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LAND UNITS COMPOSITION OF HOME RANGES AND CHANGING OF WINTER ROOSTS OF LONG-EARED OWL *Asio otus*

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Abstract

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During the years 2010–2012, we observed the spatial activity of long-eared owls by the radio telemetry in an agricultural land. The average home range size of tracked long-eared owls for 100 and 95% minimum convex polygon (MCP) was 415.93 and 350 ha, respectively. Between the breeding and the non-breeding season, we did not record significant differences in the size of home ranges. Open land units (meadows and arable lands) belonged to the most abundant land units in the home ranges of tracked owls (mean for 100 and 95% MCP was 24.6 and 24.3%, respectively). Forest edges with their ecotone character also represented the abundant land unit (mean for 100 and 95% MCP was 11.4 and 10.6%, respectively). An amount of built-inhabited areas in home ranges (mean for 100 and 95% MCP was 8.2 and 10.1%, respectively) correlated positively with their size (Spearman rank correlation: for 100% MCP: $r_s = 0.83$, $p < 0.05$; for 95% MCP: $r_s = 0.91$, $p < 0.05$) that indicates long-eared owls to be avoiding built-inhabited areas as an area of the food getting. Two individuals of long-eared owl changed the winter roosts during one non-breeding season, which were at a distance of 650 m from each other.

Key words: land units composition, home range, long-eared owl, changing of winter-roosts.

Introduction

The creation of new anthropogenic phenomena by human beings in the landscape (Ružička, Mišovičová, 2013) may influence to all elements in land. These elements bring influences that have negative impacts to natural ecosystems, natural resources, biodiversity and landscape stability (Izakovičová, Oszlányi, 2013). Biota in agricultural landscape is the most human-affected part of exploited biota (Hreško et al., 2008). The long-eared owl is a nocturnal hunter that, prefers open land for hunting (Mikkola, 1983; Hagemeijer, Blair, 1997). Open land in Slovakia is exactly represented by land with intensive agriculture. The spatial activity of long-eared owls was studied in several works. Wijnandts (1984) brought the first information about the size of long-eared owl home ranges during the breeding and non-breeding season (mean 100% minimum convex polygon [MCP] = 2025 ha) from Netherlands by radio telemetry. Craig et al. (1988) realised the study of the spatial activity of two nesting couples in Idaho (northwest of USA) where he observed the impact of several environmental factors on the spatial activity. The accurate size of home ranges has not been mentioned. Galeotti et al. (1997) studied home ranges (mean 100% MCP = 504.8 ha) in Po plain in Italy during the non-breeding season and proved the preferences of network habitats as green edges between fields and treelines. The lesser use of the open fields without the trees as was expected depending on their availability and the use of the forests bordering the fields regardless of the season in long-eared owls was observed in Switzerland by Henrioux (2000), mean 100% MCP was 980 ha. Lövy (2007) tracked a long-eared owl in an urban and a suburban zone in Czech Republic during the breeding season (mean 95% MCP was 342.1 ha) and the home ranges of owls in the urban zone were bigger than the home ranges in the suburban zone. Tome (2011) used radio telemetry to determine the survival and dispersal of fledged long-eared owls. During the winter, long-eared owls spend the daytime at communal roosting sites. These winter roosts are often located in groups of the evergreens trees (Wijnandts, 1984). Most of the observed winter roosts are situated in the town residential areas (Noga, 2007; Škorpíková et al., 2005; Zaňát et al., 2007). Zvážal, Sviečka (2009) state potential reasons of a better micro-climate of the localities and the anti-predation strategy of owls guide their roosting behaviour. The number of owls in winter roosts varied (Wijnandts, 1984; Sharikov et al., 2014), and the number of owls in wintering areas may increase considerably compared to the breeding season (Wijnandts, 1984; Ružić et al., 2009). Wijnandts (1984) also states that some winter roosts may be abandoned in the course of winters or some owls may relocate and use other winter roosts. No other study based on radio telemetry or other works inform us about the relocations of long-eared owls between the particular winter roosts (Wijnandts, 1984; Galeotti et al., 1997; Henrioux, 2000). The aim of this study is: (i) to provide information about the home ranges size; (ii) to find out the land units composition in the home ranges; (iii) to bring information about the relocations of long-eared owls between winter roosts in the course of non-breeding season.

Material and methods

Study area

This study has been realised in the west part of Prievidza basin, Prievidza district, near the town Bojnice in the central Slovakia (Fig. 1). Long-eared owls have been captured near nests and winter roosts in two areas. The first area (winter roost A, nest *Asio otus* 5) consisted of the old spa park (48°46´N, 18°34´E; 315 - 250 m above sea level) where long-eared owls have nested every year since 1992 and where they have wintered every year in the non-breeding season since 1993 (Tulis et al., 2012b). The second area was a cemetery (48° 46´ 37´´N, 18°34´48´´E; 284 m above sea level) where long-eared owls have wintered periodically since 2009 (winter roost B). Both areas were at a distance of 650 m from each other. The study area was situated in the southeast foothills of Strážovské vrchy mountains. The major part of the basin is constituted by extensive agrocenoses with several wetlands in the central part. Wetlands are consequence of anthropogenic activity (mining). These wetlands have a big impact on land and biodiversity of the whole basin (David et al., 2013).

Capture and radio tagging

Six individuals of the long-eared owl were caught using mist nets and an eagle owl *bubo* as a lure between 2010 and 2012 in Bojnice Spa locality. The owls were sexed according to the pattern of feathers and the colour of the mantle

(Blasco-Zumeta, Heinze, 2010) and ringed. Radio transmitters (Biotrack Ltd., UK) weighing 4.5 g were attached to the two central tail feathers (Kenward, 2001). The weight of transmitters was < 5% of body weight of the smallest captured individual. All transmitters were equipped with a posture sensor. Each owl was allowed to habituate to the transmitters for at least 5 days before the collection of data started (Withey et al., 2001).

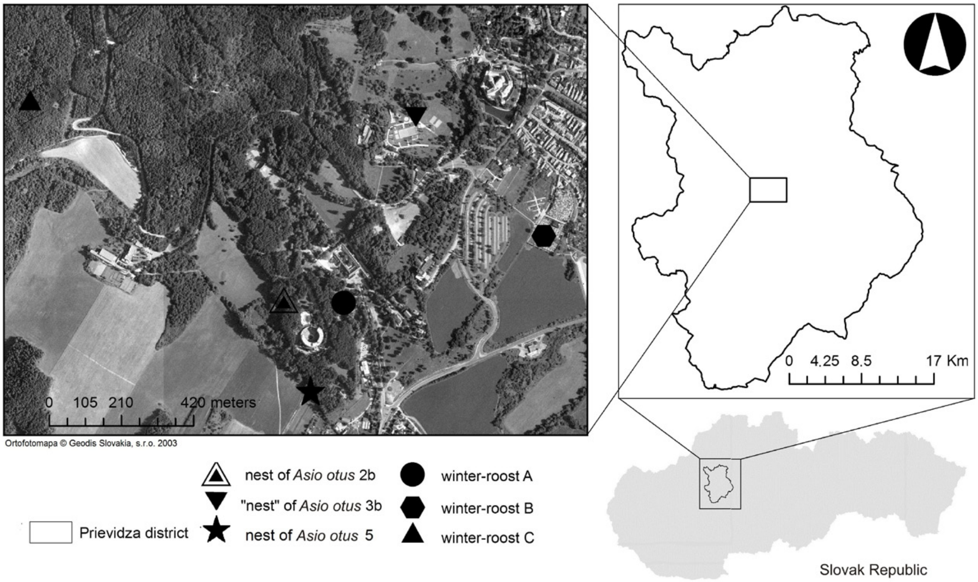

Fig. 1. Map of winter roosts and nests that were utilised by tracked long-eared owls ("nest" = nesting was not confirmed).

Radio tracking

Radio signals were received by using ICOM IC - R 10 receivers (Incom Inc., USA) and 3-element Yagi antennas. Data were recorded at 15-min intervals. Tracking was carried out by collaboration of two persons. The direction of signal (AZIMUT) was recorded from a compass and the position of tracking person was recorded using the GPS receiver and triangulation was evaluated with Triangulation 0.1.5, Animove: Triangulation of telemetry bearings module for Quantum GIS 1.7.3 software. Individuals were tracked during the breeding season (March–July) and the non-breeding season (remainder of the year) (Wijnandts, 1984). The presence of tracked owls in the winter roost was controlled every 2 days during the non-breeding season.

Home range and Land units composition

Home ranges were generated using the home range extension for ArcView, 1996 (Rodgers, Carr, 1998) in ArcView 3.2. We used the MCP method (Hayne, 1949). Our data was designed to minimise autocorrelation (Swihart, Slade, 1985). Otis, White (1999) suggested autocorrelation is typically not relevant when individual animals are used as the sample unit. Thus, we used all fixes for the home range estimates (Forsman et al., 2005; Willley, van Riper, 2007). The number of recorded fixes of the particular individuals was always $n \geq 50$, as in Willley, van Riper (2007). We used 100 and 95% isopleths of the MCP home ranges. To compare home range size between breeding and non-breeding season, we used Mann–Withney *U*-test. Land units in every home range were evaluated by accessing on a map of present landscape structure. The map was created by digitalisation of topographic maps (Bing maps, 2012) in map scale 1:5000 using the ArcMap 10.0 software. We considered eight land units by Petrovič et al. (2009) methodology: 1. woodlands, 2. park vegetation, 3. built-inhabited area, 4. gardens, 5. linear-wood vegetation (tree lines, holding cover and windbreaks), 6. water units, 7. meadows, 8. arable land. Next, the ninth land unit was created as forest edges (with a width of 30 m, where 15 m engages in the forest and 15 m to the next habitat). Differences in land units' composition between owls were tested with Friedman ANOVA test; relationship between size of home ranges and proportion of inhabited area / number of fixes was tested by Spearman rank correlation. The STATISTICA 8.0 portable software was used for all statistical analyses.

Results

Home range

Since 2010–2012, we tracked six individual long-eared owls using radio telemetry (males = 3; females = 3). Two individuals were tracked only during the breeding season, the other two were tracked during the non-breeding season and the last two were tracked during both seasons (Table 1). For these individuals, we evaluated home ranges in the breeding and the non-breeding season separately. The home range size did not correlate with the number of fixes (Spearman rank correlation: 100% MCP: r_s = - 0.09, p = 0.82; 95% MCP: r_s = 0.05, p = 0.91), which indicated the data had been gained by an independent observation and that no distortion of home range size had occurred. The average home range size for 100 and 95% MCP was 415.93 and 350 ha, respectively. The home range size of the particular owls is stated in Table 1. Although the average home range size in the non-breeding season was bigger (mean for 100 and 95% MCP was 469.9 and 446.9 ha, respectively) than the average home range size in the breeding season (mean for 100 and 95% MCP was 361.9 and 253.2 ha, respectively - Fig. 2), the differences were not significant (Mann-Whitney *U* test: for 100% MCP: *U* = 4, p = 0.25; for 95% MCP: *U* = 0.15, p = 0.15).

T a b l e 1. Home range size of tracked long-eared owls (a - individual tracked in non-breeding season, b - same individual tracked in breeding season).

Individual	Sex	Tracking period	No. of fixes	MCP 100%(ha)	MCP 95%(ha)
Asio otus 1	female	080512-300812	66	975.68	611.21
*Asio otus 2a**	male	020112-230212	86	457.92	451.68
*Asio otus 2b**	male	210312-290512	77	149.48	136.30
*Asio otus 3a**	female	020112-200212	81	400.21	371.50
*Asio otus 3b**	female	220312-300612	83	121.22	120.68
Asio otus 4	male	221111-191211	88	263.71	217.95
Asio otus 5	female	060511-030811	107	201.53	144.40
Asio otus 6	male	031210-240111	102	757.72	746.26
Mean				415.93	350.00
Median				331.96	294.72
Std. dev.				306.86	237.25
Std. error				108.49	83.88

Land units composition

Open land units (meadows and arable lands) were the most abundant land units in the home ranges (Fig. 3). Woodlands and forest edges also represented the abundant units. Friedman ANOVA test did not show differences in the composition of the particular land units in the home ranges among the individuals (for 100% MCP: Friedman ANOVA test: $\chi2 = 6.66$, $p = 0.46$; for 95% MCP: Friedman ANOVA test: $\chi^2 = 5.91$, $p = 0.55$). These results show that requirements of long-eared owls for land were equal and did not change depending on seasons or sex. A number of built-inhabited areas of all the tracked owls in home ranges correlated positively with their size (Spearman rank correlation: for 100% MCP: $r_s = 0.83$, $p < 0.05$; for 95% MCP: $r_s = 0.91$, $p < 0.05$), which indicated long-eared owls to be avoiding built-inhabited areas.

Changing of winter-roosts

Two individuals of long-eared owls changed the winter roosts during one non-breeding season. *Asio otus* 2a and *Asio otus* 3a were captured together in the winter roost B (Fig. 1) where they rested during the day together with the other six individuals. Forty seven days after the capture, both individuals had been recorded in the winter roost A, where they stayed until the end of the wintering season together with other eight owls. The winter roosts were 650 m apart from each other.

Discussion

The average size of a home range 100% MCP presented in this study was smaller compared to the results of Wijnandts (1984) (mean 100% MCP = 2025 ha; 5 tracked individuals) and Henrioux (2000) (mean 100% MCP = 980 ha; 14 tracked individuals) that tracked owls perennially and Galeotti et al. (1997) (mean

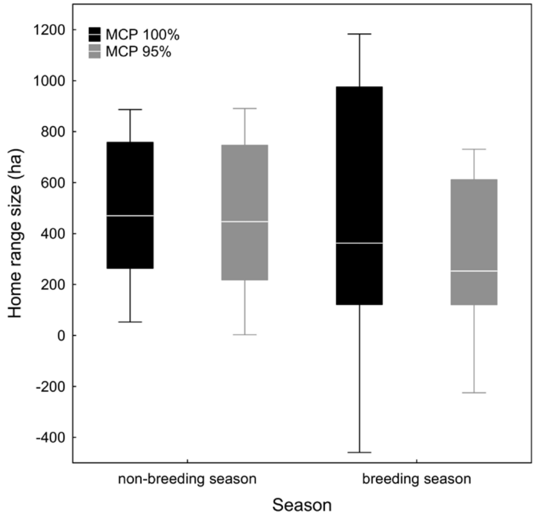

Fig. 2. Differences in long-eared owls' home range size (mean ± min.– max.; mean ± 2*SD) between breeding and non-breeding season.

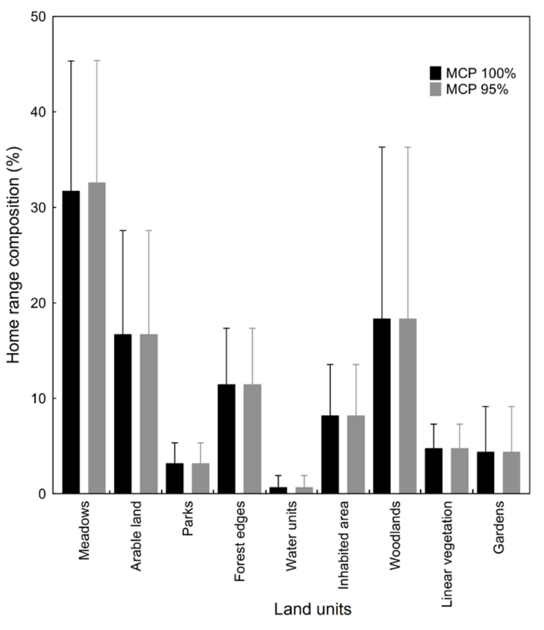

Fig. 3. Proportion of land units in home range (mean ± SD) in 100 and 95% MCP home ranges of long-eared owls.

100% MCP = 504.7 ha; 7 tracked individuals) in the non-breeding season. Lövy (2007) (mean 95% MCP = 342.1 ha, 9 tracked individuals) recorded a bigger average home range size in the breeding season. Marzluff et al. (1997) stated that the size of home ranges decreases with the increasing accessibility to food. Henrioux (2000) explains the increase of home ranges by the uneven distribution of the main prey - common vole - that leads owls to hunt in the new areas, but Aschwanden et al. (2005) showed that the vegetation structure is more important for selection of hunting ground than is prey abundance. Henrioux (2000) also found out the differences for the 100% MCP in the size of home ranges depending on the season and sex. Our results are contrary to this statement but our data are limited by a smaller sample. Long-eared owl prefers hunting in an open land (Mikkola, 1983; Hagemeijer et al., 1997) that is in accordance with the high representation of open land units (meadows and arable land) in the home ranges of the tracked owls. This preference is supported by the high representation of common vole (> 84%, Tulis et al., 2012a, b), the typical inhabitant of agrocenosis (Baláž, 2010) in the diet of long-eared owl in the study area. Woodlands were also abundant land units (mean for 100 and 95% MCP was 18.3 and 17.4%, respectively), but small frequency of woodland species (< 3.5%) like yellow-necked mouse (*Apodemus flavicollis*) or bank vole (*Clethrionomys glareolus*) in diet of long-eared owl in study area showed that owls used woodlands less as hunting place. Small amount of linear vegetation was surprising, whereas this land unit was attractive mainly for songbirds as hiding and nesting place (Kalivoda et al., 2010).

The land units' composition in the home ranges has an impact on their size (Redpath, 1995). The increasing of the home ranges size caused by the increasing number of built-inhabited areas in the home ranges point out the long-eared owls avoidance of this land unit just as has been discovered by Henrioux (2000). Lövy, Riegert (2013) recorded bigger home ranges in the urban long-eared owls than in the suburban long-eared owls. These results prove that long-eared owls use the built-inhabited areas mostly for a place to hide during the day. Nesting of long-eared owls is assumed to be mainly related to a lower predator pressure in the vicinity of human dwellings in the incubation period (Sharikov et al., 2010). Owls do not find a sufficient place to get food in the built-inhabited areas that leads them to use bigger home ranges and to hunt in an open land. The evidence is given by the low representation of synanthropic mammal species in the diet of long-eared owls in the same study area during the whole year (Tulis et al., 2012 a, b) by the fact that the main diet component - common vole gets deeper through the settlements only in the years of species gradation (Pelikán, 1986). In the forest edges, the increase of plants biomass and subsequently, the increase of herbivores abundance come about (Otto, 1994), which explains the higher representation of forest edges in the home range as a potentially suitable place to hunt. The edge habitats are very important for the land just because of their high biodiversity (Forman, 1995). Our results of the high representation of the forest edges in home ranges are in accordance with the results of Henrioux (2000). Galleotti et al. (1997), Martínez, Zubergoitia (2004), Lövy, Riegert (2013) have observed the preference of this part of the land. The number of wintering individuals changing during the winter (Noga, 2007; Pirovano et al., 2000) and their abundance culminating in December (Wijnandts, 1984) point out the fact that long-eared owls may change the particular winter roosts. It is only Wijnandts (1984) who describes the abandonment of winter roosts and the movement of the individuals between the winter roosts during the winter, however, without any specific facts. During our study, we have recorded several other observations, which support this theory. The tracked individual *Asio otus* 4 has been caught near the winter roost A (Fig. 1). During the telemetric tracking, we have localised its winter roost 1.5 km from the winter roost A in the pine wood (in the rural zone; winter roost C). Together with *Asio otus* 4, other six individuals of long-eared owl have been observed in this area. Twenty seven days after the marking, *Asio otus* 4 left the area for unspecific reasons and it was no longer recorded in the study area. The winter roost C has been abandoned since then. The individual *Asio otus* 6 remained out of reach of receivers for 12 days during the observation. It subsequently showed up in the winter roost A where it stayed for the rest of the wintering. The reason for these relocations during the winter may be a sudden change of the meteorological factors highly impacting on the diet of long-eared owls (Sharikov, Makarova, 2014), just as on the number of wintering long-eared owls itself (Pirovano et al., 2000). The other reason for the relocation to another winter roost may be a human disturbance (Noga, 2007) or other impacts and their combination.

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