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Home range sizes and roosting places in capercaillie (*Tetrao urogallus* L.) cocks living solitary in the West Carpathians

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Abstract

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From 1988–2005, home range sizes and roosting places in capercaillie cocks leaving solitary were studied in the mountains of central Slovakia (Veľká Fatra Mts., Malá Fatra Mts., Kremnické vrchy Mts., Starohorské vrchy Mts., and Nízke Tatry Mts., West Carpathians, 18°50'–19°10'E; 48°47'–49°19'N). Home range sizes in males living solitary were largest in summer (82 ha) and smallest during the display period (only 34 ha). Capercaillie males roosted during day prevailingly on the ground all year long (maximally in spring – 96%). Most roosting sites were located at the base of the tree trunks underneath the low branches (77%), then near wind-falls or stumps (9%) and rock boulders (5%). Capercaillie males roosted during night almost exclusively on trees. Only when conditions for snow-roosting were good (sufficient amount of powder snow) and temperature dropped below –15 °C, capercaillies also roosted in snow burrows (13% during winter and 3% in autumn).

Key words

capercaillie *Tetrao urogallus*, home range, roosting, Carpathians

Introduction

Capercaillie *Tetrao urogallus* L., 1758 is large ground-nesting grouse species with precocial chicks inhabiting in small isolated populations also a central-European mixed spruce-beech-fir and mountain spruce forest in the West Carpathians (Klaus et al., 1986; Saniga,1996a, b, c). These forests have been undergoing radical changes from a natural regime to a managed system in the course of the twenty century. Modern forestry is one of the most important landscape factors in forest ecosystems today. Especially during the last fifty years, the forestry practice of clear-felling has fragmented the forests into a mosaic of clear-cuts, plantations and remaining islands of old forest.

In recent years, more attention has been directed towards the effects of forest habitat changes on faunal diversity and performance of wildlife populations (e.g., Helle, 1985; Väisanen et al., 1986; Lindén,1981; Storaas et al., 1999). The loss and insularization of forest habitat are accompanied by a loss of forest species diversity. In terms of landscape ecology this large-scale change in forest mosaic is expected to have profound effects on spacing pattern and range use of wildlife species, especially those having home ranges and cruising radii within the critical area interval (Rolstad and Wegge, 1989). Capercaillie belongs to this area-sensitive category, inhabiting old forest most of the year, and having seasonal ranges between 10 and 100 hectares in size (Wegge and Larsen, 1987). Modern forestry modifies capercaillie habitats by fragmenting continuous forest, and by altering the internal structure and tree species composition of forest stands.

In recent few decades, capercaillie populations throughout most of western Europe have declined markedly (e.g., Nováková and Šťastný, 1982; Klaus et al., 1986; Klaus and Bergmann, 1994; Saniga, 1999). A decline in capercaillie populations has also been observed during the last 20–30 years in Fennoscandia and Russia (e.g., Rajala and Lindén,1984; Rolstad and Wegge, 1989).

Most Slovakian data concerning the population dynamics of the capercaillie come from hunting statistics (Bancík, 1969; Ferianc, 1977; Richter, 1983). Only few serious ecological and ethological population studies have been made on this endangered grouse species in the West Carpathians (Saniga,1996a, b, 1999).

This paper documents important structural features of the habitat, home range sizes and roosting places in capercaillie cocks leaving solitary in the mountains of the West Carpathians.

Study area

The field work took place in the mountains of central Slovakia (Veľká Fatra Mts, Malá Fatra Mts, Kremnické vrchy Mts, Starohorské vrchy Mts, and Nízke Tatry Mts, West Carpathians, 18°50'–19°10'E; 48°47'–49°19'N) from 1988–2005.

The topography rises from 600 m asl to 1,530 m asl. The climate is moderately continental with a mean temperature of the warmest month (July) of 14.5 °C and minus 5.5 °C for the coldest (January). Annual mean precipation is 1,000–1,400 mm, and the ground is usually covered with snow from mid-November to late March or April (depending on the see-level and exposure).

In the area under study, mixed forest biocoenoses consisting of the spruce-beech-fir vegetation belt dominate (90%) (*Picea abies* Karsten, 1881, *Abies alba* Miller, 1768, *Fagus sylvatica* L., 1753, *Acer pseudoplatanus* L., 1753). Coniferous forests of the spruce vegetation belt constitute around 10% of the study area (*Picea abies* dominated, sprinkled with *Acer pseudoplatanus*, *Fagus sylvatica*, and *Sorbus aucuparia* L., 1753).

The area is a mosaic of small patches of different groups of forest types (classifications according to Randuška et al., 1986). Fageto-Aceretum, Abieto-Fagetum and Fageto-Abietum cover about 80% of the forested area under study, and Sorbeto-Piceetum with Acereto-Piceetum about 10%.

As for the age-space structure of forest stands, in the spruce-beech-fir vegetation belt, islands of old forests (over 80 years) very different in size (from 5 ha to maximally 50–75 ha) are broken up into a mosaic of clearcuts and plantations of various ages and sizes. In the spruce vegetation belt, unmanaged natural forests around 150–180 years old predominate (80%).

Ground vegetation changes locally depending on the forest type. In the mixed forests (spruce-beech-fir vegetation tier), ferns (*Athyrium filix-femina* Roth, 1799, *Dryopteris* sp.) are often common. In the biocoenoses of the spruce vegetation tier, dominant ground vegetation is Bilberry (*Vaccinium myrtillus* L., 1758), some species of graminoids (*Deschampsia flexuosa* Drejer, 1852, *Calamagrostis* sp.) and also ferns (*Dryopteris dilatata* Christens, 1905).

Potential capercaillie egg and chick predators are corvid birds, particularly Jay *Garrulus glandarius* (L., 1758) and raven *Corvus corax* L., 1758, sparrowhawk *Accipiter nisus* (L., 1758), goshawk *Accipiter gentilis* (L., 1758), golden eagle *Aquila chrysaetos* (L., 1758), ural owl *Strix uralensis* Pallas, 1771, and tawny owl *Strix aluco* L., 1758. Among mammals there are red fox *Vulpes vulpes* L., 1758, pine marten *Martes martes* (L., 1758), beech marten *Martes foina* (Erxleben, 1777), small mustelids (*Mustela erminea* L., 1758, *Mustela nivalis* L., 1766), wild boar *Sus scrofa* L., 1758, brown bear *Ursus arctos* L., 1758, and lynx *Lynx lynx* (L., 1758).

According to the latest census work, the spring density of capercaillie is 0.3–0.7 males per km^2, roughly corresponding to 1/3 of female density (Saniga, 1999).

Material and methods

Home ranges of six capercaillie solitary living cocks were studied in 1988–2005 during spring (March–May), summer (June–September), autumn (October–November), and winter (December–February). Three males were studied six years and three seven years. I defined a solitary living cock as a male which lived and displayed alone and neighbouring cock lived minimally in 5 km distance. Home ranges were determined especially by searching for birds. Indirect evidence of capercaillie cocks occurrence and activity was also collected (tracks in the snow and sand, caecal droppings, shed feathers, scraps of left-over food, such as broken twigs, spilled needles and absence of buds on seedlings). These data helped to guide me to leks, roosting and feeding places (trees), and eventually, they made clear the seasonal distribution of capercaillie cocks in the forest biocoenoses of the study area.

Because ground activities take place near to feeding and roosting trees, home ranges can be mapped by locating feeding and roosting trees (activity trees). An activity tree was a tree with a minimum of five droppings beneath it. A feeding tree was an activity tree beneath which I also found spilled needles with beak marks. I consider the number of activity trees to be a good measure of how much an area was used by capercaillie, because in cases for which data were available the number of activity trees was positively corelated with the number of birds present and the time of stay. Intestinal faeces excreted regularly every 12–13 min. (Klaus et al., 1986), and caecal droppings excreted once or twice a day (Moss and Hanssen, 1980), accumulate beneath capercaillie feeding trees (identified by droppings and spilled needles) and roosting trees (droppings only) especially during winter. To ensure that the bird has stayed at the spot for some time, only heaps with three or

more droppings were included. In early spring (March-early May), conspicuous yellowish-brown faecal remnants in the melting snow show trees used during the preceding 5–6 months (Gjerde, 1991a).

Home ranges of six capercaillie cocks living solitary were investigated. In all, 1,020 roosting places (484 in spring, 140 in summer, 190 in autumn, and 206 in winter) and 584 daytime locations (229 in spring, 75 in summer, 178 in autumn, and 102 in winter) were registered. Daytime locations were used to estimate sizes of home ranges and other measures of spacing. I estimated the sizes of home ranges according to a modified version of Harvey and Barbour's (1965) „modified minimum area method". The distance between the two widest-spaced daytime positions was measured and divided in half. A line was then drawn clockwise among all successive outermost points that were spaced shorter than this half maximum distance. Positions farther away than the maximum distance were defined as excursions and were not included in the estimate of home range size.

Because home range size is a function of sample size and increased to an asymptote with increasing number of locations, the sizes of home ranges could be estimated reliably only for males that were located a minimum of 25 times. Values reported are means ± SE.

Results and discussion

Home range size in capercaillie males living solitary

Home range sizes in males living solitary were largest in summer (82 ha) and smallest during the display period (only 34 ha). Birds living in highly fragmented areas (4) have larger home ranges than those living in continuous nature forests in (Table 1). All males lived close to their home leks (showed strong affinity for their lek areas) during spring, winter and autumn seasons (Fig.1). Males belonging to highly fragmented lek areas stayed farther away from the lek in winter, spring and autumn than males with leks situated in less fragmented areas. Gjerde and Wegge (1989) found at Varaldskogen in south-east Norway that in highly fragmented areas, home ranges of capercaillie males were always large. In less fragmented areas, both large and small home ranges existed, indicating that factors other than habitat fragmentation also affected home range size. Among these factors, different quality of old forest habitats and local social situations may be of particular importance. According to Wegge and Larsen (1987), capercaillie males younger than 3 years have larger home range sizes than older than 3 years during the breeding season. These authors found home range sizes for 1 and 2 year old males 126 ha, for 3 year old cocks 61 ha, and for 4 year olds and older 21 ha during the breeding season, which corresponds with the results of this study. Young males have the largest home ranges during winter, as during spring (Wegge and Larsen, 1987) and summer (Rolstad et al., 1988). This probably reflects a general tendency of habitat exploration among young individuals. In south-east Norway, winter home range sizes of subadults was 98.4 ha and adult males 63.5 ha (Gjerde and Wegge, 1989), which are very similar values of my study. Rolstad and Wegge (1987) found that among adult capercaillies (>2 years), 77% made distinct movements from spring territories to summer home ranges at Varaldskogen in south-east Norway. A distinct movement was defined as a directional movement of 1 km or more within a 5 day period. Of these capercaillies, 21 had no overlap between spring and summer ranges, which was not observed among capercaillies living solitary investigated in the West Carpathians (Fig. 1). Rolstad (1989) and Gjerde and Wegge (1989) found that whereas spring and late winter home ranges usually overlapped, summer and autumn ranges were located further away from the lek with little or no overlap. The data from the Russian leks confirmed that capercaillie males undertook distinct seasonal movements from pine-dominated winter/spring ranges to rich spruce-dominated summer ranges (Hjeljord et al., 2000).

Thus, like tundra and steppe inhabiting grouse genera, forest-dwelling grouse may undertake well-defined long-distance migrations in certain parts of their distribution range, but may be partially migratory with short-distance movements or almost sedentary in other

Table 1. Size of home ranges in hectares (N – number of home ranges, HR – range, M – mean, SE – standard error in capercaillie cocks living solitary in the West Carpathians, Slovakia (1988–2005)

	Nighttime locations				Daytime locations			
Season	N	HR	M	SE	N	HR	M	SE
Spring	6	3–22	13	±2	0	12–58	34	±6
Summer	3	14–34	26	±5	4	37–112	82	±15
Autumn	4	11–30	18	±3	6	30–92	67	±12
Winter	4	13–29	20	±3	4	28–102	62	±11

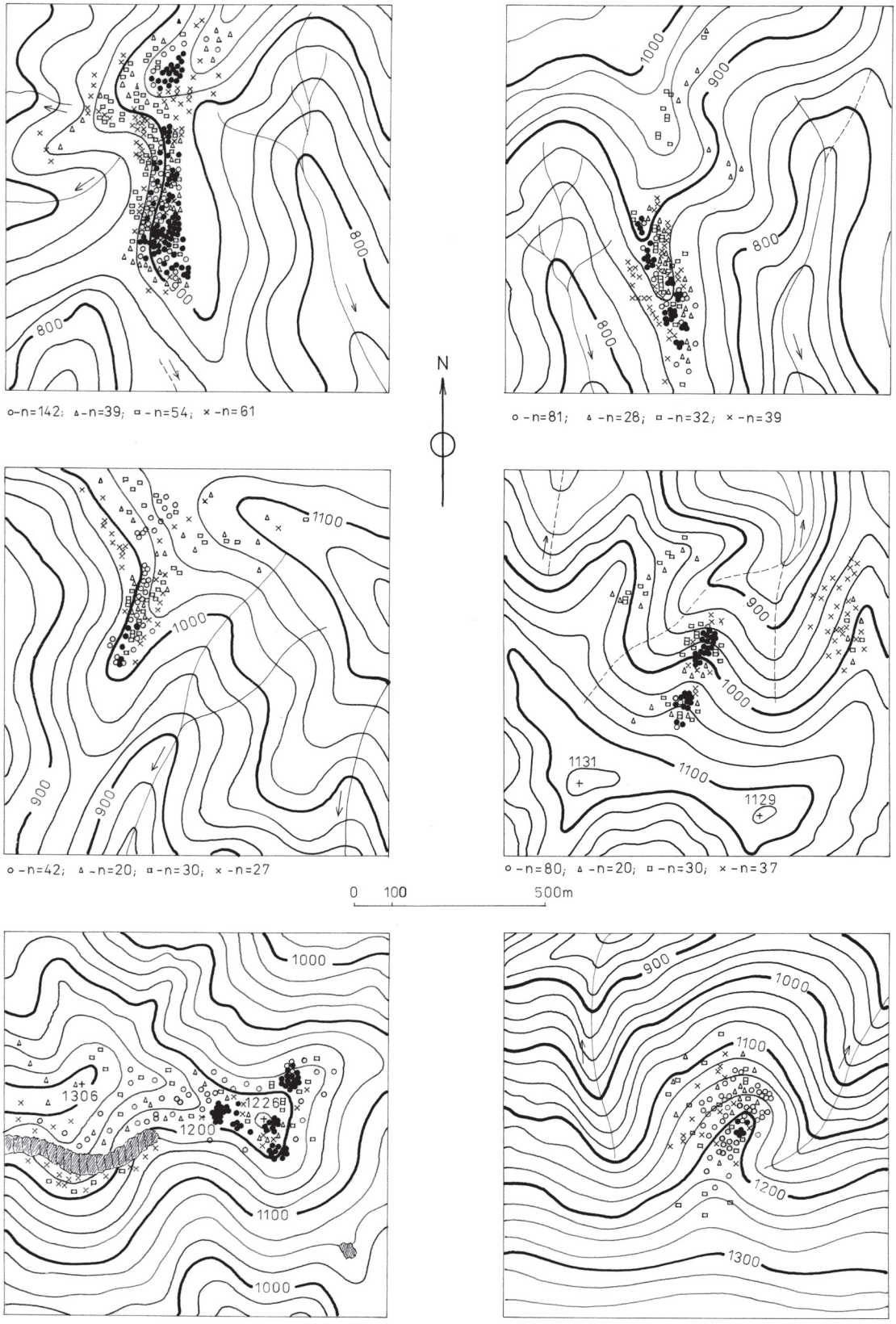

Fig. 1. Daytime and nighttime locations of roosting places in six capercaillie cocks living solitary in the West Carpathians, Slovakia, 1988–2005, n = 1020
○ – spring season, Δ – summer season, □ – autumn season, x – winter season

parts (the West Carpathians). The data from the Russian leks confirmed that capercaillie males undertook distinct seasonal movements from pine-dominated winter/spring ranges to rich spruce-dominated summer ranges (Hjeljord et al., 2000).

Areas where capercaillie cocks spent nights ("nighttime home ranges") were significantly smaller (roughly 1/3) than daytime home ranges (Table 1, Fig. 1). Site fidelity to nighttime roosting places was strong and all birds used the same territory in successive years (six and seven years, respectively). On the contrary to the investigations of Wegge and Larsen (1987), the lek area was also part of the daytime territory of all the males living solitary also during the lekking period. All investigated males visited during their lives only one lek during the display season.

Daytime roosting sites in capercaillie males living solitary

Capercaillie males roosted during day prevailingly on the ground all year long (maximally in spring – 96%, Table 2). Daytime roosting on trees was the highest during summer season (12%), because in this part of the year are best hiding places among deciduous tree species. Among the sites on the ground, most roosting sites were located at the base of the tree trunks underneath the low branches (77%), then near wind-falls or stumps (9%) and rock boulders (5%). When conditions for snow-roosting were good, capercaillies roosted in snow drifts (11% during winter season).

Birds preferred Norway spruces for daytime roosting all year long, especially during winter season (87%, Table 3). Daytime roosting places at the base of the coniferous trees were favoured to deciduous (94% and 6%, respectively). Coniferous trees were used as shelter almost dominantly especially during winter season (96%). Proportion of daytime roosting places near the trunk of deciduous tree species rised in spring and summer season (7% and 12%, respectively). Other coniferous tree species (Fir-tree, Pine) may substitute for spruce as cover when the birds roost on the ground, and a shrub layer may even be unimportant when conditions for snow-daytime roosting (drifts) are good (Gjerde, 1991a). According to this author, the importance of spruce roosts for saving energy is more uncertain, because spruce roosts are not used at night (low temperatures) and are used more frequently in late winter than in mid-winter.

In relation to height of the trees, capercaillies roosted prevailingly near the trees higher than 10 m (69%). During summer and autumn seasons, birds were found to roost in higher degree also in thickets (19%, and 22%, respectively, Table 4). Vegetation types with well developed understorey were preferred whereas forests which were thinned by reducing the amount of understorey spruce (single-layered stands) were avoided which is in accordance with Finne et al. (2000) conclusions. According to these authors, it is possible that capercaillie males prefer forest with a well-developed understorey when roosting. I never found capercaillie males roosting at plantations, which confirms Larsen and Wegge (1985) conclusions that plantations are unsatisfactory habitats for food and shelter against predators. Several studies, including this study, have documented the importance of spruce and forest understorey for capercaillie. Seiskari (1962) stated that the dependence on spruce seemed to be the essential feature in the habitat requirements of capercaillie during snow-free season. In a large uncut reserve in the northern Russian taiga, Beshkarev et al. (1995) reported an extensive use of clumps of spruce within the open pine-dominated forest during daytime in spring. The importance of understory cover for capercaillie males in winter has been documented empirically and demonstrated experimentally by removing spruce trees in intensively used areas (Gjerde, 1991a, b). According to Finne et al. (2000), to create forest suitable for both roosting and foraging a varying forest structure and density is advantageous, and thinnings in middle-aged plantations should be executed in a way that increase the heterogeneity of the stand in relation to type of tree species and stem density. High

Table 2. Positioning of daytime roosting sites in capercaillie cocks living solitary in the west Carpathians, Slovakia, n = 353 (1988–2005)

Place	Tree trunk		Rock boulder		Windfall		On tree		Snow drift		Sum
Season	N	%	N	%	N	%	N	%	N	%	N
Spring	135	83	7	4	12	7	6	4	2	2	162
Summer	43	74	2	4	6	10	7	12	0	0	58
Autumn	45	74	3	5	7	11	4	7	2	3	61
Winter	47	65	5	7	8	11	4	6	8	11	72
Sum	270	77	17	5	33	9	21	6	12	3	353

vertical cover close to the ground can also be obtained by rejuvenating the forest on the basis of selection-cutting and natural regeneration instead of clear-cutting and planting.

Because dense cover reduces the probability that the birds are detected by a predator, but at the same time increases the risk of being killed once detected, capercaillie males have to compromise between shelter and outlook. Finnes's et al. (2000) data indicate that males prefer good cover at the expense of good overview of the surroundings when selecting roosting sites, and that tree density is usually too dense in younger plantations, probably because outlook is reduced and flying obstructed. The forest structures preferred by capercaillie in winter may be optimal when hidding from predators, or those preferences may simply reflect the forest types that support the best food (Gjerde, 1991a, b).

Nighttime roosting sites in capercaillie males living solitary

Capercaillie males roosted during night almost exclusively on trees (Table 5). Only when conditions for snow-roosting were good (sufficient amount of powder snow) and temperature dropped below –15 °C, capercaillies also roosted in snow burrows (13% during winter and 3% in autumn). Both in southern Finland (Seiskari and Koskimes, 1955) and in southeastern Norway (Gjerde, 1991a) roosting of capercaillies in snow burrows was uncommon compared with roosting at the base of the spruce trees.

During display season, males preferred for nighttime roosting deciduous trees (59%), whereas in other parts of the year birds roosted more often on coniferous trees (54% in summer, 66% in winter and 74% in autumn, respectively). Seasonal differences in selection of tree species for nighttime roosting were coditioned by (1) climatic conditions (better in canopies of coniferous species); (2) protection against potential aerial and ground predators (better cover in conifers especially during the winter season); (3) display activity of the cocks (better visibility of displaying males in deciduous trees).

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Table 3. Positioning of daytime roosting sites in capercaillie cocks living solitary in relation to tree species in the West Carpathians, Slovakia, n = 270, (1988–2005)

Tree species	Spruce		Fir-tree		Pine		Larch		Beech		Sycamore		Sum
Season	N	%	N	%	N	%	N	%	N	%	N	%	N
Spring	104	77	15	11	4	3	3	2	6	5	3	2	135
Summer	25	58	4	9	5	12	4	9	2	5	3	7	43
Autumn	37	82	4	9	2	4	1	2	0	0	1	3	45
Winter	41	87	2	5	1	2	1	2	1	2	1	2	47
Sum	207	77	25	9	12	5	9	3	9	3	8	3	270

Table 4. Positioning of daytime roosting sites in capercaillie cocks living solitary in relation to tree height in the West Carpathians, Slovakia, n = 270, (1988–2005)

Season	Spring		Summer		Autumn		Winter		Sum	
Height class	N	%	N	%	N	%	N	%	N	%
1–5 m	15	11	8	19	10	22	7	15	40	15
5–10 m	19	14	8	19	8	18	7	15	42	16
>10 m	101	75	27	62	27	60	33	70	188	69
Sum	135	100	43	100	45	100	47	100	270	100

Table 5. Positioning of nighttime roosting sites in capercaillie cocks living solitary in the West Carpathians, Slovakia, n = 667, (1988–2005)

Tree species	Spruce		Fir-tree		Pine		Larch		Beech		Sycamore		Rowan		Snow burrow		Snag		Sum
Season	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N
Spring	72	23	19	6	40	12	24	7	123	38	29	9	3	1	0	0	12	4	322
Summer	15	18	7	9	12	15	10	12	23	28	11	13	3	4	0	0	1	1	82
Autumn	53	41	14	11	21	16	8	6	20	16	7	5	0	0	4	3	2	2	129
Winter	51	38	20	15	17	13	12	9	12	9	4	3	0	0	18	13	0	0	134
Sum	191	29	60	9	90	13	54	8	178	27	51	8	6	1	22	3	15	2	667

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Veľkosť teritória a odpočinkové miesta kohútov tetrova hlucháňa (*Tetrao urogallus* L.) žijúcich solitárne v Západných Karpatoch

Súhrn

Práca prináša poznatky o veľkosti teritórií a odpočinkových miestach solitárne žijúcich kohútov tetrova hlucháňa získané v rokoch 1988–2005 na lokalitách v pohoriach stredného Slovenska (Veľká Fatra, Malá Fatra, Kremnické vrchy, Starohorské vrchy a Nízke Tatry, Západné Karpaty, 18°50'–19°10'E; 48°47'–49°19'N). Najväčšie teritóriá obhajovali kohúty tetrova hlucháňa v letnom období (jún–september, 82 ha) a najmenšie na jar počas obdobia tokania (marec–máj, 34 ha). Kohúty žijúce vo viac-menej súvislých lesných komplexoch obývali menšie teritória ako na lokalitách vyznačujúcich sa vysokým stupňom fragmentácie dospelých porastov. Kohúty odpočívali počas dňa prevažne na zemi počas celého obdobia roka (najviac na jar – 96 % nálezov). V korunách stromov odpočívali kohúty vo zvýšenej miere (12 % nálezov) najmä v letnom období (jún–september), kedy olistené listnáče (buk lesný a javor horský) poskytovali vtákom vhodný úkryt. Prevažná väčšina odpočinkových miest bola lokalizovaná pri báze kmeňov pod vetvami hlboko zavetvených stromov (77 %), potom v blízkosti koreňových koláčov vývratov a povalených kmeňov stromov (9 %) a veľkých skál (5 %). Kohúty tetrova hlucháňa trávili nočný odpočinok takmer výlučne v korunách stromov. V prípade vhodných snehových pomerov (sypký sneh) a nevhodných poveternostných podmienok (silný mráz pod mínus 15 °C a vietor) hlucháne trávili odpočinok aj v snehu (13 % nálezov počas zimných mesiacov, 3 % v jeseni). Počas tokania kohúty preferovali pre nočný odpočinok listnaté stromy (59 %), zatiaľ čo v ostatnom období roka prevažovalo nocovanie na ihličnatých stromoch (54 % v lete, 66 % v zime, resp. 74 % v jeseni). Sezónne diferencie vo výbere nocovacích stromov boli podmienené: (1) mikroklimatickými podmienkami (lepšie v korunách ihličnatých drevín); (2) ochranou pred potenciálnymi vzdušnými a pozemnými predátormi (lepšie krytie v ihličnatých drevinách najmä počas zimných mesiacov, keď sú listnaté dreviny bez listov); (3) aktivitou súvisiacou s prejavmi tokania kohútov (lepšia viditeľnosť tokajúcich kohútov na neolistených listnatých drevinách než na ihličnatých).