TROPHIC RELATIONSHIPS BETWEEN WOLF AND DEER FROM THE SOUTH OF THE FĂGĂRAŞ MOUNTAINS (ARGEŞ DISTRICT, ROMANIA)

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The level of interdependence existing into the system of prey (deer)-predator (wolf) was studied in the Făgăraş Mountains area, in 3 distinct hunting districts: Râuşor, Râul Târgului and Stoeneşti. Observations on social life, trophic relationships between wolf and deer, and wolf and domestic animals were made between 1996 and 2009. It was revealed that there are two distinct periods of time during the life style of wolf: first, marked by the appearance, growth and development of wolf whelps, which started in April-May and lasted till late autumn; second, started at the end of November, beginning of December, short time before mating and lasted till April-May. 85 deer were killed during the time of 2004-2009, from which 72 were females. Only 22 individuals were killed from the beginning of April to the end of October. 20 of them were females and only 2 were males. 63 deer were killed during the late autumn and winter months of the same interval. 52 of them were females and only 11 were males. Winter months were more favorable for wolf in catching and killing deer because: 1. the existence of the snow cover which helps wolves running faster than deer; 2. hinds were pregnant during that time and were more easily caught by wolves; 3. during the winter time, wolves were associated in pack of wolves, catching deer being more easy.

Key words: wolf (predator), deer (prey), wolf whelp, hind, fawn, cervides, social life, trophic relationships.

INTRODUCTION

Trophic relationships between prey (deer) and predator (wolf) have been studied either as dynamical numerics, including mathematical models of those two populations (Atkinson & Janz, 1994; Mitteldorf *et al*., 2002; Hoppensteadt, 2006) or as phenology with the overlapping of some phases of phenology of both populations (Jensen & Miller, 2001), as generally impact of wolf on deer (Badea, 1964; Almăşan, 1967; Atkinson & Janz, 1994; Ballard *et al.,* 2001; Darimont *et al*., 2006; Nelson & Mech, 2006). Wolf is considered the most important predator of deer in Romania (Georgescu & Georgescu, 1996; Ionescu, 2000). Things are the same in other regions (Nelson & Mech, 2000 a, b; Smietana, 2005). As far as trophic relationships between wolf and deer are taken into account, the researches that have been done until now have pointed out favourable factors of wolf, comparing with deer.

The thickness of snow level (Nelson & Mech, 1986; Gula; 2004), the pregnancy of deer females during the winter time (Almăşan, 1967), as well as the existence of packs of wolves during the same time, which utilize special strategies for catching and killing deer represent advantages of wolf upon deer in their trophic relationships (Nelson & Mech, 1986; Gula, 2004).

Our researches pointed out some characteristics of the relationships between wolf and deer, in the conditions of the highest mountain massif from Romania, the Făgăraş Mountains.

MATERIAL AND METHODS

The observed area was located in the Făgăraş Mountains (South part of Romania), in the districts of Râuşor, Râul Târgului and Stoeneşti. The places where observations were made were located on the moving ways of deer herds, followed by packs of wolves, both from fix and from changing places. Chi-square (Gula, 2004) value ($N = 2$; $\chi^2 = 1.1763$; $p < 0.05$) means that there are no significant differences between males and females captured by wolves, with a correction of 1/5 for males, known to be captured much more difficult, comparing with females.

RESULTS

In the hunting districts of Râuşor, Râul Târgului and Stoeneşti there were noticed 7 packs of wolves located as follows: 1. Voievoda (Râuşor District); 2. Portăreasa (Râul Târgului District); 3. Huluba (Râul Târgului District); 4. Frăcea (Râul Târgului District, at the base of Păpuşa Mountain); 5. Dobreiaşu (Râul Târgului District), located on Găinaţu Mountain; 6. Leaota (Stoeneşti District); 7. Făgeţel (Stoeneşti District) 8. Coman Valley (Stoeneşti District).

The number of wolves and of individuals in a pack of wolves, usually 3 to 5, are conditioned by many factors but most important is food resources. From this point of view, Râul Târgului District is most favourable and Râuşor District is least favourable (Table 1). Wolves and packs of wolves, when food was missing from their own territory, passed from one hunting district to another one all the year round, even though they have developed a strong instinct of territoriality. In that case, starts fights with local owners of that area.

Appearance, growth and development of wolf whelps starts in April-May and lasts till late autumn; the second moment in wolf life starts at the end of November, beginning of December, short time before mating. In the area of Făgăraş Mountains, the winter starts nearly at the middle of autumn and the first snow is falling early at the end of October, the beginning of November. This is the most favorable time for wolf in getting food (Table 2).

During the time of growing up, when the wolf whelps are able to move, they accompany their parents in the actions of getting food or changing their territory. In this process, during the autumn, sometimes they are accompanied by their wolf whelps from the preceding year. In this way, the pack of wolfs is sometimes made of more than 3 individuals.

Table 1

Wolf numbers and packs of wolves in hunting districts

Hunting district	Localities	Number of packs of wolves	Number of wolves										
			1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Râuşor	Voievoda	1	3	2	3	2	2	2	3	3	3	3	4
Raul Targului	Portăreasa	1	2	2	3	3	3	4	4	3	3	3	3
	Huluba	1	-	-	1	2	2	2	2	2	2	2	2
	Fracea	1	2	2	2	3	3	4	5	3	3	3	2
	Dobreiasu	1	-	-	2	2	2	3	4	2	2	2	2
Stoeneşti	Leaota	1	2	2	2	3	3	3	3	3	3	3	3
	Fagetel	1	2	2	3	4	4	4	4	4	4	4	4
	Coman Valley	1	2	2	3	3	3	3	3	3	3	3	3
Total		8	13	12	19	22	22	25	28	23	23	23	23

Table 2

Monthly killed deer by wolves during the time of 2004-2009

Deer	Months of the year											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Males	3	3	3	-	-	-	-	-	1	1	1	1
Females	11	11	5	1	-	-	-	-	7	12	17	8
Total	14	14	8	1	-	-	-	-	8	13	18	9

Table 3

Annually killed deer by wolves during the years of 2004-2009

Deer	Years					
	2004	2005	2006	2007	2008	2009
Males	2	4	3	1	1	2
Females	12	10	10	13	14	13
Total	14	14	13	14	15	15

Both males and females of deer are captured mostly starting early in the autumn and ending at the end of March. During the summer time there are no killed deer because wolves are feeding with domestic animals. As far as the number of killed deer is taken into account, there were no significative differences of all six analyzed years (Fig. 1; Table 3).

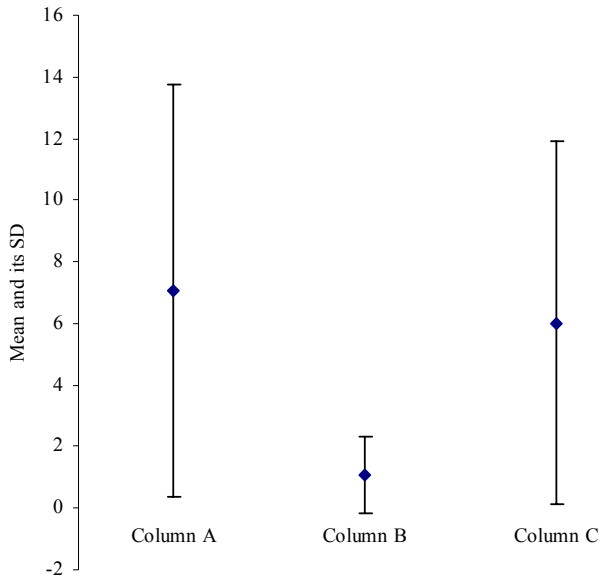

Fig. 1. Annual average of killed deer during the years of 2004-2009. Legend: Column A = total killed deer (• = mean = 7.083; vertical bar = 1 SD = 6.694); Column B = killed males (• mean = 1.083; vertical bar = 1 SD = 1.240); Column C = killed females (• = mean = 6.000; vertical bar = 1 SD = 5.893).

Table 4

Killed domestic animals by wolves between April 2004 and October 2009

Domestic animals	Site	Year	Killed animals
Sheep	Voievoda	2005	42
	Huluba	2005	28
	Dobreiaşu	2005	18
	Fracea	2006	14
	Portăreasa	2007	30
Pigs	Voievoda	2005	3
	Dobreiaşu	2005	2
Donkeys	Dobreiaşu	2005	5
	Fracea	2006	2

DISCUSSION

As Table 1 shows, the highest number of captured deer was during the time between starting autumn and ending March. Since winter starts early at the end of October, lasting 4-5 months, capturing deer by wolves is easier when the level of snow is high. That is because wolves run faster than deer on the snow. More than that, wolves are organized in packs of wolves during the winter time and have special strategies for capturing deer, being more efficient than single individuals.

At the same time, the number of killed males is much less than of killed females. The number of killed female deer is much higher, not only in total but also in each analyzed month. During the winter time, besides the fact that female could not run fast on the snow, they were pregnant, which made much more difficult their running. Losing their antlers during the winter time, males were losing one of their important weapons against wolves.

One more reason for wolves to capture deer easier during the winter is that there is no food during that time and deer are becoming weaker, that is, they are easier to be captured by wolves. Starting from April till September, there were no killed deer. During that time, wolves were feeding with domestic animals which were taken to pasture till late autumn (Table 4). The relationships between deer and wolf are significantly marked by the overlapping of two moments from their lifes: we noticed that the appearance of pack of wolves in the biotope happened nearly at the same time with the formation of deer herds for wintering, formed by pregnant females and fawns, both males and females. This type of association has a destructive effect on deer. We also seen the first female killed at the beginning of October, at the time of forming of deer herds. Then, in proportion as wolves are organizing in big pack of wolves for mating, during the months of January, February and March, the number of killed individuals is increasing. Then this number starts to decrease, at the same time with the dissociation of herds. On the basis of the observations made during the time of 2004-2009, the following conclusions are resulting: the destructive action of wolf on deer is taking place all over the year, having a strong intensity during the winter time. That is determined by the high level of snow cover, which does not allow females to run fast and by the fact that, during the last months of winter, females are pregnant. 63 deer were killed during the five months of high level of snow cover (November-March), from which 52 were females. During the remaining seven months (April-October), only 22 deer were killed, from which only 20 were females. In total, for all study time, 85 deer were killed, 13 being males and 72 being females. During that time, wolves were feeding mostly with domestic animals. Pearson chi square significance test (Gula, 2004) showed no significant differences between males and females captured by wolves, with a correction of 1/5 for males, knowing that males are much more difficult captured by wolves than females, specially when females are pregnant (Table 5). The study has concluded that the wolf is the most important

predator of cervides in the area of the Făgăraş Mountains. The thickness of snow cover was an important factor during the winter time and had important influence on trophic relationships between wolves and deer: the more thick was the snow cover, the more advantage had wolves over deer. Running faster than deer on snow cover, wolves killed (74 %) deer during the winter time, from the total of killed deer during the studied time. Only 9 deer (10.6 %) were killed from April till October, 8 (9.4%) of them being killed in October. Having the alternative of feeding with domestic animals during the summer time, wolves killed 144 different species during the months of May-August, the time that were no killed deer. For that reason but not only, wolf was considered, for so long time, a dangerous animal and was almost exterminated from some regions of the world. At the moment, wolf is going to be recovered in many such areas (Lynn, 2007).

Table 5

Chi square significance test for deer captured by wolves

Category	O	E	(O – E)	$(O – E)^2$	$\frac{(O – E)^2}{E}$
Males	13	17	–4	16	0.9411
Females	72	68	4	16	0.2352
					d f = 1; χ^2 = 1.173; p = 0.1

Abbreviations: O = Observed captured deer; E = Expected captured deer.

CONCLUSIONS

After studying the trophic relationships between wolf and deer, as well as social life of wolf from South of Făgăraş Mountains (Argeş District, Romania), the following conclusions have been drawn:

1. In the area of hunting districts Râuşor, Râul Târgului and Stoeneşti, there were 7 packs of wolves and numerical abundance of wolf was different, depending on food resources of each area: Râul Târgului and Stoeneşti were nearly the same, each having around 100 individuals, with few more in Râul Târgului; Râuşor area had fewer individuals, only 30.

2. The most favourable time for wolves in catching and feeding with deer was during the late autumn till late spring. At the high altitudes of Făgăraş Mountains, first snow was falling at the middle of autumn and lasted till late spring. Catching and feeding with deer during the winter time, with an average of 1.5 m thickness of snow cover, is easier for wolves, comparing with summer time, because: 1**.** the existence of the snow cover which helps wolves running faster than deer; 2. hinds were pregnant during that time and were more easily caught by

wolves; 3. during the winter time, wolves were associated in packs of wolves, catching deer being easier.

3. 85 deers were killed during the time of 2004-2009, from which 72 were females. Only 22 deer individuals were killed during the spring and summer months, from the beginning of April till the end of October. 20 of them were females and only 2 were males. 63 deer were killed during the late autumn and winter months of the same interval of 2004-2009. 52 of them were females and only 11 were males.

4. 144 domestic animals were killed during the summer time between April 2004 and October 2009 in the studied area, from which 132 were sheep, 10 were pigs and 2 were donkeys. In the same interval, only 18 deer were killed, 2 of them in April and 16 in September and no one during the summer months.

5. There were 7 packs of wolves in the studied area, usually each pack having 3 individuals, parents and a fawn, rarely more than 3 individuals, not more than 5.

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Received April 11, 2010

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