

Habitat Use by the Wolf (*Canis lupus* L.) in North Lithuania

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Abstract

Habitat use by wolves was researched with the aim to understand their visiting frequency of different landscape sites, priorities for resting place selection and the influence of anthropogenic factors on wolves' activity. Snow tracking of wolves was conducted through the winters of 2003/2004 and 2004/2005 with weather conditions permitting. With the use of GPS recording wolves were tracked 83.7 kilometres.

Results indicate habitat use by wolves is spread throughout the landscape; forest (43%), agricultural land (24.8%), road (12.3%), forest edge (10.6%) and frozen waterways (5.2%). Wolves are not restricted to any landscape type. However, they prefer forest stands over 20 years of age and rarely pass through clearcut areas. Frequently wolves visited mixed soft deciduous stands with spruce.

Wolves gave preference to young stands as resting sites. The highest number of recorded resting sites was between 2,580 - 3,400 m from a village and the mean distance from the forest edge was 200 m. Wolf tracks were found 50 - 300 m from homesteads.

Key words: wolf, habitat use, tracking, forest stand, resting place, territory marking, behaviour.

Introduction

The natural range of wolf (*Canis lupus*) distribution in Europe used to cover most of the continent (Okarma 1997), but present distribution of the wolf is a consequence of the past extermination programmes, as well as the contemporary barriers to dispersal and lack of suitable habitats (Mech 1995, Mladenoff *et al.* 1995, Linnell *et al.* 2001).

Many authors mention wolves in the XIX century in Lithuania, but solid evidence about their abundance is hard to find (Prūsaitė 1961). The abundance of wolves was very unstable in the XX century. From 2001 year it declines (LRAM 2004). In 1999 the monitoring of large predators started, however after three years was stopped due to a lack of funding (Bluzma *et al.* 2001). Recently the Institute of Ecology conducted a questionnaire and the Ministry of Environment organized a wolves' census (Balčiauskas *et al.* 2002, 2005, Bukelskis *et al.* 2004).

It is very important to assess the value of this large and active predator in a natural environment and in a constantly altered human environment. There is not enough information on how wolves' behaviour is influenced by habitat modification by an anthropogenic factor. Territorial behaviour of wolves in Lithuania has not been investigated. There is very fragmented forest landscape and it raises a lot of questions about

wolves lives in this landscape in Lithuania. The present situation shows a necessity not only to follow the dynamics of the wolves' population, but also to investigate the territorial distribution of this predator in a changing landscape.

Study area

The Gulbinas forest and the surrounding forests in Northern Lithuania were chosen for the investigation. The total study area occupied about 250 km². In the Šiauliai district, forest cover (35.03%) is higher than the mean of Lithuania (31.7%) (Lithuanian statistical yearbook of forestry 2004). Comparative index of forest edge perimeter and forest area (D), which shows the complexity degree of forest shape, is 1.28 in the Šiauliai district (Deltuva 1999). The investigated forest mosaic represents the average type of Lithuania. The most important environmental conditions limiting the density of wild animals are feeding capacity and the conditions of optimal refuge sites (Padaiga 1996). Fertile soil is typical of the study area and determines rich composition and abundance of vegetation, which in turn contributes to a higher diversity and abundance of wild animals. The prevailing mixed stands of spruce (*Picea abies* (L.) Karst.) with birch (*Betula pendula* L.), aspen (*Populus tremula* L.), grey alder (*Alnus incana* L.) and black

alder (*Alnus glutinosa* L.) determines the high density of ungulates. In the Šiauliai district the abundance of wolves is higher than the average of Lithuania. This is typical not only of the later decades, but also of the later centuries too. According to D. Vilinski (Вилинский 1876) the high abundance of wolves in the Šiauliai district is because there are many wet and hard impassable places. The Gulbinas Forest was mentioned as an important place for wolf reproduction, even at the time of population decline in the 1060's, when about 100 wolves were recorded in Lithuania. During these times wolves inhabited 36 districts with higher forest coverage out of the 82 districts (Prūsaitė 1961). Wolves have maintained a continuous population in the study area.

Material and methods

Snow tracking methodology was applied to investigate the habitat use of wolves. It is an indirect (according to activity signs of animals) method of observation (Belova 2001). Snow tracking was conducted through the winters of 2003/2004 and 2004/2005 with weather conditions permitting (adequate snow cover). 83.7 kilometres of wolves' paths were tracked.

Tracks were recorded with the GPS "EMAP" (Global Positioning System). The data were processed by the computer program ARCVIEW GIS 3.2. The following data were measured and recorded in forest stand maps (M 1:10000) and in tables during tracking:

- 1) Distances in the forest: a) in mature and pre-mature stands (age more than 40 years), b) in middle-age stands (age 21 - 40 years), c) in young stands (age 6 - 20 years), d) in young stands (age less than 6 years) and e) in clearcuts;
- 2) Distances in shrubs;
- 3) Distances by the forest edge (distance from the forest border less than 60 meters);
- 4) Distances on the ice (frozen waterways);
- 5) Distances on agricultural land;
- 6) Distances on roads: a) district roads, b) local roads (with gravel surface), c) forest or field road (with natural surface);
- 7) Resting places;
- 8) Territory marking places: a) excrements, b) urine, c) scratch of the soil;
9. Territorial behaviour changes influenced by the approach of human activity: a) exploitable clearcuts, b) clearcuts and young stands aged <5-year, c) roads (district, local and forest), d) homesteads, e) recent tracks of human activity.

According to conditions for the living of wild animals the forests habitats in Lithuania are divided into pure pine (0%), pine with spruce (0.1%), wet pine

(0.9%), spruce with deciduous (50.6%), deciduous with spruce (38.5%) and wet deciduous (9.9%) stands (Padaiga 1996). The number in brackets shows the percentage of such stand in the study area.

During this investigation young stands were divided into two groups, because in young stands <5 year old conditions are similar to open places, and 6 - 20 year old young stands characterize high stocking levels, heavily impassable. The total of useful distance (excluding the distance used for looking for tracks of wolves) was spread throughout such elements of the landscape: forest, forest edge, shrubs, agricultural land, road and frozen waterways. During the tracking, changes in the wolves' behaviour influenced by the approach of human activity places or objects were recorded. Other tracks of wolves were registered, however were not tracked further. The frequency of place urination was not investigated due to possible inaccuracy after snowfall.

Wolves' resting places distribution using the distances from the forests edge, homesteads and villages were compared using Kruskal-Wallis non-parametric test (Statistica 5.0).

The search routes were picked by considering the highest possibility of finding the tracks of wolves. Some places of the tracking routes containing a high number of tracks were bypassed. In such cases estimations were made on the number of wolves and their travel directions. Wolf tracks were followed for as long as possible, often requiring more than one day of tracking. Tracking stopped if snow cover condition changed unfavourably and on the loss of the wolves' tracks.

Results

Different landscape elements used by wolves.

There were three wolves in the winter of 2003/2004 and six wolves in the winter of 2004/2005 in the study area. Tracks of a solitary large male were observed as well. The selected pack has a home range, which covers four forest districts in three state forest enterprises and two hunting clubs.

Wolves travelled the greatest distance (43%) in the forest (Figure 1). In this instance stands and clearcuts are considered as forest. Wolves travelled 24.5% of the distance recorded in agricultural land, 12.3% on roads, 10.6% in the open forest edge (field near the forest border), 5.1% on frozen waterways, 4% in shrubs and 0.5% in the covered forest edge (inside forest).

Wolves' tracks may be found in stands of various age as well as in clearcuts (Figure 2). Wolves give priority to forest stands aged >20-year, with a strong

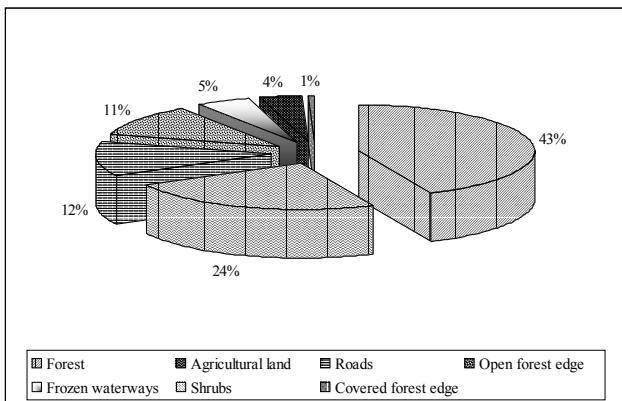


Figure 1. Distribution of wolves' tracks in landscape elements

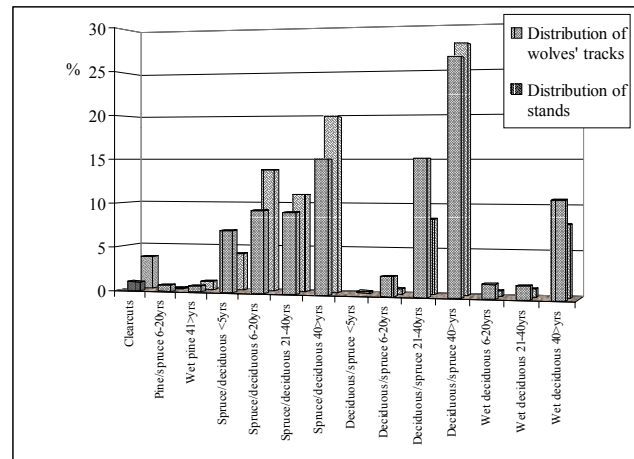


Figure 3. Distribution of wolves' tracks in forest stands containing a dominant tree species and age

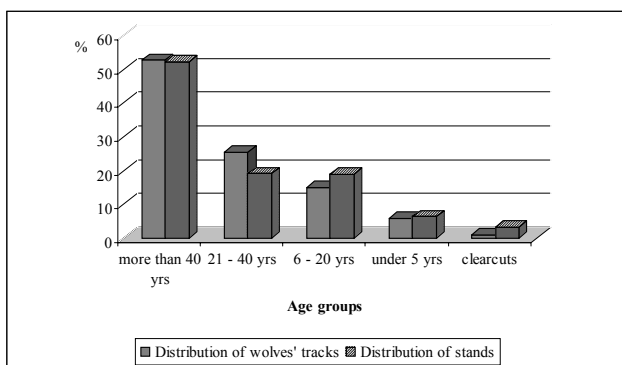


Figure 2. Comparison of wolves' track lengths and stand area depending on age



Figure 4. A wolves' resting place in a mixed spruce with deciduous forest (II age class)

preference for forest stands aged between 20–40-year. However, wolves rarely visit clearcuts.

Distribution percentage of wolf tracks subject to dominant tree species and stand age (Figure 3) was compared. Wolves in this region have no significant preferences of forest type in winter. All types of forest (with some positive selection of deciduous stands) and even clearcuts are walked by wolves.

The resting places

Ten places used by wolves for resting were found, and of these nine were in the forest, and one in an open field. The resting places, found in the forest, were in the young stands: two cases in the first age class, three cases in the second age class, three cases in the third age class (Figures 4 and 5) and one case in the fourth age class (Figure 6). Five resting places were in mixed spruce with deciduous stands (90% Spruce and 10% Birch; 80% Spruce, 10% Birch and 10% Grey alder; 70% Spruce and 30% Grey alder; 60% Spruce and 40% Birch; 50% Spruce, 40% Birch and 10% Grey alder), two resting places were in mixed deciduous with spruce stands (60% Birch, 3% Black



Figure 5. A wolves' resting place in a mixed deciduous with spruce forest (II age class)

alder and 10% Spruce; 50% Asp, 30% Birch and 20% Spruce), one resting place was in mixed deciduous stand (60% Asp, 20% Birch, 10% Grey alder and



Figure 6. A wolves' resting place in a mixed spruce with deciduous forest (IV age class)

10% Black alder) and one resting place was in a pure grey alder stand. The resting place found in the open field was near a ditch full of shrubs, roe deer fur was found here.

The wolves' resting places location from villages, homesteads and the forest edge differed significantly; $H(2, N=27) = 22,86765$ $p = 0,0000$ (Figure 7). The distance from a village ranged from 260 - 4,450 m with most of the resting places found between 2,580 - 3,400 m from a village. The distances from the nearest homestead were between 760 - 2,640 m. The distance from the edge of forest ranged from 10 - 420 m, on average 200 m. The resting places of two wolves were found in open areas; the distance from the forest was 290 m.

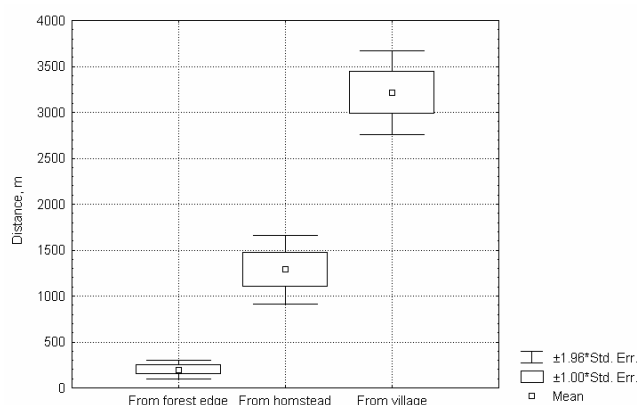


Figure 7. Wolves' resting places distribution using the distances from the forests edge, homesteads and villages

The territorial marking

Wolves marked their territory by urine, excrements and other methods. During the investigation the main attention was focused on the place of the urine

marking. A total of 56 markings were found. Objects marked by urine were recorded including the recurrence rate (Table 1).

Table 1. Frequency of object marking by urine

No.	Marked object	Number of marks	
		n	%
1.	Hump of grass	21	37.5
2.	Spruce (H<1m)	7	12.5
3.	Trunk of mature tree	6	10.7
4.	Pendulous branches of spruce	5	8.9
5.	Shrub	4	7.1
6.	Hump of soil	4	7.1
7.	Small stool	3	5.4
8.	Broken off dry branch	2	3.6
9.	Stone	2	3.6
10.	Pendulous branches of willow	1	1.8
11.	Edge of reed	1	1.8
Total		56	100

The most frequently urine marks were found on humps of grass 37.5%, usually on reed grass. The second most frequently used mark of urine was found on young spruces, <1 m high (12.5%). Excrements were found in the forest and on the forest edge and were concentrated in one area. Only one case of soil scratching was observed.

The influence of human activity on wolves' behavioural traits

Only once a wolf track was recorded approaching an exploitable clearcut. In this case the wolf avoided the clearcut preferring to stay 20 m from its edge. However, this could be an example of atypical behaviour, as the wolf had strayed from its pack and was outside the territory surrounded by fladry. The insecurity and fear of the wolf was visible during the tracking, for instance, the usual route from one forest to another was bounded across. On approaching a road from the forest the wolf was hesitatingly moving back, forth and parallel to the road before crossing. In another case two wolves travelled leisurely along the road next to forest stand being cleared.

Clearcuts were not frequently visited by wolves. However, wolves showed no apparent fear or effort to avoid old clearcuts.

The wolves' tracks indicated no fear when approaching or crossing open areas, leading to the observation that wolves are accustomed to landscape change. Young stands <5 years least influenced the behaviour of wolves with the track and stand percentage repartition practically the same (Figure 2). On two occasions wolves explored human traces (2-5 m) when crossing paths. In one case wolves constantly used the footpath of foresters.

Wolves showed no tendency to fear homesteads, with tracks found 50 - 300m away from homesteads. On two occasions wolves approached within 50 - 100 m of a homestead, three occasions within 100 - 150 m and on two occasions within 150 - 200 m. Wolves constantly used a path, which was 300 m away from two homesteads. The wolves' tracks showed no increased caution (stopping and windings) when approaching a place of human activity. In one case wolves changed their direction and approached within 100 m of a village. This is believed to be due to the ownership of dogs on all homesteads passed by the wolves.

Discussions

The distribution of wild animals in the area is irregular, depending on species requirements and density. Constantly used wolves' tracks, the number of territorially concentrated resting places and places of excrements were found in the study area. Such evidence indicates this area is the core area of the wolf pack. Wolves often visit agricultural land, as the investigated place belongs to the north central district of Lithuania, which characterizes the most opportune conditions for the breeding of wild animals (Padaiga 1996). The proportion of agricultural land in the total paths length may be overestimated, because it was tended to pick up the wolves' path that followed the agricultural land. But it can not be said, that wolves avoid agricultural land.

The effect of forest edge influence is typical of a zone of 60 - 100 (200) m wide (Padaiga 1996). During the investigation, the forest edge was calculated as an open territory not wider than 60 m from the edge of the forest. Ungulates and hares use the forest edge to feed, as this zone provides good feeding and protective conditions. This frequently used feeding area provides a good site for wolves to find potential prey. Covered forest edge was only occasional in the wolves' paths.

Comfort and fast movement was also the very reason for wolves' preference for forest roads and frozen waterways. Results prove wolves immediately veer from frozen waterways, when obstacles such as shrubs or grasses appear in their way. Wolves indicated a strong preference for their chosen routes. Selecting forest as the preferred path followed by other roads, block lines, technological lines, ditches and frozen waterways respectively. Rather often wolves use other animal tracks. 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). Their prey sometimes used

tracks of the wolves as well (Kübarsepp *et al.* 2003). Young dense forest stands and shrubs were strongly avoided by wolves. Shrubs on the wolves' routes comprised only 4.1%, whereas overgrown shrubs are rarely observed in the study area.

As mentioned above, wolves travelled 12.3% of the distance on roads: regional (3%), local (45%), forest and field (52%). The network of local, forest and field roads is denser compared with the regional roads network, so it is the bigger possibility that the direction of them would coincide with wolves' movement direction. Also all wolf tracks travelled perpendicular to the regional road. The quiet of forest, field and local roads can have influence for preferring them too. This could explain why wolves travelled more on forest, field and local roads. But it is important to mention, that regional road was crossed multiple times by wolves. A research project on wolves' habitat use in Bialowieza Primeval Forest showed that roads were used 36% of the total distance travelled by wolves (Jedrzejewska *et al.* 1998). However the percentage might be over exaggerated, as wolf trackers would firstly notice tracks along and across roads.

According to Jedrzejewska *et al.* (1998) and Bibikov (1985), wolves willingly use the possibility to travel on roads, as roads provide a comfortable surface and during winter the snow cover is often shallow. Throughout the project wolves showed no signs of hesitation, fear or concern when approaching roads used by humans. There were no observations of disturbance to the route of wolves caused by fresh vehicle tracks. Conversely, wolves move along the ruts in less driven roads. However, N. A. Zvorikinas (1950) states wolves usually avoid tracks of man by fleeing. In this study wolves explored and used the tracks left by humans. L. D. Mech (1998) maintains the notion that wolves can manage to adapt to human activity.

Wolves more often visited forest stands >20 years of age. Middle age forest stands are the least beneficial for foraging, but provide good protective conditions for herbivores. (Padaiga 1996). Ecological conditions of premature and mature stands are totally different. Deciduous undergrowth, underbrush, sub shrubs and herb vegetation flourish when old stands mature, becoming less dense and yielding more light. The abundance of ground vegetation provides much feed for herbivores – the potential prey of wolves. It was suggested, that wolves movements are mostly influenced by the localisation of prey animals as well as by controlling pack territory (Kübarsepp *et al.* 2003). Wolves rarely visited forest stands <20 years old. A reason for their low visitation could be explained by the high fertility of these forest stands,

which contribute to a very dense impenetrable ground layer. Clearly wolves most seldom visited clearcuts; however it could not be stated, that wolves avoided and feared clearcuts. Wolves' tracks can be found in any forest stand age group and clearcuts. Still and all it can be said, that wolves in this region have no significant preferences for forest type in winter. Besides it has not been observed that hunting pressure influences wolves' distribution.

The research conducted in Bialowieza primeval forest indicates individual peculiarity of habitat use is not typical of wolves. All forest types (with a higher priority for coniferous stands) and irregular little forest stands in agricultural land were visited by wolves looking for prey and cover (Jedrzejewski *et al.* 2001). In summary, it is important to mention that spruce (48%) and birch (37%) are the dominant forest type in the study area. As wolves have a long history with the study area one can believe that such forest stands provides a stimulus for wolves when selecting habitat.

Thompson (1952) reported that wolves regularly used the same travel routes when moving in a certain area. So special attention was required to the sites wolves' visited 3 or more times, as these sites might become potentially attractive.

Analysing the question on habitat selection by wolves, one firstly needs to take into consideration the distribution of potential prey source. If there is an abundance of potential prey for wolves then the number of wolves will increase. Accordingly ungulates are more abundant in areas where their food selection is rich and diverse. Thus the fertility of soils is one of the main factors influencing the abundance of animals. As a consequence forest stands growing on rich soils were visibly seen as a site often visited by wolves.

Wolves most often visited mixed deciduous stands dominated by birch or black alder with spruce 56.3%, followed by stands of spruce with deciduous species 31.2% and pure birch and black alder stands 12.5%. Of the sites visited by wolves 3 or more times 84.2% of the sites were mixed forest stands.

The most often visited sites hosted a large age diversity indicating age class is not a priority for wolves. The same can be said about the tree density and area of the sites. Thus the sites visited most by wolves are rich soils that host a diverse range of rich vegetation.

Conclusions

1. Wolves most often visited forests, followed by agricultural land, roads and forest edge respectively.

2. Wolves prefer forest stands aged >20-year and can cross any stands irrespective of age (including clearcuts) if required, but in general will avoid clearcuts.

3. Wolves selected to rest in places situated in young stands, between 2,580–3,400 m from villages and on average 200 m from the forest edge.

4. Wolves are accustomed to human activity and are able to evaluate the dangers and advantages associated with humans.

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МЕСТА ОБИТАНИЯ ВОЛКОВ (*CANIS LUPUS* L.) В СЕВЕРНОЙ ЛИТВЕ

Р. Шпинките-Бачкайтене

Резюме

Территориальное распределение волков было исследовано с целью выяснить частоту их посещаемости в отдельных типах ландшафта, приоритеты выбора мест дневки, а так же установить, как антропогенный фактор влияет на деятельность волков. Исследования были проведены в двух этапах в 2003/2004 и в 2004/2005 году, когда был подходящий для тропления снежный покров. По волчьему следу пройдены 83,7 км. Маршруты регистрировались с помощью GPS.

Маршруты перемещения волков в элементах ландшафта распределились по следующему: леса (43%), сельскохозяйственные угодия (24,8%), дороги (12,3%), опушки (10,6%), канавы, ручьи, пруды покрытые льдом (5,2%). Целенаправленно идя, волки могут зайти в древостои разного возраста и вырубки, но преимущество отдают древостоям старше 20 лет и редко заходят в вырубки. В часто волками посещаемых участках преобладали лиственные породы с елью, но определяющей особенностью можно выделить плодородность земли.

Дневки волков были в молодняках. Множество дневок (70%) найдено на расстоянии 2580-3400 м от поселков и в среднем в 200 м от границы леса. Следы волков были найдены на расстоянии 50-300 м от усадеб.

Ключевые слова: волк, территориальное распределение, древостой, место дневки, территориальное мечение, поведение.