HABITAT USE OF ROE DEER IN A FLOODPLAIN FOREST AND THE NEIGHBOURING AGRICULTURAL AREA

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ABSTRACT: Habitat use of roe deer in a floodplain forest and the neighbouring agricultural lands
The purposes of this study were 1) to determine the annual and seasonal home range sizes of roe deer captured and radio-tagged in a floodplain forest, and 2) to evaluate the habitat-use in light of the differences in vegetation between the floodplain forest and the neighbouring agricultural lands. We used one year localization data of six roe deer equipped with GPS-GSM collars in January 2007. Their home ranges were estimated with minimum convex polygon and kernel home range (with 60% and 90% probability contours) methods. To evaluate the habitat-use we also utilized the land cover map of the study area. The size of the MCP home ranges varied between 500-1000 hectares. The size of the KHRs (90% probability contours) varied between 30-120 hectares, while the core areas (60% probability contours) were between only 5-35 hectares. The core area of each roe deer contained at least 10% forested habitat; while the agricultural habitat type played a significant role only in four of the cases (the proportion of agricultural land was higher than 50% only in three of them). Significant differences were found between home range sizes and also between the proportions of the used habitat types. The results of yearly vegetation-preference calculations showed that each studied roe deer avoided the agricultural lands. Based on these results we suppose that different space-use strategies can exist among roe deer living in our study area.

Keywords: roe deer; home range, habitat, floodplain forest, vegetation preference

INTRODUCTION

Roe deer is one of the most important big game species for wildlife management in Hungary, occuring throughout the whole country (CSÁNYI ET AL., 2003, CSÁNYI ET AL., 2006a). To widen our knowledge about the habitat use and behaviour of European roe deer, the Institute for Wildlife Conservation (Szent István University) has lead a research programme in Jász-Nagykun-Szolnok county, Hungary since 2001 (CSÁNYI ET AL., 2003, CSÁNYI ET AL., 2006a,b). Based on the results up to now, in an average year the home range of males was approx. 349 ha, while that of females was approx. 309 ha (CSÁNYI ET AL., 2009).

The aim of our examinations is to identify the extent of the yearly and seasonal home ranges of roe deer tagged in a floodplain forest and to value the habitat usage in terms of the vegetational differences, with an emphasis on the usage of floodplain forest and agricultural land. Our questions were: (1) Do the home ranges of roe deer tagged in a floodplain forest contain agricultural fields? If so, to what extent? (2) Are there some seasonal characteristics in the habitat-use if the individual roe deer visit the rural areas?

MATERIAL AND METHOD

The study area

The field of the research was the area of Hofi Géza Vadásztársaság Egyesület (game management unit). The size of the area is 5238 ha, with mostly agricultural fields (73.75%). Forest is only 6.56% of the studied area – mainly floodplain forests of the Tisza river, as it is the northern borderline of the area. The game management unit has excellent brown hare and pheasant populations, as well as a quantitatively and qualitatively good roe deer population.

Capturing and marking

Capturing and tagging of roe deer took place on 17-18 January 2007 in the floodplain forest. We supplied altogether 10 animals with GPS-GSM collars (GPS PRO Light-1 Collar) which are able to provide satellite localization and use a GSM system for data transmission. The collars were made by the German Vectronic Aerospace GmbH.

Data collection with radiotelemetry

The collars recorded localization points every three hours, which were stored on a SIM-card, and were sent in SMS format to the ground receiver through the GSM system. We then imported the localization information to the computer with Vectronic’s own software. The number of localization points for each studied individual are showed in *Table 1*.

Table 1: Data of studied roe deer and the number of their localizations in 2007

Collar code	sex of individual	age at tagging	Number of localisation points				
			Winter	Spring	Summer	Autumn	Sum
S1	female	2 years	332	729	733	715	2509
SG1	female	1 year	333	730	736	722	2521
B1	male	3 years	338	731	731	720	2520
B2	male	3 years	331	729	735	726	2521
S2	female	2 years	331	735	718	720	2504
S3	female	2 years	329	724	723	712	2488

Data processing and evaluation

To visualize the localization data, to calculate and represent the home ranges and to calculate the usage of vegetation types we used the ESRI ArcView GIS (Version 3.1) software. We determined the home ranges of individuals with minimum convex polygon (MCP; WHITE & GARROTT, 1990; SAMUEL & FULLER, 1996) and kernel home range estimates (KHR; SEAMAN ET AL., 1999). In our research we used 60% and 90% probability contours and we considered these areas as home ranges (KHR 90) and core areas (KHR 60). To reveal the usage of certain vegetation types we intersected the MCP and KHR home ranges with the land cover map of the research area (updated every year). This digital land cover (vectorial) map shows the various natural and artificial habitats of the area. The two main vegetation types in this study are forest and agricultural land. After the intersecting process we exported the calculated areas to MS Excel and we calculated the proportions of the usage of various vegetation types. To determine the preferred and the avoided (unpreferred) vegetation types we used Ivlev’s preference-index calculation method (CSÁNYI ET AL., 2006a). The calculations have been made based on the year (2007) and on seasons. In this study we represent the data of two males, three females and one non-adult female of the ten tagged animals (*Table 1*).

RESULTS

The size of yearly home ranges and the proportion of used vegetation types
The size of the MCP home ranges varied between 500-1000 hectares (*Table 2*). The size of the KHR (90% probability contours) varied between 30-120 hectares, while the core areas (60% probability contours) were only between 5-35 hectares.

Table 2: The sizes of the annual home ranges were estimated with minimum convex polygon (MCP) and kernel home range (KHR) methods

Collar code	Yearly		
	Minimum convex poligon (ha)	Kernel home range	
		area on 60%(ha)	area on 90% (ha)
S1	487,44	5,35	43,08
SG1	521,05	9,95	68,8
S2	1011,31	34,76	118,29
S3	620,57	10,07	33,94
B1	549,81	9,73	32,83
B2	896,27	15,13	55,62

The various vegetation types appear in different proportions in the MCPs of the individual roe deer. It was striking that agricultural lands constituted the largest area proportions in the home ranges of each studied roe deer (*Figure 1.*). Based on the KHR90 estimates (Figure 1.), agricultural lands dominate in three individual roe deer home ranges (S1, SG1, B2) and the other three (S2, S3, B1) show a preference for forestlands. The home range of S3 does not contain agricultural lands, but contains more than 95% forest habitat. In general we may establish that – apart from the two main vegetation types that are important for seemingly all of the examined individuals - the „ways, channels and their edge zones" and „embankment side and ways" are also essential in their home ranges. The results of KHR60 estimates were similar to KHR90, but the area proportions of dominant vegetation types became more expressed.

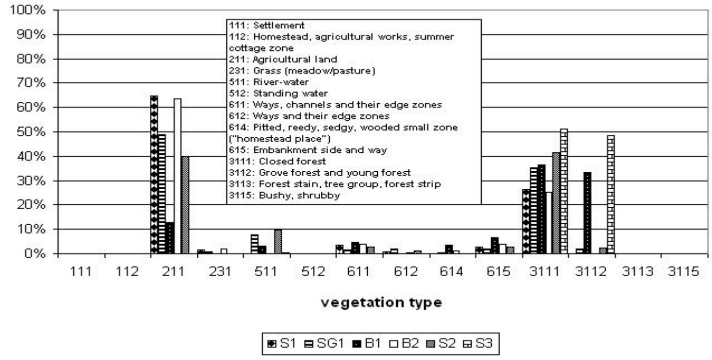

Figure 1: Space-use of studied roe deers in relation to their home ranges estimated with kernel home range method in 2007 (90% probability contours)

The size of seasonal home ranges and the proportion of used vegetation types
The size of the seasonal MCP home ranges varied between 50-600 hectares (*Table 3*). The size of the seasonal KHR (90% probability contours) varied between 4-160 hectares, and the seasonal core areas (60% probability contours) were only between 1-60 hectares. In general we may establish that summer home ranges are the smallest, while the winter and

the spring home ranges are the largest. (We have to notice that roe deer marking was in January, so we had only half of the localization points in winter compared to the other seasons.)

Table 3: The sizes of each studied roe deer seasonal home ranges estimated with minimum convex polygon (MCP) and kernel home range (KHR) methods

Collar code	Minimum convex poligon (ha)				Kernel home range calculation							
					Winter		Spring		Summer		Autumn	
	Winter	Spring	Summer	Autumn	area on 60% (ha)	area on 90% (ha)	area on 60% (ha)	area on 90% (ha)	area on 60% (ha)	area on 90% (ha)	area on 60% (ha)	area on 90% (ha)
S1	308,24	357,13	76,35	136,32	56,91	154,9	33,38	87,52	1,24	4,5	14,76	38,64
SG1	310,95	382,43	108,76	158,76	57,62	157,34	42,26	94,75	1,91	6,11	27,17	80,55
S2	161,09	97,67	414,31	524,9	11,56	48,16	12,64	31,81	26,14	83,76	49,07	197,23
S3	133,85	531,88	54,38	131,48	11,38	24,03	7,91	18,93	3,44	21,13	16,96	46,44
B1	329,82	174,75	52,68	129,67	13,67	50,27	15,12	42,48	5,43	23,22	4,91	24,69
B2	373,15	586,18	244,19	201,01	16,35	59,32	6,44	18,66	7,8	41,04	14,77	46,26

We present the characteristics of habitat selection based the KHR 60 estimate (Table 4). The proportion of agricultural lands in the tagged roe deer home ranges were the highest in winter and spring, the lowest in summer and autumn. We have to emphasize that in the proportions of the main vegetation types in the core areas in a single season, considerable differences can be observed between the seasons and also between the individuals.

Table 4: The proportion of habitat-types in each studied roe deer seasonal home ranges estimated with kernel home range (KHR) method (60% probability contours).

Collar code	Yearly		Winter		Spring		Summer		Autumn	
	Agricult. Area	Forest	Agricult. Area	Forest	Agricult. Area	Forest	Agricult. Area	Forest	Agricult. Area	Forest
S1	55,13%	31,40%	49,74%	39,89%	62,71%	28,15%	13,39%	0,00%	24,82%	63,40%
SG1	66,29%	12,61%	49,31%	39,01%	69,03%	22,63%	43,68%	0,00%	29,42%	60,43%
S2	27,41%	94,92%	50,80%	43,19%	29,24%	65,57%	0,00%	87,00%	58,42%	29,64%
S3	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%
B1	0,93%	60,90%	26,23%	56,47%	8,69%	77,09%	0,00%	100,00%	0,00%	98,97%
B2	59,37%	29,00%	57,19%	29,78%	84,62%	0,00%	83,65%	10,33%	37,15%	55,14%

The results of the estimate of vegetation preferences

It is clear from the results that all the examined individuals avoided agricultural areas based on the yearly data (*Table 5*). This is stated in contradiction with the fact that there were individuals (S1, SG1, B2) for which agricultural areas formed the largest part of their yearly home range. Looking at the distribution of the localization points of these individuals on the map, it is visible that the localization points which are on the agricultural lands are near some kind of natural habitat patches. Examining the seasons separately, with one single exception (S1 summer), the avoidance of agricultural areas can be observed everywhere. In the yearly calculation, with one exception (S1), the examined roe deer showed a positive preference towards forest lands. However in the seasonal calculation with two exceptions (S1 summer, SG1 summer), the marked individuals preferred the forest. We also examined the popularity of all the other vegetation types. The used vegetation types were the “ways, channels and their edge zones”, “ways and their edge zones”, “pitted, reedy, sedge, wooded small zones”, and the lawn area. Five examined individuals showed positive preference towards “roads, channels and their edge zones”.

Table 5: Results of the yearly and seasonal vegetation-preference calculations

individual	Yearly		Winter		Spring		Summer		Autumn	
	ac.	forest	ac.	forest	ac.	forest	ac.	forest	ac.	forest
S1	-	--	-	+	-	+	+	--	-	+
SG1	-	+	-	+	-	+	-	--	--	+
B1	--	++	--	++	--	+	-	+	--	++
B2	-	++	-	+	x	x	-	+	-	+
S2	-	+	x	+	-	+	--	+	-	x
S3	--	+	--	+	--	+	x	x	x	+

+: 0-0.49: positive preference -: 0- 0.49: negative preference
++: 0.5- 0.99: positive preference --: 0.5- 0.99: negative preference
grey cell: exception x cell: not significante value
ac: agricultural land

CONCLUSIONS

The yearly MCP sizes exceeded the average values established in our previous examinations (CSÁNYI ET AL., 2003, CSÁNYI ET AL., 2006a,b). Based on our results the difference between MCP and KHR90 was in order of magnitude. This also means that the most important areas used by the tagged individuals are merely some ten hectares. In fact, the KHR60 areas (core area) did not attain ten hectares (!) in the case of three individuals. There were considerable differences in the home range sizes between seasons and also between individuals.

We predicted that forests play an important role in the habitat use of the observed roe deer. Taking it as a starting point that roe deer is a sylvan or gallery sylvan species of philogenetic origin (LISTER ET AL., 1998), we captured and marked them in the floodplain forest. Although there were individuals whose MCPs covered more agricultural fields than forests, this habitat type constituted the largest parts of their core areas. Each individual’s core area contained at least 10% forested habitat, while the agricultural habitat type played a significant role only in four of them. However the proportion of agricultural fields was high only in three of them (at least 50%). Significant differences were found between the sizes of the individual home ranges and also between the proportions of the used habitat types. However there was one individual that spent the whole year in the floodplain forest. The results of yearly vegetation-preferences showed that each studied roe deer avoided agricultural lands and preferred the forest habitat. Numerous factors influence the habitat selection and the size of the home range: food availability and cover (TUFTO ET AL., 1996; BORKOWSKI & UKALSKA, 2008), population density (KJELLANDER ET AL., 2004), elevation of the habitat (MYSTERUD ET AL., 1999), and human disturbance (HEWISON ET AL., 2001). Based on these results we suppose that different space-use strategies can exist among roe deer living in our study area. That brings up an additional question: what defines the differences experienced in the individual habitat use and how do these differences influence the successfulness of the individuals?

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