Acta Biol. Univ. Daugavp. 12 (1) 2012
ISSN 1407 - 8953

DIET COMPOSITION OF WOLVES (*CANIS LUPUS* L.) IN LITHUANIA

Renata Špinkytė-Bačkaitienė, Kęstutis Pėtelis

Špinkytė-Bačkaitienė R., Pėtelis K. 2012. Diet composition of wolves (*Canis lupus* L.) in Lithuania. *Acta Biol. Univ. Daugavp., 12 (1): 100- 105.*

The wolves (*Canis lupus* L.) diet was studied during the period from 2004 to 2012 by examining food remnants at locations of prey kills and consumption, through stomach analysis and through analysis of scats. Having 225 samples, 14 types of wolf food source were identified: moose (*Alces alces* L.), red deer (*Cervus elaphus* L.), roe deer (*Capreolus capreolus* L.), wild boar (*Sus scrofa* L.), beaver (*Castor fiber* L.), brown hare (*Lepus europaeus* P.), racoon dog (*Nyctereutes procyonoides* G.) and mousses (Muridae spec.), as well as small birds (Aves spec.), beetles (Coleoptera spec.), fruits and herbs and, in scats, remnants of cattle and objects of anthropogenic origin (plastic products). Using data obtained from 200 samples examined (wolf scats, vomit and stomach contents) it was determined that the remnants of ungulate animals prevailed (76.4% of samples examined). Wolf diet in the researched territory consisted mainly of Cervidae (roe deer and red deer) 43.4%, wild boar 33.0% and beaver 18.1%. %. A proportion of Cervidae in consumed biomass was calculated to be 56.4%, wild boar 27.0% and beaver 12.8%. It was found that wolves' diet in Lithuania differed from that half century ago.

Key words: wolf, diet, scat, Lithuania.

Renata Špinkytė-Bačkaitienė, Kęstutis Pėtelis, Aleksandras Stulginskis University, Faculty of Forestry and Ecology, Studentų g. 11, 53361, Kauno r., Lithuania, Renata_shpy@yahoo.com

INTRODUCTION

Damage made by wolves, namely the loss of livestock as well as competition to hunters, remains the point of most contention and thus an examination of diet should be central to scientific research. Most of the data on this issue was collected in the middle of the last century (Prūsaitė 1961) and is not representative of the current situation. More recent information is fragmentary.

J. Prūsaitė (Prūsaitė 1961) has studied wolves' (*Canis lupus* L.) diet in Lithuania during 1958-1959 winters. According to the results of 57 stomach and 6 scats analysis there was determined that wolves fed mainly on roe deer (27,6%), dogs (12,0%), and hares (6,9%). Horseflesh used for bait totaled 12% (Prūsaitė 1961). As suggested by the data of the research of 1980 wolves fed on moose and red deer too (Balčiauskas 2002). Depredation on livestock occurred most often in summer and autumn. Cattle and sheep were killed most often (Balčiauskas et al. 2002).

Wolf diet was researched more exhaustive in neighborhood countries. It was found 22 food categories in wolves' diet in Latvia, where Cervidae 49,4-51,2% (summer-winter), wild boar 20,0-33,9%, beaver 18,8-3,9% were most common (Andersone & Ozolinš 2004). The data of wolves' diet in summer and winter in Estonia was obtained by H. Valdmann and colleagues (Vald-

mann et al. 1998) as well as specific studies on wolves' diet in different ecosystems (Kubarsepp, Valdmann 2003). Many of researches of wolves' diet were done in Bialowieza Primeval Forest (Jedrzejewska & Jedrzejewski 1998, Jedrzejewski et al. 2000, Jedrzejewski et al. 2002), and South part of Poland (Smietana & Klimek 1993, Nowak et al. 2005).

The aim of this study was to find out the wolf diet composition and selection patterns.

MATERIAL AND METHODS

The wolf diet was studied during the period from 2004 to 2012 by examining food remnants from the wolves themselves (at locations of kills and consumption, through stomach analysis and through analysis of scats).

Data from scats and stomachs were pooled together (Andersone & Ozoliņš 2004), but the data from prey kills remnants were analyzed separately in order to escape the increase of big prey part in wolf diet.

Laboratory analysis followed standard procedures of drying and washing through a sieve (Lockie 1959, Goszczynski 1974, Litvaitis et al. 1996). Prey was identified by hair, bone, hooves, claws and feather remains. Dried remains from scats were weighed using an electronic balance to 1 g precision. Food remnants were identified with the help of microscopic analysis, using the data of B.J Teerink (1991) and A.M. De Marinis, and A. Asprea (2006), as well as the author's own collection of samples.

Composition of wolf food was expressed in two ways: the percentage of scats, which contained different prey species relative to the total number of analyzed samples (frequency of occurrence F%) and the percentage of biomass of a particular food component relative to the total biomass consumed by wolves (B%). (Goszczynski 1974, Jędrzejewski & Jędrzejewska 1992).

Collected samples were classified into two seasons for analysis: winter (October – March) and summer (April - September). The Morisita index (C_H) (Krebs 1998) formula was used to estimate similarities between the food compositions of the two seasons.

$$C_H = \frac{2\sum_i^n p_j\, p_k}{\sum_i^n p_j^2 + \sum_i^n p_k^2}$$

where p_{ij} – fraction of food item *i* in the total biomass consumed by wolves in the season *j*, p_{ik} – fraction of food item *i* in the total biomass consumed by wolves in the season *k*; *i* = 1, 2, 3, ..., *n*; *n* – total number of food items.

The food niche breadth (B) was calculated using the R. Levins (1968) formula:

$$B = 1 \Big/ \sum p_i^2$$

where p_i is a contribution of every group of wolf prey in the total biomass of food consumed by wolves. Food niche breadth was calculated according to five groups of food: (1) wild ungulate animals, (2) livestock, (3) mammals of average size (beaver, hare, racoon dog), (4) small prey (muridae, birds), (5) vegetative food.

The selection priority (D) of wolf diet objects was estimated using the Ivlev selectivity index, modified according to the methods of J. Jacobs (Jacobs 1974).

$$D = (r - p)/(r + p - 2p\ )$$

where r – frequency of occurrence of a given prey in the wolf's diet, p – frequency of occurrence of the same prey in the environment (according to the official estimates).

The wolf diet was studied on the basis of 225 samples collected in the territory of Lithuania.

RESULTS AND DISCUSSION

Having 225 samples, 14 types of wolf food source were identified: moose (*Alces alces* L.), red deer (*Cervus elaphus* L.), roe deer (*Capreolus capreolus* L.), wild boar (*Sus scrofa* L.), beaver (*Castor fiber* L.), brown hare (*Lepus europaeus* P.),

Table 1. Wolf diet in the Lithuanian territory acceding to the material collected from 2004 to 2012

Item	Season				Whole year	
	Summer		Winter			
	F%	B%	F%	B%	F%	B%
Cervidae	36	50.0	52.4	63.3	43.4	56.4
Wild boar	36	27.7	29.3	26.4	33.0	27.0
Livestock	2	2.4	-	-	1.1	1.3
Sheep	2	2.6	-	-	1.1	1.3
Beaver	19	15.4	15.9	10.0	18.1	12.8
Hare	2	0.4	-	-	1.1	0.2
Racoon dog	1	0.4	1.2	0.2	1.1	0.3
Muridae	7	0.6	1.2	0.1	4.4	0.4
Birds	3	0.4	-	-	1.6	0.2
Beetle	1	+	-	-	0.5	+
Fruit	1	0.1	-	-	0.5	+
Herb	13	0.1	2.4	+	8.2	0.1
Anthropogenic material*	1	+	-	-	0.5	+
Number of samples	106		94		200	
Consumed biomass, kg		159.5		150.8		310.3
Food niche breadth		1.58		1.23		1.4

Note: Seasons of the year: summer = April – September, winter = October – March; F% – incidence percentage in the scats, B% – percentage in all consumed biomass; * plastic products; food niche breadth was calculated according to five groups of food: (1) wild ungulate animals, (2) livestock, (3) mammals of average size (beaver, hare, racoon dog), (4) small prey (Muridae, birds), (5) vegetative food; + means less than 0.05% of composition.

raccoon dog (*Nyctereutes procyonoides* G.) and mousses (Muridae spec.), as well as small birds (Aves spec.), beetles (Coleoptera spec.), fruits and herbs and, in scats, remnants of cattle and objects of anthropogenic origin (plastic products).

Using data obtained from 200 samples examined (wolf scats, vomit and stomach contents) it was determined that the remnants of ungulate animals prevailed (76.4% of samples examined) (Table 1). Ungulate animals prevailed in the wolf food during both summer and winter seasons as well as in Latvia (84.4%) (Andersone & Ozolinš 2004) and Poland (93.1%) (Nowak et al. 2005). Wolf diet in the researched territory consisted mainly of Cervidae (roe deer and red deer) 43.4%, wild boar 33.0% and beaver 18.1%. A proportion of Cervidae in consumed biomass was calculated to be 56.4%, wild boar 27.0% and beaver 12.8%. Wolves selected Cervidae, especially in winter, when its ratio in the diet increased to 52.4% from 36.0% in summer. The remains of wild boar (36.0%) were mostly found in wolf scats of summer season, meanwhile it's proportion decreased to 29.3% in winter. There were found a small part of herbs in scats through all the year just its amount was bigger in summer (13.0%) than in winter (2.4%). Niche breadth was broader in summer (B = 1.58) than in winter (B = 1.23). Comparing the diet in summer and winter according to the Morisita index, it was determined that food between the seasons was rather similar. (C_H = 0.97).

There was only one case when remains of livestock were found in wolf scat. Although the wolves make damage to livestock in Lithuania (Špinkytė-Bačkaitienė & Pėtelis 2011), but according to this researches, the wolves mainly feed on wild ungulates and they are irrespective of anthropological food.

There were found small predators, rodents and beetles in wolfs' scats from whole territory of Lithuania. Other researchers showed the presence of small mammals in a minor quantity in wolf diet too, but this food category plays usually insignificant role (Jedrzejewski et al. 1992).

It was found that now wolf diet in Lithuania differed from that in 1958-1959. It was influenced by variation of plenty of different species. There was a small population of wild boars fifty years ago so they were just a small part of wolves' diet (3,3%). Meanwhile roe deer was the common food for the wolves as it had a big population in the forests (27,6%) (Prūsaitė 1961).

Data from Kamanos State Nature Reserve suggested that prey species' distribution in wolves' diet was rather similar like distribution of these species' in environment (Fig. 1). The priority of objects in the wolf diet on the basis of the Ivlev selectivity index was calculated taking wolves of the Kamanos State Nature Reserve territory too (Fig. 2). The result showed that the wolves preferred only red deer and roe deer (D = 0.15). Wild boar (D = -0.02) and beavers (D = -0.09) as a prey were less selected. With regard to the current potential density of prey, the wolves hunted for moose the least frequently (D = -0.36). There were counted 29 hares living in Kamanos State Nature Reserve, but in scats of wolves they were not found. The same situation was with foxes, badgers, raccoon dogs, martens – they lived in territory otcats.

Small rodents, beetles, insects were not found in wolves' scats from Kamanos State Nature reserve.

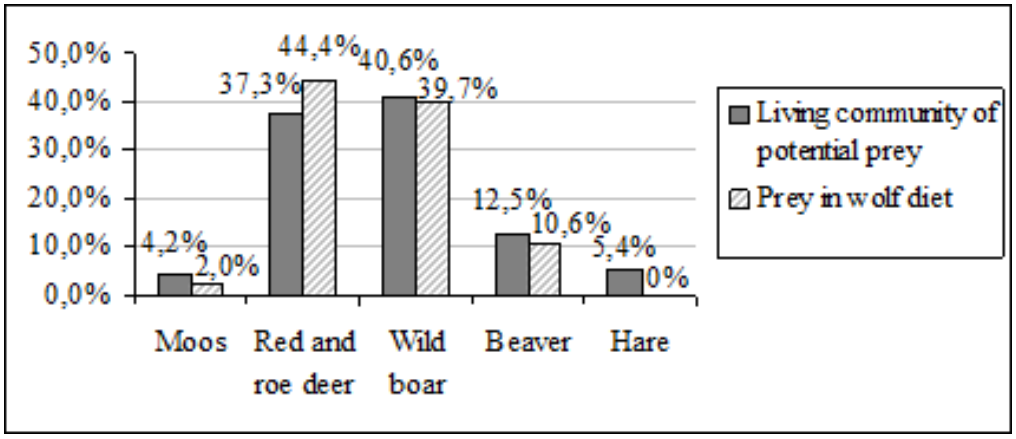

Fig. 1. Comparison of prey in wolves' diet and in community living in Kamanos State Nature Reserve.

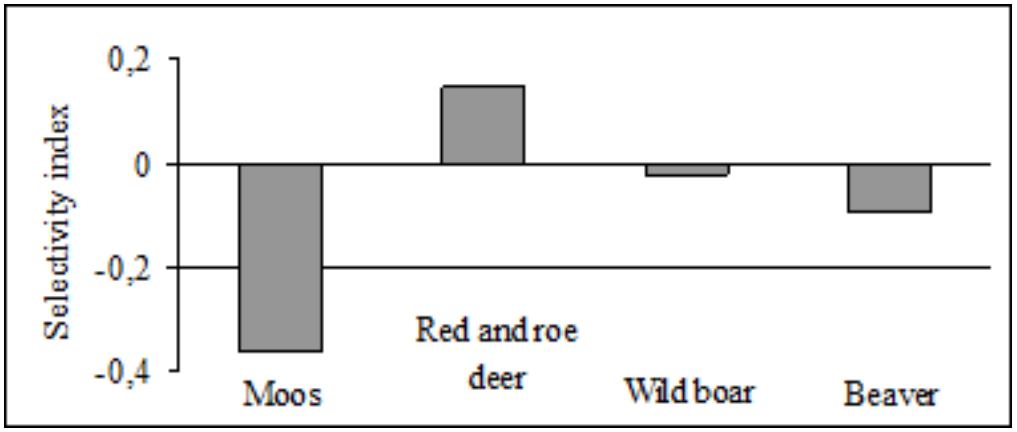

Fig. 2. Ivlev's selectivity index for wolf predation on different prey species in Kamanos State Nature Reserve.

Also no domestic animal remnants were present in the wolf scats collected in the Kamanos State Nature Reserve. Moreover, no claims by residents regarding damage due to wolves have been registered in the territories near the Kamanos State Nature Reserve in recent years, even though small farms are typical of the surroundings of the reserve.

The Statistical dependence between wolves' number and wild ungulates (the main source of wolves' food) number was not found. According accounting of wild animals by regions of Lithuania (2010 year), correlation between number of wolves' and wild ungulates was very week (wolves and red deer, r = 0,08) or week (wolves and wild boars, r = 0,27; wolves and roe deer+red deer+wild boars, r = 0,30; wolves and roe deer, r = 0,34). Consequently, there is enough prey for wolves at present and it has no influence on the distribution of these predators.

CONCLUSIONS

Most of the wolf food consists of the ungulates that dominate in the environment. Wolf diet in the researched territory consisted mainly of Cervidae and wild boar.

Wolves mainly fed on wild ungulates and they were irrespective of anthropological food.

A link between the number of wolves and the quantity of food sources was not determined. Consequently, there is enough prey for wolves at present and it has no influence on the distribution of these predators.

ACKNOWLEDGMENTS

We are very grateful to members of Association for Nature Conservation "Baltic Wolf" ("Baltijos vilkas") and employees of the Kamanos State Nature Reserve for helping with material collection.

REFERENCES

Andersone Ž. Ozolinš J. 2004. Food habits of wolves *Canis lupus* in Latvia. *Acta Theriologica* 49 (3): 357-367.

Balčiauskas L. 2002. Possibilies of the development of the wolf population management plan for Lithuania. *Acta Zoologica Lituanica* 12 (4): 410-418.

Balčiauskas L., Balčiauskienė L., Volodka H. 2002. Preliminary assessment of damage caused by the wolf in Lithuania. A*cta Zoologica Lituanica* 12 (4): 419-427.

De Marinis A.M., Asprea A. 2006. Hair identification key of wild and domestic ungulates from southern Europe. *Wildlife Biology*, 12 (3): 305–320.

Goszczynski J. 1974. Studies on the food of foxes. *Acta Theriologica* 19: 1-18.

Jacobs J. 1974. Quantitive measurement of food selection. A modification of the forage ratio and Ivlev's selectivity index. *Oecolobia* 14: 413-417.

Jedrzejewska B. Jedrzejewski W. 1998. Predation in vertebrate communities. The Bialowieza Primeval Forest as a case study. Springer, Berlin and New York, 450 p.

Jedrzejewski W. and Jedrzejewska B. 1992. Foraging and diet of the red fox *Vulpes vulpes* in relation to variable food resources in Bialowieza National park, Poland. *Ecography* 15: 212-220.

Jedrzejewski W., Jedrzejewska B., Okarma H., Ruprecht A. L. 1992. Wolf predation and snow cover as mortality factors in the ungulate community of the Bialovieza National Park, Poland. *Ecologia* 90: 27-36.

Jedrzejewski W., Jedrzejewska B., Okarma H., Schmidt K., Zub K., Musiani M. 2000. Prey selection and predation by wolves in Bialowieza Primeval Forest, Poland. *Journal of Mammalogy* 81 (1): 197-212.

Jedrzejewski W., Schmidt K., Theuerkauf J., Je-

drzejewska B., Selva N., Zub K., Szymura L. 2002. Kill rates and predation by wolves on ungulate populations in Bialowieza Primeval Forest (Poland). *Ecology* 83 (5): 1341-1356.

Krebs C. 1998. Ecological methodology. Addison-Wesley Education Publishers Inc., New York, 620 p.

Kubarsepp M., Valdmann H. 2003. Winter diet and movements of wolf (*Canis lupus*) in Alam-Pedja nature reserve, Estonia. *Acta Zoologica Lituanica* 13 (1): 28-33.

Levins R. 1968. Evolution in changing environment. Princeton University Press, Princeton: 1-120.

Litvaitis J. A., Titus K. and Anderson E. M. 1996. Measuring vertebrate use of terrestrial habitats and foods. [In: Research and Management Techniques for Wildlife and Habitats. T. A. Bookhout, ed]. The Wildlife Society, Bethesda, Maryland: 254-274.

Lockie J. D. 1959. The estimation f the food of foxes. *The Journal of Wildlife Management* 23: 224-227.

Nowak S., Myslajek R. W., Jedrzejewska B. 2005. Patterns of wolf preying on wild and domestic ungulates in Western Carpathian Mountains (S Poland). *Acta Theriologica* 50 (2): 263-276.

Prūsaitė J. 1961. Diet and breeding of wolves in Lithuania. LTSR MS Darbai, Serija C1 (24): 177-191. (In Lithuanian with Russian summary)

Smietana W. Klimek A. 1993. Diet of wolves in the Bieszczady Mountains, Poland. *Acta Theriologica* 38 (3): 245-251.

Teerink B. J. 1991. Hairs of West European mammals. Cambridge University Press, Cambridge, 224 p.

Valdmann H., Koppa O., Looga A. 1998. Diet and prey selectivity of wolf *Canis lupus* in Middle and southeastern Estonia. *Baltic Forestry* 4 (1): 42-47.

Špinkytė-Bačkaitienė R., Pėtelis K. 2011. Wolf Depredation on Livestock in Lithuania in 2009 and 2010. *Rural development: the fifth international scientific conference proceedings*. Vol. 5 (b. 2): 149-155.

Received: 08.09.2011.
Accepted: 01.06.2012.