

Seasonal and circadian activity patterns of two sympatric carnivores in an agricultural habitat, Southern Bulgaria

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Abstract. To establish the circadian activity of the Red Fox (*Vulpes vulpes*) and the Stone Marten (*Martes foina*) in agricultural habitats of Southern Bulgaria a total of 5 camera traps were set in protected area "Maritsa - Parvomay". Both carnivores demonstrated bimodal nocturnal activity with close or coincident hour intervals. They showed peak activity in the dark and in the twilight, which is usual for areas with strong anthropogenic influence.

Key words: *Vulpes vulpes*, *Martes foina*, agroecosystem.

Introduction

Agricultural landscapes are mostly mosaics formed by a matrix of an agroecosystem permeated by remnant patches of native vegetation (Forman 1995). While for many carnivores species this landscape transformation can have negative conservation consequences, for others it could represent a window of opportunity (Verdade *et al.* 2011).

The Stone Marten (*Martes foina*) and The Red Fox (*Vulpes vulpes*) are sympatric carnivores which often have close ecological niche (Petrov *et al.* 2016, Tsunoda *et al.* 2020). Although they have different body sizes and behaviors, the use of similar food resources and habitats suggests the possibility of competition between the two species (Serafini & Lovari, 1993). Few studies on the circadian activity of both carnivores (and other sympatric carnivores) have been conducted in agricultural regions of Bulgaria (Dudin & Georgiev 2015, Dudin 2017, Petrov *et al.* 2022, Petrov 2022, Tsunoda *et al.* 2022). Our study aimed to provide new information on the behavior and activity of the Red Fox and the Stone Marten in a protected area with highly developed agriculture.

Material and Methods

The study was conducted in Natura 2000 area "Maritsa - Parvomay" located in Thracian Lowland (Fig. 1).

A total of 5 camera traps (BolyGuard BG590-K2) were set up on threes along the wildlife trails. The study was conducted from 1-Sept-21 to 31-Aug-22. The devices were angled at 45-90 degrees to the trails. The height the devices were mounted on the trees was tailored to the size of the studied species, the slope and the vegetation of the terrain. No baits or lures were used. The cameras were set to take 3 consecutive photos with 5 minutes delay. The events (an independent observation of a particular species) were separated by thirty-minute intervals.

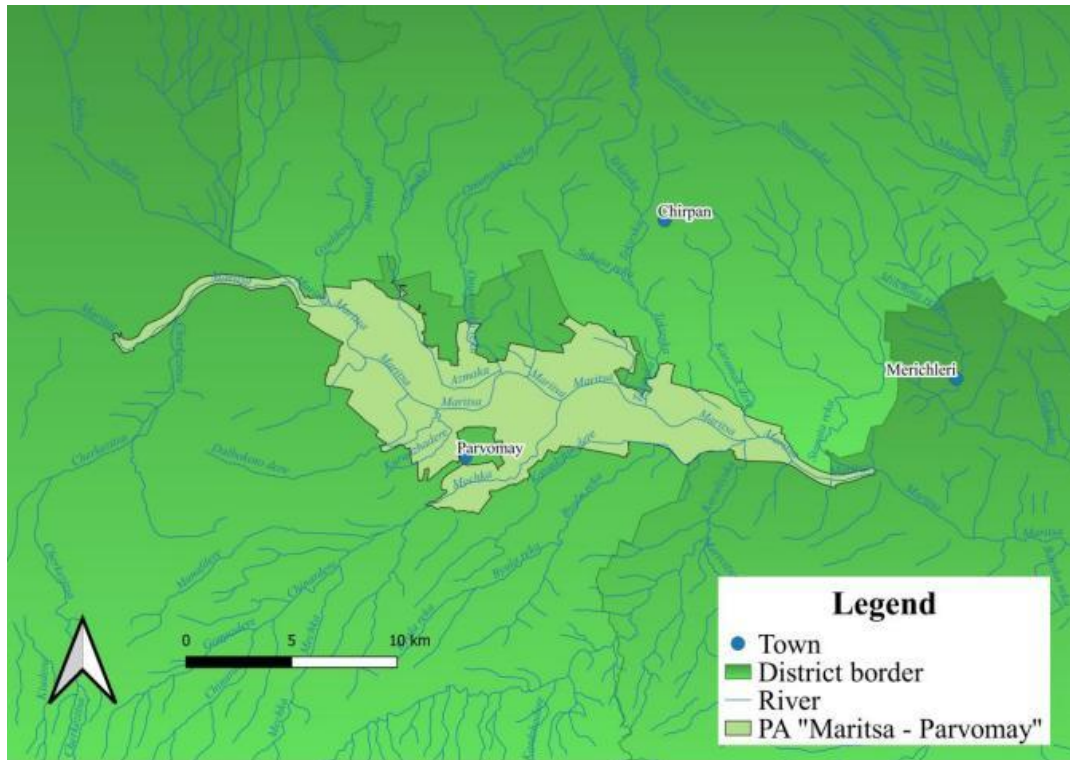


Fig. 1. Natura 2000 area “Maritsa - Parvomay”.

Results and Discussion

The Red Fox (Fig. 2 - left) and the Stone Marten (Fig.2 - right) demonstrated bimodal nocturnal activity with close or coincident hour intervals. A total of 287 photos were obtained.



Fig. 2. Red Fox (*Vulpes vulpes*) - in the left and Stone Marten (*Martes foina*) - in the right photographed in Natura 2000 area “Maritsa - Parvomay”.

There is a discrepancy in the first peaks of their activity - the Stone Marten reaches its peak between 20:00 and 22:00, and the Red Fox - between 22:00 and 00:00 (Fig. 3). The small peak coincides with the appearance in the twilight hours between 4:00 and 6:00.

During the autumn-winter and spring-summer seasons, the fox has one peak of activity - between 20:00 and 22:00 (Fig. 4). In both periods, there is a small activity increase in the range of the time of 04:00 - 06:00.

The Stone Marten maintains its bimodal nocturnal activity during the autumn-winter period, but during the spring-summer period its activity has only one peak - between 20:00 and 22:00 (Fig. 5).

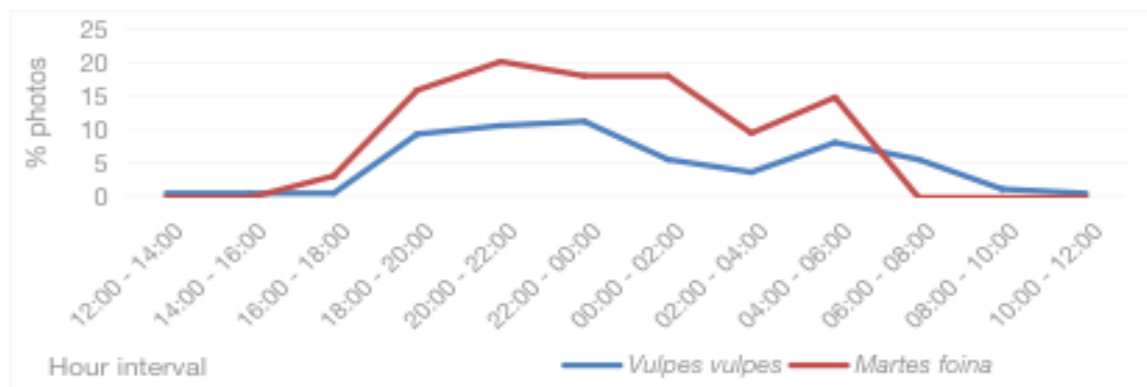


Fig. 3. Activity of the Red Fox and the Stone Marten during the studied period in Natura 2000 area “Maritsa - Parvomay”.

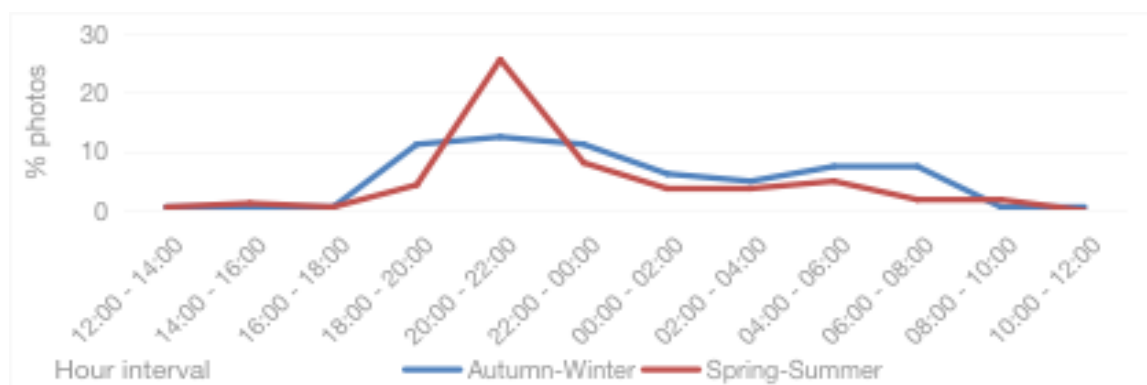


Fig. 4. Activity of the Red Fox during the different seasons in Natura 2000 area “Maritsa - Parvomay”.

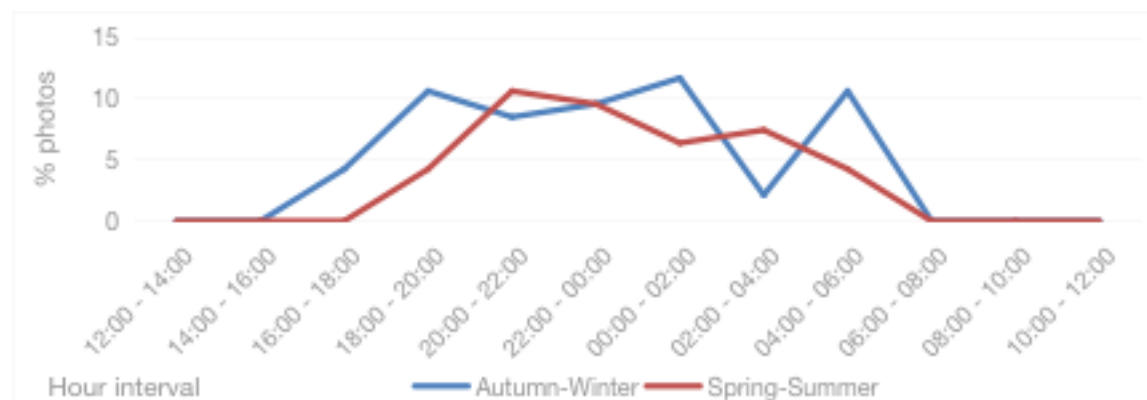


Fig. 5. Activity of the Stone Marten during the different seasons in Natura 2000 area “Maritsa - Parvomay”.

The studied carnivores showed peak of activity in the dark and in the twilight, which is usual for areas with strong anthropogenic influence (Dudin & Georgiev 2015, Petrov *et al.* 2022, Petrov 2022, Tsunoda *et al.* 2022). Nocturnal but unimodal activity for both species was described by Tsunoda *et al.* (2020) for Central Bulgaria - Sarnena Sredna Gora Mts.

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