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Notes on autumn-winter stomach contents of the Stone Marten (*Martes foina*) in the Balkan Mountains, Central Bulgaria

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Abstract. We studied autumn-winter food (November-February, 1997-2003) of the Stone Marten in the Balkan Mountains, Central Bulgaria. A total of 26 stomachs (18 of males and eight of females) were examined, of which contents was expressed as the number of occurrence and relative frequency of occurrence. The result clearly showed that rodents are primary prey for the Stone Marten. Birds and insects were the following categories consumed. The edible dormouse was detected as a prey for the first time in Bulgaria. Besides, wild ungulates and domestic animals were occasionally scavenged, while neither fruits nor artificial materials were detected in the marten stomachs. Thus, our study showed that the Stone Marten in the Balkan Mountains tended to be more carnivorous in winter.

Key words: *Balkan Mountains, food habits, Glis glis, stomach contents, Martes foina*

Introduction

The Stone Marten (*Martes foina* Erxleben, 1777) is widely distributed from Mongolia and the northern Himalayas to most of mainland Europe (Proulx e al. 2004). The species' wide range of food habits allow it to inhabit variable environments (Bakaloudis *et al.* 2012) such as mountainous forests, rocky areas, fields, pastures, villages and urban areas, and the population status is generally stable across its distributional area (Proulx e al. 2004).

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Accumulating regional information on life history of the Stone Marten is important to understand its ecology and local status. Food habits of the species have been well studied across the European countries, and it is known that it behaves as an opportunistic feeder (Rödel & Stubbe 2006), which principally takes advantage of small mammals, birds, insects and fruits (Lanszki 2003; Posłuszny *et al.* 2007).

In Bulgaria, dietary studies on the Stone Marten were attempted in natural environment in the Osogovo Mountain (Vasileva *et al.* 2005) and the Sakar Mountain (Georigiev & Raichev 2009), which, respectively, lie in the southwest and the southeast of the country.

With regards to Central Bulgaria, Georgiev (2013) studied the diet of the Stone Marten in two large cities, Plovdiv and Stara Zagora. Besides, we have examined the feeding spectrum of populations around villages and hills of Sarnena Sredna Gora (Hisano *et al.* 2013), the environment of which is human-altered. However, dietary information on the Stone Marten in its natural habitat in the region has not been reported yet.

The aim of this study is to present the primary data of autumn-winter stomach contents of the Stone Marten in the Balkan Mountains. Besides, we compare it with our previous study in Sredna Gora to briefly discuss regional differences.

Materials and Methods

The study area was set on the south slopes of the eastern Balkan Mountains (Stara Planina), north of Kazanlak, the area of which is ca. 280 km^2 (42°36-42'N, 25°25-46'E; Figure 1). The terrain is steep and cut by a multitude of short, steep valleys and elevation ranges between 500-1.200 m a.s.l. The climate in the area is transitional between moderate-continental and continental-Mediterranean (WeatherOnline ltd. 2014; Curtis 1992). The average annual temperature varies from 1.5 to 10 °C depending on elevation, with an average January temperature from 0 °C at the foothills to -7 °C in the mountainous area (Velev 2002). Winter precipitation in these foothills is 130-200 mm, with snow depth of 10-14 cm. On the summit of the mountain, snow cover lasts from November to the middle of April, to a depth of 14-25 cm (Velev 2002). The mountains are mainly covered with primary forests of European beech (*Fagus sylvatica* Linnaeus, 1753), which is also home to congener pine marten (*Martes martes* Linnaeus, 1758). The area includes no cultivated land, with very few hamlets.

Stone marten stomachs were collected during the autumns and winters of 1997-2003 through the cooperation of local hunters. Stomach contents were washed with water in a plastic tray or a petri dish to sort the food items and then examined by microscopy (magnification: 4x and 10x). Contents were identified to the species level, or at least to the level of Order, where digestion had degraded content integrity. We used hair and feather collections from the Laboratory of Zoology and Anatomy at Trakia University for reference. Since the samples were entirely composed of stomach contents subject to different extents of digestion, it was not possible to measure sample weights, or relative content weights precisely. The Stone Marten diet was thus expressed as the number of each food item from sampled stomachs (n) and the relative frequency of occurrence (RFO: the number of occurrences of each food item/the total number of food items × 100; e.g., Klare *et al.* 2011).

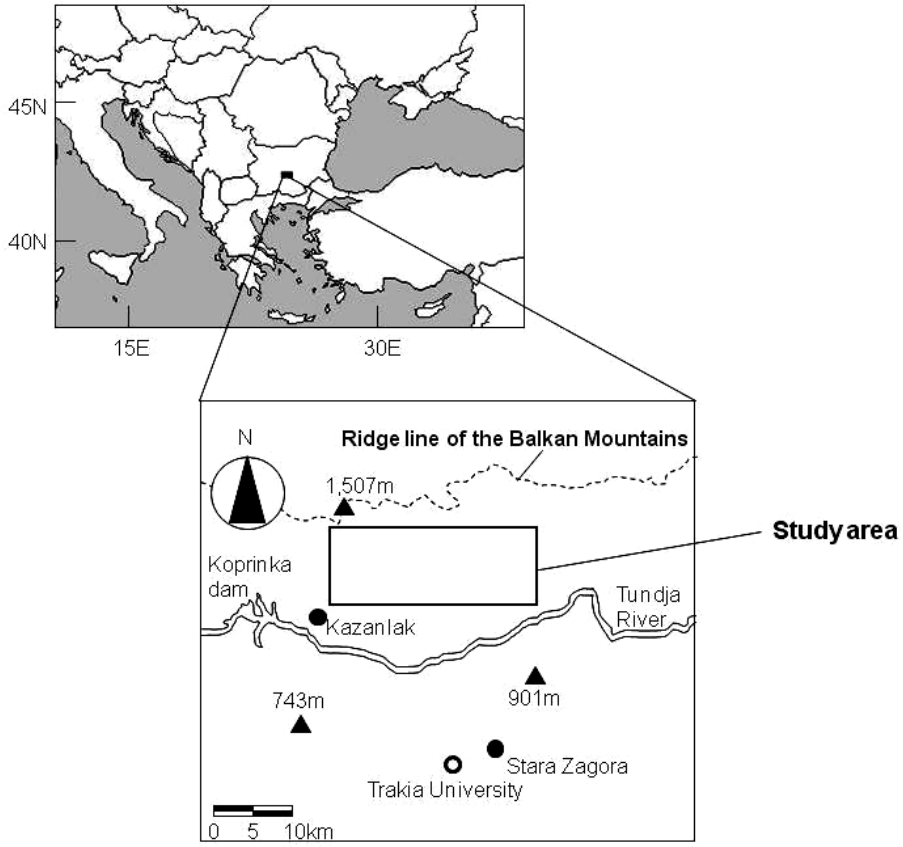

Fig. 1. Location of the study area.

Results

A total of 26 stomach samples were collected, and the number of the empty stomach was nine. We detected four species of mammals and unidentified rodents, three species of birds, and two orders of insects from the stomach contents. Mammals (RFO = 70.0 %), particularly rodents (50.0 %), were the predominant food of the Stone Marten. Birds (20.0 %) and insects (10.0 %) were the following categories (Table 1).

For males, a total of 18 stomach samples were collected (one in November, six in December, four in January and seven in February), and the number of the empty stomachs was seven. They preyed on unidentified rodents (n = 6), Edible Dormouse (*Glis glis* Brisson, 1758) (n = 1, February), Brown Hare (*Lepus capensis* Linnaeus, 1758) (n = 1, January), Roe Deer (*Capreolus capreolus* Linnaeus, 1758) (n = 1, December), Great Tit (*Parus major* Temminck & Schlegel, 1848) (n = 1, February), Common Blackbird (*Turdus merula* Linnaeus, 1758) (n = 1, February), Domestic Fowl (*Gallus gallus* f. *domestica* Linnaeus, 1758) (n = 1, February), Orthoptera sp. (n = 1, February) and Coleoptera sp. (n = 1, February) (Table 1).

For females, a total of eight stomach samples were collected (three in December, three in January and two in February), and the number of the empty stomachs was two. They consumed unidentified rodents (n = 3), Roe Deer (n = 1, January), Domestic Sheep (*Ovis aries* Linnaeus, 1758) and Common Blackbird (n = 1, February) (Table 1).

Table 1. Sample size (*n*) and relative frequency of occurrence (RFO) of food items of the Stone Marten in the Balkan Mountains in Central Bulgaria between 1997 and 2003.

Food items	Male (*n* = 11)	Female (*n* = 6)	Total (*n* = 17)	
	n	*n*	*n*	RFO (%)
Mammals	9	5	14	70.0
Rodentia				
Glis glis	1	0	1	5.0
Unidentified rodents	6	3	9	45.0
Lagomorpha				
Lepus capensis	1	0	1	5.0
Artiodactyla*				
Capreolus capreolus	1	1	2	10.0
Ovis aries	0	1	1	5.0
Birds	3	1	4	20.0
Passeriformes				
Parus major	1	0	1	5.0
Turdus merula	1	1	2	10.0
Gallus gallus f. *domestica*	1	0	1	5.0
Insects	2	0	2	10.0
Orthoptera sp.	1	0	1	5.0
Coleoptera sp.	1	0	1	5.0
* being considered as carcass				

Discussion

The result that rodents were the most frequently consumed coincides with the other cold seasons studies in Europe (e.g., Carvalho & Gomes 2004; Lanszki *et al.* 1999) and Sredna Gora in Central Bulgaria (Hisano *et al.* 2013). Intriguingly, one male marten preyed on edible dormouse in February, which was first record in Bulgaria. The dormouse hibernates during winter typically in the underground burrow (Jurczyszyn 2007; Kryštufek 2010), but it could also choose tree hollows (Jurczyszyn 2007). The Stone Marten probably hunted the dormouse hibernating in a hollow because the *Martes* species have not evolved to dig out subterranean preys, but they are rather suited to arboreality (Newman *et al.* 2011). Also in Italy, plenty of them were consumed in winter (November-February) (Bertolino and Dore 1995). The dormouse would be valuable protein source for winter because it gains weight in autumn, accumulating body fat reserve (Kryštufek 2010).

Birds and insects were eaten complementarily as in other European regions (e.g., Bertolino and Dore 1995; Lanszki *et al.* 1999). In Sredna Gora (Hisano *et al.* 2013), the Stone Marten consumed some fruits in winter as in Greece (Bakaloudis *et al.* 2012) and Poland (Posluszny *et al.* 2007). However, none of them constituted its diet in the Balkan Mountains, even though this item was predominant food for the summer period in the same study area (Hisano *et al.* unpublished data). This may be because most fruits dropped off before winter in the Balkan Mountains dissimilar to those in other areas, or simply the sample size in this study was not enough to encounter the seasonally rare food. Scarcity of

this alternative food in the study area could make carnivorous prey (mammals and birds) predating more meaningful to the Stone Marten.

Large ungulates (Roe Deer and Domestic Sheep) were also consumed by the Stone Marten in Sredna Gora (Hisano *et al.* 2013). Additionally, accessing this food category was more frequent in winter than in summer for both study areas (Hisano *et al.* 2013; Hisano *et al.* unpublished data) although the sampling years were different between the seasons. Since body sizes of these ungulates are apparently too large to be hunted by the marten itself, they are considered as carcasses killed by game hunters or a sympatric larger predator, for example Grey Wolf (*Canis lupus* Linnaeus, 1758). It is thereby assumable that the Stone Marten may well benefit from scavenging in winter, when fruits and insects become less available.

To summarize, our study showed that the Stone Marten in the Balkan Mountains tended to be more carnivorous in the cold seasons studied.

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