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Relative density and habitat use of four pheasant species in Xiaoshennongjia Mountains, Hubei Province, China

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Summary

Many species of China's Galliformes live in forests and it is often difficult to assess populations of species in these habitats. Such assessments are becoming increasingly important because much of China's forest has been altered through logging and other forms of human activity. After describing and mapping habitat types, we assessed two commonly used methods for counting pheasants (transects and point counts at dawn) in the Xianshennongjia Mountains in the Three Gorges area of Hubei Province in east-central China. Four pheasant species were recorded: Golden Pheasant *Chrysolophus pictus*, Temminck's Tragopan *Tragopan temmincki*, Koklass *Pucrasia macrolopha* and Common (or Ring-necked) Pheasant *Phasianus colchicus*. Golden Pheasants were detected most often by calls heard during transects and Koklass were recorded mostly during point counts at dawn. Temminck's Tragopan was detected during transects (by sightings) and also by calls at dawn. The relatively few Common Pheasants that were detected were registered mainly during transects. Golden Pheasants were found at the lowest altitudes, closest to human habitation and both Temminck's Tragopan and Koklass lived in various forest types above this. Common Pheasant was found in meadows at higher altitudes. We conclude that the methods used can determine general habitat use, but that no one method is likely to prove sufficient to unravel the detailed pattern of habitat use across all four species. In particular, further study is required to assess the relative importance of different forest types to Golden Pheasant, Temminck's Tragopan and Koklass. It would appear that human impact on the forest has affected the distribution of the pheasant species. For example, Common Pheasant is now absent from low-lying areas and occurs at what appears to be an unusually high altitude in the study area.

Introduction

China is home to more species of pheasant and more threatened species of pheasant than any other country (see Fuller and Garson 2000). Many species of pheasant in China live in forested habitats and these have suffered substantially throughout many parts of the country because of deforestation. Although much of the conservation attention on this group of birds has, understandably, concentrated on the species that are found on the IUCN Red List (see Hilton-Taylor 2000), the loss and degradation of forested habitats is likely to have resulted in the fragmentation of populations of many species. Change in the remaining forested areas is also likely to have affected the habitats used by these species. Therefore, we set out to examine the detectability and relative densities of

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four pheasant species in a human-altered habitat in the Three Gorges area of western Hubei. The four species were Temminck's Tragopan *Tragopan temminckii*, Koklass *Pucrasia macrolopha*, Common (or Ring-necked) Pheasant *Phasianus colchicus*, and Golden Pheasant *Chrysolophus pictus*.

The majority of the geographical distribution of Temminck's Tragopan is in China, although it also occurs in north east India, northern Myanmar and northern Vietnam (Fuller and Garson 2000). Within China, it occurs from south-eastern Tibet to northern Yunnan, and in Sichuan, Shaanxi, Hubei, Hunan and Guizhou Provinces (Zheng *et al*. 1978). The species is listed in the China Red Data Book of Endangered Animals as vulnerable (Zheng and Wang 1998). Koklass has a larger global distribution, extending from Afghanistan in the west, along the Himalaya and into China, where it is widespread. In China, it occurs in Tibet, Yunnan, Sichuan, Gansu, Shaanxi, Shanxi, Hebei, Liaoning, Anhui, Hubei, Zhejiang, Fujian and Guangdong Provinces (Han 1991).

Common Pheasant also has a very large global range, extending from the Caucasus in the west throughout a large part of China into Japan. In China it is widely distributed, although it is absent from the Qiangtang Plateau in Tibet and Hainan Province. Golden Pheasant is the only one of these four species endemic to China, where it is found in Central China. It is considered to be near-threatened (Hilton-Taylor 2000) and is listed in the China Red Data Book of Endangered Animals as vulnerable (Zheng and Wang 1998).

The Three Gorges portion of the Yangtze River lies at the boundary of the Palearctic and Oriental Realms. The natural vegetation is dominated by evergreen broadleaved forest below 1,300 m, deciduous forest between 1,300 m and 1,700 m, mixed coniferous and deciduous forest between 1,700 m and 2,200 m, and subalpine coniferous forest from 2,200 m to 3,105 m (Xiao *et al*. 2000).

The original forest in the Three Gorges area of the Yangtze River was probably first significantly altered by humans during the Yuan Dynasty in the 15th Century. Since the 1950s, the forests have been very seriously impacted by human activities and the human population in the area has increased markedly. This has led to a considerable rise in agriculture and the demand for timber. Forest destruction continued until the 1980s, at which time a national level nature reserve was created in Shennongjia (N31°15′–31°57′, E109°56′–110°58′), adjacent to Badong County, Xingshan County and Fang County in western Hubei Province. As this area had relatively gentle slopes, it had been largely cleared of forest by the time the reserve was established.

Xiaoshennongjia is a mountainous area that lies to the south of Shennongjia National Natural Reserve and which has forests that were less affected by forest loss than the area that now comprises the reserve. Although part of the forest in Shennongjia National Natural Reserve is adequately conserved on some steep mountains, the proportion of well-conserved forest is higher in Xiaoshennongjia. This is because the mountains are much steeper and so cutting trees and farming much more difficult than on the relatively gentle slopes of Shennongjia.

The natural habitat of the Xiaoshennongjia area was dominated by evergreen broadleaf forest at lower altitudes, mixed evergreen conifer and deciduous broadleaf forest at mid-altitudes above which occurred deciduous forest with occasional conifer trees, and at higher altitudes, subalpine coniferous forest. Although the forest has been selectively logged for a long time, some areas have

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been relatively unaffected and are not being seriously impacted now. Parts of the area are very steep and there is, therefore, some completely natural forest remaining.

Our objectives were to: (1) describe the habitats present in the study area and provide a sketch map of their distribution; (2) compare methods of detecting pheasants in this area; and (3) to then determine their use of habitats. By comparing our habitat use results with other studies we aimed to see if human activities have affected the altitude and habitat use of the pheasants.

Study area

The study was carried out in about 20 km^2 of Xiaoshennongjia Mountains in the northern Three Gorges of the Yangtze River in Hubei Province and close to the Shennongjia National Nature Reserve. The northern part of the study area is high plateau and the south has steep-sided valleys with an average slope of 50°. The altitude range is 800–3,014 m, with the highest point in the northwest. The valley bottoms are farmland with patches of scrub that have been cut for fuelwood for many years. Above this, most of the vegetation is natural or well-grown secondary forest.

From 1,800 m to 2,400 m conifers have been logged but because of the steepness of the valleys, large areas of mixed conifer-deciduous and pure deciduous forest remain. The main coniferous species are Bashan Fir *Abies fargesii* and Armand Pine *Pinus arizonica* and the main deciduous tree species is birch *Betula* sp. Above 2,400 m, where the slopes are less steep, firs were cleared a long time ago, after which the land was cultivated and used for pasture. Now, it is no longer cultivated and the vegetation cover is meadow and mixed fir/rhododendron forest.

Methods

Habitat mapping

There was no existing map of the forest types in the study area. Therefore, we prepared a sketch map during transects and other fieldwork. We identified vegetation types following the description in Xiao *et al*. (2000). Each vegetation type was clearly identifiable and their boundaries could easily be demarcated either during transects or from vantage points along mountain ridges. We did not have access to equipment that would allow us to measure boundaries and the extent of habitats exactly, so boundaries were demarcated from vantage points and plotted directly on to a 1:50,000 topographic sheet.

Detection rates of the four pheasant species

Transects of varying lengths were carried out both along existing forest trails and also by walking through the habitat. These transects were walked early in the morning (from 04h30 and 06h30). Although it was still dark at 04h30, it was necessary to start at this time to allow a direct comparison with results

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obtained during point counts (see below). A trained dog was used to increase the likelihood of flushing pheasants. In some habitats there were no trails. The trails that were walked were small forest trails and so had not altered the habitat significantly. It was not possible to have the same proportion of transect in each habitat because of the topography of the study area. Some habitats were on very steep slopes and, therefore, long transects could not be walked. When walking along each trail, all calls, sightings, dropped feathers, recognisable droppings or evidence of kills were recorded. Each transect was surveyed 1–3 times, from mid-April to mid-May. The sampling effort in each habitat type is given in Table 1.

We also conducted point counts to record calls made by each species. Point counts were started at 04h30 when it was still dark. Temminck's Tragopan and Koklass began to call at about 05h00 every morning. The calling lasted a short time and was usually 30–60 min before and after sunrise, which was about 05h30. Koklass called later than Temminck's Tragopan by 10–30 min. When Temminck's Tragopan started to call it was still dark. On foggy days the calling lasted longer. We did not hear Koklass in the evening and Temmimck's Tragopan called less than in the morning. The other pheasants called at any time of day, although more so in the morning. Only birds recorded between 04h30 and 06h30 were recorded for this analysis. All four species can be heard up to 200–300 m away.

Habitat use

When a pheasant record was made, the habitat type (see Results below) was noted. It was not possible to determine the exact amount of each habitat type available in the study area and, therefore, we could not compare habitat use with habitat availability. Instead, encounter rates for each species were compared between each habitat type.

Table 1. Transect and point count survey effort during pheasant surveys in the Xiaoshennongjia Mountains, Hubei Province, China.

Habitat type	No of transects	Total transect length (km)	No of point stations	Total area sampled by points (km^2)[a]
A	6	9.7	2	0.24
B	7	9.7	2	0.49
C	12	18.1	7	1.20
D	2	1.2	1	0.20
E	4	2.4	0	–
F	2	2.1	1	0.28
G	4	5.2	3	0.28
H	6	14.1	1	0.03

Habitat types are described in the text. [a] the area sampled by each point was derived from estimates of the radius of each point count. These were not the same for each point because of variations in topography (e.g. ridges and cliffs) and the distribution of the habitat being sampled. The area sampled in each habitat by points varied according to the number of point counts and factors that affected the radius of the point count area. These were the proximity of the observer to the habitat boundary, and hence the extent of each habitat type surveyed and also whether or not factors such as noise from streams affected the detection distance (and hence the radius of the point count).

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Results

Habitat mapping

We identified the following nine habitats in the study site and mapped their distribution (see Figure 1).

(A) Farmland, young forest and forest edge between 800 and 1,700 m. This was mainly at the bottom of valleys where there was considerable human activity. Slopes $< 45°$ with thick soil had been cultivated. Close to the plantation the scrub had been cut for a long time for fuelwood.

(B) Mixed forest of evergreen and deciduous broadleaf forest between 1,200 and 1,800 m. This had been logged, mainly for woodcoal production. This practice is less intensive than other forms of extraction, and even though it was still continuing, the relatively modest exploitation kept the forest in reasonably advanced secondary successional stages. This forest type was found mainly on north-facing slopes of steep mountains with relatively thin soil.

(C) Deciduous forest between 1,600 and 2,000 m. This was comprised of many tree species with little or no exploitation, resulting in advanced secondary forest. The understory consisted mainly of bamboo and open patches. Some parts of the forest had, however, been logged and were dominated

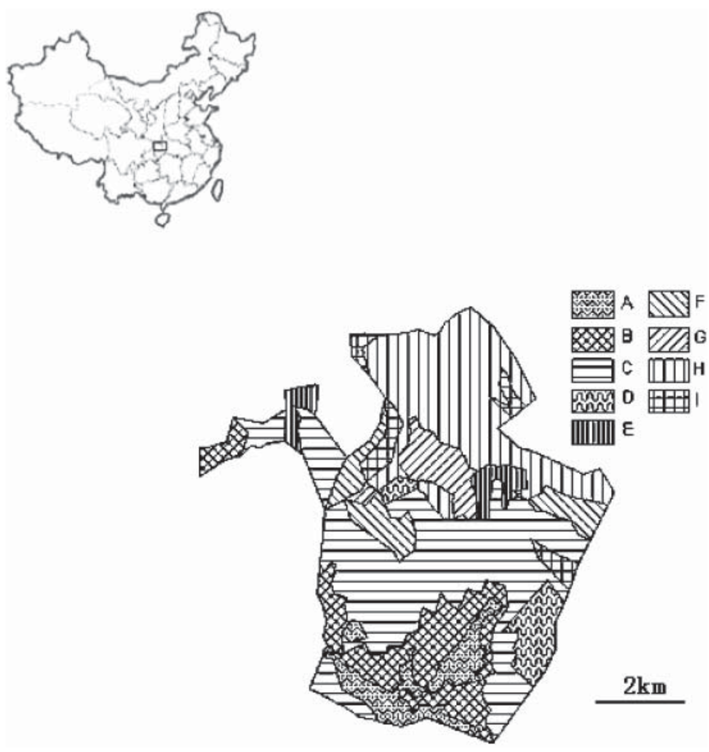

Figure 1. The location of the Xiaoshennongjia Mountains in western Hubei Province (upper map), and the distribution of vegetation types within the study area (lower). Letters refer to the vegetation types described in the text.

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by patches of young trees. This was the most widespread habitat, found mainly on the less steep south-facing slopes.

(D) Birch forest between 2,000 and 2,500 m. This occurred where the forest had been selectively cut more than five years previously. There was little understorey. Only a few patches of this habitat were found, on the upper slopes.

(E) Mixed deciduous/conifer forest between 1,800 and 2,400 m. The dominant trees were Armand Pine, Chinapaper Birch *Betula albo-sinensis* and a small proportion of fir. The forest had been logged severely and no longer resembled natural forest. There was only a small patch of this forest remaining, below the rhododendron forest and meadow (see below).

(F) Subalpine conifer forest between 2,300 and 3,000 m. The conifer-deciduous forest on relatively steep slopes in deep valleys had been selectively logged.

(G) Rhododendron *Rhododendron fargesii* and *Abies fargesii* forest between 2,400 and 2,700 m. This lies on the slopes just to the south of the high altitude meadows in the north of the study area. The natural conifer forest has been logged and the main secondary vegetation is rhododendron. There are patches of younger fir trees developing around some of the surviving fir trees.

(H) Meadow between 2,400 and 3,000 m. The original conifer forest had been removed many years previously, since when the area had been farmed. Most of the secondary vegetation was meadow and bamboo, principally Umbrella Bamboo *Fargesia spathacea* and *Indocalamus longiauritus*. All of the Umbrella Bamboo was dead because it had recently flowered.

(I) Fir forest. This was found on top of mountains with the steepest slopes and had never been logged. There were very few patches, mainly in the west of the study area. The terrain here was too steep for conducting fieldwork.

The main disturbance by humans in the study area at the time of this study was through hunting, cutting trees for fuelwood and the collection of herbs. Hunting using guns or traps was a serious threat until recently for some big mammals, such as black bear and wild pig, but is not thought to have been too severe for pheasants. In 2001, guns were confiscated and now the residents hunt for meat mainly in winter close to villages using traps. Herbs are collected in the high mountains during any free time, except for the ploughing and harvest seasons.

Detection rates of the four pheasant species

During the transects, Golden and Common Pheasants were detected mainly by hearing calls and Temminck's Tragopan and Koklass were mainly detected by sight records (Table 2). Each species was detected relatively infrequently by other detection methods. During the point counts, all birds were detected by calls (Table 3), although on a few occasions Temminck's Tragopan were subsequently seen.

Habitat use

Of the four pheasant species found in Xiaoshennongjia Mountains, Golden Pheasant had the widest altitudinal distribution (960 m to 2,700 m) and Common

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Table 2. Number of records of four pheasant species made by seven detection methods during transects in the Xiaoshennongjia Mountains, Hubei Province, China.

Species	No. calls	No. sightings	No. feathers	No. droppings	No. nest	No. egg shell	No. killed
Golden Pheasant	65	6		4			
Temminck's Tragopan	5	41		14	2	2	
Koklass		10	4	2	1	1	
Common Pheasant	9	11		7	1		1

Table 3. Number of call registrations heard during dawn call counts in the Xiaoshennongjia Mountains, Hubei Province, China.

Species	No. registrations
Golden Pheasant	17
Temminck's Tragopan	32
Koklass	26
Common pheasant	5

Table 4. The altitudinal distribution (m) of four pheasant species recorded during surveys in the Xiaoshennongjia Mountains, Hubei Province, China.

Species	Mean	*n*	S. D.	Minimum	Maximum
Golden Pheasant	1,699	77	485	960	2,700
Temminck's Tragopan	1,964	74	360	1,220	2,680
Koklass Pheasant	1,866	29	270	1,350	2,490
Common Pheasant	2,600	28	125	2,400	2,900

Pheasant the narrowest (2,400 to 2,900 m) (Table 4). The other two species were distributed widely between these two. When examined in more detail, it was evident that Golden Pheasant was not equally distributed in all habitats between 960 and 2,700 m (Table 5).

Relative encounter rates of the four species were expressed as the number of encounters per km, using the most readily detectable method for each of transect counts and point counts (Table 5). On transects, Golden Pheasant was most often detected by calls. In contrast, both Temminck's Tragopan and Koklass were encountered more frequently by sightings than calls and their transect encounter rates are thus expressed as the number of sightings made per km. These encounter rates were calculated for each habitat type to give an indication of habitat use.

The two detection methods did not reveal consistent habitat preferences for three of the four species (Table 5) and there were too few encounters of Common Pheasant to assess relative habitat use (Table 2). Golden Pheasant had the highest encounter rates using both methods in farmland, young forest and forest edge. Point counts also suggested a relatively strong preference for rhododendron and rhododendron/fir forest. Both methods showed the highest encounter rates of Temminck's Tragopan in birch forest between 2,000–2,500 m, but differed as to

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Table 5. Relative encounter rates of four pheasant species obtained during transects and point counts during surveys in the Xiaoshennongjia Mountains, Hubei Province, China.

Habitat type	Golden Pheasant		Temminck's Tragopan		Koklass		Common pheasant	
	Transect (Call/km)	Points (Call/km^2)	Transect (S/km)	Points (Call/km^2)	Transect (S/km)	Points (Call/km^2)	Transect (Call/km)	Points (S/km^2)
A	4.0	21.2	–	–	–	–	–	–
B	0.4	–	1.4	6.2	0.1	20.5	–	–
C	0.5	2.5	0.6	16.7	0.4	11.7	–	–
D	–	–	2.5	20.4	–	10.2	–	–
E	2.1	–	–	–	0.8	–	–	–
F	–	–	0.5	7.1	–	–	–	–
G	1.5	31.8	1.9	10.6	–	–	0.2	7.1
H	–	–	0.1	–	–	–	0.7	95.5

Transect results are given for the detection method (calls heard or sightings made) that provided most encounters (see Table 2). S, sightings per kilometre of transect.

the relative preferences for other habitat types. There were high encounter rates using both methods in rhododendron and rhododendron/fir forest, but whereas transects had high encounter rates in mixed forest between 1,200 and 1,800 m, point counts did not, but had high encounter rates in deciduous forest between 1,600 and 2,000 m instead.

As the number of Koklass detected during transects was low, it is unlikely that comparing encounter rates obtained using the two detection methods would be reliable. Point counts revealed relatively more birds in mixed forest than either deciduous forest or birch. Numbers of Common Pheasants recorded were also low, but in the small area of upland meadow sampled the number detected by point counts may indicate a very high population density. In contrast, however, the relatively long transect distance walked recorded relatively few Common Pheasants. None were detected below 2,400 m or in forested habitats by either method.

Discussion

Detection methods and population estimation

There were four species of pheasant present in the study area. During transects, Golden Pheasants were most readily detected by calls, whereas both Koklass and Temminck's Tragopan were seen more often than heard. No single detection method was solely suitable for recording encounters of all four species. Transects appeared useful for encountering Golden Pheasants (calls) and Temminck's Tragopans (sightings) and both Temminck's Tragopan and Koklass were most readily detected during dawn call counts. Common Pheasant was not widely distributed in the study area and so was relatively infrequently encountered overall, although it was not difficult to detect in suitable habitat.

Overall, it would appear that Golden Pheasant is best counted using transects, Koklass using dawn call counts and that both techniques may be appropriate

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for Temminck's Tragopan. Although there were few Common Pheasants in the study area, both methods also appear useful for assessing the population status of this species. Although our sample sizes were small, we believe that they were sufficient to conclude that both sampling methods would be required to provide indices of population size (see Conroy and Carroll 2001). Making reliable estimates of population density in each habitat would require both larger sample sizes and a critical assessment of the variation in detectability between different habitat types. For example, the distance at which each species can be seen will vary between open and closed habitats according to the thickness of the vegetation.

Habitat use in Xiaoshennongjia Mountains

Although this study was brief it has highlighted important methodological considerations in assessing habitat use with non-invasive techniques, mainly related to the detectability of the target species. Despite the general patterns of habitat use appearing reasonably clear, there are some important differences between the two methods used that indicate caution should be applied to the interpretation of similar habitat use studies. Broadly, it appeared that Golden Pheasant favoured farmland and lightly wooded habitats in the valley bottoms below 1,700 m, whereas both Temminck's Tragopan and Koklass were encountered more frequently in various forest types (deciduous, mixed and birch forests) at 1,200–2,500 m. Common Pheasant was mostly restricted to the higher altitude meadows.

Detailed inspection of encounter rates obtained from transects and point counts, however, suggests that there may be important methodological factors to consider before habitat use can be clarified in greater detail. This is because of the variation in the relative importance of each habitat type as determined by visual ranking of encounter rates for each species. Therefore, whilst it was evident that Temminck's Tragopan and Koklass use forested habitat types, the relative importance of each forest type identified here was not clear because the two methods provide different rankings.

There are two possible reasons for this disagreement, and both seem likely to be important. First is our small sample size which indicated that a larger number of transects and point counts covering a larger sampling area is necessary to further tease apart detailed habitat use with confidence. The second factor is the difference in detectability of each species in each habitat type, as alluded to above. For example, it is well known that Koklass is easier to detect by calls at dawn rather than by sightings at other times of the day (Gaston 1980: see also Nawaz *et al.* 2001).

Comparison of habitat use in Xiaoshennongjia Mountains with other studies

The detailed use of certain habitat types by the four pheasant species present in Xiaoshennongjia Mountains remains to be clarified, but, as noted above, the general pattern is clear. Comparison of this pattern with other studies may shed light on the impact of habitat alteration in this part of China on the currently observed pattern of habitat use by these species.

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In Xiaoshennongjia Mountains, Golden Pheasant was encountered most frequently in the more disturbed habitats with a higher degree of secondary vegetation and close to farmland. Both Temminck's Tragopan and Koklass inhabit a wide range of forest types and Common Pheasant is found only in meadows at high altitudes. Elsewhere in its range, Golden Pheasant occurs mainly in evergreen broadleaf forest, mixed evergreen broadleaf-deciduous forest and mixed deciduous-conifer forest where it tends to utilize forest edge close to farmland (Liu 1991). It is found at altitudes up to 2,800 m, the highest record being from Liupan Mountains in Ningxia Province (Liu 1991), which is only 100 m above the highest altitude from which we recorded it. The original habitat of Golden Pheasant is believed to be upper elevations of evergreen broadleaf forest and lower elevations of broadleaf-deciduous forest, which is the predominant natural forest type throughout its range. However, human activity has reduced this habitat considerably such that there are now few patches left and Golden Pheasant is mainly found at the edge of cultivated land. Our study indicates that although Golden Pheasant does have a large vertical distribution, it is encountered more often in human-altered habitats. Encounter rates in natural habitats within its altitude distribution were much lower. In neighbouring Shennongjia National Natural Reserve it is the commonest pheasant in a pine plantation between 1,800 and 2,500 m (Wang Nan unpubl. data).

Temminck's Tragopan has a very wide altitudinal distribution and can occur above 3,500 m. Its habitat includes scrub in the low mountains and various forest types, such as bamboo forest, evergreen broadleaf forest, mixed deciduous-conifer forest and conifer forest (Li 1991). The species inhabits a similarly wide range of forested habitats in the Xiaoshennongjia Mountains, which occur over a wide altitudinal range. At higher altitudes it is found in bushes or even meadows close to forest and scrub, but at low altitudes it is found almost exclusively in forest, and away from farmland. In the Qinling mountains, Temminck's Tragopan was frequently recorded amongst Umbrella Bamboo in clear cut fir forest that had scattered high trees. However in Xiaoshennongjia, no tragopans were found in this habitat (Wang Nan unpubl. data). This may be partly because of the flowering and subsequent death of the bamboo, but may also be because bamboo is less extensive in Xiaoshennongjia than in Qinling Mountains.

Across its range Koklass is found between 1,000 m and 4,000 m, where it occurs in various forest types. In China it has been recorded in deciduous-conifer forest in mid-altitude mountains and in conifer forest at higher elevations in Sichuan Province (Shi 1984), and in deciduous forest at low altitudes and in deciduous-conifer forest at mid-altitudes in the Qinling Mountains (Yu *et al.* 2000). In neighbouring Shennongjia National Natural Reserve this was virtually the only pheasant detected in an area dominated by secondary deciduous forest and evergreen forest at 1,200–2,300 m, and no Temminck's Tragopan feathers were found (Wang Nan unpubl. data). Our findings support these at lower altitudes, although the proximity of these forests to farmland suggests that the species can tolerate some human disturbance, provided that there is little pressure on the forest structure from logging.

Throughout China, Koklass and Temminck's Tragopan often occur together in similar habitats (Li 1991). In Xiaoshennongjia Mountains Koklass overlapped partially with the habitat and altitude used by Golden Pheasant, and used

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similar habitat to Temminck's Tragopan in broadleaf forest. It was recorded most frequently in forest where human disturbance was high, but the forest was not degraded or was only slightly degraded. Both species tended to be found in deep forest at low and mid-altitude, above the Golden Pheasant range. Koklass is able to inhabit forest at an earlier successional stage than Temminck's Tragopan, and this forest is typically found closer to farmland. This may suggest that in Xiaoshennongjia Mountains Koklass can tolerate human disturbance to some degree. Comparison with other sites suggests that the Temminck's Tragopan may be less tolerant.

Although we had relatively few records of Common Pheasant in Xiaoshennongjia Mountains, it is of note that it was not recorded at lower altitudes adjacent to farmland. This is its main habitat in much of its range, and in China it is recorded from scrub, brushwood, valley-bottom meadows etc. close to farmland. It is recorded up to 2,900–3,000 m in Wenchuan in Sichuan (Zheng *et al.* 1978), but mostly occurs at lower altitudes. However, in Xiaoshennongjia Mountains it was found only in meadow on tableland above 2,400 m and not in habitats close to farmland lower down.

The habitat use of Common Pheasant in Xiaoshennongjia was surprising when compared with other areas. Throughout its range, it is found mostly in low altitude grassland, cultivation and scrub, and adjacent forest areas (Delacour 1977). The meadow on the tableland in Xiaoshennongjia Mountains is the result of forest clearance and is now dominated by grasses and patches of bamboo scrub, which structurally resemble the habitat used elsewhere, albeit at a higher altitude. Furthermore, as this habitat is far from villages, it is little affected by human activities and patches of bamboo have, therefore, spread. It would appear that altitude *per se* does not limit the distribution of Common Pheasant. The extensive deforestation and replanting of high mountains in Xiaoshennongjia twenty years ago may have led to a significant increase in the altitudinal distribution of Common Pheasant.

The mountains in Xiaoshennongjia are very steep, and the forest has been logged and subsequently restored a long time ago. Thus there is an intricate landscape of original and secondary forests present and these have presumably had an impact on the spatial distribution of pheasants in the area. It also appears that the ability of individual species to tolerate human disturbance has significantly influenced their current habitat and altitudinal distribution.

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References

Conroy, M. J. and Carroll, J. P. (2001) Estimating abundance of Galliformes: tools and application. Pp. 204–211 in M. Woodburn, P. McGowan, J. Carroll, A. Musavi and Zhang Zheng-wang, eds. *Galliformes 2000*. Kathmandu, Nepal: King Mahendra Trust for Nature Conservation.

Delacour, J. (1977) *Pheasants of the world*. Hindhead, UK: Spur Publishing and Bures, UK, World Pheasant Association.

Fuller, R. A. and Garson, P. J., eds. (2000) *Pheasants: status survey and conservation action plan 2000–2004*. Gland, Switzerland and Cambridge, U.K.: IUCN and Reading, U.K.: World Pheasant Association.

Gaston, A. J. (1980) Census techniques for Himalayan pheasants including notes on individual species. *J. World Pheasant Assoc.* 5: 40–53.

Hilton-Taylor, C. (compiler) (2000) *2000 IUCN Red List of Threatened Species*. Gland, Switzerland and Cambridge, U.K.: IUCN

Han Demin (1991) Koklass. Pp. 300–313 in Lu Taichun, Liu Rusun, He Fenqi, eds. *The rare and endangered gamebirds in China.* Fuzhou, China: Fujian Science and Techonology Press.

Liu Rusun (1991) Golden Pheasant. Pp. 372–289 in Lu Taichun, Liu Rusun, He Fenqi, eds. *The rare and endangered gamebirds in China.* Fuzhou, China: Fujian Science and Techonology Press.

Li Xiangtao (1991) Temminck's Tragopan. Pp. 177–185 in Lu Taichun, Liu Rusun, He Fenqi, eds. *The rare and endangered gamebirds in China.* Fuzhou, China: Fujian Science and Technology Press.

Nawaz, R., Garson, P. J. and Malik, M. (2001) Monitoring pheasant populations in montane forest: some lessons learnt from the Pakistan Galliformes Project. Pp. 196–203 in M. Woodburn, P. McGowan, J. Carroll, A. Musavi and Zhang Zheng-wang, eds. *Galliformes 2000*. Kathmandu, Nepal: King Mahendra Trust for Nature Conservation.

Shi Dongchou (1984) Survey of Pheasants in Baishuihe Natural Reserve, Nanping, Sichuan. *Chinese J. Zool.* 2: 13–17.

Xiao Wenfa, Li Jianwen, Yu Changqing, Ma Juan, Cheng Ruimei, Liu Shaoying, Wang Jinxi, Ge Jiwen (2000). *Terrestrial animal and plant ecology of the three gorges of Yangtze River*. Chongqing, China: Southwest Normal University Press.

Yu Yuqun, Wu Jian-ping, Guo song-tao, He Peng-ju, Ji Ming-zhou, Hu Yong-le (2000) The population density and community structure of the pheasants in northern Qinling Mountains. *Chinese Biodivers*. 8(1): 60–64.

Zheng Guangmei and Wang Qishan (1998) *China Red Data Book of endangered animals. Aves*. Beijing, Hong Kong, New York: Science Press.

Zheng Zuo-xin, Tan Yaokuang, Lu Taichun, Tang Chanzhu, Bao Guijun, Li Fulai (1978) *Fauna Sinica Series Vertebrata, Aves* 4. Galliformes. Beijing, China: Science Press.

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