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Notes on the natural history and behaviour of the Chinese grouse *Bonasa sewerzowi*

Yue-Hua Sun & Yun Fang

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The mating behaviour of Chinese grouse *Bonasa sewerzowi* at the Lianhuashan Natural Reserve in Southern Gansu Province was studied in 1995. Eleven birds were radio-marked during the breeding season. Pair formation began in late March. Males held territories of 1.8-3.2 ha (N = 3). The 'flutter-jump' behaviour was believed to be used by males for advertising territories and attracting females. It also could serve as a warning signal. Males competed for females in April and May, but not all males paired with females. Female-female aggression was not observed. The mating system of Chinese grouse was primarily monogamous, however, the possibility of polyandry or extra-pair copulations remains. In addition, female choice was believed to be the main factor affecting pair formation.

Key words: Bonasa sewerzowi, Chinese grouse, mating behaviour

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The Chinese grouse *Bonasa sewerzowi* is an endemic and rare species in China, distributed in the high mountains of Gansu, Qinghai, Sichuan, northwestern Yunnan, and eastern Tibet (Cheng, Tan, Lu, Tang, Bao & Li 1978, Xu 1983). Because of a long history of deforestation and over-hunting this bird is believed to be endangered and is listed as a 'first-rate protected bird' in China.

Mating behaviour in the Tetraonidae is variable. Most forest and prairie grouse are typically polygamous (Johnsgard 1973). All three ptarmigan species are typically monogamous, while two other grouse, hazel grouse *B. bonasia* and the Chinese grouse are thought to be monogamous (Wittenberger 1978). Swenson & Boag (1993) confirmed that the social organisation of the hazel grouse during the breeding season was primarily monogamy with some possibility of polyandry. The Chinese grouse was reported strictly monogamous (Wang, Liu, Chen, Yang & Xu 1987, Liu & Geng 1994). Here we present our preliminary radio-tracking results of 1995 to assess Chinese grouse mating behaviour.

Methods

Our study was conducted at the Lianhuashan Natural Reserve in Gansu Province, central China (34°56'-34°58'N, 103°44'-103°48'). The highest peak in the reserve is 3,578 m a.s.l. The yearly average temperature is 5.1-6.0°C, with a maximum of 34°C and a minimum of -27.1°C. It is dry on the southern slopes, with the habitat being shrubs and grasses. It is wet on the northern slopes and on some northeastern or northwestern slopes, with forest habitat occurring that was dominated by the following tree species: fir *Abies fargesii*, spruce *Picea aserata*, birch *Betula* spp., and many kinds of willow *Salix* spp.

Chinese grouse were captured in spring using snare poles, nets, and walk-in traps. In 1995, 11 grouse were captured and equipped with necklace transmitters weighing about 12 g (4% of their body weight; Table 1). Age (yearling or adult) was determined by characteristics of the ninth primary (Swenson, Sun & Liu 1996).

The breeding period encompassed late March to

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Table 1. Sex, age, and body weight of 11 radio-tagged Chinese grouse in the Gansu Province, central China, in 1995.

Bird	Day of capture	Sex	Age	Bodyweight (g)
A	25 March	♂	Yearling	365
B	27 March	♂	Yearling	345
C	11 April	♂	Adult	375
D	13 April	♂	Yearling	360
E	21 April	♂	Yearling	318
F	26 April	♀	Adult	310
G	27 April	♀	Yearling	270
H	27 April	♂	Yearling	350
I	28 April	♀	Adult	297
J	28 April	♂	Adult	290
K	3 May	♀	Adult	283

June. At Lianhuashan, incubation began on 9 June in 1995. Thus, according to Swenson & Boag (1993) the receptive period would have begun around 20 May in 1995. Radio-marked birds were located 5-15 times per week. Territory sizes were determined by the Minimum Convex Polygon method (Jennerich & Turner 1969). Marked males and females were approached as often as possible to determine whether they were with an unmarked bird. We assumed, for purposes of this study that a male and female seen within 10 m or subsequently located within 25 m of each other were paired.

Results

Flock dissolution and pair formation

In winter, Chinese grouse form flocks, at the juncture of southern and northern slopes. In 1995, the last flock containing more than five birds was observed in early March. Smaller groups (3-4 birds) were seen in mid-March. The first pair was seen on 13 March at the altitude of 2,850 m a.s.l.; pairs were seen commonly starting in late March.

'Flutter-jump' and display behaviour

Male Chinese grouse used a 'flutter-jump' display to mark their territories and attract females. When flutter-jumping, the male jumped from the ground, a stem, or atop sticks while fluttering his wings to make a sound like "pu, pu, pu, pu, ..."; normally he jumped about 0.5-1.4 m high and 0-0.4 m long. We first observed the flutter-jump on 12 April in 1995, the peak of flutter-jumping was during 1-10 May (Fig. 1). The flutter-jump occurred throughout the day except during the noon hours (12:00-15:00), but most frequently in the morning (Fig. 2).

When Chinese grouse pairs were disturbed, the males performed 2-3 flutter-jumps, and the females

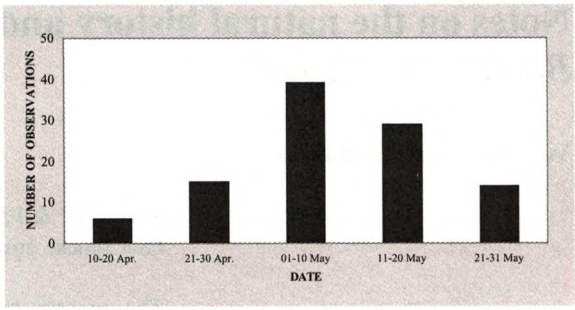


Figure 1. Number of observations of flutter-jump behaviour exhibited by Chinese grouse during April-May 1995 in the Gansu Province, central China.

quickly went into the cover (N = 4). Therefore, we believed that the male's flutter-jumps also could serve as vigilance signals for females.

During late May, we observed display behaviour (N = 5) of Chinese grouse. Males fanned their tails, lowered their head, and expanded their body feathers. Then they quickly ran to the females; when at their side, they walked quickly 3-4 paces back and forth, and sometimes laid on the ground and rubbed their feathers.

Home range size and territorial interactions

During the breeding season male home ranges were 1.8-3.2 ha (N = 3). Home range overlap between two neighbouring males G and A in May was only 5.6% of their home range size. During April and May, D was observed 29 times, but he was never seen paired with a female. However, D was seen fighting twice with other males at the border of his home range even though he had no mate. No other males were seen in the core area of D's home range. Therefore, we believed D to hold a territory. Another male, H, showed a pattern similar to that of D, and was observed 14

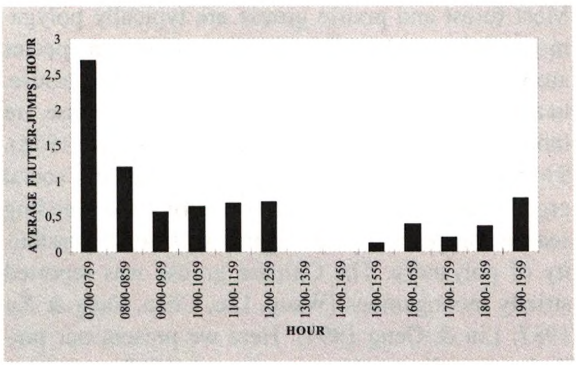


Figure 2. Average number of flutter-jumps by Chinese grouse observed throughout the day during April-May 1995 in the Gansu Province, central China.

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times alone. Thus, it appears that although some males may hold territories, they do not necessarily form pairs. These observations also suggest that home range size might approximate territory size.

Male fights were observed (N = 6), when two males were in close proximity. They also would give a low and hoarse sound like "en, er, en, er, en, . . ." to each other which probably was used as a threat signal. No fights between females were observed even though we observed them in close proximity (<10 m).

Pair bonds and social behaviour

In spring, Chinese grouse were observed alone or in pairs. Further, no bird was observed with more than one bird of the opposite sex at the same time, suggesting a monogamous system. Using telemetry data, the nature of some relationships between the marked birds was revealed.

For example, male D and female G were a pair in April, their neighbouring male A paired with a female, but lost it soon. After D died by predation at the end of April, A took over his territory. Male J and female I were captured at the same walk-in trap in late April, but female I left J's territory and went 600 m away to another male's territory. After a fight between males A and J, G paired with J in his territory. From 6 May, when this pair formed, to 9 June, when G started incubating, the pair was observed on 22 occasions; 21 times they were together, only one time was G with another male.

After female K lost her mate in early May, she went northwards for 700 m and paired with another male. However, in late May, she returned to her former place and paired with the male now occupying her former partner's territory, and at last made her nest there. Thus, our study revealed some dynamic aspects of pair formation and stability in the Chinese grouse.

In summary, during the early breeding period, males (A, J) and females (G, I, K) paired with more than one partner. In the receptive period, pairs were more stable. The mating system of the Chinese grouse was mainly monogamous, with female choice being the main factor affecting the social behaviour in the breeding season. Since we observed at least one female with a different male during the breeding season the possibility of polyandry or extra-pair copulation occurring cannot be entirely eliminated.

Discussion

The Chinese grouse's flutter-jump behaviour is quite different from that of other species in its genus. The hazel grouse maintains territories and contacts each other by whistling, while the ruffed grouse *B. umbellus* uses wing drumming as a social signal (Johnsgard 1973). In the Qilian Mountains of northwest Gansu Province the Chinese grouse uses a 'flutter-fly' instead of a flutter-jump. During pair formation the males flutter-fly in the forest, producing sounds such as "hwu, hwu, ..." (Liu & Geng 1994). When flutter-flying, males fly from one spruce to another, for about 8-10 m, and at a height of 4-6 m (Liu, unpubl. data).

We hypothesise that the difference in behaviour of these two populations of Chinese grouse was local adaptation to the different habitats they used in the two areas. The habitat of Chinese grouse in the Qilian Mountains was also spruce/fir forest, but there were fewer shrubs on the ground. With fewer shrubs the grouse would be more vulnerable to predation because of a lack of cover. Thus, flutter-jump behaviour may be a disadvantage to grouse in the Qilian Mountains. On the other hand, the density of Chinese grouse in the Qilian Mountains was relatively low and they held larger territories. Thus, the sound made by a flutter-flying male could help advertise territories and attract females more effectively. We plan to compare the behaviours displayed in the two areas in more detail in future studies.

Some males did not pair during the breeding season. However, they still held the territories but we do not know if they ever had a chance to mate. We thought females were responsible for mate choice. Swenson & Boag's (1993) observations suggested that most hazel grouse males mated monogamously and that at least 37% of females had an opportunity to mate polyandrously. Our observations also suggested that some females changed their partners or may have paired with more than one male.

In grouse, only the willow ptarmigan *Lagopus lagopus* are reported to have males that care for young. Liu & Geng (1994) reported that both parents of Chinese grouse looked after their young. In contrast, we found that after hatching, hens (N = 10) led their young away, while males stayed on their territories.

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