Ornis Fennica 71:43–46. 1994

Hazel Grouse *Bonasa bonasia* group sizes and sex ratios in Japan and Sweden

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Received 10 March 1994, accepted 25 May 1994

The social behavior of Hazel Grouse (*Bonasa bonasia*) has been reported to vary geographically; they form flocks in autumn and winter in Asia, but overwinter as pairs or singly in Europe. We compared seasonal group sizes and population structure in Japan and Sweden. Group size was statistically similar in both areas during all seasons except autumn, when it was smaller in Japan. Our results suggest a similar social organization in both areas, with loosely bound pairs and a male-biased sex ratio.

1. Introduction

The social behavior of a species may be a product of its phylogenetic heritage, an adaptation to ecological constraints, or both (Vehrencamp & Bradbury 1984). The Hazel Grouse (*Bonasa bonasia*) has an extensive range throughout Palearctic boreal and montane forests from western Norway to northeastern Siberia, extending southwards into France, Greece, North Korea, and the Japanese island of Hokkaido, and exhibits plasticity in social behavior during the nonbreeding period (Bergmann et al. 1982). In Europe, Hazel Grouse are territorial yearlong and overwinter alone or in pairs, whereas in Asia they are territorial during the breeding season but form flocks in autumn and winter (Zhao 1977, Bergmann et al. 1982, Andreev 1979, Potapov 1989, Gao & Zhao 1991). Few references to mean flock sizes are available, but winter flocks averaged 5.6 in northeastern China (Gao & Zhao 1991) and 6.0 in far eastern Siberia (Drovetskii 1992).

Here we compare the social behavior and population structure of Hazel Grouse throughout the year on Hokkaido Island, Japan, (*B. b. vicinitas*) with that from central Sweden (*B. b. bonasia*). Our goal was to examine differences and similarities in more detail than is possible from a literature search, by comparing group size in each season and comparing sex ratios of observed birds. We did not study possible mechanisms behind social behavior. In Hazel Grouse study areas nearest to Hokkaido Island, groups are most common during the nonbreeding period, eg. Sakhalin Island (Mishin 1960), lower Amur Valley in the southeastern corner of Asian Russia (Babenko 1987), Changbai Shan Mountains of northeastern China near North Korea (Zhao 1977), and in North Korea (Austin 1972). The most common group size in these areas is reported to be about 5–8 birds.

2. Study areas and methods

The study areas in Japan were in south-central and eastern Hokkaido (42–44° N and 141–145° E). Coniferous forests dominated by fir *Abies sachalinensis* and spruce *Picea jezoensis* and *P. glehnii* occur in middle elevations. The low-elevation forests are mixed coniferous and deciduous forests or pure deciduous broad-leaved forests dominated by maple *Acer mono*, oak *Quercus mongolica,* and linden *Tilia japonica.* Mature coniferous plantations are found in the low elevations as well. The dominant undergrowth species are bamboograsses (*Sass paniculata* in the central part and *S. nipponica* in the eastern part). Detailed descriptions of the main study areas are found in Fujimaki (1986, 1988). These mature forests were dense, with a multilayered structure (Fujimaki & Hikawa 1982, Fujimaki 1986, 1988).

The number of Hazel Grouse was recorded whenever grouse were observed throughout Hokkaido from 1957 to 1991. Whenever possible, the sex and age (young or adult) was determined. Birds were separated by sex based on the presence (male) or absence (female) of a black chin patch.

The study area in southcentral Sweden was the Grimsö Wildlife Research Area (140 km^2, 59–60°N and 15–16°E). Most of the research area is intensively managed industrial forest. It is relatively flat, 100–150 m in elevation, and dominated by forest (72%) and bogs (18%). Norway spruce *Picea abies*, Scots pine *Pinus sylvestris* and birch *Betula pendula* and *B. pubescens* are the most common trees; other deciduous trees (aspen *Populus tremula*, black alder *Alnus glutinosa*, great willow *Salix caprea*, and rowan *Sorbus aucuparia*) are uncommon. The dominant field layer species are billberry *Vaccinium myrtillus*, cowberry *V. vitis-idaea*, and wavy hairgrass *Deschampsia flexuosa*. Hazel Grouse only occur in the most dense stands at Grimsö (Swenson & Angelstam 1993).

Hazel Grouse observations were recorded by personnel of the Grimsö Wildlife Research Station from 1978 to 1991. Number of grouse, age (young or adult), and sex (when possible) were recorded.

Phenology was similar in both areas, as hatching of chicks occurs mainly in mid- to late June on Hokkaido (Haga & Takamata 1986) and early to mid-June in Sweden (Swenson 1991). Therefore, the year was divided into the same four seasons in both areas. Winter was November through March, spring was April and May, summer was June through August, and autumn was September and October. Others also have chosen Hokkaido and Fennoscandia to compare biological phenomena in similar habitats located far apart (Henttonen et al. 1992).

3. Results

The seasonal group sizes of Hazel Grouse showed a similar pattern in both study areas. Group sizes were similar throughout the year, except for smaller groups in autumn on Hokkaido (Table 1). During all seasons and in both areas, the most commonly observed group size was one bird, and, except for summer on Hokkaido, the second most common group size was two birds (Table 2). The largest observed group sizes were 5 in winter, 2 in spring and 3 in autumn in both areas. In summer, the largest observed group size was 8 on Hokkaido and 10 at Grimsö.

The sizes of broods observed in the two areas were very similar; 4.2±2.6 (SD) young (n = 17)

Table 1. Comparison of observed Hazel Grouse group sizes (mean ± SD, N) by season on Hokkaido Island, Japan, and in southcentral Sweden. P = Mann-Whitney U-test.

	Japan		Sweden		P
Winter	1.50±1.00	58	1.43±0.61	327	0.39
Spring	1.36±0.49	25	1.47±0.50	187	0.30
Summer	2.36±2.11	61	1.83±1.39	241	0.44
Autumn	1.09±0.36	45	1.36±0.55	197	0.0008

Table 2. Distribution (percent of observations) of group sizes by season on Hokkaido Island, Japan, and in southcentral Sweden (see Table 1 for sample sizes).

	Japan			Sweden		
Birds:	1	2	>2	1	2	>2
Winter	71	19	10	62	34	4
Spring	64	36	0	53	47	0
Summer	57	15	28	56	27	16
Autumn	93	4	2	68	28	4

on Hokkaido and 4.2±2.0 young (n = 27) at Grimsö (t = 0.07, df = 43, P = 0.95). However, broods were observed relatively more often on Hokkaido (28% of 61 observations during summer) than at Grimsö (13% of 245 observations during summer). This difference was statistically significant ($\chi^2 = 7.43$, df = 1, P = 0.006).

Observed sex ratios were similar in the two areas. Here, only data from autumn and winter were analyzed, because females were often hidden while incubating eggs in spring, and more observable while leading a brood in summer. Combining autumn and winter, 61% of the observed birds that were identified to sex were males on Hokkaido (n = 88), compared with 64% in Sweden (n = 50). These values were not significantly different ($\chi^2 = 0.02$, df = 1, P = 0.90), but both differed from a 50:50 ratio (one-group $\chi^2 = 4.54$, df = 1, P = 0.03 in Japan and $\chi^2 = 3.92$, df = 1, P < 0.05 in Sweden).

4. Discussion

Our results suggested that Hazel Grouse social behavior was similar on Hokkaido and in Sweden. The basic social units of Hazel Grouse in both areas were singles and pairs in autumn, winter, and spring; single birds were observed most often in both areas. Outside of the summer, when young and females were observed, groups larger than two were relatively uncommon in both areas during all seasons. This indicates that a loosely bound pair was the dominant social organization in both areas, as was documented in the Swedish area with radiotelemetry during the nonbreeding and breeding seasons (Swenson 1993, Swenson & Boag 1993). Brood sizes were similar in both areas, but broods were relatively more common on Hokkaido than at Grimsö. In both areas, the mean clutch size was 7.0 (Haga & Takamata 1986, Swenson 1991). Loss of entire broods may have been more common at Grimsö, as all of ten radio-marked females at Grimsö laid eggs in spring (Swenson 1991).

Unpaired males are apparently common in these populations, which probably partially accounts for the large number of single birds we observed. The male-biased sex ratio was similar to that found by Gaidar (1974) among over 1000 grouse trapped in autumn and winter in European Russia (58% males). The sex ratios of observed birds in Japan and Sweden in autumn and winter differed from a 50:50 ratio, but did not differ significantly from 58% males (one-group $\chi^2 = 0.43$, df = 1, P = 0.51 in Japan and $\chi^2 = 0.78$, df = 1, P = 0.38 in Sweden). Although males may be more easily observed or identified than females, the similar results obtained from two methods in three areas suggested that Hazel Grouse populations commonly are male-biased in autumn and winter. In addition, Swenson & Boag (1993) found a spring sex ratio of 58% males (including both territorial and transient males) on an intensively studied area on a portion of the Grimsö area where most of the birds were radio-marked.

The finding that Hazel Grouse social behavior and sex ratio were so similar was unexpected, based on the literature reviews in Bergmann et al. (1982) and Potapov (1989). Obviously something else than just geography or subspecies is involved. Our study was not designed to examine the possible mechanisms behind differences or similarities of social behavior. However, social behavior varied with vegetative structure and distance from cover in the nonbreeding season in Sweden (Swenson 1993) and Hazel Grouse habitat in both of our study areas was characterized by relatively dense forests. Perhaps the apparently similar social behavior is related to both areas having dense forests.

Acknowledgements. We thank D. A. Boag, H. C. Pedersen, H. Lindén, P. Majewski, M. A. Schroeder and P. Rintamäki for constructive comments on this manuscript, L. Saari for translating the Finnish summary, the personnel of Grimsö Wildlife Research Station for recording Hazel Grouse observations, and Sun, Y.-H. for translating Chinese papers for us.

Selostus: **Pyyn talviparvet Japanissa ja Ruotsissa**

Kirjallisuustietojen mukaan pyyn yleisin talvinen ryhmäkoko on Aasiassa 5–8 yksilöä, Euroopassa linnut puolestaan elävät pareittain. Tästä syystä vertailimme lajin vuodenaikaisia ryhmäkokoja ja sukupuolten lukumääräsuhteita Japanissa ja Ruotsissa. Tutkituilla alueilla ryhmäkoot eivät

poikenneet tilastollisesti merkittävästi toisistaan, paitsi syksyllä, jolloin se oli Japanissa peinempi. Sukupuolten lukumääräsuhteissa ei ollut eroja tutkimusalueiden välillä, kannat olivat sekä syksyllä että talvella koirasvoittoisia. Tuloksemme viittaavat samanlaiseen sosiaaliseen järjestykseen sekä Japanissa että Ruotsissa: löyhiin parisiteisiin ja koirasvoittoiseen kantaan.

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