1). The beginning of its activity was in the interval 14:00-16:00 h, with smoothly increase until peak onset, when sharply decreased after it. This finding is consistent to nocturnal locomotor activity established for the brown hare during winter in France (Pepin & Cargnelutti, 1994) and in England (Holley, 2001). No diurnal winter activity was detected for the species in Central Italy as well (Zaccaroni et al., 2013).

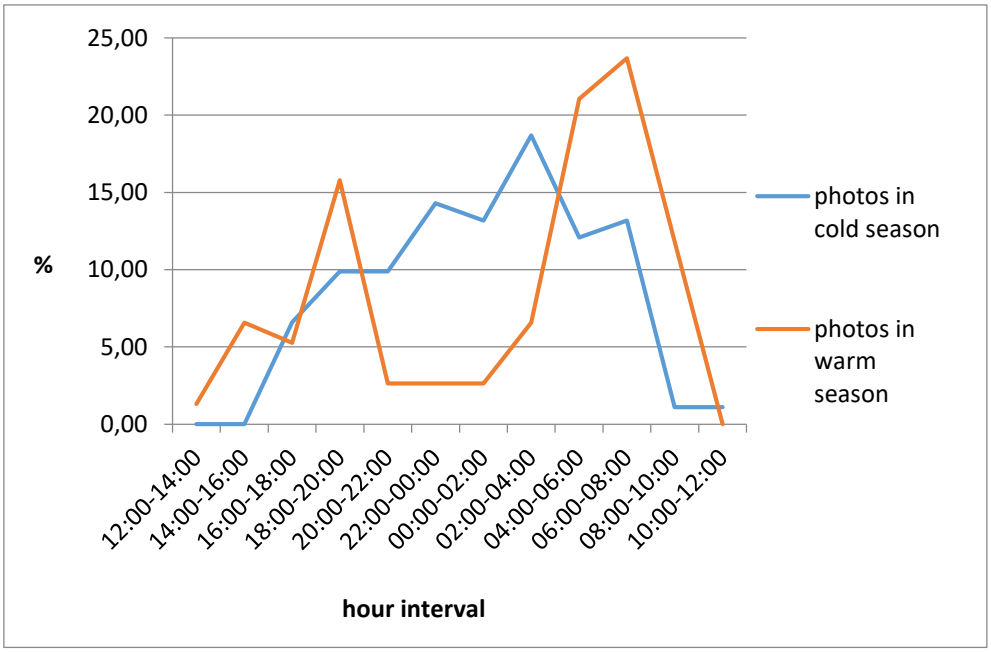

Fig. 1. Daily activity of the European hare in the region of Central Stara Planina Mts, Bulgaria.

During warm season hare activity peaked twice - in the interval 18:00-20:00 h and in 06:00-08:00 h (Fig. 1). Schai-Braun at al. (2012) also reported summer bimodal activity pattern for the hare with preference to move during day. Considering the photoperiod, it can be noted the hare to behave as a nocturnal animal during the cold season, with about 80% recordings at night (Fig. 2). Contrary, during warm season, half of its activity shifted to day. In the present study the hare exhibited low crepuscular activity with preference to move at dawn.

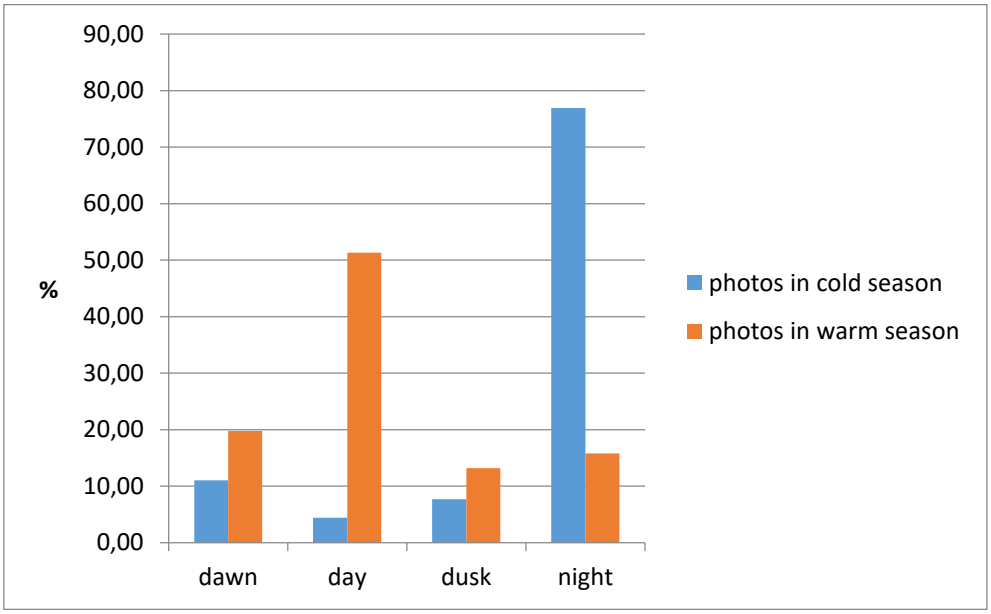

Fig. 2. Relative frequency of the European hare registrations at different time of the day in Central Stara Planina Mts, Bulgaria.

On a large scale, the established brown hare activity pattern matches those of the warm season jackal's and the cold season fox's reported for the same area by Tsunoda et al. (2020). On a fine scale, however, the peaks of their activities differ considerably during cold season, while a similarity only in hare and jackal activities could be noted for warm season. Further studies are needed to reveal the drivers for brown hare activity in near-natural habitat.

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