

S11-3 Habitat isolation and fragmentation of the Chinese grouse (*Bonasa sewerzowi*) at Lianhuashan Mountains, Gansu, China

SUN Yue-Hua¹, Siegfried KLAUS², FANG Yun¹, P. SELSAM², JIA Chen-Xi¹

1. Institute of Zoology, Chinese Academy of Sciences, 19 Zhongguancun Rd., Beijing 100080, China; sunyuehua@sina.com

2. Thüringer Landesanstalt für Umwelt and Geologi, Prüssingstrasse 25, D-07749 Jena, Germany

Abstract The habitat (altitude 2 600–3 600 m) of the Chinese grouse in the Lianhuashan Mountains of Gansu province comprises a mixture of conifers for cover and deciduous trees (willow, birch) for food. Logging of virgin forest in this area over the past 30 to 40 years has destroyed much of the coniferous forest. Using digitized SPOT satellite images, we mapped the surviving distribution of the forest, the key habitat of the Chinese grouse. The population of the Chinese grouse there is isolated from others elsewhere and has now been broken into two subpopulations. Within a study area of 120 000 ha, we found 77.3% of forest patches to be smaller than 10 ha, indicating a high level of habitat fragmentation. From a survey of 31 forest patches, we found that grouse only occupied tracts larger than 100 ha and closer to one another than 600 meters. On this basis, proposals have been put to local government to protect the whole habitat of this isolated population.

Key words Chinese grouse, Habitat fragmentation, Conservation

1 Introduction

The endemic Chinese grouse (*Bonasa sewerzowi*) inhabits isolated remnants of the coniferous mountain forests of Gansu, Qinghai, Sichuan, Yunnan and Tibet (Sun, 2000). The decline and increasing fragmentation of this endangered species is being caused by natural aridity and the effects of agriculture, logging and deforestation on mountain forest (Zheng and Wang, 1998). Habitat fragmentation, beyond that of habitat loss, has apparently had greater negative effects on its survival than for mammal species (Andrén, 1994). As the hazel grouse (*B. bonasia*), the species most closely related species to the Chinese grouse, is exceptionally sensitive to habitat isolation and habitat fragmentation (Åberg et al., 1995; Saari et al., 1998), we set out to determine the status of the Chinese grouse in the Lianhuashan Mountains at landscape scale.

Remote sensing is a powerful and accurate tool for assessing wildlife habitat, particularly for large areas where access is difficult. In this study, we used satellite imagery to determine the distribution of the Lianhuashan conifer forest, a habitat considered primary for the Chinese grouse.

2 Study area and methods

The study area in the Lianhuashan Mountains (34°45'–35°06'N, 103°27'–103°51'E) in Gansu Province, west China, includes the Lianhuashan Nature Reserve and parts of the Yangsha and Yeliquan forestry farms in the counties of Kangle, Lintan and Zhuoni. Forests there occur on northern and some northeast and northwest slopes at altitudes between 2 600 m and 3 600 m a.s.l. On the dry, insolated southern slopes, only shrub and grass grow. The forests

are dominated by fir (*Abies fargesii*), spruce (*Picea asperata*), birch (*Betula* spp.) and many kinds of willow (*Salix* spp.). The yearly temperature in the Lianhuashan Nature Reserve ranges from a mean low of –27.1°C to a mean high of 34°C. Except in the Lianhuashan Nature Reserve, the forests in this area had been selectively logged for 30 to 40 years until 1998, when the Chinese government stopped logging in virgin forests in Gansu and Sichuan.

The TM-satellite picture, taken on 8 December 1996 (ground area: 185×185 km²) was used to assess the external isolation of the study area. For determining the extent of internal fragmentation, we used a SPOT image taken on September 1998, with a ground area of 60×60 km². ERDAS IMAGIE 8.4 was used for analyzing it. As all mating and nesting territories for the grouse were found to be confined to spruce-fir forest mixed with deciduous trees, mainly willow and birch (Sun and Fang, 1997; unpublished data), we selected conifer forest as the key indicator habitat for survival and reproduction. In an area of about 120 000 ha, all conifer forest patches bigger than 2 ha were numbered and mapped. In spring 1999 to 2001, we then went to 31 larger forestry tracts to survey for Chinese grouse, assisted by local forestry maps, topographic maps of 1:50 000 and GPS.

To determine presence, we searching mainly for droppings under possible night-roosts in conifer trees, as the grouse usually roost in conifers in winter and spring (Klaus et al., 1996) and defecate many times (more than 30 droppings/night). We also used other methods, such as direct observation and the finding of dusting and nesting sites.

3 Results and discussion

3.1 External isolation

Combining the forest distribution map for Gansu and TM satellite imagery showed that the population of Chinese grouse in the Lianhuashan Mountains is isolated from all others. At its eastern limits there, it is separated by about 120 km from its nearest neighboring population to the west in Xunhua County, Qinghai Province. Although patches of logged forest remain in between, no grouse have been recorded in them. The nearest population to the north is found in the Liancheng Nature Reserve in Yongdeng county of the Qilianshan Mountains, some 200 km away; no forest has been left in between. The nearest population there lives on the Kache and Muer forestry farms in Zhuoni (Jone) county, separated by 30 km and 10 km, respectively, of unforested mountains.

3.2 Internal fragmentation

Within a proscribed study area of 120 000 ha, 1 762 forest patches larger than 2 ha were determined from the SPOT satellite image (Fig. 1). Of these, 1 362 (77.3%) were smaller than 10 ha, and only 31 were larger than 100 ha, indicating a particularly high level of fragmentation.

3.3 Survey of Chinese grouse

Of the 31 larger (>100 ha) forest patches checked in the spring of 1999 through 2001, Chinese grouse were found in only 16. They were present in patches that had been subject to cut over rates of up to 60% of trees, but only in low numbers. Grouse also only occupied tracts that were closer to one another than 600 meters. No grouse were found in the 5 forest patches between the two subpopulations in the Lianhuashan Nature Reserve and on the Yeliguan Forestry Farm.

3.4 Recommendations for conservation

Our studies of the Chinese grouse in the Lianhuashan Nature Reserve since 1995 show that population density

has been stable through the subsequent five years (Sun et al., 2003). Because of this, the Lianhuashan Nature Reserve has great conservation value for the species and other regional wildlife and, partly due to our efforts, was upgraded to a national reserve in 2002. Although the reserve is linked to the Yeliguan Forestry Farm (and the other local grouse population) by a forest corridor, that corridor is less than 1 km wide, locally broken and contains no grouse. The local management plan should attend to plantings that will improve connectivity between the two forested areas.

Many other endemic birds occur in the conifer forests of the Lianhuashan Mountains. Examples are the blood pheasant (*Ithaginis cruentus*), blue-eared pheasant (*Crossoptilon auritum*), chestnut-throated partridge (*Tetraophasis obscurus*) and snowy-cheeked laughing-thrush (*Garrulax sukatschewi*). Our study also recorded the Sichuan wood owl (*Strix davidi*) there (Sun et al., 2001). For them, the Chinese grouse may served as an umbrella species for protection. As a next step, we recommend that the Lianhuashan Nature Reserve should be enlarged to cover the whole conifer forest in the Lianhuashan Mountains.

In October 1998, the Chinese government stopped the logging of virgin forests in Gansu and other provinces. Despite this, local people are still continuing to log extensively and illegally in the Lianhuashan Mountains. We strongly recommend that the local government should take action to stop this and pay better attention to forest management.

Acknowledgements This study was supported by grants from the National Natural Science Foundation of China and Deutsche Forschungsgemeinschaft, the Chinese Academy of Sciences Innovation Program, and the Bird Protection Conservation Programme. We thank Liu Xiu-Sheng, Song Jiang-Ning and others in the Lianhuashan Nature Reserve for their great help. We also thank Bi Zhong-Lin and Zhou

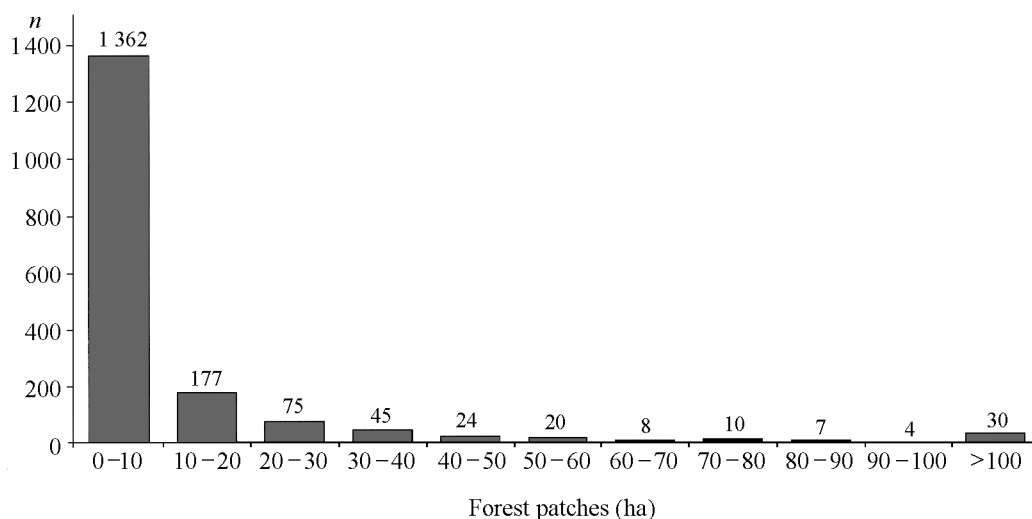


Fig. 1 The number (shown above the columns) of conifer forest patches in categories of patch size in the Lianhuashan Mountains, Gansu Province, west China

Forest patches bigger than 2 ha were determined from SPOT satellite imagery.

Jiang for their excellent field work, and Jon Swenson and Wolfgang Scherzinger for their valuable comments on the study.

References

- Åberg J, Jansson G, Swenson JE, Angelstam P, 1995. Effect of matrix on hazel grouse occurrence in isolated habitat patches. *Oecologia* 103: 265–269.
- Klaus S, Scherzinger W, Sun YH, 1996. Ecology and behaviour of the Chinese grouse *Bonasa sewerzowi*. *Ornithol. Beobachter* 93: 343–365.
- Saari L, Åberg J, Swenson JE, 1998. Factors influencing the dynamics of occurrence of the hazel grouse (*Bonasa bonasia*) in a small-grained managed landscape. *Conserv. Biol.* 12: 586–592.
- Sun YH, Fang Y, 1997. Notes on the natural history and behaviour of the Chinese grouse *Bonasa sewerzowi*. *Wildl. Biol.* 3: 265–268.
- Sun YH, 2000. Distribution and status of the Chinese grouse. *Wildl. Biol.* 6: 275–279.
- Sun YH, Scherzinger W, Liu NF, Klaus S, Fang Y, 2001. New distribution areas of the Sichuan wood owl in Gansu. *Acta Zool. Sinica* 47: 473–475.
- Sun YH, Swenson J, Fang Y, Klaus S, Scherzinger W, 2003. Population ecology of the Chinese grouse, *Bonasa sewerzowi*, in a fragmented landscape. *Biol. Conserv.* 110: 177–184.
- Zheng GM, WANG Q, 1998. China Red Data Book of Endangered Animals (AVES). Beijing, Hong Kong, New York: Science Press.