Population study of the Capercaillie *Tetrao urogallus* in the Malá Fatra mountains (West Carpathians, Slovakia)

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Zusammenfassung

Von 1988–1999 wurden die jahreszeitlichen Unterschiede in der Nutzung des Habitats und in der Brutbiologie des Auerhuhns *Tetrao urogallus* im Malá Fatra Gebirge (Westkarpaten, Slowakei) erforscht. In diesem Gebiet nutzte das Auerhuhn vorwiegend natürliche Biozönosen innerhalb des Fichten-Buchen-Tannenwaldes und des reinen Fichtenbestandes. Während des Frühlings (März–Mai) wurden Auerhühner sehr häufig in den Bereichen des Fichten-Buchen-Tannenwaldes registriert (55% der Beobachtungen), weniger wurden in der Biozönose des Fichtenbestandes gezählt (29,6%). Im Sommer (Juni–September) hingegen wurden die Fichtenwälder bevorzugt (47,5% der Beobachtungen), ebenso (58,4%) in der Herbst-Winterperiode (Oktober–Februar).

Summary

From 1988–1999 inter-seasonal differences in habitat use and breeding biology of the capercaillie *Tetrao urogallus* were studied in the Malá Fatra mountains (West Carpathians, Slovakia). In the study area, the capercaillie population mostly occupied natural forest biocoenoses within the spruce-beech-fir and spruce vegetation structures. During the spring season (March–May), capercaillies were recorded most frequently in the areas of the spruce-beech-fir vegetation structure (55% of observations). Fewer records were obtained from the biocoenoses of the spruce vegetation structure (29,6%). Forests of the spruce vegetation structure were favoured during the summer period (June–September) (47,5% of observations) and during the autumn-winter season (October–February) (58,4%). Seasonal differences in habitat selection were found.

Introduction

The negative influence of human activities on forests has gradually been increasing. Air pollution, acid rains and their long-term effects have resulted in changes to the qualitative-quantitative structure of the forest biocoenoses, and therefore have had a secondary impact on animal organisms.

There are only a few mountains in central Europe where more or less natural forests still remain and in which mostly sparse capercaillie *Tetrao urogallus* populations have survived (KLAUS et al. 1986). In central Europe, the disappearance of capercaillie from many parts of its original habitat has been explained by the isolation effect of

large-scale changes of the environment and the fragmentation of its habitat (MARCSTRÖM 1978, PORKERT 1982a,b, MÜLLER 1990). Fragments of primeval forests which are unaffected as yet by human activities have been conserved at several remote sites in the spruce-beech-fir and spruce – dwarf pine vegetation structures in the Malá Fatra mountains. Its natural geographic peculiarities (long valleys, steep slopes) have allowed forest biocoenoses to form suitable capercaillie habitat there.

Although various aspects of the capercaillie biology have been much studied in Europe (e.g. HJORTH 1970, SCHERZINGER 1976, LINDER 1977, SCHRÖDER et al. 1982, SPIDSO & STUEN 1988, GJERDE 1990, 1991a,b), its population in the mountains of Slovakia has received little attention. Most Slovakian data concerning population dynamics of the capercaillie come from hunting statistics (BANCÍK 1969, FERIANC 1977, HUDEC 1977, RICHTER 1983). Some information on ecology of the capercaillie in Slovakia was provided by SLÁDEK (1959). Data about seasonal differences in capercaillie habitat selection are available in the previous author's papers (SANIGA 1996a,b,c).

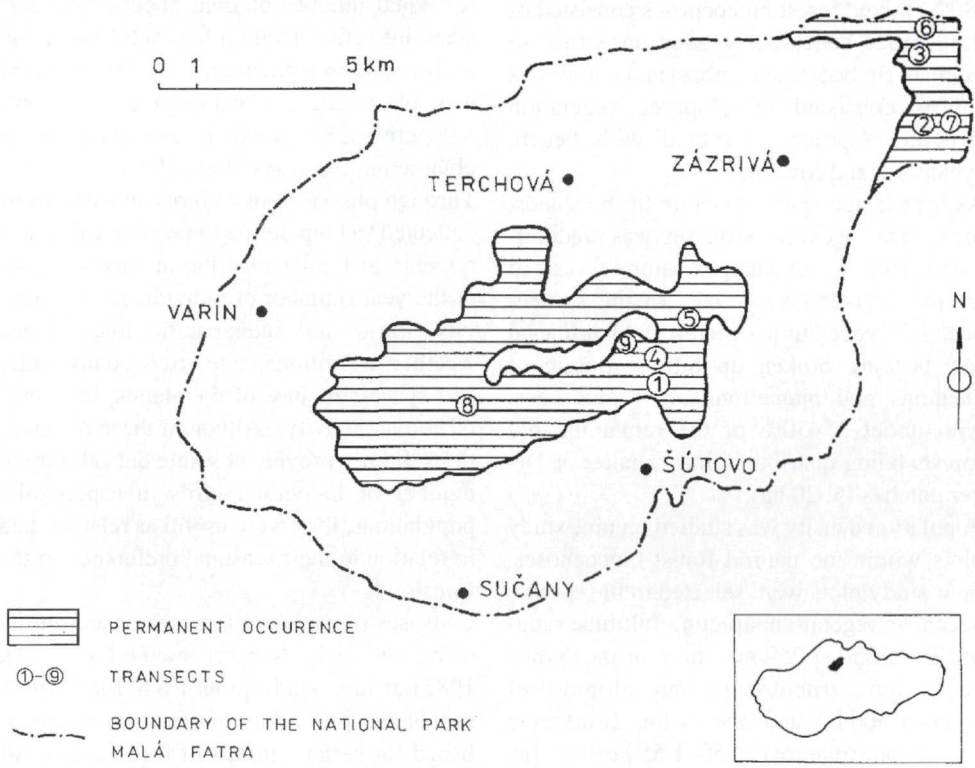


Fig. 1: Schematic distribution-map of the capercaillie in the Malá Fatra mountains (Slovakia)

This paper reports on the findings of a twelve-year study of the capercaillie in the Malá Fatra mountains. This study is aimed at establishing seasonal differences in habitat use and population density in various groups of forest types.

1. Study area

The field work took place in the Malá Fatra mountains (18°50'–19°14'E/49°08'–49°19'N, West Carpathians, Slovakia) from 1988 to 1999. Seasonal occurrence of the capercaillie was studied covering the whole forested area of the mountains *(figure 1)*. In the area where capercaillie occurred, the predominantly (80%) mixed forest biocoenoses consisted of the spruce-beech-fir vegetation structure (spruce, fir, beech, sycamore) and coniferous forests consisted of a spruce vegetation structure (spruce, sprinkled with beech, sycamore, and rowan).

As for the age-space structure of the stands, the spruce vegetation structure was predominated (70%) by unmanaged natural forests of around 100–250 years old. In the spruce-beech-fir vegetation structure, old primeval forests were broken up into a mosaic of clearcuts and plantations of various ages, with about 25–30% of the remaining old forests being distributed into smaller or larger patches (5–20 ha).

Population density was studied on nine study plots within the natural forest biocoenoses. Four study plots were selected in the spruce-beech-fir vegetation structure (altitude ranging from 850–1 250 m), three in the spruce vegetation structure (at an altitude of 1 250–1 500 m) and one in the dwarf pine vegetation structure (1 350–1 550 m) and fir-beech vegetation structure (700–850 m) based on the groups of forest types (ZLATNÍK 1959, RANDUŠKA et al. 1986). Furthermore, special research (display activity) was conducted on nine display grounds, which were situated near the transects. The geobiocoenology nomenclature of groups of forest types according to Randuška et al. (1986) was used.

2. Material and Methods

The occurrence of the capercaillie in forest biocoenoses was studied covering three seasons: the spring season (March–May), the summer period (June–September), and the autumn-winter season (October–February). An equal number of field checks (50) was taken into consideration for each season and each vegetation structure. If at least one bird was observed, I considered it a record. Altogether, 387 records of capercaillie were obtained in the years 1988–1999.

Through observations of birds, evidence was collected to help define the ecological requirements of the capercaillie at various times of the year (number of individuals, sex, activity, intra- and interspecific interactions, weather conditions, age, tree composition and space-structure of the stands, influence of human activity). Although these observations did not provide absolute data about the number of individual birds in capercaillie populations, they were useful as relative data in relation to their seasonal preference in the forests.

Censuses of capercaillie were carried out by using the strip transect method (VERNER 1985) at nine study plots from 1989–1992, so that absolute values of density were established for certain groups of forest types. All individuals seen up to a distance of 50 m to

each side of the axis of the transect were counted. Transect lengths were minimally 1,5 km. Capercaillie were counted at each transect minimally eight times per season. During the spring and summer season, the birds were usually counted twice a day (early in the morning from 03°° to 09°° CET and later in the evening from 17°° to 20°° CET). During the autumn-winter period, quantitative research was conducted in the morning after sunrise and in the afternoon before sunset. Data from the field checks from the transects under study were subsequently analysed and the density per 100 ha was calculated (ind/100 ha).

Indirect evidence of capercaillie occurrence and activity was also collected (footprints in snow, faeces, shed feathers, scraps of leftover food, such as broken twigs and absence of buds on seedlings, and findings of nests or egg-shells). These data helped to guide me to display grounds, roosting and feeding trees, and eventually, they made clear the seasonal distribution of bird species in the forest biocoenoses of the study area.

3. Results and Discussion

3.1. Habitat and distribution

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 up to the tree limit in the Alps, Pyrenees, and the Carpathians (KLAUS et al. 1986). Primeval forests in a stage of disintegration fit the ecological requirements of the capercaillie perfectly (EIBERLE 1974).

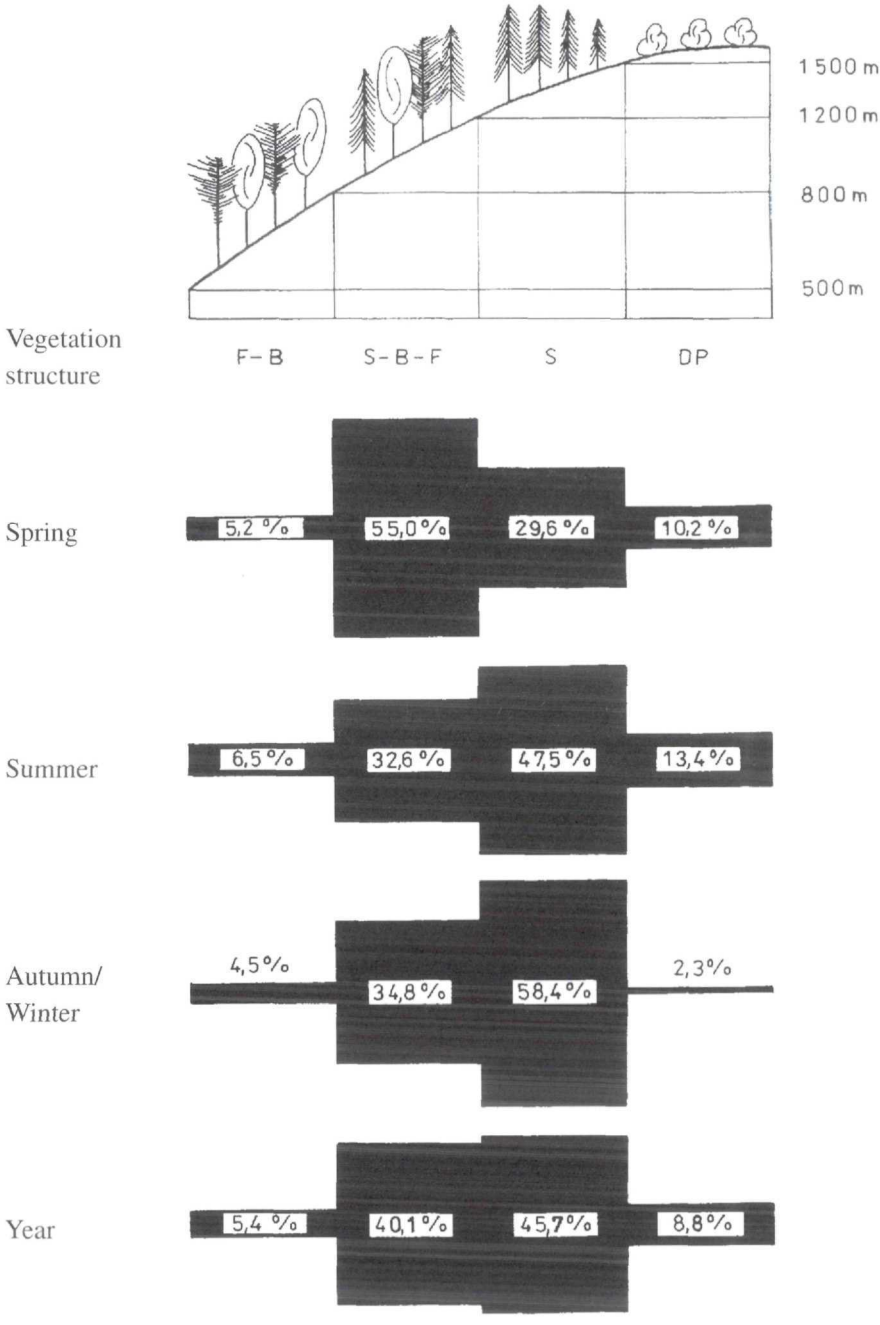
In the Malá Fatra mountains, the capercaillie inhabited old natural forests (100–250 years old) in the spruce-beech-fir (850–1 250 m) and spruce vegetation (1 250–1 500 m) structures. Optimal conditions were met not only in mixed mountain forests with a canopy closure of 60–70%, composed of spruce, fir, beech, and sycamore, but also in primeval spruce forests sprinkled with beech, rowan, and sycamore.

The presence of not too dense lower regions, composed of the tree-species of the upper regions (for concealment, roosting and feeding), and of a 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 1 350–1 550 m also created a suitable habitat for this tetraonid *(figure 2)*, especially the zone adjacent to the spruce vegetation structure where the stands tended to be discontinued. However, there had to be numerous glades with bilberry bushes. In the study region, capercaillies occurred only occasionally in the forests of the fir-beech vegetation structure below 700 m.

Capercaillies were not permanent inhabitants 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 (20%) 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 spe-

Fig. 2: Percentage proportion of capercaillie observations in the vegetation structures under study, the Malá Fatra mountains, Slovakia, 1988–1999 (F-B = fir-beech, S-B-F = spruce-beech-fir, S = spruce, DP = dwarf pine vegetation structure).



cies-space structure to natural forests (80–120 years old, canopy closure of the upper region of 60–80%, developed lower region, 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)–30 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.

Similar forests are occupied by capercaillies in other mountains of Slovakia (FERIANC 1977; HUDEC 1977, SANIGA 1996a,b,c). In the Alps (SCHRÖDER et al. 1982), the capercaillie population especially prefers mixed mountain forests composed of spruce, fir, beechs, and sycamore up to an altitude of 1 500 m. In higher alpine altitudes (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 Malá Fatra mountains (primeval spruce forests and mountain mixed stands up to 1 453 m).

In the mountains of the Czech Republic, capercaillie is now a very rare bird. In the past, capercaillie populations were found in these mountains, as in the Malá Fatra mountains, in either mountain spruce forests or mountain mixed forests with predominance of spruce, at an altitude of 700–1 300 m (PORKERT 1982a).

3.2. Seasonal differences in habitat selection

The capercaillie's use of habitat differed from season to season *(figure 2)*. During the spring season (March–May), capercaillies were more frequently recorded in the forests of the spruce-beech-fir vegetation structure (55% of observations), but less so in the stands of the spruce vegetation structure (29,6%). These two types of habitat were preferred to the remaining two habitats, which made only 15,7% of the observations. The distribution of observations during the period of capercaillie lek corresponded with the distribution of the display grounds in the study area: five out of seven examined display grounds were situated in the spruce-beech-fir vegetation structure while two were at the lower edge of the spruce vegetation structure. The display grounds were found in 90–250 years old mixed (4), coniferous (2), or deciduous stands sprinkled with fir or spruce (1), always situated in the upper half of the more or less convex, lateral ridges a certain distance (30–300 m) from the main ridge. The locations depended on the shape of the surrounding terrain and also on local weather conditions, which might be determined by the site aspect.

According to the strip transect censuses, the capercaillie population density fluctuated between 0,6 ind/100 ha (dwarf pine stands), 2,3 ind/100 ha (forests of the spruce-beech-fir vegetation structure), and 1,5 ind/100 ha (forests of the spruce vegetation structure). For the population occupying dwarf pine stands, density value was affected by the methodological bias derived from the disproportionately shorter length of examined transect (12,0 km), in comparison with the lengths of transects in the inferior vegetation structures (76 km, and 115 km, respectively).

A higher spring population density was found only in central Finland, where Rajala (1974) found it to be 5,98 ind/100 ha and

according to KLAUS et al. (1986), this upper-limit value corresponded with optimal habitat. During especially favourable years, the population density could be even higher and theoretically it could reach the value of 24 ind/100 ha (SEMENOV-TJAN-SHANSKIJ 1960).

From the population density established in respect of natural forest biocoenoses of the spruce-beech-fir and spruce vegetation structures, and from the extent of suitable stands in these structures, the total capercaillie population in the Malá Fatra mountains was calculated at circa 110–120 birds in spring.

In summer (June–September), a certain degree of preference was shown for the forest biocoenoses of the spruce vegetation structure, where 47,5% of all bird observations were found. Within the natural forests of the spruce-beech-fir vegetation structure, 32,6% of the observations were ascertained. Clearings were visited both by cocks and by hens leading chicks, because there was ample food supply (ants, an early ripening of raspberries and bilberries). The highest percentage of observations came from the spruce vegetation structure because of high food availability. Bilberry forms an essential food component of capercaillie diet at this time of year (KLAUS et al. 1986, HEINEMANN 1989, SANIGA 1998), and plant communities with bilberry bushes are almost exclusively limited to the forests of the spruce vegetation structure in the study area.

Quantitative data obtained from summer transects also showed that the population reached its highest density value in the spruce vegetation structure (3,9 ind/100 ha). Fewer birds were found in natural forests of the spruce-beech-fir vegetation structure (2,6 ind/100 ha), and in the dwarfed pine biocoenoses (0,8 ind/100 ha). These values of population density agreed with data from other regions in Europe: 6,13–7,0 ind/100 ha in north and central Finland (RAJALA 1974), 5,3–7,0 ind/100 ha in southern Norway (SPIDSO & STUEN 1988), and 2,7–6,6 ind/100 ha in south-west Norway (WEGGE & GRASAAS 1977).

During the autumn-winter period (October–February), the majority of observations (93,2%) were confined to the natural forests of the spruce (58,4%) and spruce-beech-fir vegetation structures (34,8%). Only 2,3% of observations came from the dwarf pine biocoenoses and 4,5% from the stands of the fir-beech vegetation structure. A similar distribution was also calculated from quantitative research on transects: the highest population density was found in natural spruce forests (3,9 ind/100 ha), the population occupying forests of the spruce-beech-fir vegetation structure had a lower density (1,9 ind/100 ha). Within this period, capercaillies were always recorded in the coniferous parts of the stands. Characteristic differences in habitat use during the autumn-winter period resulted both from the larger number of suitable hiding- and roosting-places and from the more favourable climatic conditions (higher average day-temperature, less wind) in coniferous stands, and from their food-offer during the autumn-winter season. Spruce creates the main food item in most of the European mountains during winter (KLAUS et al. 1986, HEINEMANN 1989, KRIŠTÍN 1990, SANIGA 1998).

During the autumn-winter period, hens often appeared in groups of 2–3(4) birds, whereas cocks were mainly observed as solitary individuals, with the exception of roosting-pla-

ces, where 2–3 cocks sometimes spent the night a few metres (20–250 m) from each other. During the period of the autumn lek (October–mid-November), some of the cocks would visit display grounds and spend part of the day there (sometimes the whole night, sometimes they arrived in the early morning and flew away about an hour after dawn). Participation of hens in the autumn lek seemed to be occasional.

In southern Norway, contrary to my observations, the most obvious cue in habitat selection during the winter period for both sexes was the presence of pine trees, which were used for feeding and arboreal roosting (GJERDE 1991a) and spruce-dominated forests and younger plantations were avoided by all sex/age Capercaillie groups (GJERDE & WEGGE 1989). In Norway, according to GJERDE et al. (1985), hens often appeared in groups of 2–4 birds, whereas cocks lived mainly in solitary fashion. This confirmed the findings of the study. GJERDE (1991a) also established that cocks avoided forests when canopy closure exceeded 70–80%.

In the course of the year most observations were made in the forests of the spruce vegetation structure (45,7%) and fewer in the natural spruce-beech-fir vegetation structure (40,1%). Only 8,8% of observations occurred in the dwarf pine biocoenoses and even fewer (5,4%) in the stands of the fir-beech vegetation structure.

The results of this study on seasonal differences in habitat selection show that permanent occurrence of capercaillie in the Malá Fatra mountains is restricted to the area of both natural and managed forests of the spruce-beech-fir, spruce and dwarf pine vegetation structures. Occurrences in the fir-beech vegetation structure below the altitude of 700 m were considered temporary, since there were no suitable coniferous stands for birds to spend the winter permanently.

The results of a twelve-year study of the capercaillie grouse in the Malá Fatra mountains clearly demonstrate seasonal differences in habitat selection, conditioned by (1) time-space food offer (in winter, the birds concentrate in stands with a predominance of spruce – groups of the *Sorbeto-Piceetum*, *Acereto-Piceetum*, *Fageto-Piceetum* forest types; in summer, they prefer forest biocoenoses with an abundance of bilberry bushes in form of grown vegetation – *Sorbeto-Piceetum*, *Acereto-Piceetum* and *Fageto-Piceetum*; in spring, capercaillies occur increasingly in the spruce-beech-fir vegetation structure); (2) climatic conditions, and the possibilities of concealment and roosting places (in winter, they are almost completely limited to the coniferous part of the stands); (3) characteristic behaviour within the period of the spring and autumn lek (visit of the traditional display grounds). These differences in observations were statistically significant between all seasons (spring-summer $Chi^2=26,71$, df=3, $P<0,05$; spring-autumn-winter $Chi^2=58,35$, df=3, $P<0,05$; summer-autumn-winter $Chi^2=87,77$, df=3, $P<0,05$). Similar seasonal differences in habitat selection by capercaillie have been described from the Vel'ká Fatra mountains (SANIGA 1996a) and also from other areas of central and northern Europe (SCHERZINGER 1976; GJERDE 1991a,b; PULLIAINEN 1982).

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ANSCHRIFT DES VERFASSERS

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