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WINTER DIET AND MOVEMENTS OF WOLF (*CANIS LUPUS*) IN ALAM-PEDJA NATURE RESERVE, ESTONIA

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Abstract. Wolf (*Canis lupus*) diet was studied in Alam-Pedja Nature Reserve from October to April 1999–2001. 119 wolf scats were collected and analysed. Remains of eight mammal species were found in wolf scats of which ungulates formed nearly 80%. Wolf diet in the nature reserve consisted mainly of wild boar (*Sus scrofa*; 37%), moose (*Alces alces*; 30.5%) and roe deer (*Capreolus capreolus*; 12.1%). A proportion of moose in ungulate biomass was calculated to be 77.5%; wild boar 20.4% and roe deer only 2%. It was found that wolf diet in the nature reserve differed from that of Estonia in general. We have concluded, that in areas with insufficient roe deer availability, wild boar and moose form the main prey items for wolf. It was suggested, that pack movements in area are mostly influenced by the localisation of prey animals and controlling of pack territory.
Key words: wolf, diet, movements, ungulates

Introduction

Wolf (*Canis lupus*) diet in Estonia was studied earlier (Valdmann *et al*. 1998), but no specific studies have been conducted to learn of the wolf diet in different ecosystems. Wolf diet has been also studied in Latvia (Andersone 1998), and also comparatively between these two countries (Valdmann *et al*. in prep.). Current study aims to fulfill several tasks:
1. To analyse the diet habits of wolves (mostly of one certain pack) in a local ecosystem and to compare the results with a more generalised analysis of wolf diet in Estonia;
2. To track wolf pack movements in the context of location of prey animals.

Study area

The study area is situated in Southern Estonia to the northeast of Lake Võrtsjärv, around the upper reaches of the Emajõgi River and lower reaches of the Pedja and Põltsamaa Rivers and occupies about 260 km^2. The Alam-Pedja Nature Reserve (NR) belongs to the Inland-Estonian climate region, the South-Estonian district and the Lake Võrtsjärve depression subdistrict. Alam-Pedja NR is a very marshy area: mires cover at least 60% of the area, forestlands occupy 27%, floodplain grasslands and shrubbery cover 10% of the area (Aaviksoo & Paal 2001). Hunting is banned in the study area, and there are three species of ungulates present in it: the wild boar (*Sus scrofa*), the moose (*Alces alces*) and the roe deer (*Capreolus capreolus*). They coexist there with three species of large predators: the wolf (*Canis lupus*), the lynx (*Lynx lyn*x) and the brown bear (*Ursus arctos*). Habitats of roe deer are mostly situated in the borderlands with a greater number of cultivated areas. During the winters of 1999/2000 and 2000/2001, this area was inhabited by a pack of 7–9 wolves.
The Alam-Pedja NR is one of the core areas of large predators in Estonia; the Nature Reserve is located on the migration route of large predators, such as the lynx, the wolf and the brown bear.
The study area is inhabited by the following mammals considered potential prey for wolves: the hare (*Lepus* sp.), different species of small rodents, the beaver (*Castor fiber*), the red fox (*Vulpes vulpes*), and the raccoon dog (*Nyctereutes procyonoides*).

Material and methods

Predator diets are generally assessed by examining scats, stomach or intestinal contents and regurgitated pellets. To determine the species composition of wolf diet, we examined the scat samples. The total number of 119 scats was collected. The methodology that we used for the scat analysis has been applied in several diet studies of wolves from the Baltic countries (Andersone 1998; Valdmann *et al*. 1998).

Scat samples were collected in winter and in early spring from forest roads, trails and bog islands regularly used by wolves and in October–April of 1999–2001 in the process of snow-tracking to record the movements of wolf packs.

Scats were carefully weighed and washed, prey remains, such as hair, bones and teeth were separated and identified. Hair from the scats was compared to the hair present in our reference collection using features such as colour, thickness, length and medullary configuration. As a rule, we found only one prey species per scat. We did not identify species of small rodents. In wild boar, it was possible to separate young animals (up to one year of age) from older ones by the hair colour.

Frequency of occurrence of mammalian prey species in carnivore scats is a commonly used parameter in predator diet studies, but if prey sizes are highly variable, frequency of occurrence can considerably distort the relative numbers of different prey types in the diet (Ackerman *et al*. 1984). In such cases, the relative biomass and numbers of different prey species are to be computed. The regression method of Floyd *et al*. (1978), considered accurate for the purpose (Huggard 1993; Karanth & Sunquist 1995) and extrapolated for ungulate prey animals (wild boar, roe deer and moose), was used to convert percent occurrence in scats to the proportion of biomass provided by each ungulate species. Average body weights were obtained for the wild boar from Valdmann (1991), for roe deer from Randveer (1989), for moose from Kozlo (1983). Food niche breadths (B) were calculated after Levins (1968) for six main prey groups (incl. wild boar, moose, roe deer, hare, small rodents and other carnivores). $B = 1/\sum p$, where p is a frequency of occurrence (F%) of a particular prey group.

Although the movements are generally assessed by the radiotracking data (Ciucci *et al*. 1996), snow-tracking is still a method often adopted in wolf research (e.g., assessment of winter kill-rates, scent-marking, nutritional status, behaviour, etc.) and a significant sample can provide accurate data on the movements and habitat use (P. Wabakken, pers. comm.)

During winters from 1999 to 2001 we followed 67 km of tracks in the snow from a pack of 7–9 wolves in Alam-Pedja NR. The study area was defined by connecting the outermost locations reached by wolf tracks in the snow, and it corresponds to the core of the pack's territory where the presence of snow and conditions generally allow tracking from November till the end of March. Wolf movements were recorded directly in the field on 1:25,000 maps. GPS navigator Garmin 12 was used to fix the co-ordinates.

Pack size was estimated by tracking wolves as long as possible along snow covered roads, and additional packs were listed only if there were clear separations between sets of tracks. Scat and track surveys are relatively quick, easy, and inexpensive methods for determining relative abundance of wolves.

Thompson (1952) reported that wolves regularly use the same travel routes when moving in a certain area. The same author observed that wolves use the same routes as their prey and they follow the herds of their prey animals (Ognev 1931; Thompson 1952; Makridin 1959). In areas where only migrating individuals occur, it is very often obvious that wolves use certain travel routes. If there are ungulates, which move in herds in that area, wolves often use game trails, i.e. the same routes as the prey animals. It is biologically very fitting that wolves should select the same routes as their prey animals, because in this way they avoid unnecessary travels (Pulliainen 1965).

Ognev (1931) stated that the winter movements of wolves are dependent on the snow conditions. Thus snow forms a special problem in the winter ecology of wolves (Pulliainen 1965).

Results

Scats contained remains of eight different prey species, the most common item, wild boar, made 37% of all items, moose made 30.5% and roe deer made only 12.1% of all scats. In winter diet of wolves, wild ungulates were the primary prey and formed 79.6% of all items. Hare formed 7.6% of all items, small rodents formed 6.7%, beaver formed 3.7%, raccoon dog made 2.5%, and fox made 0.8% (Table 1).

Moose was the predominant prey type making 77.5% of the total ungulate biomass, wild boar 20.4% and roe deer 2%. In wild boar, the biomass of piglets (<1 year) formed 26.2% and the biomass of subadults (1–2 yr) and adults (>2 yr) 73.8%.

During the period from 3 to 7 March 2000, the pack moved 29 km and four attacks were registered: three on wild boars and one on moose. All of them unsuccessful. Movements were mapped from one resting place to another. For some reasons, the pack members rested in separate groups: three older animals and four younger animals. On the next day, they killed one moose. The wolves mostly attacked wild boars. Altogether seven attacks were registered during the study period: five on boars and two on moose.

Wolf pack movements, mapped during snow-tracking and located groups of its prey animals are presented on map (Fig. 1).

Wolves preferred to move over higher patches of min-

Table 1. Composition of the winter diet of wolves in Alam-Pedja Nature Reserve. F% – frequency of occurrence (%); B% – relative ungulate biomass eaten (%); B – food niche breadth; B (b) – food niche breadth by relative ungulate prey biomass.

Taxa	Number of scats, n	F% ±SE	Ungulate biomass eaten, kg	B% ±SE
Roe deer	14	12.1 ± 8.7	5.5	2.1 ± 3.8
Wild boar	44	37 ± 7.3	54.1	20.4 ± 6.0
Moose	36	30.5 ± 7.7	205.6	77.5 ± 7.0
Hares	9	7.6 ± 8.8		
Beaver	4	3.4 ± 9.0		
Small rodents	8	6.72 ± 8.8		
Raccoon dog	3	2.52 ± 9.0		
Fox	1	0.8 ± 9.9		
Total	119	100	265.1	100
B		3.8		
B (b)				1.6

eral soils in marshy areas. These patches of soil usually have remains of human activity (abandoned orchards, fields, remains of houses, etc.) and are actively visited by wild boars. Special attention was paid to places of artificial feeding of wild boars.

Wild boar herds were visited by wolves on colder days, when they were able to occupy lowlands close to the rivers. One such movement is mapped (42.5 km) during two nights when one moose was killed (Fig. 1).

After the pack had killed the moose, it stayed there for two days. After consuming the moose, the pack split into two. It is possible that the wolves had clustered into one pack for hunting or due to low temperatures.

Deep snow tracks of prey animals were often used by the wolves for moving; tracks of the wolves were sometimes used by their prey as well. Forest roads and river ice were often used for moving too.

Discussion

As it has been demonstrated, dominating ungulate species for Estonia tend to dominate in wolf diet as well (Valdmann *et al*. in prep.). In Alam-Pedja NR, wild boar and moose are dominant ungulate species, which is reflected in the local wolf diet, differing from generalised results from other Estonian areas (Valdmann *et al*. 1998). Roe deer, mostly due to the lack of suitable habitats in the Nature Reserve, are largely being replaced by wild boar and moose.

As a result, wolves (probably one certain pack) in the Nature Reserve possess a narrower food niche range according to the biomass, indicating domination of moose and to lesser extent wild boar meat in the diet, although several more prey types occur. Roe deer is mostly hunted beyond the boundaries of the area where agricultural landscape dominates.

The predation rate of wolves on moose can be influenced by several factors: the mean wolf pack size, moose density and physiological condition of moose.

We suggest, that this local, relatively large (7–9 specimens) pack is able to hunt moose and wild boar more effectively, probably enhancing selection of larger prey. Besides the domination in biomass, moose have also higher frequency of occurrence in the diet of wolves (30.5%). As a rule, it can also reflect relatively high moose poaching on the area boundaries (consuming the animals, that were wounded and not found during illegal hunting).

Wolves limit moose numbers and, potentially, they may even regulate moose populations at low densities, especially when moose are exploited by humans and brown bear (Messier & Crete 1985; Messier 1994; van Ballenberghe & Ballard 1994). Although wolves may kill moose at a somewhat higher rate and occupy slightly smaller territories in regions with a higher moose density (Kojola 2002).

In contrast to most European locations where wild boar is avoided (Belyanin 1979; Nesterenko 1988; Jędrzejewska *et al*. 1994; Okarma *et al*. 1995), in this study area wild boar was the dominant prey species (by F%). Wild boar is also a dominant prey species in Latvia (Valdmann *et al*. in prep.), Russia (Litvinov 1981) and Italy (Mattioli *et al*. 1995). In Estonia, in general, due to the probable differences in the local densities of this species, it was preferred, but not dominant (F%; Valdmann *et al*. 1998).

It is proposed (Mattioli *et al*. 1995) that positive selec-

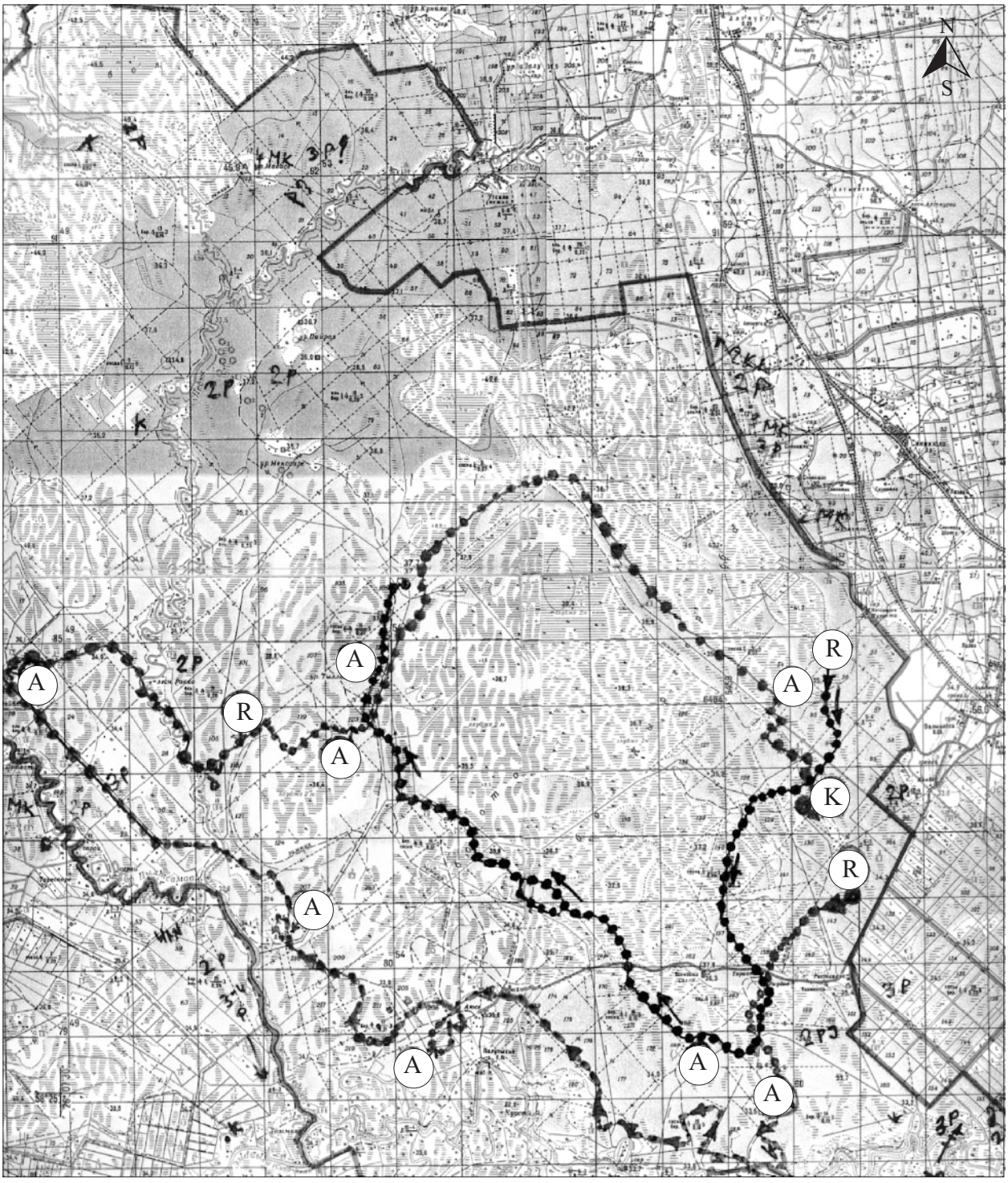

Figure 1. Movements of single wolf pack in Alam-Pedja NR during the period from 3 to 7 March 2000 compiled from snow-tracking (●●●●●● – wolf movements; A – locations of attacks; K – location of killing; R – resting places). Grid 1 × 1 km.

tion of wild boar can be caused by its vulnerability compared to roe deer or moose and that wild boar form easily identified groups that contain defenceless, relatively slow young animals having smaller body size than in Central and Eastern Europe.

Wild boar meat is also rich in fat (Stribling *et al*. 1984), having higher energetic value than that of cervids and thus probably being more cost-effective for wolves (Valdmann *et al*. 1998).

Although brown bear is not rare in Alam-Pedja NR, it has not occurred in wolf diet like in some locations of Russia (Pozio *et al*. 2001). We suggest, that the abun-

dant local ungulate community forms sufficient prey base for this certain wolf pack.

After having done the analysis of a wolf pack movements in the study area, we suggest that it is influenced by the localisation of prey animals and controlling of pack territory.

Wolf movements in the study area certainly need to be investigated further, including the analysis of winter habitats and localisation of prey species. Since the pack territory in the study area (it may also extend over its boundaries) includes winter habitats of both wild boar and moose, it seems that prey is attacked and killed on the random basis, i.e. no selection of certain prey species has occurred.

Of course, data may be biased towards over-expression of the proportion of moose in the diet due to the mentioned fact of moose poaching in the Nature Reserve.

On the other hand, local relatively large wolf pack is certainly able to effectively attack and kill moose, especially compared to the fragmented packs and pairs outside of the Nature Reserve, where wolf hunting is allowed.

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Vilkų (*Canis lupus*) mityba ir judėjimas žiemą Alam-Pedja rezervate, Estija

M. Kübarsepp, H. Valdmann

Santrauka

1999–2001 metų spalio–balandžio mėnesiais tirta vilkų mityba Alam-Pedja rezervate, Estija. Išanalizuota 119 vilkų ekskrementų pavyzdžių. Rastos aštuonių rūšių žinduolių liekanos, tarp kurių dominavo kanopiniai (80%). Pagrindinę rezervato vilkų raciono dalį sudarė šernai (*Sus scrofa*) (37%), briedžiai (*Alces alces*) (30,5%) ir stirnos (*Capreolus capreolus*) (12,1%). Kanopinių biomasėje briedžiai sudarė 77,5%, šernai 20,4%, o stirnos tik 2%. Nustatyta, kad vilkų mityba rezervate skyrėsi lyginant su kitomis Estijos vietovėmis. Daroma išvada, kad nesant pakankamai stirnų, pagrindiniu vilkų medžioklės objektu tampa šernai ir briedžiai. Vilkų gaujos judėjimą labiausiai įtakoja potencialių aukų teritorinis pasiskirstymas bei poreikis kontroliuoti gaujos užimamą teritoriją.

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