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Patterns of black grouse, *Tetrao tetrix* distribution in northwestern Russia at the turn of the millennium

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Abstract. Grouse populations have considerably declined in Finland, and local declines have also been reported from Russian Karelia (Helle et al. 2003). Reasons for the decline are poorly understood. We have studied the relationship between landscape structure and black grouse density in Russian Karelia and compared it with East Finland. The spatial density distribution of the black grouse population is relatively even, especially in areas with a high proportion of forest land. Correlations between forest structure and black grouse abundance were generally low. We found three significant correlations for Russian Karelia: positive for clear cuts and young forests and negative for the proportion of old forests. Areas with high abundance of black grouse are characterized by high representation of clear cuts and secondary forests (1.3 and 1.2 times higher than the average, respectively) and low representation of built-up areas, roads and old forests (1.3, 2.0 and 1.8 times lower than the average, respectively; the differences are significant). In Russian taiga "natural factors" (e.g. predation, diseases and climatic factors) might be of higher importance, than forestry.

Key words: black grouse density, forestry, landscape ecology.

Introduction

Grouse populations have considerably declined in Finland; also further local declines have been reported in Russian Karelia (Helle et al. 2003). Reasons have been insufficiently studied. Black grouse are sometimes considered not to be very sensitive to forest management at a local scale, but nowadays the abundance of this forest species is relatively low in Europe, especially in central Europe (Storch 2000, Ludwig & Storch 2003). Patterns in black grouse abundance under the impact of modern forest management are studied inadequately. It is rewarding to study these patterns and abundance changes of black grouse at the border area between intensive (Finland) and extensive (Russian Karelia) forest management practices.

Material and Methods

We have studied the problem in Eastern Fennoscandia: Eastern Finland and Russian Karelia, the total study area being about 300 000 sq. km. The data bases are the Wildlife Triangle

Scheme in Finland (Lindèn et al. 1996) and the Winter Track Counts in Russian Karelia (Priklonski 1973). Altogether more than 100 grids of 50x50 km are included. The results obtained and utilized are grouse abundance indices (birds seen per 10 km of route in winter counts, average for a 5 year period in each grid). From Forest Inventory results, we have obtained proportions (in percentages) of forest areas, bogs, lakes, etc. of the total area of the grid. Forests were classified as more than 100 years old: old, 40 – 100 years: middle age, and 20–40 years: young, and also as coniferous or deciduous forests. We constructed statistical models using SYSTAT.

Results

History of forestry

The analyses of history, the scale and the dynamics of forest exploitation in the region allow us to assume that logging in Eastern Fennoscandia is the dominating factor determining present status of the habitat of taiga animals. Statistical data on forest cuttings in Finland and Karelia in the 20th century were analyzed and the index called "the impact of forest utilization on ecosystems" was used for comparison. This index gives the average annual volume of wood removed from 100 ha of forest area (Kurhinen et al. 1999). It appeared, that the dynamics of this index was similar in Finland and Russian Karelia in spite of some political and economic differences (correlation coefficient estimated for the period of the past half of 20th century was +0.54, $p< 0.001$). However, the total amount of forest utilization in Karelia during the same period was only some 60% of that in Finland (144 vs. 235 m^3/100 ha). Also the strategies of logging and forest management were different and impacted game habitat and populations differently (Lindèn et al. 2000).

Based on new information, however, we predict that the situation may be changed soon: the forest industry in North-West Russia might develop in the near future. As a result, some old forest areas serving as forest grouse habitat may soon be transformed.

Forest landscape changes

The dissimilar forest management strategies have resulted in different structures of forest landscape in the neighbouring areas of the two countries (Table 1). The proportions of old forests (older that 100 years) and bogs in Russian Karelia are higher than in Eastern Finland (ratios Karelia/Finland 1.6 and 5.2, respectively). As might be expected, in Eastern Finland

Table 1. Habitat proportions in Eastern Finland and Russian Karelia in 1990-94. * - differences are significant

Habitats	The whole region	Eastern Finland	Russian Karelia
Forest area old coniferous*	64.1±1.18	64.7±1.18	63.6±1.85
(more than 100 years)	16.2±0.93	11.8±1.03	19.4±1.30
middle aged (40–100 years)*	24.4±1.30	29.5±0.90	20.8±2.04
– young	20.9±0.70	22.3±0.71	19.9±1.08
– clear cuts*	2.5±0.17	1.1±0.08	3.5±0.22
bogs*	14.8±1.30	4.3±0.63	22.4±1.70
water*	13.4±0.89	16.3±1.43	11.3±1.07
agricultural*	2.4±0.33	5.1±0.57	0.2±0.05
roads*	0.6±0.05	0.9±0.09	0.3±0.03

the proportions of built-up areas, roads, agricultural areas are much higher (ratios Finland/ Karelia 2.4, 3.0, 25.5, respectively; Table 1). The proportion of middle-aged forests (40–100 years) in Finland is 1.4 higher than in Russian Karelia.

The greatest difference between the NW Russian and East Finnish landscapes is the ratio between so-called wilderness areas (combined area of old forests, virgin and unused lands) and human-influenced areas (roads, clear cuts and young forests, built-up and agricultural areas): in Finland the ratio is 30:70 whereas in Karelia it is close to 50:50.

There are no any clear changes in structure of forest habitat of black grouse in North-West Russia at the period 1994–2004. The proportion of old forest, for example, was about 19 % on average per grid of all area both in 1994–1996 and in 2004–2006.

Patterns in black grouse density

Distribution of the black grouse is relatively even, especially in areas with a high proportion of forest land. In these areas, we have not observed any clear relationships between black grouse abundance and variations in forest landscape structures. We found only one statistically significant relationship:

$$Y = 0.18 \; x \; A + 0.12 \; x \; B - 0.07$$

where Y: black grouse abundance (ex. per 10 km of transect), A: young forest proportion (%), B: water proportion (lakes, %). R = 0.56, R^2= 32 %, $p < 0.001$.

The statistical associations between forest structure and black grouse abundance are minor. For black grouse, there seems to be no clear negative impact of logging and forest

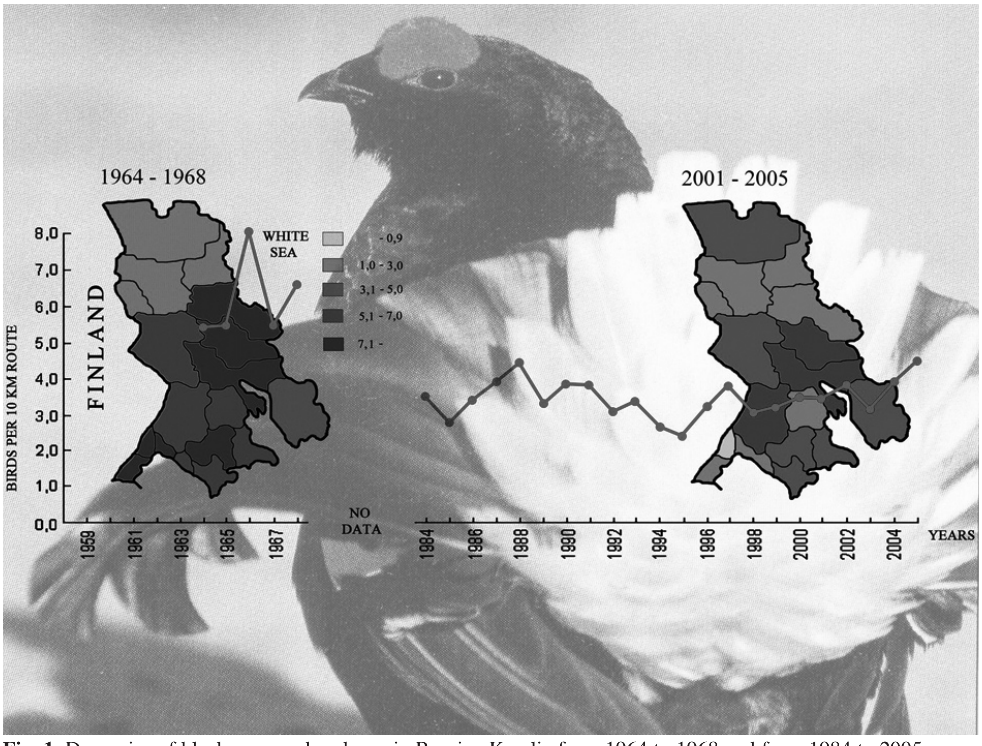

Fig. 1. Dynamics of black grouse abundance in Russian Karelia from 1964 to 1968 and from 1984 to 2005.

management in North-West Russia. We found only three significant correlations for the eastern part of the research area (Russian Karelia): clear cuts and young forests are positive, old forests proportion is negative (?!). This assertion is correct only for the all Russian Karelia in 1994–1996 (61 grids). However, already in 2004–2006 in areas of Russian Karelia with a shortage of old forests proportions (lower than 15 %, 34 grids) a positive correlation appeared between old forest proportion and black grouse abundance: $r = 0.34$, $p < 0.05$.

Besides this, areas with high abundance of black grouse are characterized by a high representation of clearings and secondary forests (1.3 and 1.2 higher than the average respectively), but a low representation of built-up areas, roads and old forests (1.3, 2.0 and 1.8 lower than the average respectively).

The level of mean abundance of black grouse in North-West Russia at the turn of the Millennium was about 1.5 times lower than 40 years ago (Fig. 1).

Discussion

We did not find any clear changes in structure of forest habitat of black grouse in North-West Russia during the period 1994–2004, for example – in old forest proportion. A reason might be the low activity of the forest industry.

The effects of landscape fragmentation and forest succession on grouse habitat selection have been studied in Scandinavia and Finland (Swenson & Angelstam 1993, Kurki et al. 2000). In North-western Russia, there seemed to be no clear negative effect of human activity (habitat or landscape change) on black grouse abundance. Moreover, some positive effects of forestry are founded, mainly in the "wilderness" areas. In Russian boreal forests some "natural" factors, such us infections, small predators and climate (e.g. weather in spring; Annenkov 1995) might be of more importance.

We suppose, however, that some negative impacts caused by human activity were present at the turn of the millennium. In addition to our predictions (Kurhinen et al. 2006, 2007), we underline that there are some signs of negative effect of forests changes (e.g. decreasing black grouse abundance in areas with shortage of old forests and the structural specificity of forests in the "best" and "wrong" for black grouse areas). We assume that possible intensification of the forest industry in 2007–2015, might led to increased negative effect of forest changes compared to the last 15 years.

It is interesting to try to explain, why the black grouse abundance at the turn of the millennium was relatively low in comparison with the 1960s (Fig. 1). We cannot explain it simply by changes in forest structure because they are insignificant. One of the possible reasons – the adverse effect of climate warming on the breeding success of black grouse has been demonstrated in Finland (Ludwig et al. 2006).

Thus, we can identify some signs of the negative impact of forestry on the black grouse distribution in North-West Russia. They were insignificant at the turn of the millennium. But possible intensification of human activity in forest landscapes and climate warming might lead to considerable changes in black grouse distribution and abundance in North-West Russia.

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