APPLICATION OF THE LoCoH METHOD IN THE ANALYSIS OF ROE DEER HABITAT USE

BÁLINT TÓTH, NORBERT BLEIER, RÓBERT LEHOCZKI, SÁNDOR CSÁNYI

Szent István University, Institute for Wildlife Conservation
Páter K. Street 1., Gödöllő H-2100,
tr.balint@gmail.com

ABSTRACT
The purposes of this study were (1) to demonstrate a novel and effective method of home range estimation, and (2) to determine the annual home range sizes of roe deer - captured and radio-tagged in a floodplain forest – with the fix-k LoCoH method. We used one year localization data of six roe deer equipped with GPS-GSM collars in January 2007. The home ranges were estimated with the fixed-k LoCoH (with 50% and 95% isopleths). To calculate the k value we used the "minimum spurious hole covering" (MSHC) rule. The obtained k values varied between 16 and 21. The size of the LoCoH home ranges varied between 230-540 hectares. The size of the 95% isopleths varied from 38 to 82 hectares, while the core areas (50% isopleths) were between only 5.02 and 8.23 hectares. To illustrate home ranges we also utilized the land cover map of the study area. Based on these results we propose this method to achieve better estimates of roe deer home ranges living in our study area.

Keywords: roe deer, home range, floodplain forest, LoCoH, k value, Hungary

INTRODUCTION

Roe deer is one of the most important big game species for wildlife management in Hungary, occurring 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 been conducting a research programme in Jász-Nagykun-Szolnok county, Hungary since 2001 (CSÁNYI ET AL., 2003; CSÁNYI ET AL., 2006A,B). Up to the present to identify the home ranges we used minimum convex polygon (MCP) and Kernel home range (KHR) methods (WHITE AND GARROTT, 1990; SAMUEL AND FULLER, 1996; SEAMAN ET AL., 1999).
GETZ AND WILMERS (2004) described a new method for home range estimation: the local nearest-neighbour convex-hull (LoCoH), which was referred as a more accurate method (GETZ AND WILMERS, 2004; RYAN ET AL., 2006; RYAN, 2011). The purpose of our study is to identify the extent of the annual home ranges of roe deer living in a floodplain forest with this new method LoCoH.
Our questions were: (1) Is the LoCoH method better to determine the home ranges of roe deer? (2) What are the appropriate k values for the localization points of the captured and observed roe deer?

MATERIAL AND METHOD

The study area

Roe deer were captured and radio-tracked on the area of Hofi Géza Hunting Club (game management unit). The game management unit has excellent brown hare and pheasant populations, as well as a quantitatively and qualitatively good roe deer population. The size of the area is 5238 ha, with mostly agricultural fields (73.75%). Forest cover is only 6.56% in the study area – mainly floodplain forests of the Tisza River lying on the northern border of the area.

Capturing and marking

Capturing and radio-tagging of roe deer took place on 17-18 January 2007 in the floodplain forest. In this paper we used the data of 6 roe deer (*Table 1*) which were supplied with GPS-GSM collars (GPS PRO Light-1 Collar). These collars are able to provide satellite localization and use GSM system for data transmission. The collars were made by the German Vectronic Aerospace GmbH (www.vectronic.de).

Data collection with radio-telemetry

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 numbers of localization points for each 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 (2007)
S1	female	2 years	2509
SG1	female	1 year	2521
B1	male	3 years	2520
B2	male	3 years	2521
S2	female	2 years	2504
S3	female	2 years	2488

Data processing and evaluation

To visualize the localization data, and to calculate and represent the home ranges we used the ESRI ArcView GIS (Version 3.1) software. We determined the home ranges of individuals with the method of fixed-k LoCoH also known as k-NNCH (k - nearest neighbour convex hull). The fixed-k LoCoH takes every localisation point and locates its "k" nearest neighbours. It then forms a convex polygon hull using these points (much like the MCP approach, but for a subset of k points). Every hull successively is merged from small to large to form isopleths (contour lines). For example, the 50% isopleth contains 50% of the points (GETZ AND WILMERS, 2004; RYAN, 2011). (In our research we used 50% and 95% isopleths and we considered these areas as home ranges (95% isopleth) and core areas (50% isopleth) (MORSE ET AL., 2009). The k value was selected with the "minimum spurious hole covering" (MSHC) rule (GETZ AND WILMERS, 2004). In this study we represent the data of two males (B1, B2), three females (S1, S2, S3) and one non-adult female SG1) of the tagged animals (*Table 1*).

RESULTS

Selecting the k value

To select the value of k we used the MSHC rule. The home ranges at low k value contain a number of holes that disappear with the increasing value of k. If we know the topology of the area (inappropriate areas for habitat), we can select the smallest value of k with the

MSHC rule that produces a cover with the same topology as the given set (GETZ AND WILMERS, 2004). In our study area there are not any considerable inappropriate areas, so we could not decide what holes are spurious and what holes are real. Differences between real and spurious holes in LoCoH coverings of data sets should also be evident in plots of the number of holes in a particular LoCoH covering against the value of k: the covering of spurious holes should correspond to a levelling off of the resulting graph (GETZ AND WILMERS, 2004). The right k is the last value in the sequence before the sudden value increase (INTERNET 1). So we performed the calculation with k between 10 and 30 and we select the appropriate k from the graph. The "right" of final k is differed between the individuals, it varies from 16 to 21 (*Table 2*).

Table 2. the sizes of the annual home ranges were estimated with different k values with the method locoh

Collar code/ Value of k	Size of home range (100%, ha)					
	S1	SG1	B1	B2	S2	S3
10	302.31	272.84	243.09	492.76	249.13	116.30
11	305.36	310.33	249.23	520.68	262.04	175.75
12	337.76	317.57	254.52	527.40	268.46	186.85
13	343.18	324.58	269.70	529.08	281.09	196.55
14	345.69	331.46	274.49	531.70	287.02	200.55
15	347.69	335.74	276.15	534.56	290.56	217.36
16	350.25	337.14	277.75	536.71	294.43	224.60
17	354.40	340.57	282.53	538.21	295.53	227.45
18	358.43	341.71	282.89	539.35	298.63	228.71
19	358.96	344.22	283.34	553.25	300.91	231.86
20	360.93	346.03	286.46	604.72	304.32	232.39
21	363.03	346.55	287.18	606.02	306.01	233.60
22	366.87	350.47	287.26	608.08	308.72	233.86
23	367.58	351.02	287.52	609.86	309.81	236.67
24	370.53	351.31	287.73	618.18	311.06	237.11
25	373.16	352.33	287.75	669.08	312.69	237.53
26	375.23	352.68	288.83	669.23	316.18	237.99
27	375.37	355.70	290.12	670.57	318.59	238.24
28	376.25	356.16	290.16	671.25	319.25	239.25
29	376.31	356.48	290.18	673.05	320.37	239.71
30	376.38	356.99	290.20	673.05	321.79	239.11

The size of annual home ranges and core areas

The size of the annual LoCoH home ranges varied between 38-82 hectares (*Table 3*). The size of the core areas (50% isopleths) varied between 5-8.2 hectares. There is a sample map to demonstrate the fixed-k LoCoH home range and core area (*Figure 1*).

Table 3: the sizes of each studied roe deer annual home ranges estimated with the LoCoH method

Collar code	Value of k	Home range isopleths	
		95% (ha)	50% (ha)
S1	19	67.30	5.02
SG1	21	76.37	6.39
B1	16	54.02	6.01
B2	18	81.91	6.95
S2	17	72.86	8.23
S3	18	37.93	5.70

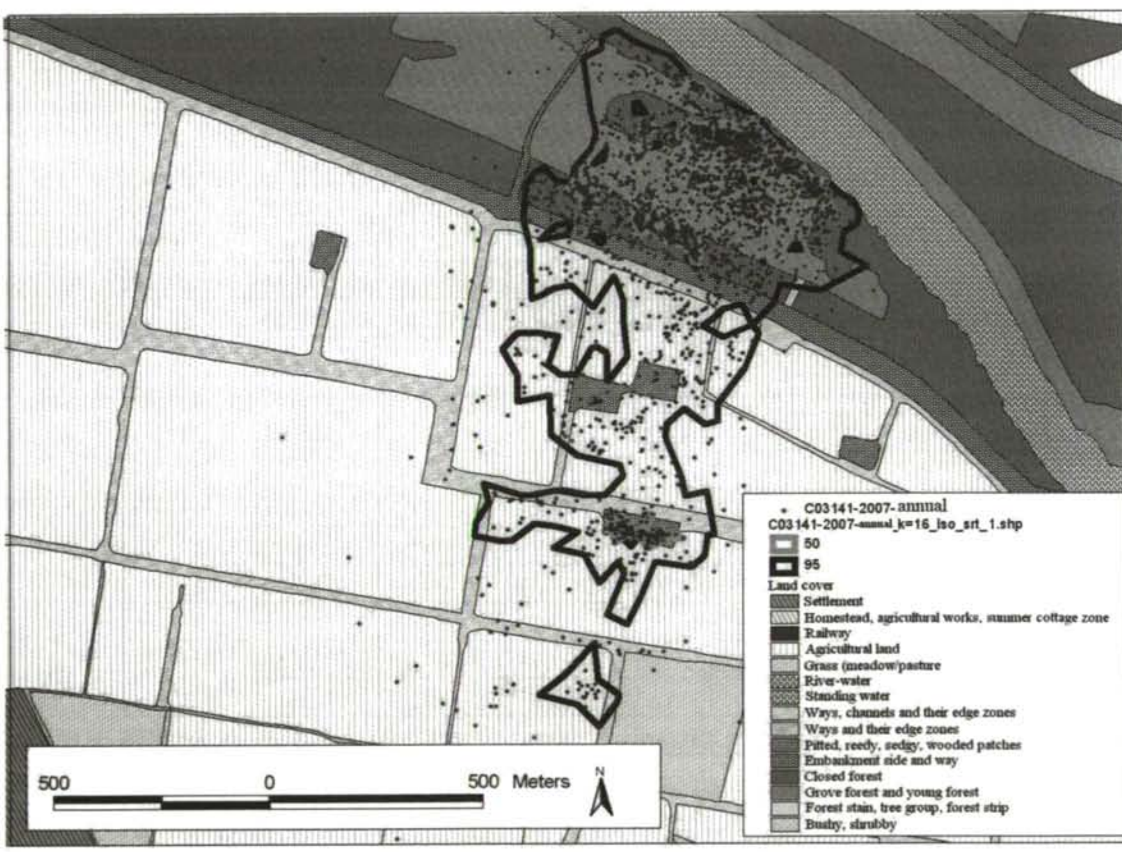

Figure 1. The annual home range (95% isopleth, red) and core area (50% isopleth, pink) of the B1 roe deer

CONCLUSIONS

The data and maps are showing that the MSHC rule seems appropriate to select the k value as proposed by (GETZ AND WILMERS, 2004; MORSE ET AL., 2009), and can be used in further research. Based on our results the annual home ranges did not exceed 82 hectares, and the core areas did not attain nine hectares (!) in the case of the 6 individuals. This also means that the most important areas used by the tagged roe deer are merely some ten hectares. We notice that there were considerable differences in the home range sizes between individuals.

It also can be seen that the localisation points have a number of centres (*Figure 1*). The LoCoH method is a good estimate if the localisation points are clustered around one or more centres of activity, because in such cases the minimum convex polygon will overestimate the area of the home ranges (RYAN, 2011).

Based on these results we suppose that this method may be better to estimate the home ranges of roe deer, but it needs more examination. We will compare the results of home range sizes to our earlier results of MCP and KHR home ranges methods.

ACKNOWLEDGEMENTS

We would like to especially thank the Hofi Géza Hunting Club, for providing the site of the research program. In capturing and data collection the work of the colleagues and students of the Institute for Wildlife Conservation was very important and greatly appreciated. We would also like to thank the Department of Fishery and Hunting (Ministry of Rural Development) for their support of this research.

REFERENCES

CSÁNYI, S., LEHOCZKI, R., SOLT, SZ. (2003): Space use of roe deer in open, agricultural landscapes in Hungary. – Vadbiológia 10: 1-14

CSÁNYI, S., LEHOCZKI, R., SCHALLY, G., BLEIER, N., SONKOLY, K. (2006A): Habitat use of roe deer in agricultural habitats in the Great Plain, Hungary. – Vadbiológia 12: 7-20

CSÁNYI ,S., LEHOCZKI, R., SONKOLY, K., BLEIER, N., SOLT, SZ. (2006B): Space use of roe deer in open, agricultural landscapes in Hungary. – Research report, Gödöllő

GETZ, W., C. WILMERS (2004): A local nearest-neighbor convex-hull construction of home ranges and utilization distributions. Ecography 27: 489-505.

INTERNET 1: http://nature.berkeley.edu/~alyons/locoh/av3x/index.html

MORSE, B. W., NIBBELINK N. P., OSBORN D. A., MILLER K. V. (2009): Home range and habitat selection of an insular fallow deer (Dama dama L.) population on Little St. Simons Island, Georgia, USA. Eur J Wildl Res, 55: 325-332.

RYAN, J. M. (2011): Mammalogy techniques manual. 2nd edition, Lulu, Raleigh, NC. pp 270

RYAN, S. J., KNECHTEL, C. U., GETZ, W. M. (2006): Range and Habitat Selection of African Buffalo in South Africa. Journal of wildlife management, 70(3): 764-776

SAMUEL, M. D., FULLER, M. R. (1996): Wildlife radiotelemetry. 370-418. pp. - In: Bookhout, T. A. (szerk.) Research and management techniques for wildlife and habitats. – The Wildlife Society, Bethesda, MD

SEAMAN, D. E., MILLSPAUGH J. J., KERNOHAN B. J., BRUNDIGE G. C., RAEDEKE K. J., GITZEN, R. A. (1999): Effects of sample size on kernel home range estimates. Journal of Wildlife Management, 63: 739-747

WHITE, G. C., GARROTT, R. A. (1990): Analysis of wildlife radio-tracking data. – Academic Press, San Diego 383