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Habitat features of the capercaillie (*Tetrao urogallus*) leks in the West Carpathians

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ABSTRACT: Habitat characteristics of 43 capercaillie (*Tetrao urogallus*) leks were studied in the mountains of Central Slovakia (West Carpathians) in 1984–2002. Macro-habitat was described with respect to topography and succession stage. Micro-habitat was described with respect to forest type and forest stand structure. Twenty-seven out of forty-three display grounds were situated in the upper half of the lateral ridges. Sixteen leks were located on hills of the lateral ridges (slope < 10%). All the leks were situated in old succession stages of the forest (80–200 years old). Twenty-seven display grounds were located in natural forests, sixteen leks were situated in man-managed stands more than 80 years old. Leks were situated in a variety of forest types with overstorey tree-density between 400–1,050 stems per ha. Distribution of leks was limited above all by macro-habitat characteristics (elevated sites, old stands). Age-space structure seemed to be a significant micro-habitat feature (preference of multi-layered stands).

Keywords: capercaillie; *Tetrao urogallus*; lek; habitat; West Carpathians

Capercaillie (*Tetrao urogallus* L.) is distributed throughout the northwestern and central part of the Palearctic region, occupying the old seral stages of boreal forests (SEISKARI 1962; KLAUS et al. 1986).

Habitat studies of capercaillie leks reported from Central Europe emphasize the significance of old, heterogeneous and multilayered forests (SCHRÖDER 1974; EIBERLE 1976; SCHERZINGER 1976; MÜLLER 1978; SANIGA 1996a,b). On the other hand, some authors claim that lek habitat requirements are rather wide (VALKEAJÄRVI, IJÄS 1986). According to HJORTH (1982, 1985), a long term constant habitat structure is a crucial characteristic of lek habitats.

The aim of this study is to summarize the knowledge of habitat features of capercaillie leks in the mountains of Central Slovakia (West Carpathians) obtained between 1984–2002.

MATERIALS AND METHODS

STUDY AREA

The field work was conducted 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 1984 to 2002.

The topography rises from 600 m a.s.l. to 1,530 m a.s.l. The climate is moderately continental with mean temperature of the warmest month (July) 14.5°C and –5.5°C for the coldest month (January). Yearly mean precipitation 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 altitude and exposure).

In the area under study, mixed forest biocoenoses consisting of the spruce-beech-fir vegetation zone dominate (90%) (*Picea abies, Abies alba, Fagus sylvatica, Acer pseudoplatanus*). Coniferous forests of the spruce vegetation zone constitute around 10% of the study area (*Picea abies* dominant, interspersed *Acer pseudoplatanus, Fagus sylvatica,* and *Sorbus aucuparia*).

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 zone, 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 zone, unmanaged natural forests around 150–180 years old predominate (80%).

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Ground vegetation changes locally depending on the forest type. In the mixed forests (spruce-beech-fir vegetation zone), ferns (*Athyrium filix-femina, Dryopteris* sp.) are often common. In the habitats of the spruce vegetation zone, dominant ground vegetation is bilberry (*Vaccinium myrtillus*), some species of graminoids (*Deschampsia flexuosa, Calamagrostis* sp.) and also ferns (*Dryopteris dilatata*).

FIELD INVESTIGATIONS

Habitat features and numbers of displaying cocks were studied in forty-three leks. During a systematic search of potential areas during evening and morning display activities, and by snow-tracking and field-checking information provided by local sources twenty-five leks in the Veľká Fatra Mts., six leks in the Malá Fatra and Kremnické vrchy Mts., three in the Nízke Tatry and Starohorské vrchy Mts. were found.

All the leks were censused at least twice during the second half of April and the first decade of May between 1984–2002. Leks were described with respect to their macro-habitats (topography and succession stage of stands) and micro-habitats (forest type, tree composition, and forest structure). Habitat features were assessed within a 1 ha (100 × 100 m) sample quadrat (SQ). It was selected around the most centrally located display site, usually the mating site. I regard the term lek as the place where males collect. In this paper, I use the term lek interchangeably with display and lekking grounds.

To permit statistical analysis of lek features, I compared lek SQs (43) with SQs (20) selected randomly in the study area. In the statistical analysis I used χ^2 test and Bonferroni *Z*-test (ZAR 1996; HINTZE 1997).

Geobiocoenological characteristics of the leks were described according to the typology maps and Forest Management Plans made in 1986–2001 by Lesprojekt Žilina. Some habitat features were obtained in the field. The geobiocoenological nomenclature of groups of forest types was used according to RANDUŠKA et al. (1986).

RESULTS AND DISCUSSION

GENERAL HABITAT FEATURES

As a typical inhabitant of the Palearctic boreal forests, in Central Europe the capercaillie is bound to the climax stage of the forest from lowlands to the tree limit in the Alps, Pyrenees, and the Carpathians (KLAUS et al. 1986). Primeval forests in the stage of disintegration fit the ecological requirements of the capercaillie perfectly (EIBERLE 1974).

In the study area in the West Carpathians, the capercaillie inhabited old natural forests (100–250 years old) in the spruce-beech-fir (850–1,270 m a.s.l.) and spruce vegetation zones (1,250–1,530 m a.s.l.). Optimal conditions were met not only in mountain mixed forests with canopy closure of the overstorey of 60–70%, composed of spruce, fir, beech, and sycamore maple, but also in primeval spruce forests interspersed with beech, rowan, and sycamore maple.

The presence of not very dense understorey composed of the tree species of the overstorey (for concealment, roosting and feeding), and of good species diversity of vegetation cover (for feeding) seemed to be very important features of the capercaillie habitat. Dwarf pine biocoenoses at an altitude of 1,350–1,480 m also created a suitable habitat for this tetraonid, especially the zone adjacent to the spruce vegetation zone where the stands tended to be discontinued. However, there had to be numerous glades with bilberry bushes. In the study region, capercaillie occurred only occasionally in the forests of the fir-beech vegetation zone below 700 m a.s.l.

The capercaillie was not a permanent inhabitant in stands near the centres of human activities (frequented tourist paths, ski-slopes, mountain hotels), although these biocoenoses also fulfilled the capercaillie's habitat requirements in their species-space structure.

Because the area of original forest is smaller (17%) than that of plantation stands, part of the population had to use the latter. The birds preferences were largely for those man-plantations very similar to their species-space structure to natural forests (80–120 years old, canopy closure of the overstorey of 60–80%, developed understorey, rich vegetation cover). Birds were often seen on clearings until the plantation closed and they could move among the trees (7–12 years old). Managed stands of the age of 12 (15)–50 years were avoided, which was understandable because the stands were too close to permit movement of birds, and there was not enough light to allow food plants to grow.

In the Alps, the capercaillie population especially prefers mountain mixed forests composed of spruce, fir, beech, and sycamore maple to an altitude of 1,500 m (SCHRÖDER et al. 1982). In higher alpine locations (1,500–1,900 m), birds occupy the larch-cedar-pine forests.

Capercaillie habitat in the Bavarian forest (SCHERZINGER 1976) does not differ from that of the West Carpathians (primeval spruce forests and mountain mixed stands up to 1,453 m a.s.l.).

MACRO-HABITAT

Topography

Twenty-seven out of forty-three leks were situated in the upper half of more or less convex, lateral ridges a certain distance (30–300 m) from the main ridge. Sixteen leks were situated on hills of lateral ridges (slope < 10%) (Figs. 1–3). A significantly greater proportion of the display grounds was situated at a higher terrain level than expected (Bonferroni *Z*-test; $Z = 3.19$, $P < 0.01$). This was in accordance with Central European and Scandinavian investigations which have reported hills and ridges to be attractive capercaillie display grounds (EIBERLE 1976; SCHERZINGER 1976; ROLSTAD, WEGGE 1987). Also other forest-dwelling grouse, e.g. the blue grouse

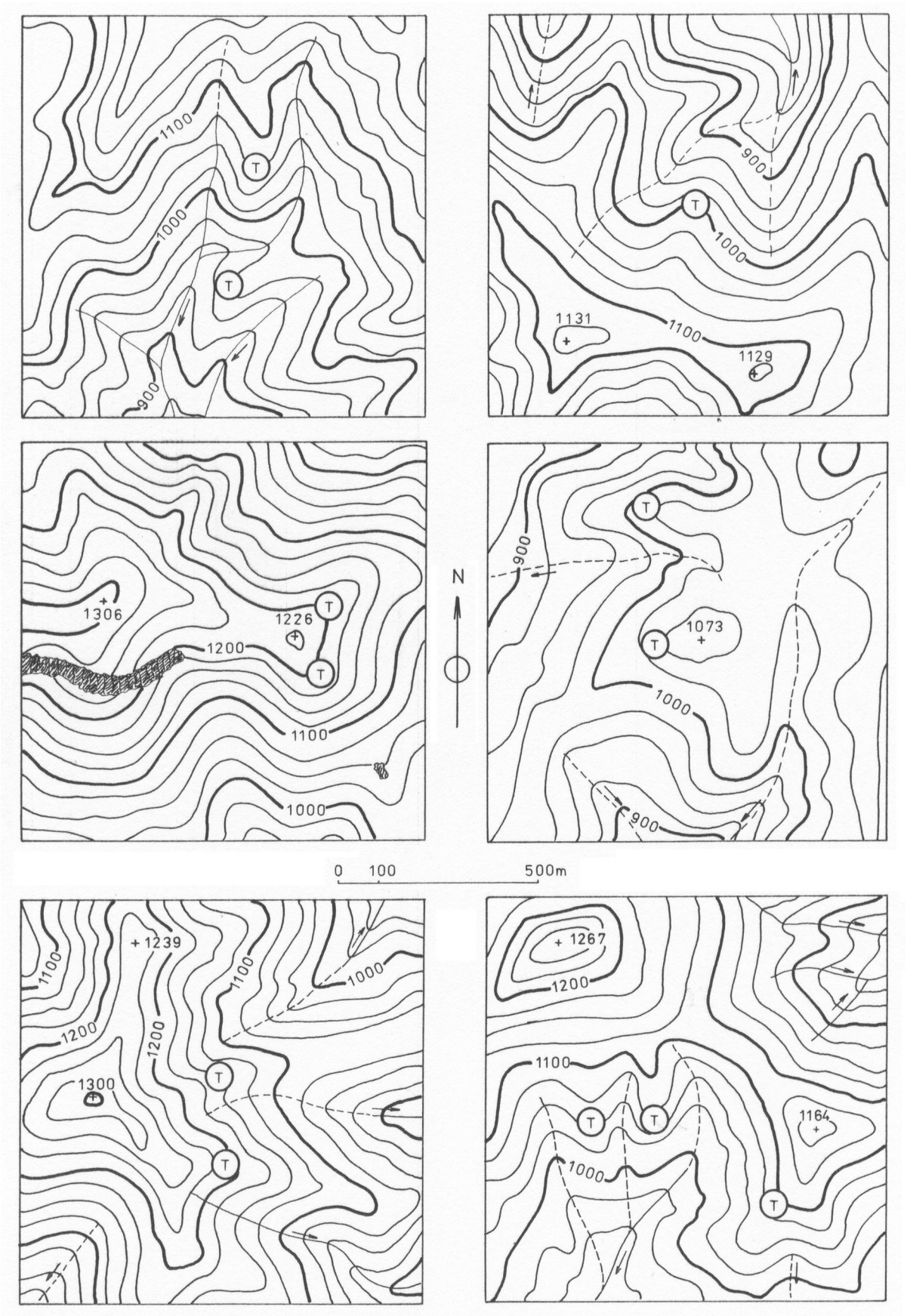

Fig. 1. Location of the capercaillie leks with respect to topography, Veľká Fatra Mts. (5), Starohorské vrchy Mts. (1) – West Carpathians. (Explanation: L – lek, contour interval: 25 m)

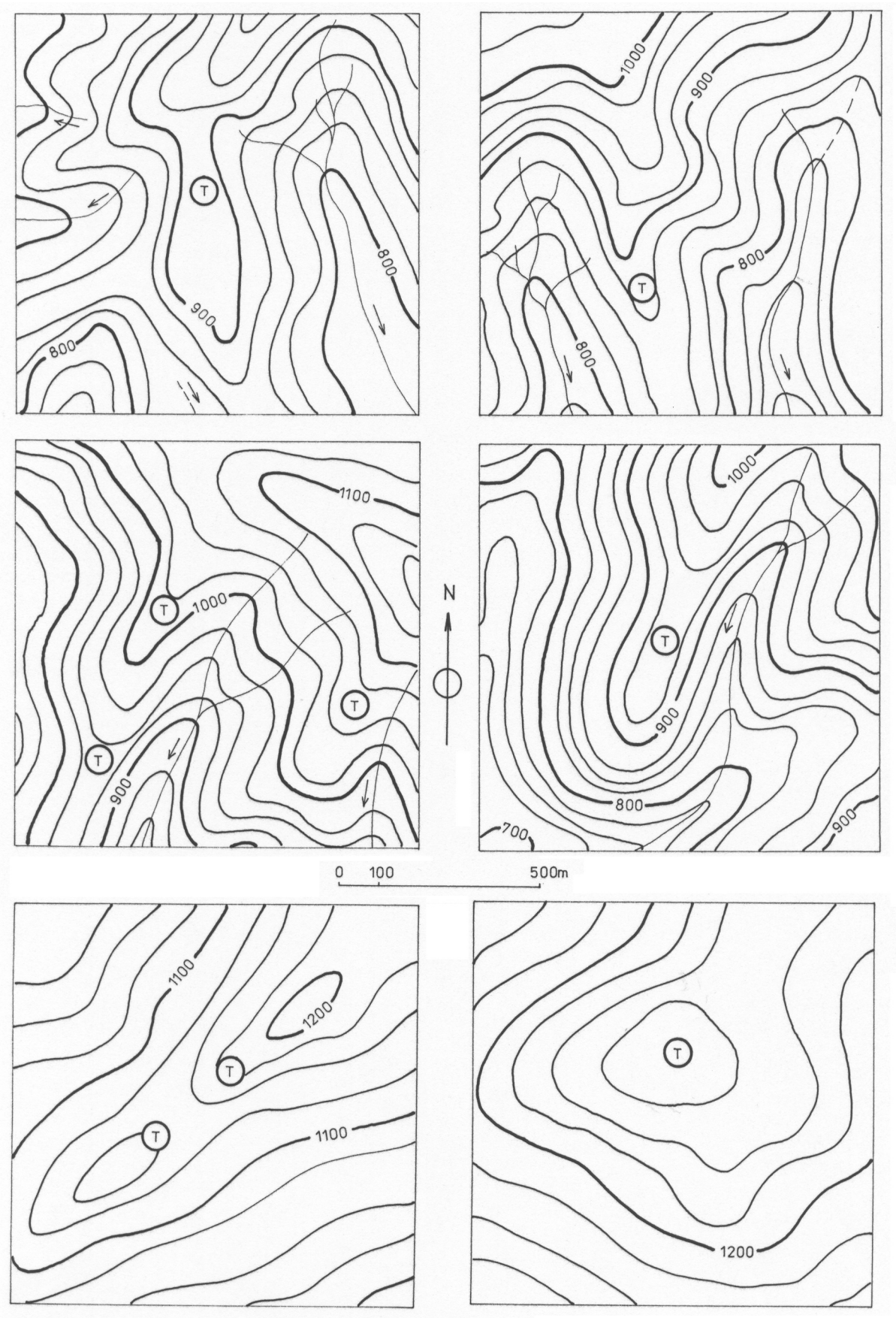

Fig. 2. Location of the capercaillie leks with respect to topography, Veľká Fatra Mts. (4), Kremnické vrchy Mts. (2) – West Carpathians. (Explanation: L – lek, contour interval: 25 m)

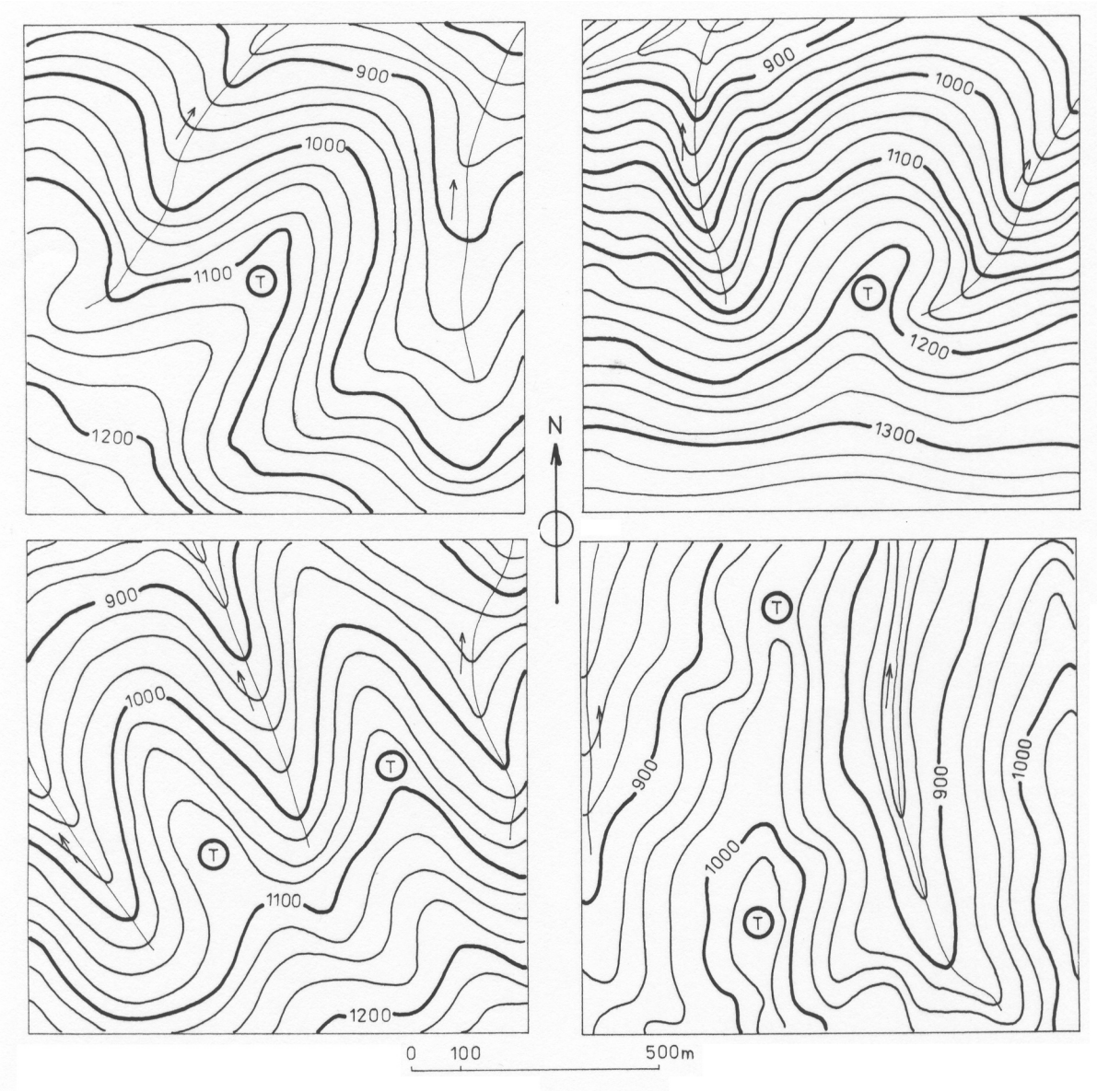

Fig. 3. Location of the capercaillie leks with respect to topography, Veľká Fatra Mts. – West Carpathians. (Explanation: L – lek, contour interval: 25 m)

(*Dendragapus obscurus*), seem to prefer elevated parts of the terrain for display (LEWIS 1981). Leks were located at an altitude between 850–1,400 m.

As no significant differences in habitat features between the terrain levels could be found, capercaillie seemed to prefer elevated sites independently of other habitat characteristics, corresponding with ROLSTAD and WEGGE's (1987) findings. LEWIS (1981) suggests that elevated sites facilitate the display signalling effect and the detection of predators, probably because such habitats are more open than the lower ones. To my knowledge, displaying at hills and topographic ridges may also be due to the fact that such sites are more easy for birds to find, especially in foggy weather and at dusk. MÜLLER (1974) suggests that leks are located at elevated sites because they are used as "flight-corridors" by hens during the mating period. According to ROLSTAD and WEGGE (1987), cocks are able to find secluded places more easily when moving out radially from an elevated site than from a low lying site making it easier to fly away and escape from predators.

With respect to exposure a slight preference to the east was found (12 leks), 7 leks were exposed to the south, 6 to the north, 6 to the north-west, 6 to the south-east, 3 to the north-east, and 3 to the south-west (number of observations was insufficient for the proof of statistical significance: $\chi^2 = 5.0$, $k = 6$, $df = 5$, $\chi^2_{0.05} = 10.925$). However, locations of the leks were predestined according to the aspect of the valley axis. Locations were dependent on the shape of the surrounding terrain and also on local weather conditions, which might be determined by the site aspect. On the contrary, ROLSTAD and WEGGE (1987) did

not find any special preference with respect to exposure in southeastern Norwegian lekking grounds.

Succession stage

All the leks were situated in old succession stages of forests thereby coinciding with some literature data claiming that capercaillie is adapted to old forest habitats (e.g. SEISKARI 1962; EIBERLE 1976; MÜLLER 1978). This preference for old succession stages of the forest was highly significant (Bonferroni *Z*-test; $Z = 7.22$, $P < 0.001$). Twenty-seven leks were located in virgin forests, the remaining sixteen leks were situated in man-managed stands more than 80 years old. As for the tree-height of the stands where capercaillie displayed, cocks preferred trees from 10 to 32 m tall. Cocks did not start display on tops of the trees but they used internal parts of the tree-crown. Most leks (35) had a multilayered stand structure and only eight leks had a monolayered stand (statistically significant difference: $\chi^2 = 4.615$, $df = 1$, $P < 0.032$). Scandinavian studies state that pine-dominated stands more than 50–70 years old with a tree-height of 11–12 m can serve as lek habitats (VALKEAJÄRVI, IJÄS 1986; ROLSTAD, WEGGE 1987).

MICRO-HABITAT

Forest type

Leks were situated in a variety of forest types. Most display grounds (15) were located in the *Fageto-Aceretum* forest type, 8 leks in the *Fageto-Piceetum* forest type, 5 leks in *Abieto-Fagetum* and *Fageto-Abietum*, and 5 leks in the *Sorbeto-Piceetum* and *Acereto-Piceetum* forest types (number of observations was insufficient for proof of statistical significance: $\chi^2 = 6.0$, $k = 6$, $df = 5$, $\chi^2_{0.05} = 11.071$).

Regarding the tree species composition, display grounds occurred in habitats ranging from predominance of coniferous tree species (< 80%, 14 leks) to forests with

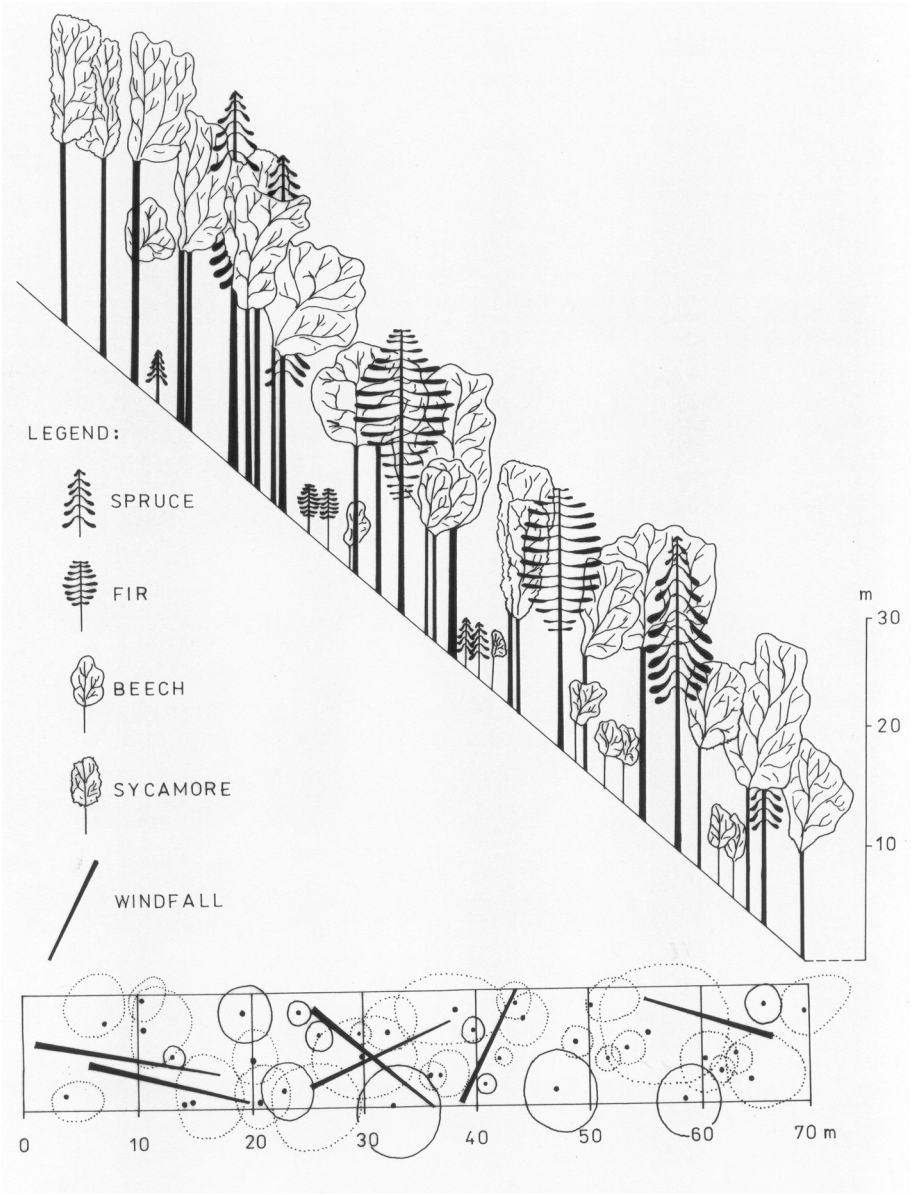

Fig. 4. Forest stand profile of a capercaillie lek in the *Fageto-Abietum* forest type (a virgin forest in the state of ingrowth; mean age of the overstorey – over 150 years; 950 m a.s.l.; Veľká Fatra Mts. – West Carpathians)

predominance of deciduous trees (< 80%, 10 leks). Most leks (19) were made up of mixed forests. Neither absolutely pure coniferous nor deciduous forests were used for the leks (differences in preference of individual forest types by this number of observations were statistically insignificant: $\chi^2 = 2.4$, $k = 3$, $df = 2$, $\chi^2_{0.05} = 5.991$). Coniferous tree species that formed leks were Norway spruce (*Picea abies*, 0–95%), fir (*Abies alba*, 0–20%), Scotch pine (*Pinus sylvestris*, 0–15%), and larch (*Larix decidua*, 0–25%). Deciduous tree species were beech *(Fagus sylvatica*, 0–80%), sycamore maple *(Acer pseudoplatanus*, 0–20%), rowan (*Sorbus aucuparia*, 0–5%), and elm (*Ulmus glabra*, 0–5%). Judging from this knowledge, the age-space structure of forest seemed to be more important than its tree species composition, thereby being in accordance with the MOSS and PICOZZI's (1994) conclusions.

Stand structure of the leks

Overstorey stand age ranged between 80–250 years with mean of 128 years. Understorey stand age ranged from 10 to 60 years. Overstorey tree-density varied between 400–1,050 stems per ha (mean 725, stand density 05–08), which agrees with Finnish (VALKEAJÄRVI, IJÄS 1986), and Norwegian (ROLSTAD, WEGGE 1987) findings. Understorey tree density ranged from 5 to 650 trees per ha (mean 290). Stands with higher overstorey and understorey density values were too dense to give the birds an opportunity to move in and through the canopy fairly easily. On the other hand, forests with overstorey stand density value below 0.5 (400 stems per ha) were too open and did not provide suitable hiding places from predators.

The occurrence of small patches of windthrow at most (19) of the leks was remarkable (see Figs. 4–6). As forest type and tree density of the leks varied and micro-habitat characteristics of the forest surrounding most of the leks did not differ from the lekking grounds, the micro-habitat features of the forest did not seem to limit the distribution of leks. The same conclusion was confirmed by Scandinavian scientists (VALKEAJÄRVI, IJÄS 1986;

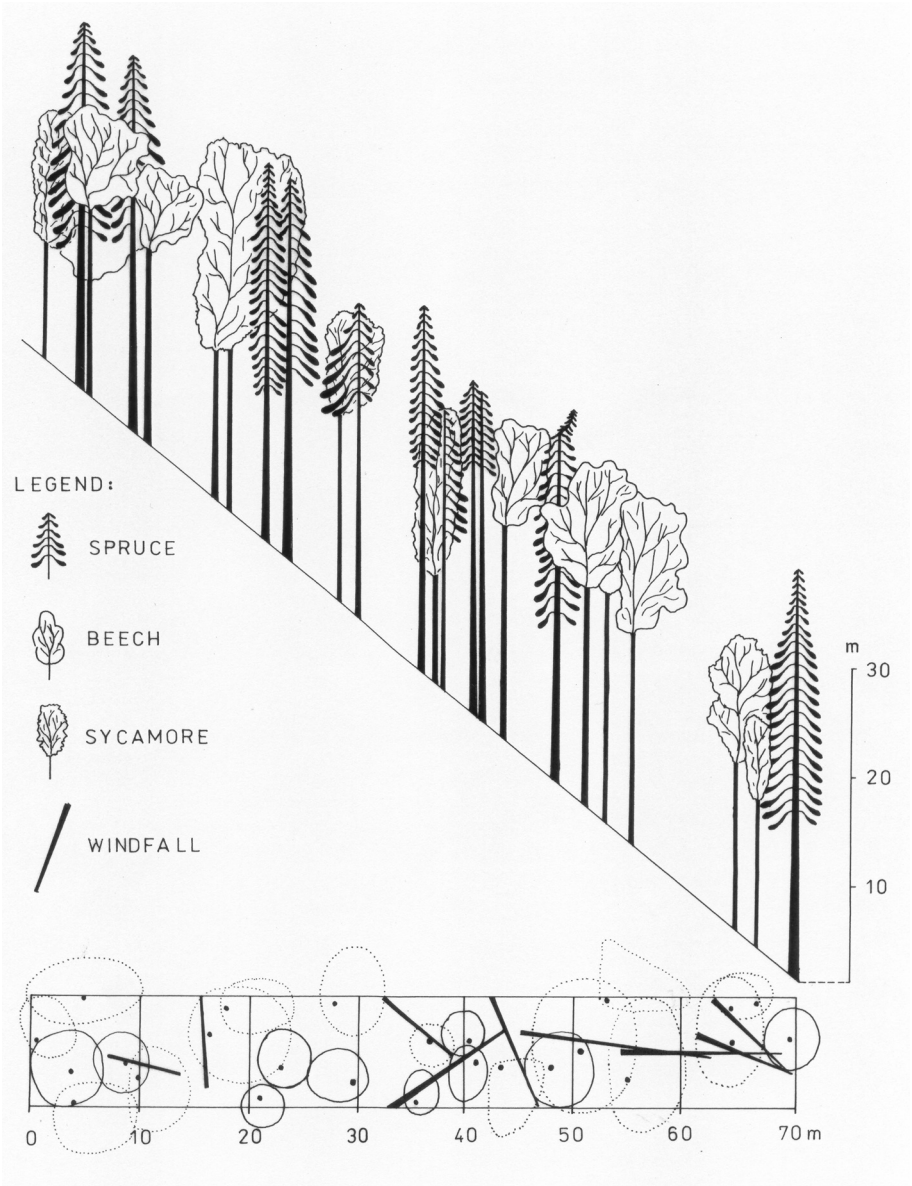

Fig. 5. Forest stand profile of a capercaillie lek in the *Fageto--Piceetum* forest type (a virgin forest in the state of optimal preservation; mean age of the overstorey – over 200 years; 1,230 m a.s.l.; Veľká Fatra Mts. – West Carpathians)

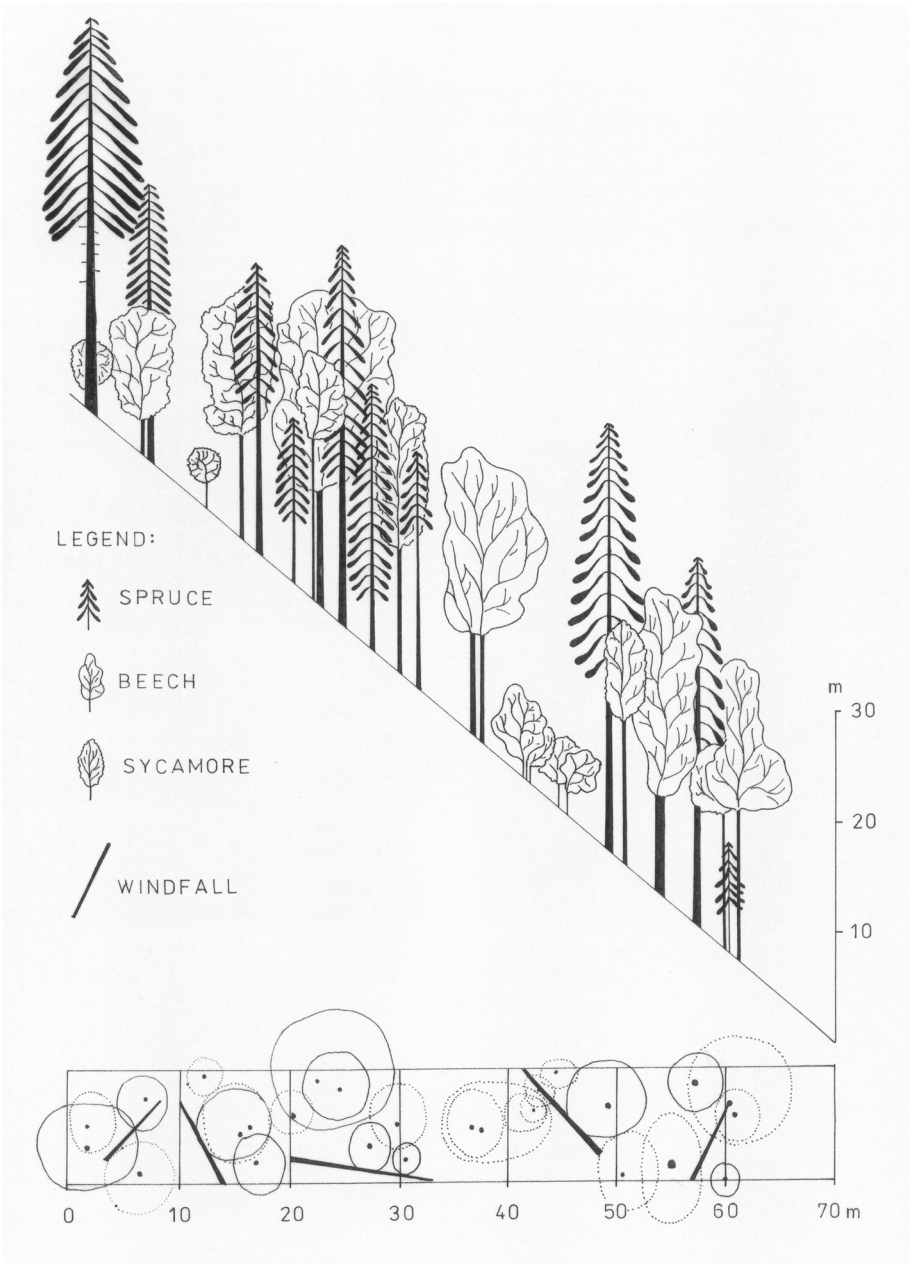

Fig. 6. Forest stand profile of a capercaillie lek in the *Fageto--Aceretum* forest type (a virgin forest in the state of disintegration; mean age of the overstorey trees – over 200 years; 1,250 m a.s.l.; Veľká Fatra Mts. – West Carpathians)

ROLSTAD, WEGGE 1987). A significant micro-habitat feature of the leks seemed to be the age-space structure of the stands – preference of multilayered stands. This was in agreement with several Central European studies (SCHRÖDER 1974; SCHERZINGER 1976; MÜLLER 1978). According to ROLSTAD and WEGGE (1987), micro-habitat composition of forests varies considerably and does not seem to limit the distribution of leks; on the contrary, spatial distribution of old forests is important for their distribution.

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Habitatové charakteristiky tokanísk tetrova hlucháňa (*Tetrao urogallus*) v Západných Karpatoch

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ABSTRAKT: Biotopové charakteristiky 43 tokanísk tetrova hlucháňa (*Tetrao urogallus*) boli skúmané v pohoriach stredného Slovenska (Západné Karpaty) v rokoch 1984–2002. Makro-habitatové charakteristiky predstavujú topografia a sukcesné štádium lesa. Mikro-habitatové charakteristiky predstavujú lesný typ a priestorová štruktúra lesa. Dvadsaťsedem zo štyridsaťtri tokanísk bolo situovaných pod vrcholmi bočných hrebeňov. Šestnásť tokanísk sa nachádzalo priamo na vrcholoch bočných hrebeňov (sklon < 10 %). Všetky monitorované tokaniská tvorili porasty starších sukcesných štádií lesa (80–200 rokov). Dvadsaťsedem tokanísk bolo lokalizovaných v prírodných lesoch, šestnásť tokanísk sa nachádzalo v obhospodarovaných lesoch vo veku nad 80 rokov. Tokaniská boli situované v lesných porastoch rozličných lesných typov s denzitou vrchnej etáže stromov 400–1 050 na hektár. Rozmiestnenie tokanísk bolo limitované predovšetkým makro-habitatovými charakteristikami (vyvýšené miesta, staré porasty). Vekovo-priestorová štruktúra sa zdala byť významnou mikro-habitatovou charakteristikou (preferencia viacetážových porastov).

Kľúčové slová: hlucháň; *Tetrao urogallus*; tokanisko; habitat; Západné Karpaty

Habitatové charakteristiky a počet tokajúcich kohútov boli skúmané na 43 tokaniskách. Počas systematického výskumu územia s potenciálnym výskytom tetrova hlucháňa bolo zistených 25 tokanísk v pohorí Veľkej Fatry, šesť tokanísk v pohorí Malej Fatry a Kremnických vrchov a tri tokaniská v pohorí Nízkych Tatier a Starohorských vrchov (Západné Karpaty).

Všetky monitorované tokaniská boli kontrolované minimálne dvakrát počas druhej polovice apríla a prvej dekády mája v rokoch 1984–2002. Tokaniská boli

popisované z hľadiska makro-habitatových (topografia a sukcesné štádium porastov) a mikro-habitatových charakteristík (lesný typ, drevinové zloženie, vekovo-priestorová štruktúra lesa). Habitatové charakteristiky boli vyhodnocované na kvadrátoch 100 × 100 m. Kvadráty boli vytýčené v centre tokanísk, ktoré zvyčajne predstavujú miesta párenia.

V skúmanom území Západných Karpát tetrov hlucháň obýval prírodné lesy vo veku 100–250 rokov v smrekovo-bukovo-jedľovom (850–1 270 m n.m.) a smrekovom lesnom vegetačnom stupni (1 250–1 530 m n.m.). Optimálny biotop predstavovali nielen prírodné horské zmiešané lesy s korunovým zápojom vrchnej etáže 60–70 %, pozostávajúce zo smreka obyčajného (*Picea excelsa*), jedle bielej (*Abies alba*), buka lesného (*Fagus sylvatica*) a javora horského (*Acer pseudoplatanus*), ale aj smrekové pralesy s vtrúsenou jarabinou vtáčou (*Sorbus aucuparia*), bukom lesným (*Fagus sylvatica*) a javorom horským (*Acer pseudoplatanus*).

Dvadsaťsedem tokanísk bolo situovaných v hornej polovici viac-menej konvexných bočných hrebeňov vo vzdialenosti 30–300 m od hlavného hrebeňa. Šestnásť tokanísk bolo lokalizovaných na vrcholoch bočných hrebeňov (sklon < 10 %). Signifikantne viac tokanísk bolo lokalizovaných v hornej časti svahu (Bonferroni *Z*-test; $Z = 3{,}19$, $P < 0{,}01$).

Všetky tokaniská boli situované v starých porastoch vo veku nad 80 rokov (Bonferroni *Z*-test; $Z = 7{,}22$, $P < 0{,}001$). Dvadsaťsedem tokanísk bolo lokalizovaných v pralesoch, zostávajúcich šestnásť tokanísk bolo situovaných v obhospodarovaných porastoch vo veku nad 80 rokov. Väčšinu tokanísk (35) tvorili viacetážové porasty (štatisticky významný rozdiel: $\chi^2 = 4{,}615$, $df = 1$, $P < 0{,}032$).

Tokaniská boli situované v rozličných typoch lesa. Najviac tokanísk (15) bolo lokalizovaných v skupine lesných typov *Fageto-Aceretum,* osem tokanísk v skupine lesných typov *Fageto-Piceetum*, päť tokanísk v skupine lesných typov *Abieto-Fagetum* a *Fageto-Abietum* a päť v skupine lesných typov *Sorbeto-Piceetum* a *Acereto-Piceetum* (kvantitatívne údaje nepostačujú na štatistické zhodnotenie: $\chi^2 = 6{,}0$, $k = 6$, $df = 5$, $\chi^2_{0{,}05} = 11{,}071$).

Pokiaľ sa jednalo o druhové zastúpenie drevín, tokaniská boli lokalizované v porastoch s dominanciou ihličnanov (< 80 %, 14 tokanísk), menej v porastoch s prevahou listnatých drevín (< 80 %, 10 tokanísk). Väčšinu tokanísk (19) tvorili zmiešané lesné porasty (rozdiel nebol štatisticky významný: $\chi^2 = 2{,}4$, $k = 3$, $df = 2$ $\chi^2_{0{,}05} = 5{,}991$).

Vek hornej etáže porastov na tokaniskách kolísal v rozmedzí 80–250 rokov (priemer 128 rokov). Vek spodnej etáže sa pohyboval medzi 10–60 rokmi. Hustota stromov hornej etáže sa pohybovala medzi 400–1 050 na hektár (priemer 725 stromov). V spodnej etáži porastov na tokaniskách bola zistená hustota stromov 5–650 na hektár (priemer 290 stromov). Lesné porasty s vyššou hustotou stromov sú pre hluchána nevhodné, pretože v nich nemôžu lietať. Na druhej strane lesné porasty s hustotou pod 400 stromov na hektár vo vrchnej etáži sú príliš otvorené a neposkytujú hluchániom dostatočný úkryt pred predátormi.

Rozmiestnenie tokanísk bolo limitované predovšetkým makro-habitatovými charakteristikami (vyvýšené miesta, staré porasty). Vekovo-priestorová štruktúra sa zdala byť významnou mikro-habitatovou charakteristikou (preferencia viacetážových porastov).

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