Annual of Sofia University "St. Kliment Ohridski"
Faculty of Biology
Book 4 - Scientific Sessions of the Faculty of Biology
2020, volume 105, pp. 49-59
Youth Scientific Conference "Kliment's Days", Sofia 2019

# CAMERA TRAPPING MARTENS IN TWO DIFFERENT MOUNTAINS – EFFECT OF THE LURE

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**Keywords:** Martes martes; Martes foina; Vitosha Mountain; Rhodope Mountain; Bulgaria

**Abstract:** Stone marten (*Martes foina*) and pine marten (*Martes martes*) are two sympatric European species which overlap their distribution and inhabit similar habitats in the Bulgarian mountains. The study of their interactions, in sense of interspecific competition, is difficult due to their similar external appearance and similar tracks and signs of their presence. Camera trapping provides valuable data on the species' presence and behaviour, but a lure is often used to intensify the data collection. During April-November 2019 equal numbers of camera traps (n=10) were set in two mountains in Western Bulgaria with different habitats – Vitosha and Rhodope with three different methodological approaches: 1. Without lure; 2. Applying valeriana lure with attenuating effect for a month (two times for Rhodope and once for Vitosha); 3. Intensive luring session for 7 days. The camera traps in Rhodope Mtn recorded two times more martens (n=119) than those in Vitosha (n=63). Both locations yielded a significant number of non-identifiable martens (n=52 for Vitosha and n=87 for Rhodope). The stone marten was the more registered species, which is in agreement with the presumption that it is widespread and abundant in Bulgaria. Both species (and the unidentified martens) were more frequently registered in coniferous forests in Vitosha and in mixed forests in Rhodope, which reflects their adaptability to various habitat compositions. The Valeriana lure, despite being widely used as an attractant in many studies, actually had a negative effect on the registrations of martens in our study area. However, the martens reacted more intensively when the lure was applied for the first time, in comparison to subsequent luring, i.e. they showed signs of habituation.

## INTRODUCTION

The two focal species of this research – the stone marten (*Martes foina* Erx.) and the pine marten (*Martes martes* L.) are similar in their morphology, habitat selection and overlapping distribution, which complicates their identification and studying.

One of the most reliable methods to distinguish between closely related species as these two is genetic sampling (Piggott and Taylor, 2003), especially with non-invasive faecal DNA sampling (Pilot et al., 2007; Rosellini et al., 2008; Ruiz-González et al., 2008). This method is also used in diet studies for the two species (Posłuszny et al., 2007). Yet, genetic studies per se are expensive and are not applied very often due to financial reasons. That is why many of the studies on these species are based on camera trapping, which provides valuable data on the species presence, habitat use, numbers/density and behaviour (Rosellini et al., 2008; Manzo et al., 2012; Monterroso et al., 2014; Lombardini et al., 2015; Petrov et al., 2016). Camera trapping provides relatively inexpensive and effortless way of collecting data on martens, not only in intended studies but also as a bycatch from other surveys. As such, the presence of pine marten in Vitosha Mtn (Bulgaria) was officially confirmed by camera traps (Doykin et al., 2017) during a wild cat study. Lure is often used to intensify the data collection (Mortelliti and Boitani, 2008; Burki et al., 2010). Due to the advantages and disadvantages of these two methods (camera trapping and genetic analysis), it is often recommended to use a combined sampling approach (Rosellini et al., 2008; Croose et al., 2019)

The aim of the current study was to compare the presence of the pine and stone marten with camera traps in two mountains in Bulgaria with different habitat structure and to account for the effect of the lure on the species' registrations. To achieve this aim we set a hypothesis that despite the habitat structure, the two species will have similar response to the lure.

## MATERIALS AND METHODS

### Study area

The study was conducted in two mountains in Bulgaria – Vitosha and Rhodope (Fig. 1).

Vitosha Mtn is managed as a Nature Park (the oldest in Bulgaria and on the Balkan Peninsula, established in 1934). More than 50% of the whole territory of the Park is covered with forests, 25% - with meadows and pastures and the rest with rocky massifs and stone screes. There are four vegetation belts (Hubenov, 1990): 1. Mixed oak (*Quercus* spp.) – hornbeam (*Carpinus betulus* L.) forests (altitude 1100-1400 m); 2. beech (*Fagus sylvatica* L.) forests (1400-1840 m); 3. Coniferous forests (1700 - 2050 m); 4. subalpine belt (above forests) consisting

of mountain pine (*Pinus mugo Turra*), common juniper (*Juniperus communis* L.), European blueberry (*Vaccinium myrtillus* L.), lingonberry (V*accinium vitis-idaea* L.) and bog bilberry (*Vaccinium uliginosum* L.). The mountain's northern slopes are strictly protected (hunting is forbidden, it is used mainly for tourism), while the southern slopes are within the premises of the Vitoshko-Studena State Hunting Enterprise (regulated hunting throughout the year and provision of supplementary food – mainly corn). The study area is situated on the grounds of Vitoshko-Studena State Hunting Enterprise (N42.53124° E23.16320°), near Studena dam, at an average altitude of 1005 m.a.s.l.

The study area in Rhodope Mtn is situated in its Western part, around the village of Slaveyno (N41.63568° E24.87326°), at an average altitude of 1334 m.a.s.l. The area is forested and covered uniformly or as mixed type, predominantly with Scots pine (*Pinus sylvestris* L.) and to a lesser extent with European beech (*Fagus sylvatica* L.).

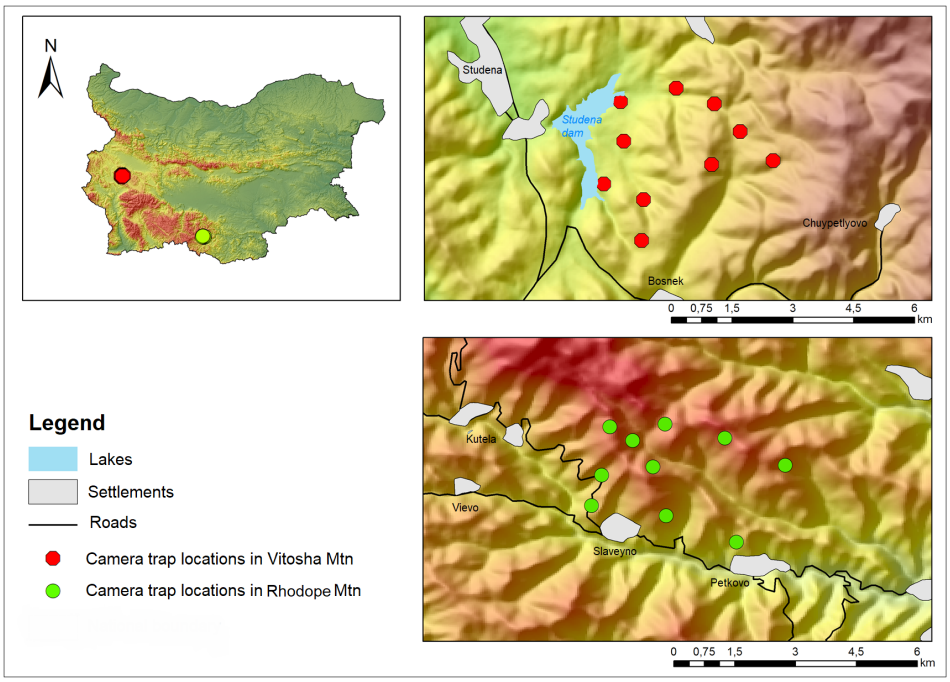



**Fig. 1** Study area and camera trap locations in the study area.

## Camera trapping

The study was conducted between April – October 2019 in Rhodope Mtn and between May-November 2019 in Vitosha Mtn. In each of the mountains, 10 camera traps were set at an average distance of 1 km from each other (Fig. 1). The camera traps in Vitosha Mtn (model Ltl Acorn 6210) and Rhodope Mtn (model Moultrie A-30i) were set up opportunistically at specific sites chosen to maximize

animal detection – typically on animal trails, away from attractants (feeding sites or water).

The cameras were distributed in the different forest types as follows (Table 1):

**Table 1** Camera traps placement in the two study areas, according to the forest type

| Forest type | Vitosha Mtn | Rhodope Mtn |
|---|---|---|
| Coniferous | 4 | 3 |
| Deciduous | 5 | 2 |
| Mixed | 1 | 5 |
| **Total** | **10** | **10** |

The camera traps were set up to take 3 consecutive pictures (5 seconds apart). Additionally, in Vitosha Mtn, a hybrid mode was activated to take also a 10-sec video upon triggering. Next series of photos and a video could be taken one minute after the previous triggering. A standard form was filled for each camera trap location, describing habitat characteristics. A common database was set up through Camera Base 1.7 (Tobler, 2015), modified and translated in Bulgarian (Zlatanova, unpublished). Photos showing the prolonged stay (up to 5 min) of an individual in front of the camera trap were considered as one independent registration to avoid overrepresentation of the species.

During the study three methodological approaches were applied (Table 2): 1. Without a lure; 2. Applying valeriana lure (*Valeriana* and olive oil in proportion 3:1) with attenuating effect for a month; 3. Intensive luring session for 7 days (lure is applied every morning).

**Table 2** Periods and duration of lure application in both study areas

| Vitosha Mtn | | Rhodope Mtn | |
|---|---|---|---|
| **Period** | **Lure** | **Period** | **Lure** |
| 19.05.2019 - 27.06.2019 | - | 20.4.2019 - 16.05.2019 | - |
| 28.6.2019 - 21.07.2019 | +, *attenuation* | 17.5.2019 - 14.06.2019 | +, *attenuation* |
| 22.07.2019 - 28.07.2019 | +, *intensive session* | 15.6.2019 - 07.07.2019 | - |
| 29.7.2019 - 22.08.2019 | - | 08.07.2019 - 14.07.2019 | +, *intensive session* |
| 23.8.2019 - 21.10.2019 | +, *attenuation* | 15.7.2019 - 23.08.2019 | +, *attenuation* |
| 22.10.2019 - 20.11.2019 | - | 24.08.2019 - 23.10.2019 | - |

During the whole study period the camera traps made the following numbers of independent registrations of the target species (Table 3):

**Table 3** Number of independent camera trap registrations in the study area.

| **Study area** | **Species** | **# of independent registrations** | **# of locations** |
|---|---|---|---|
| **Vitosha Mtn** | *Martes foina* | 10 | 5 |
| (total reg. n= 63) | *Martes* spp.* | 52 | 9 |
| | *Martes martes* | 1 | 1 |
| **Rhodope Mtn** | *Martes foina* | 25 | 8 |
| (total reg. n= 119) | *Martes* spp.* | 86 | 9 |
| | *Martes* spp./*S. vulgaris* | 1 | 1 |
| | *Martes martes* | 7 | 4 |

**Analyses**

Detection rate (DR) index (O'Connell et al., 2011) was calculated for the two species and Martes spp. for 100 camera trap days. This index standardizes the data and allows comparison between the numbers of registrations from different studies with various numbers of camera trap days. This detection rate was further analysed against the mountain, forest type and presence of lure. Registrations without a lure were considered those which are captured more than 3 days after the lure was applied.

## RESULTS AND DISCUSSION

The total DR for *M. foina, M. martes* and the unidentified martens (*Martes* spp.) are presented in Fig. 2. It is evident that the stone marten was the more registered species, which is in agreement with the presumption that it is widespread and abundant in Bulgaria. Pine marten registrations were scarce, which is expected, since it is the less common species in the study areas. Larger DRs were estimated for both martens in the Rhodope study area, which might consist of more suitable habitats.

However, a large proportion of the marten registrations are of unidentified individuals. This is due to the fact that camera trap photos often capture only parts of the animal and frequently in positions that do not allow identification. This is especially a problem in nocturnal photos (which is the most active time for the martens) and is exacerbated by the rapid movement of the individuals. New approaches have been developed, such as the one proposed by for Sirén et al. (2016) for American martens, which utilises an additional platform that positions the individual in such a way in front of the camera trap that its identification characteristics are visible.

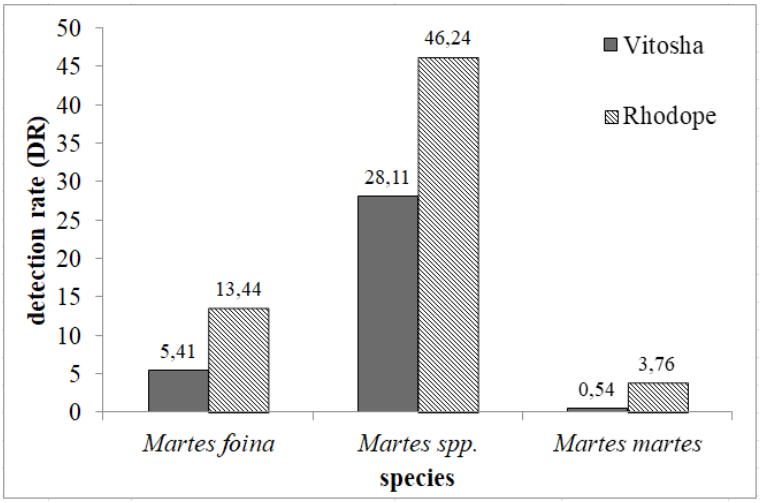
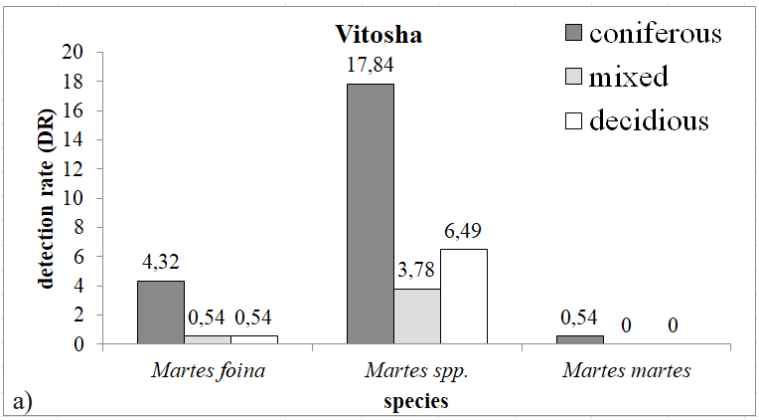



**Fig. 2** Comparison between the DRs (detection rates) of the martens in the two mountains.

Detection rates by habitat are presented in Fig. 3. Both species (and the unidentified martens) are more frequently registered in coniferous forests in Vitosha and in mixed forests in Rhodope. This is an interesting observation, since it is typically assumed that the pine marten inhabits coniferous, mixed and sometimes deciduous forests (as a typical forest specialist) (Clevenger, 1993; Virgos et al., 2012; Wereszczuk and Zalewski, 2015; Doykin et al., 2017), is synanthropic in most of its range, but can also be found in various forest types (Sacchi and Meriggi, 1995; Virgos et al., 2012). However, in our case both martens appeared to adapt towards the most prevalent habitat type in the study area. Additionally, we do not have evidence for habitat segregation between the two species.



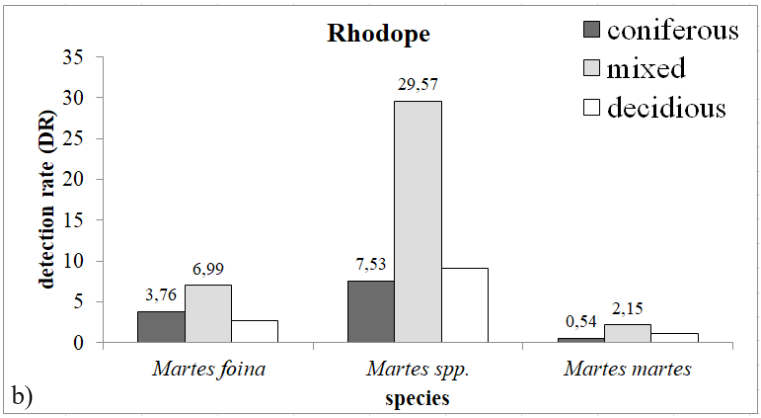



**Fig. 3** Detection rates per species in the different habitats:
a) for Vitosha and b) for Rhodope.

An even more unexpected result was obtained when comparing the DRs in periods with and without lures (Fig. 4). It appears that the Valeriana lure, despite being widely used as an attractant for mesocarnivores in many studies (Miklós et al., 2005; Ferreras et al., 2016), actually had a negative effect on the registrations of martens in our study area. This brings up the need to test other attractants and select a more suitable one.

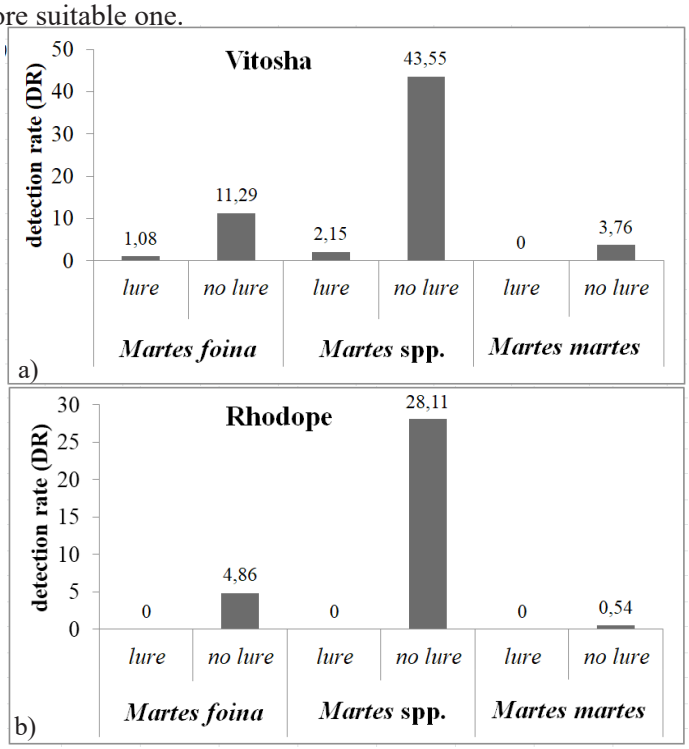



**Fig. 4** Detection rates for the martens in periods with and without lure.

The percentage of registrations obtained for the martens by day after lure placement was also compared (Fig. 5). It was expected that the attenuating effect of the lure will attract less and less individuals as time goes by. According to our data, the pine marten was not affected by the lure, since its registrations were accumulating at a steady rate after lure placement. However, for the stone marten and *Martes* spp. another interesting trend was observed. 100% of the registrations accumulated in a smaller number of days following the first placement of the lure ("1st period") compared to the 2nd or the 3rd (*Martes* spp. in Vitosha). This might indicate the fact that the lure was most effective the first time it was introduced, as a novel, interesting smell for the animals. With consecutive lure placements, the martens might have already been aware that the smell is not associated with food or other attractant and thus they did not react to it with such intensity.

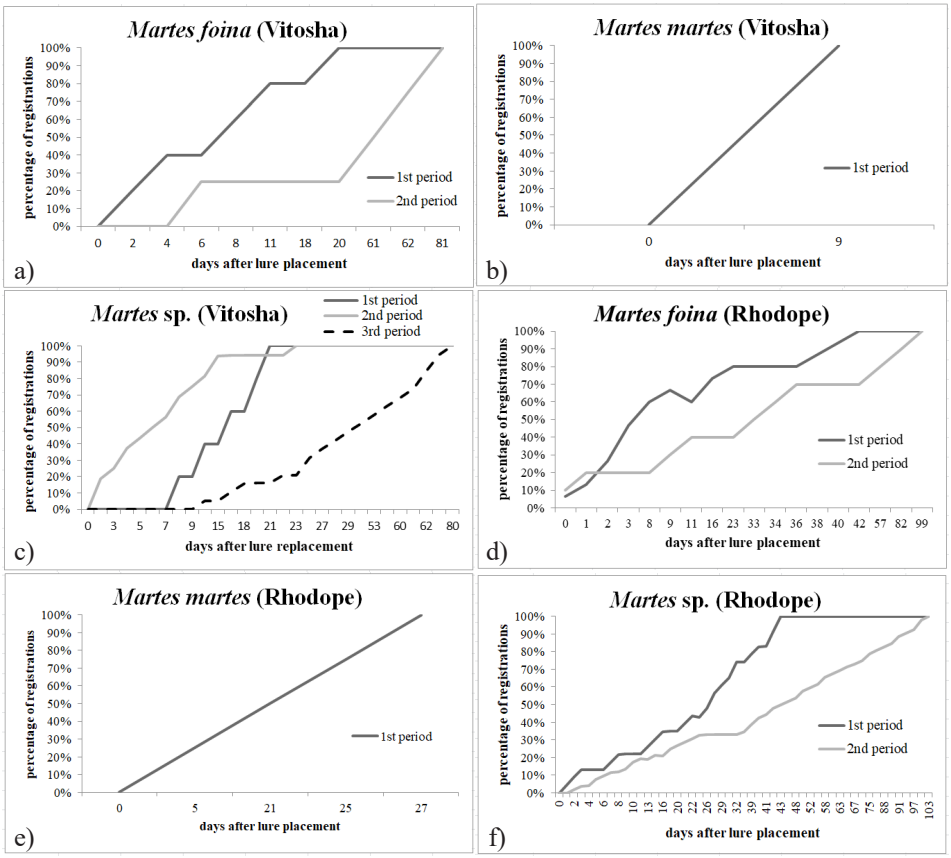



**Fig. 5** Attenuating effect of the lure – percentage of marten registrations by day after lure placement.

## CONCLUSIONS

The results of this study lead to the following conclusions:

1. The stone marten was the more registered species, which is in agreement with the presumption that it is widespread and abundant in Bulgaria.
2. Both species (and the unidentified martens) were more frequently registered in coniferous forests in Vitosha and in mixed forests in Rhodope, which reflects their adaptability to various habitat compositions.
3. The Valeriana lure, despite being widely used as an attractant in many studies, actually had a negative effect on the registrations of martens in our study area.
4. However, the martens reacted more intensively when the lure was applied for the first time, in comparison to subsequent luring, i.e. they show signs of habituation.
5. All of this brings up the need to search for alternative lures and camera trapping protocols in order to enhance the study of martens in Bulgaria.

**Acknowledgement:** The study was conducted within the projects: „Relationship between stone marten and pine marten in Vitosha Nature Park and the effect of lure on their registrations“ (contract 80-10-70/2019) funded by The Scientific Research Fund of SU „St. Kliment Ohridski“ and the National Program for Young Scientists and Post-doctoral fellows (contract RD-22-1028/17.04.2019). We would like to thank to the administration of Vitosha Nature Park for the provision of camera traps and for the technical assistance in the field. We would like to thank also to Mr. Rosen Kassabov from Sofia University Centre “Rhodope” - village of Slaveyno, Rhodope Mountain for the assistance and logistic help.

The authors declare no existing conflict of interest.

**Authorship statement**

Conceived and designed the analysis: E.P., D.Z., M.P.
Collected the data: E.P., D.Z., P.P., N.D.
Contributed data or analysis tools: E.P, D.Z., M.P.
Performed the analysis: E.P., D.Z.
Wrote the paper: E.P.

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