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Feeding habits of the stone marten (*Martes foina*) in villages and farms in Hungary

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Lanszki, J., Sárdi, B., & Széles, L. G.: *Feeding habits of the stone marten (Martes foina) in villages and farms in Hungary.*

Abstract: Habitat type dependent feeding habits of the stone marten (*Martes foina*) was examined in eight villages and four farms of Somogy county on the basis of scat analysis (n=1227). In the studied summer-autumn period plants (mainly pear, plum, cherry/sour-cherry, grape) formed the dominant component of the diet (villages: 35.6-87.4%, farms 54.1-91.3%). Relying on the animal food, in villages primarily birds (42%, mainly with small singing-birds), secondly small mammals (33%), while on farms primarily small mammals (46%, mostly voles), secondly birds (27%) were consumed, but the difference depending on the type of habitat was not significant. Martens in villages compared with the ones which live on farms consumed more prey species living on trees and bushes (43% vs. 27%) and less terrestrial preys (56% vs. 72%, $P<0.05$). Irrespectively of type of habitat, small prey species, 15-50 g in range of weight primarily (60%, vs. 50%), mainly habitat-generalist prey species, namely also living in open and forest habitat (84% vs. 87%), and prey species living in human habitat (40% vs. 47%), or also existing in wild and human habitat, were consumed. Consumption ratio of domestic animals (poultry and egg, 7-48%), and rodent pests (house mouse and brown rat, 7-29%) were considerable.

Keywords: terrestrial prey, poultry, rodent pest, predator management

Introduction

Occurrence and colonization of numerous human culture follower animal species in settlements were noticed (Szemethy et al. 2000). In continental Europe, stone marten (*Martes foina*) is a common occupant of urban areas. Nowadays, it can be found not only in natural or nearly-natural areas but also from villages to cities, in different human settlements. According to surveys (Heltai 2002), it was found in 80% of Hungary. As for hiding-place, mainly neglected, ruined buildings, ports, lofts are chosen, but church-lofts are also often used. Reasons behind urbanization are also the decrease of natural habitats, safe and secure hiding-places and food given by built up areas (Powell 1994, Adams et al. 2005, Tóth et al. 2007). The presence of wildlife in settlements is usually welcomed, it sometimes also results in more or less severe conflict situations, which may reduce tolerance of the animals in questions. It could have filled a part of management of substance of economic damage causing rodent pests (e.g. house mouse, rat), which also has public sanitation and economical consequences. In close contact of man, stone marten could be a vector of certain zoonoses, furthermore in declining of the barn-owl (*Tyto alba*) populations (Tóth et al. 2007). Conflicts between humans and martens arise

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when the animals den under the roofs of inhabited buildings or damage in poultry stock or car engine components (HERR et al. 2009b, in Hungary: LANSZKINÉ and LANSZKI 2005, HELTAI and SZŐCS 2007). From 1st September to 28th February marten is a fair game in Hungary, its bag shows permanent growing. In the hunting season of 2007/2008 1058 individuals were shot by hunters (CSÁNYI 2008).

The marten "question" is a new discipline and it could be involved in urban wildlife management. Finding a definition for 'urban' is not straightforward and the meaning often depends on the context in which the term is used. Generally, social scientists use urban to refer to areas with high human densities, while ecologists use the term more widely to refer to areas under human influence (MCINTYRE et al. 2000). In the United States, urban wildlife management has already been handled for a long time (e.g. SOUTHWOOD and HENDERSON 2000, ADAMS and LINDSEY 2005), and it has also been the item on the agenda in Europe (e.g. HERR et al. 2009a, 2009b). Managing urban habitats of wild species, possibly their increase, reduction and prevention of caused damages together with constitutioning of legislative regulation are the main sections of it (MCIVOR and CONOVER 1994, DECKER and CHASE 1997, HELTAI and SZŐCS 2007).

Marten is an omnivorous feeder (WAECHTER 1975); feeding habits examinations show that within choice of food it shows generalist and opportunist features. It can also be the reason behind its successful spread. The marten is mostly terrestrial, but it also hunts and moves easily in the foliage level (arboreal). Seasonally and depending on habitat its diet is also shown high variability, which were also analyzed by numerous studies, such as in urban environments (HOLISOVÁ and OBRTEL 1982, TESTER 1986, RASMUSSEN and MADSEN 1985), rural environments, such as villages, farms and outside buildings (RASMUSSEN and MADSEN 1985, ROMANOWSKI 1991, LODÉ 1994), highland, forest and rocky areas (MARTINOLI and PREATONI 1995, GENOVESI et al. 1996, PADIAL et al. 2002, PRIGIONI et al. 2008), and wetlands (LODÉ 1994). In Hungary, feeding habits of the stone marten were investigated in Aggteleki Baradla cavern (SALAMON 1981), Tibolddaróc, village in the Bükk-mountains (LANSZKI 1992), Budapest, green district (TÓTH 1998), Fonó, village and its surrounding agricultural environment in Somogy county (LANSZKI et al. 1999, LANSZKI 2003), Látrány, grassland, Somogy county (LANSZKI and NAGY 2003), Gödöllő, by human disturbed environment (HELTAI et al. 2005), Pettend, village and agricultural environment in the Ormánság region (LANSZKI and SZÉLES 2007). However, the marten has been widely distributed and common in Hungary, the habits of those which live in rural areas are relatively less known.

The aim of this study was to examine the habitat type dependent feeding habits of the stone marten which exists in villages and farms, including weight of preys, habitat levels, examination by its connection to habitat type and human resources, and collecting of feeding-biology knowledge for the urban wildlife management. In our study we focused on the summer and early autumn reproduction period, when adults are "noisy", young martens have already been able to hunt, and tenants noticed their presence.

Material and methods

Study areas

The study was performed in the centre and northern part of Somogy county in eight villages and four outside farms (Figure 1) in September and October of 2006, once per localities, parallel with the collection of barn-owl pellets. Study locations (and sample sizes) in villages: Somogysimonyi, Catholic church (n=75 marten scats), Nemesvid,

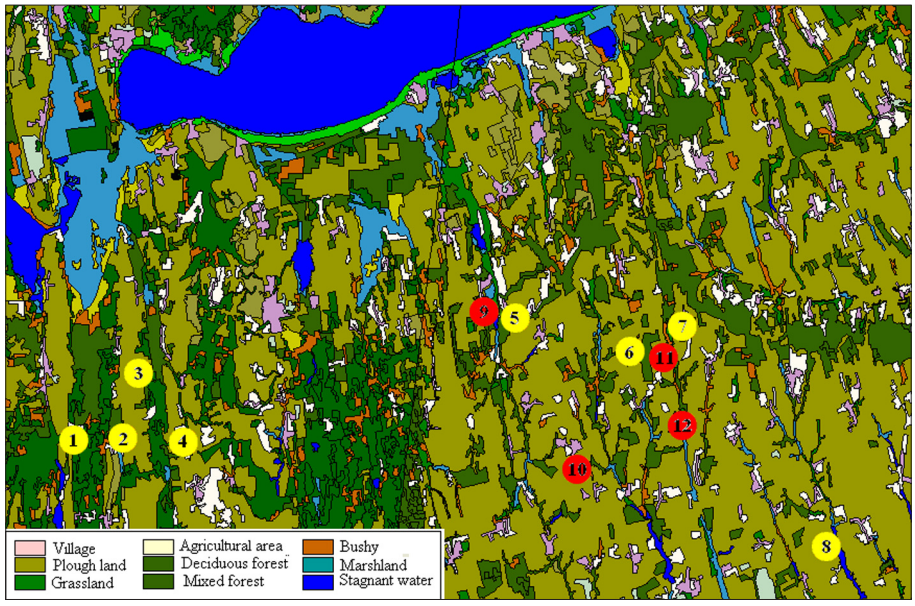

Fig. 1: Geographic location of the stone marten samples collected in villages (yellow circles) and farms (red circles) in Somogy county (Hungary).
Locations: 1 – Somogysimonyi, 2 – Nemesvid, 3 – Csákány, 4 – Nagyszakácsi, 5 – Somogyvár, 6 – Polány, 7 – Felsőmocsolád, 8 – Kisgyalán, 9 – Somogyvár, 10 – Somogyjád, 11 – Mernyeszentmiklós and 12 – Mernye**.**

Catholic church (n=145), Csákány, Catholic church (n=80), Nagyszakácsi, Catholic church (n=84), Somogyvár, Catholic church (n=106), Polány, Lutheran church (n=101), Felsőmocsolád, granary (n=80) and Kisgyalán, granary (n=203). These villages have orchards with various fruit trees and domestic animals – especially poultry – kept in house yards. Study locations in outside farms: Somogyvár, stock-yard and granary (n=104), Somogyjád-Magyaróvölgy, stock-yard (n=111), Mernyeszentmiklós, granary (n=82) and Mernye, granary (n=52). The distribution of the different habitat types around farms was as follows (mean): plough land 72,6%, building and garden 8.4%, grassland 4.2%, forest 8.2% and wetland 6.6%.

To study the possible interaction between the stone marten and the barn owl, sample collection was also performed on further eight localities, such as Andormajor, granary (n=12), Mesztegnyő, Catholic church (n=0), Buzsák, Catholic church (n=0), Buzsák, stock-yard (n=10), Öreglak, chapel (n=36), Ecseny, Evangelic church (n=0), Felsőmocsolád, Catholic church (n=0), Gamás (n=33). The sample size was under 50 in these localities, therefore no diet analysis was made. Owl pellet numbers origined from J.J. Purger (PURGER 2008 and PURGER J.J. pers. data).

Sample collection and analysis

The feeding habits of stone martens were investigated by analysis of scats, using standard procedure (JEDRZEJEWSKA and JEDRZEJEWSKI 1998). Prey determination was performed by microscope on the basis of feather, bone, dentition and hair characteristics (e.g. MÄRZ 1972, UJHELYI 1989, TEERINK 1991, BROWN et al. 1993, and own collections).

For the quantitative (percentage biomass or %B) estimation the scats were washed through filters (0.5 mm pore diameter) and dried, after which the remains of each items were separated. All dry prey or plant remains were weighed and multiplied by coefficients of digestibility described by JEDRZEJEWSKA and JEDRZEJEWSKI (1998) for the marten, such as small rodents, insectivores, bats and weasel ×23, medium-sized mammals, e.g. brown hare ×50, cervid carcasses ×15, domestic ungulate carcasses ×118, birds ×35, reptiles and amphibians ×18, fish ×25, insects ×5, and plants ×14. In the rare case of dog or cat food, factor of birds was used.

Plant and animal food was evaluated separately because the plant material was unlimited food source for martens in the study localities and period. Distribution of prey body weight was determined in accordance with CLEVENGER (1993), to create categories such as <15 g, 15-50 g, 51-100 g, 101-300 g and >300 g. Classification of prey on the basis of zonation (characteristic level of occurrence or the physical stratification where a species is most active) was made according to published data from GITTLEMAN (1985) on predators, 1 – terrestrial and terrestrial but sometimes arboreal, 2 – arboreal and arboreal but sometimes terrestrial, and 3 – aquatic or water-linked. Prey species were classified on the basis of their typical environment associations such as 1 – open field species, 2 – forest species or species living in dense shrubby, and 3 – mixed or habitat generalist species which may live both in open field and in forest. Prey species were classified on the basis of their human associations (LANSZKI 2003), 1 – wild, 2 – human-linked, and 3 – mixed. List and category of each animal food species contains Appendix 1.

Statistical analysis

The main animal food categories used in the trophic niche and environment dependent calculations were 1 – small mammals, 2 – domestic animals and house-food (plain cooking and pet food), 3 – birds, 4 – other vertebrates (reptiles, amphibians and fish) and 5 – invertebrates (arthropods and molluscs). Non-food (originally indigestible) substances ingested and hair fibres swallowed by the stone martens while grooming were not included in the calculation.

Trophic niche breadth (B) was calculated in accordance with Levins' index (KREBS 1989): $B= 1/\Sigma p_i^2$, where p_i = the relative biomass consumed of the ith taxon; and standardized across food taxa: $B_A =(B-1)/(n-1)$, rating from 0 to 1.

Diet composition depending on the habitat types was expressed in two ways (Table 1): number of occurrences in each food categories (N), and percentage of biomass consumed (%B). The consumption of main food taxa on the basis of the estimated percentage biomass values was compared with the two habitat types using independent samples t-test. The Chi-square (χ^2) test was applied for distribution analysis for the diet composition; prey consumption on the basis of weight, zonation and environmental associations of prey of the martens living in the two environments (village and farm). The Chi-square (χ^2) test was also applied for distribution analysis of marten scat and owl pellet numbers in each localities, furthermore for distribution analysis for the non-food item in the two habitat types. Small pebbles which probably originated from gizzard of birds were excluded from this calculation. Hierarchical cluster analysis was used to compare data of diet composition (%B) recorded for different study locations. SPSS 10 (1999) statistics program was used for processing data.

Table 1: Plant diet composition of stone martens living in villages and farms in Hungary

Food taxa	Village																							
	Farm																							
	1		2		3		4		5		6		7		8		9		10		11		12	
	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B
Grape	20	25.6	46	17.6	5	8.8	8	8.8	3	0.9	13	11.3	35	18.1	38	4.0	6	0.4	14	7.7	6	7.3	1	0.2
Cherry, soure cherry	3	4.7	11	18.8	9	57.3	15	42.2	5	8.1	7	19.4	25	31.8	71	33.8	5	4.9	17	16.0	9	14.7	6	10.3
Plum	12	33.4	10	12.6	2	5.0	2	3.9	43	68.2	8	26.7	17	24.5	89	49.3	64	82.0	37	53.9	7	15.4	36	74.1
Pear	3	0.8	16	19.2	4	3.2	1	0.6	7	6.2	26	27.4	7	3.4	8	0.6	9	8.3	3	2.4	3	4.4	6	11.1
Other fruits	25	32.7	44	20.7	22	19.2	48	27.1	21	14.2	17	12.0	34	20.8	64	10.1	13	3.5	28	13.9	20	27.3	10	4.0
Seeds	7	1.7	18	9.6	12	3.9	9	4.6	10	1.7	8	3.1	11	1.0	102	2.0	4	0.8	19	4.5	41	30.4	2	+
Other plant material	8	1.1	22	1.4	17	2.6	16	12.8	3	0.7	5	0.2	9	0.3	15	0.3	1	0.1	4	1.6	11	0.7	6	0.2
Sample size (n)	75		145		80		84		84		101		106		203		104		111		82		52	
Plant consumption[1]		60.2		47.3		44.7		44.6		87.4		64.4		71.2		77.6		84.3		67.3		54.1		91.3

Locations: 1 – Somogysimonyi, 2 – Nemesvid, 3 – Csákány, 4 – Nagyszakácsi, 5 – Somogyvár, 6 – Polány, 7 – Felsőmocsolád, 8 – Kisgyalán, 9 – Somogyvár, 10 – Somogyjád, 11 – Mernyeszentmiklós and 12 – Mernye. N – number of food elements, %B – biomass consumed, + – less than 0.05%, [1]within the overall food. Empty cells mean that the given taxon was not detected.

Results

Diet composition and trophic niche breadth of martens

Plant material – especially fruits – formed the dominant component of the diet of stone martens in the studied summer-autumn period (mean, villages: 62.2%, farms 74.2%, Table 1). Of the fruits available, depending on the locality, pear, plum, cherry or sour-cherry, grape or berry were consumed in the largest proportions. The composition of plant or animal food of stone martens living in villages and farms did not differ significantly (t_{10}=1.22, P=0.255).

Primary animal food type of martens living in villages (Table 2) was birds (42.1±4.70%, mean±SE), but besides this, proportion of small mammals consumed was also considerable (32.5±3.90%). Primary animal food in farm environment consisted of small mammals (45.7±5.14%) and secondary foods were birds (27.0±6.00%). Between habitat types the distribution of taxonomically different food items was statistically significant (χ^2_4=23.23, P<0.001), but consumption (%B) of each food categories depending on habitat types did not differ significantly (t_{10}=0.41-2.00, P=0.073-0.693)

On the basis of hierarchical cluster analysis (Fig. 2), three groups were separated. Those locations (from top to bottom on the dendogram) where bird consumption was high (min.-max. 47.3-67.2%) fell into one group, those where consumption of small mammals was in high ratios (35.7-57.0%) into the second one, and those where consumption of domestic food was considerable (37.8% and 47.9%) fell into the third group.

The samples of the martens contained summarized 91 different food taxa (Table 2, Appendix 1): 12 small mammals, 1 ungulate, 7 domestic animals (+ pet food), 4 birds, 2 reptiles, 1 amphibian, 3 fish, 33 invertebrates, 13 fruit, 11 seed taxa and 3 other plant material. Trophic niche for the diet composition (%B) of the martens living in villages and farm environments was relatively narrow (B_A, 0.25±0.019 and 0.23±0.027, respectively), and between the two habitat types did not differ significantly (t_{10}=0.55, P=0.597). Highest value was measured in Somogysimonyi (B_A=0.32) and the lowest one in Nagyszakácsi (B_A = 0.14).

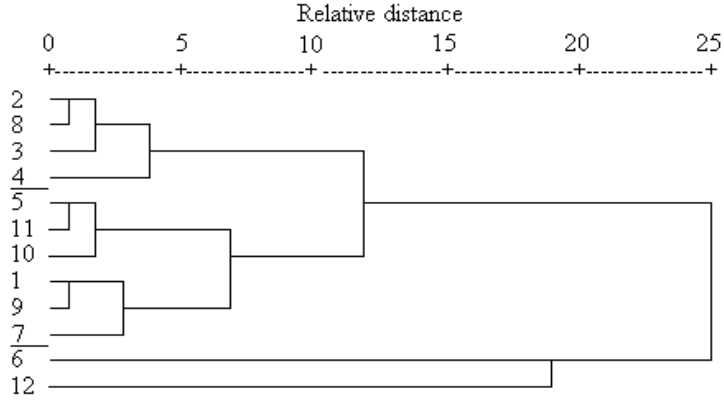

Fig. 2: Dendogram of diet similarity of stone martens, calculated with hierarchical cluster analysis on the basis of estimated percentage biomass (%B) data

Cluster method: between-groups linkage; interval of measure: Pearson correlation. For numbers of each locations see Fig. 1. Short horizontal lines (—) are separate clusters.

Table 2: Composition of animal foods of stone martens living in villages and farms in Hungary

Food taxa[1]	Village												Farm															
	1		2		3		4		5		6		7		8		9		10		11		12					
	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B	N	%B
House mouse	6	9.7	16	9.0	3	2.8	4	4.6	3	6.9	2	0.6	5	11.5	12	7.0	2	4.0	14	9.9	11	19.0	1	12.7				
Brown rat	4	10.9	5	1.6	2	5.2	1	2.0	3	3.1	5	4.4	13	17.4	8	3.7	2	3.2	7	7.0	8	22.9	2	6.9				
Field mouse	9	11.1	13	7.2	7	6.5	11	10.1	8	35.2	10	5.8	10	11.5	16	10.7	12	23.0	21	25.3	5	2.9						
Common vole			8	9.5	7	11.1	3	0.8			3	2.8	3	2.7	18	10.0	2	1.8	9	8.0	7	9.8	5	8.5				
Other rodents	1	0.5	5	1.5	3	4.8	4	2.9	2	0.3	2	0.1	5	3.4	6	0.4	3	1.3	2	1.4	3	1.5	4	11.1				
Insectivores[2]	3	3.5	4	0.9	4	4.2	2	1.1							1	+	2	1.9			3	0.8						
Other mammals[3]			1	0.4							1	0.3					1	0.1										
Poultry	4	15.9	5	6.9	4	6.9	4	4.0	4	6.3	11	35.6	9	13.5	21	16.4	4	20.5	8	14.1	2	4.4	4	42.3				
Poultry egg	22	10.6	26	9.9	15	4.0	13	5.5	6	4.8	23	7.5	14	11.5	41	2.3	6	6.5	17	2.4	5	2.5	7	5.6				
Other house-food	1	2.4	1	0.6					1	0.5	3	4.1							2	0.4								
Singing birds[4]	31	30.5	77	47.6	37	47.2	37	67.1	12	32.1	45	37.8	26	26.0	99	48.2	23	34.7	32	29.9	25	33.8	7	9.3				
Eggs			1	+			1	0.1	1	0.2	2	0.1					1	0.1	2	0.1								
Reptiles	2	0.3			3	0.5	1	0.1	1	7.7							1	0.4										
Frogs			1	+											1	0.1												
Fish													1	0.1					2	0.8			2	0.6				
Chafer			25	2.6	33	5.1	1	0.2	1	0.6	8	0.6			2	+					1	0.1	1	0.5				
Mole-cricket	4	0.1	15	0.3	1	+	8	0.5			1	+	2	0.0	15	0.1			1	+	4	0.1						
Hymenoptera	34	3.4	25	0.9	19	1.1	7	0.3	2	0.1	11	0.1	11	0.8	21	0.2	2	+	12	0.1	10	0.8	7	0.5				
Other rodents	17	1.0	33	1.0	9	0.6	30	0.7	22	2.4	24	0.2	33	1.6	73	1.0	38	2.4	37	0.5	22	1.4	14	2.1				

[1]for Latin names see Appendix 1, [2]shrews, and a noctule in Csákány (location 3), [3]roe deer in a sample collected in Somogyvári farm (location 9), weasel in Nemesvid (location 2) and in Polány (location 6), [4]Mernyeszentmiklós (in one case an indetermined medium-sized bird was consumed). For other abbreviations see Table 1.

Feeding habits of martens on the basis of prey characteristics

Small sized prey species (ranging between 15 and 50 g) were the most important food of martens on both habitat types (Fig. 3a); it means that consumption of these foods was 60.2% in villages (min.-max. 42.4-80.8%) and 50.4% in farms (28.9-64.2%). Effect of habitat type was not significant when calculating percentage of consumed biomass data (t_{10}= 0.84-1.67, P=0.125-0.550), while prey weight distribution for the martens living in the various environments differed (χ^2_4 =16.50, P<0.01).

The martens typically preyed on terrestrial species (Fig. 3b) both in villages (mean 56.0%, min.-max. 32.9-69.7%), and farm environments (mean 72.4%, min.-max. 64.9-90.2%), however the habitat type dependent difference only on the level of terrestrial prey was significant (t_{10}=2.27, P<0.05). Martens living in villages compared to those living in farms consumed more arboreal prey and less terrestrial prey, but the habitat type dependent difference in this case was not statistically significant (t_{10}=2.09, P=0.063). The overall diet on the basis of prey zonation did not differ significantly (χ^2_2= 3.46, P=0.178).

Martens living in villages and farms consumed primarily habitat generalist prey species (Fig. 3c) which may live both in open habitats and forests or shrubby areas. It means that consumption ratio of these animals was 84.2% in villages (min.-max. 40.0-99.0%) and 87.3% in farms (82.6-92.0%). Nor the habitat dependent difference (on %B data) (t_{10}=0.32-1.24, P=0.243-0.754) neither the distribution of prey depending on habitat association in the diet of martens living in different habitat types was not significant (χ^2_2=4.90, P=0.086).

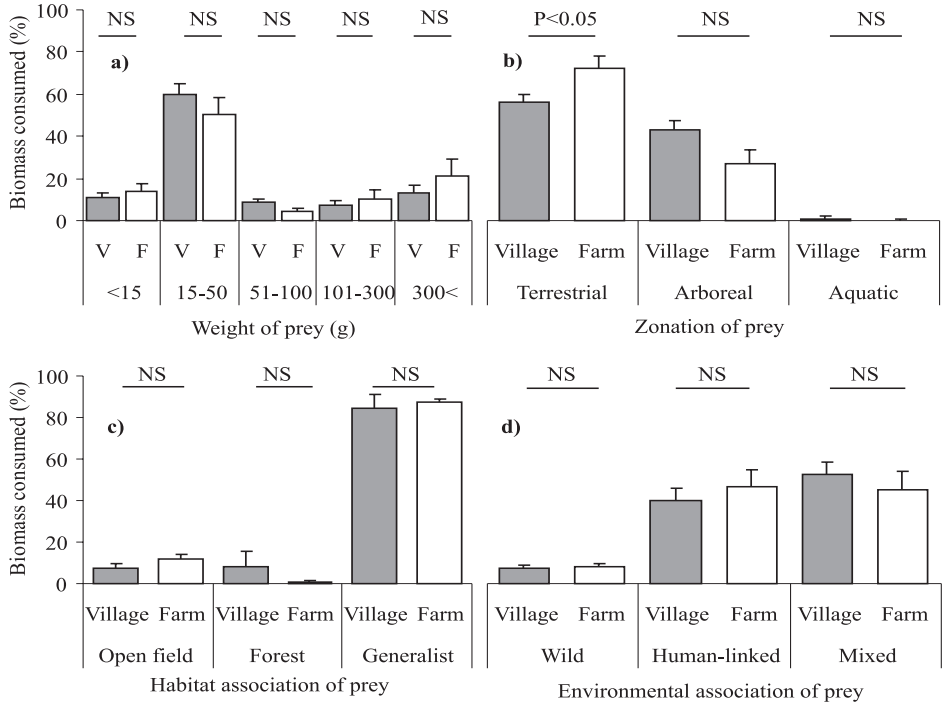

Fig. 3: Distribution of animal food types in the diet on the basis of weight (a), zonation (b), habitat association (c) and environment association (d) of food species.

Martens living in villages and farms consumed in great proportion prey species linked to human environment (39.9%, or 46.8%, respectively), and mixed (living both in wild and human environment) prey species (52.9%, or 45.1), while wild living prey species were eaten in low proportions (Fig. 3d). The consumption ratio of the human-linked prey species in villages the lowest (20.8%) was in Nagyszakácsi, and the highest (65.2%) was in Felsőmocsolád, while on farms ranged between 33.9% (Somogyjád) and 68.7% (Mernye). The habitat type dependent difference was not significant in any case of the groups (t_{10}=0.34-0.80, P=0.442-0.744). The distributions of prey depending on human association in the diet of martens living in the two habitat types was not significant (χ^2_2=4.76, P=0.093).

Consumption of domestic animal, rodent pests and garbage

Martens living in villages and farms also consumed in a quite high ratios of domestic animals (Table 2). In the animal food, the poultry and the poultry egg was found in the largest biomass ratio in Mernye (47.9%) and in Polány (43.1%, from this part of domestic rabbit 0.9%). Pigeon at the farm in Somogyvár (0.2%) and at Felsőmocsolád (5.9%), pig at Nemesvid (0.6%), cat at inner-district of Somogyvár (0.5%) were consumed. In Kisgyalán remains of a parrot (budgerigar), which had been flown away from a house was detected in a scat. Consumption of pet food was found in samples collected in Somogysimonyi (2.4%) and in Polány (3.2%). In a sample collected in Somogyjád, remains of a dog (0.4%) were found. Consumption of domestic animal carrion (and scraps of meal or kitchen offal) - by simultaneous occurrence of carrion and fly pupa - were been significant at such locations (Nemesvid 33%, Nagyszakácsi and Somogyjád 25%, and Kisgyalán 19%).

In animal food, consumption ratio of house mouse and brown rat according to biomass calculation were over than 10% at many of settlements (Table 2). The consumption of these harmful small mammals was especially high on the Mernyeszentmiklós farm (41.9%) and on Felsőmocsolád (28.9%).

In marten scats numerous, originally indigestible material occured, such as pieces of wood (in 51 cases), pieces of tile/brick scrap (12), nylon and straw (10-10), string and wall pieces (9-9), aluminium foil and paper (8-8), piece of rubber (7), salami husk (6), acrylic string (4), slag (3), power cable, limestone and leaf (2-2), styrofoam, sponge, mineral wool, rag, iron-, ceramics scrap, sheep wool and unknown substance (1-1).

In the case of martens living in villages, the relation the indigestible material and the food elements compared was 4.5: 95.5, while in case of farms 3.8: 96.2. The habitat type dependent difference was not significant (χ^2_1=0.75, P=0.388).

Relationship between stone marten and barn owl

In some cases (e.g. in Nemesvid, Polány and Mernyeszentmiklós) samples were collected from both predators in a large sample size (Fig. 4). But in numerous locations either marten scats (e.g. in Felsőmocsoládi farm, Somogysimonyi, Mernye and Gamás), or owl pellets were only found (e.g. in Mesztegnyő, Buzsák, Ecseny and Felsőmocsoládi church).

Distribution of marten scat and owl pellet numbers significantly different by location (χ^2_{19}=1733.38, P<0.0001).

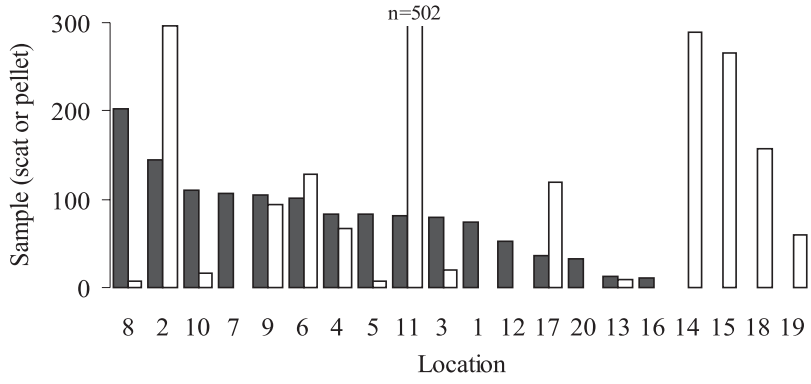

Fig. 4: Distributions of stone marten scat (black bars) and barn owl pellet numbers (open bars) Location order based on the declining number of stone marten samples. For number of locations from 1-12 see Fig. 1; further locations are: 13 – Andormajor, granary, 14 – Mesztegnyő, Catholic church, 15 – Buzsák, Catholic church, 16 – Buzsák, stock-yard, 17 – Öreglak, chapel, 18 – Ecseny, Evangelic church, 19 – Felsőmocsolád, Catholic church and 20 – Gamás.

Discussion

The diet and feeding habits of martens living in the examined villages and farms showed similarity in the summer-autumn period. There was not such a definite habitat dependent difference as it was found in other studies (e.g. in Denmark, urban and rural areas: RASMUSSEN and MADSEN 1985; in Switzerland, urban and rural habitats: TESTER 1986; in France, farmland and marshes: Lodé 1994; in Hungary, village and agricultural environments: LANSZKI 2003). Relying on the overall diet independent of habitat types, cultivated fruits dominated which means unlimited food sources in locations of this study. Fruits are important sources of vitamin and carbohydrate, their consumption is generally high (or primarily) in the summer-autumn period (e.g. HOLISOVÁ and OBRTEL 1982, TESTER 1986, GENOVESI et al. 1996, MARTINOLI and PREATONI 1995, LODÉ 1996, LANSZKI et al. 1999, PRIGIONI et al. 2008). Seeds are defecated without digest by martens and because they have large home ranges (in villages: 10-88 ha, HERRMANN 1994; 66 ha, SEILER et al. 1994; and in farm environments: 350-400 ha, SERAFINI and LOVARI 1993; 185-300 ha, HERRMANN 1994) they have an important role in spreading seeds.

However, in the villages primarily small birds, in farms small mammals were the most important animal foods, but from a taxonomic viewpoint was not a significant habitat-type dependent difference in the diet of the martens. Similarly to the present study, bird consumption was more typical in feeding of those martens which live near settlements (RASMUSSEN and MADSEN 1985, TÓTH 1998, LANSZKI 2003, HELTAI et al. 2005). Although in most of cases a species level identification can not be given, consuming of birds primarily being unbeneficial in viewpoint of nature conservation. It also makes problem that martens often choose such hiding places where bats or barn owls also find shelter (TÓTH et al. 2007). Distribution differences made by marten scat and barn owl pellet

Fig. 5: Granary in Kisgyalán in 2006 (photo: J. Lanszki)

Fig. 6: Egg cacth of marten

Fig. 7: Prey remain of barn rat

Fig. 8: Young stone marten

Fig. 9: Coming out

Fig. 10: Under the roof

numbers do not meant negative direct relationship, but by implication it shows that presence of one of the species is influenced by the presence of the other.

Small mammals dominated in the animal diet of martens living in farms during the summer-autumn period as it was found in other studies (DELIBES 1978, RASMUSSEN and MADSEN 1985, TESTER 1986, GOSZCZYNSKI 1986, SERAFINI and LOVARI 1993, LODÉ 1994, LANSZKI 2003). Especially rodent density of farms could have been considerable, where martens are the natural enemy of house mouse and rat and on the basis of current study important consumer of them. There were significant differences against tendencies beyond in connection with, for instance, near to refuse dumps (rubbish: PRIGIONI et al. 2008, rabbit: LANSZKI and NAGY 2003), during low availability of food sources (birds: LANSZKI and SZÉLES 2007), and Mediterranean areas (invertebrates: GENOVESI et al. 1996).

Martens living in villages have higher food density and more available food, e.g. domestic animals, pigeon, rat, sparrow, vegetable, garden, waste, etc. (HOLISOVÁ and OBRTEL 1982, RASMUSSEN and MADSEN 1985, LUCERINI and CREMA 1993, SIDOROVICH 1997, TÓTH 1998, LANSZKI 2003), furthermore a smaller area is able to ensure enough food (POWELL 1994), fewer competitors are needed furthermore to divide the sources (HOLISOVÁ and OBRTEL 1982, LUCERINI and CREMA 1993).

Marten may cause damages in villages by killing and surplus killing domestic animals (LANSZKINÉ and LANSZKI 2005), while in towns mainly by car damage (e.g. HERR et al. 2009a, 2009b). About one part of consumed domestic animals scavenge were proved (supposedly feeding from rubbish). Consumption of plastic and rubber from indigestible materials are connected with its (especially of cubs) curious and playful temper. These could be the reasons behind their damaging of cables and other plastic equipments of cars too, which were experienced in the examined settlements too in many cases.

Small, mainly terrestrial and habitat-generalist prey species meant the main food of martens in both types of habitat. There weren't such marked habitat type-dependent differences as in a former study (LANSZKI 2003).

To avoid or to reduce marten's damage we have got to recognize those sources which are attractive for martens within human environment (HELTAI et al. 2005). Protection against marten can be built upon prevention, alerting, exclusion and capture (more details: SZEMETHY and HELTAI 2001, HELTAI and SZŐCS 2007). On the basis of the present study ruined buildings, fruits, communal trash, rest of domestic animal cutting, dog or cat food mean important and available sources for martens. Availablity of pet food was limited, but according to the study of LANSZKINÉ and LANSZKI (2005) alerting by dog or any other way is not or just temporarily meant solution for the problem in itself. Elimination of nests is hardly carried out, but getting into preferred buildings, (e.g. in spires) is prevented. The base of an essential methodical management would be only the stantardized model of urban wildlife management (ADAMS et al. 2005).

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Appendix 1. Classification of animal foods of stone martens

In brackets the order is weight, zone, habitat type and assiciation to human environment.

Weight: 1 – < 15 g, 2 – 15-50 g, 3 – 51-100 g, 4 – 101-300 g, 5 – >300 g.

Zone: t – terrestrial, a – arboreal, q – aquatic.

Habitat type: o – open, f – forest, bush, g – habitat generalist, - – non-classifiable.

Association to human environment: w – wild-living, h – house-linked, m – mixed.

Vertebrates:

Noctule *Nyctalus noctula* (1, a, g, w), common vole *Microtus arvalis* (2, t, o, w), bank vole *Clethrionomys glareolus* (2, t, f, w), fat dormouse *Glis glis* (4, a, g, m), undetermined dormouse (2, a, f, w), common field mouse *Apodemus sylvaticus* or yellow-necked field mouse *Apodemus flavicollis* (2, t, g, m), striped field mouse *Apodemus agrarius* (2, t, g, m), undetermined field mouse *Apodemus* spp. (2, t, g, m), harvest mouse *Micromys minutus* (1, t, o, w), eastern house mouse *Mus musculus* (1, t, g, h), brown rat *Rattus norvegicus* (4, t, g, h), undetermined rodents (2, t, g, m), undetermined *Crocidura* spp. (1, t, g, m), undetermined shrews (1, t, g, m), common mole *Talpa europaea* (3, t, o, m), weasel *Mustela nivalis* (3, t, o, w), roe deer *Capreolus capreolus* (5, t, g, w), poultry (5, t, -, h), poultry egg (3, t, -, h), pigeon (4, a, -, m), rabbit (5, t, -, h), domestic pig (5, t, -, h), dog (5, t, -, h), domestic cat (5, t, -, h), dog/cat food (-, t, -, h), sparrow *Passer* spp. (2, a, g, h), starling *Sturnus vulgaris* (3, a, g, m), budgerigar *Melopsittacus undulatus* (2, a, -, h), undetermined small passerines (*Passeriformes* spp. (2, a, g, m), medium-sized bird (5, a, g, m), egg (2, t, g, m), lizard *Sauria* spp. (1, t, o, m), colubrine *Colubridae* spp. (3, q, g, w), undetermined *Rana* spp. (2, q, g, w), frog *Anura* spp. (2, q, g, m), pike *Esox lucius* (5, q, o, m), perch *Perca fluviatilis* (2, q, o, m), silver carp *H. molitrix* or *A. nobilis* (5, q, o, m).

Invertebrates:

1, t, o, m: acridoids (*Acridoidea* spp.), mole cricket (*Gryllotalpa gryllotalpa*), honeybee (*Apis mellifera*), beeswax.

1, t, g, m: forest caterpillar hunter (*Calosoma sycophanta*), carabid beetles (*Carabus hortensis, C. scheidleri, C. violaceus, C. coriaceus, C. ullrichi/C. cancellatus*), corn ground beetle (*Zabrus tenebrioides*), other small sized ground beetles (*Pterostichus* and *Harpalus* spp.), undetermined ground beetles and larvae (*Carabidae*), stag beetle (*Lucanus cervus*), lesser stag beetle (*Dorcus parallelepipedus*), undetermined longhorn beetles (*Cerambycidae*), undetermined dor beetles (*Scarabeidae*), rose chafer (*Cetonia* spp.), cockchafer (*Melolontha melolontha*), chafers and larvae (*Melolontha* spp.), snout beetles (*Curculionidae*), ladybird (*Coccinella*), flour-beetle (*Tenebrio molitor*), undetermined beetle and beetle larvae, hornet (*Vespa crabro*), social wasps (*Polistes nimfa, Paravespula germanica*), undetermined wasps, larvae and nest, hymenoptera (*Hymenoptera*), fly (*Brachycera*) pupa, undetermined caterpillar (*Lepidoptera*) and larvae, *Heteroptera* and *Lygaeidae*, undetermined insects (*Insecta*), larvae and pupa.