論文 (Original Article)

Habitat Use of the Copper Pheasant *Syrmaticus soemmerringii* in Central Japan

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Abstract

Forest habitat use of the Copper Pheasant *Syrmaticus soemmerringii* was studied at Tama Forest Science Garden, Tokyo. The survey was conducted for 5 consecutive days each month from November 1997 to October 1998. We walked randomly to observe birds from sunrise to sunset in the study area. When birds were found, the time, behavior of the birds, and environments of the places were recorded. Total time of the survey was about 570 hours in the year and the total number of birds observed was 106. Most of the observations were of males (about 80%). We observed the most birds between March and June, and the fewest in November. Birds showed a noticeable preference for vegetation in the study area. They were most frequently observed in broad-leaved forests, whereas there were few observations in coniferous forests and cherry plantations, and even fewer in both high and low density shrub. Relatively high gradients were preferred but there was no significant difference between compass orientations. Broad-leaved trees produce nuts and berries that are the main foods of the pheasants. Moderate density of shrubs provided shelter and high gradients provided barrier against the predators. Those habitats might be preferred by the Copper Pheasants.

Key words : Copper Pheasant, *Syrmaticus soemmerringii*, Habitat use, Broad-leaved trees, Shrub layer, Gradient

Introduction

The Copper Pheasant *Syrmaticus soemmerringii*, which is endemic to Japan, has long been a popular game bird. Though the number of hunted pheasants has shown a drastic decrease since the 1970's (Yamashina, 1976), the causes of the decline are still unknown, and more than six thousand birds are being shot each year (Ministry of the Environment, 2002). The hunting data reported does not really reflect the natural status, and there may not be the same trend in the natural population.

On the other hand, a number of captive-bred birds have been released in mainly northern and central areas of Japan in order to restore the natural population of the species (Ministry of the Environment, 2002), but the effect of the release has not been sufficiently evaluated (e.g. Kawaji *et al*., 2002). We have to make the adequate plan based on ecological knowledge for restoring the wild population, if they show the drastic decreases of the hunted populations. However, we have not yet obtained sufficient ecological data because the bird skulks in the steep slopes of dense forests and we can rarely observe their behavior in detail by direct observation. A few references have described the ecology of the species (e. g. Yamashina, 1976), albeit only briefly. In this paper, we describe the observation of the Copper Pheasant in the forests of central Japan and estimate its habitat use from the results.

Study area and Methods

We conducted the study at Tama Forest Science Garden, (elevation 180-250m), Hachioji, Tokyo, Japan, (Fig.1). The 57 ha study area includes natural forest (23%), secondary forest (51%), arboretum of various planted tree species (12%) and a cherry plantation (14%). The cherry plantation is maintained in the garden to preserve horticultural strains of cherry.

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The arboretum and the cherry plantation are kept devoid of the lower layer throughout the year. The secondary forests consist of broad-leaved deciduous trees, mainly *Shiira sieboldii* and *Quercus serrata*, and a coniferous tree *Abies firma*, while the lower layer consists of *Aucuba japonica* and *Eurya japonica*. There are some patches of planted cedar *Cryptomeria japonica* and cypress *Chamaecyparis obtusa* in these forests. Thus, the study area has a complex vegetation with mosaic forest types.

This study area is located on the boundary between Tokyo and Kanagawa prefectures and is adjacent to Mt. Takao (522m of altitude) in the west. However, it is mostly separated from Mt. Takao by the Chuo Expressway. In the east, there is the Tama Mausoleum that is also separated from the study area by a wide road. Therefore, the Copper Pheasants could not easily move to these areas. Other parts of the study area border on suburban areas that the Copper Pheasants cannot inhabit (Fig. 1).

We conducted the survey for 5 consecutive days each month from November 1997 to October 1998. Since it was necessary to observe as many Copper Pheasants as possible, we walked randomly from sunrise to sunset in the study area, and almost all roads were surveyed at least once a day. While walking, we made an effort to observe birds by the cues such as wing-whirring displays, calls, and footsteps without any disturbance, then recorded their numbers, sex, age, and behavior. Because survey periods of each month were different due to differences in daytime or weather conditions, we calculated the "encountered efficiency" of each month by the number of birds observed per survey time in the month. As the Copper Pheasant behavior is closely related to stream proximity and time after sunrise (Kiyosu, 1978), observation times were converted into times after sunrise and we identified the stream which was nearest to the encountered place and calculated difference of relief. We conducted all analyses in this study as combined data of both sexes except for observation times of each month.

In order to analyze the habitat selection of the bird, we classified its habits into four environmental factors of encountered places: 1) overstories, 2) shrubs, 3) gradient, and 4) direction of slope. Furthermore, overstories were divided into six categories: i) broad-leaved trees, ii) combination of broad-leaved trees and planted *Cryptomeria japonica* and *Chamaecyparis obtusa*, iii) combination of broad-leaved trees and coniferous trees (*Abies firma* and *Pinus densiflora*) as natural vegetation, iv) miscellaneous plantation, v) cherry plantation, vi) no overstory. We compared the frequencies of overstory vegetation between the study area and encountered places to understand the habitat preferences of the Copper Pheasants.

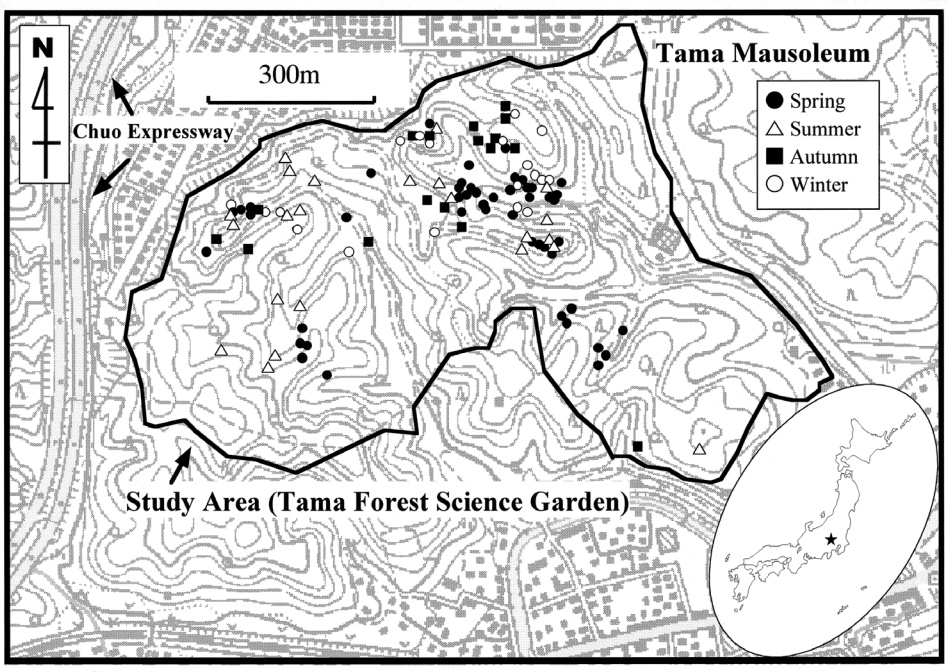

Fig. 1. Study area and encountered places.
Encountered places were mapped by the season.

We recorded the density and species of shrubs covering the forest floor. The degree of density was visually divided into six grades ranging from 0 (no vegetation) to 5 (full coverage). The gradients in encountered places were measured by a clinometer, and frequency distribution graphed in five degree intervals. Slope orientation was divided into 16 directions.

Results

1. Observation

Total survey time was about 570 hours, and there were a total of 106 Copper Pheasant observations. Encountered places were mapped by season, i.e., spring (March-May), summer (June-August), autumn (September-November), and winter (December-February) (See in Fig. 1). The number and area of plots depended on the season. There was no encountered place in the arboretum and cherry plantation. The Copper Pheasants were observed more in the spring and they often showed wing-whirring displays. This trend was indicated in Fig. 2, which shows observation times of each month. Most observations (80%) were of males, which were observed 82 times. In contrast, there were only 11 observations of females. Pairs were observed 8 times from March to June. A female with a chick was observed only twice in June in one place. At that time, we observed the female behavior of injury feigning. In August, a flock of juveniles was observed once.

Encountered efficiency (no./hour) was high from March to June especially in April (0.38). The seasonal trend was shown in Fig.3. November had the lowest efficiency, 0.06, meaning that one sighting was made every 18 hours or so. Average efficiency was 0.18 in a year. There was no significant linear increase in the height of encountered places after sunrise (Fig.4). Most observations were within three hours after sunrise.

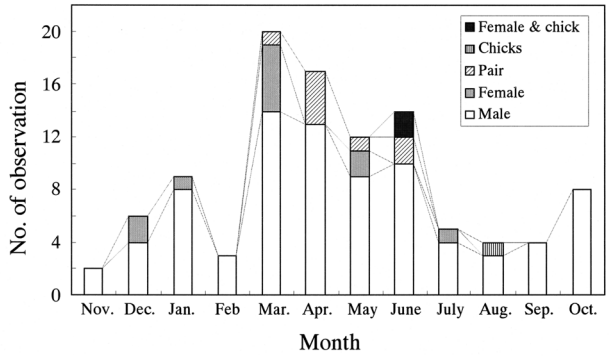

Fig. 2. Observation times of the Copper Pheasants in each month.

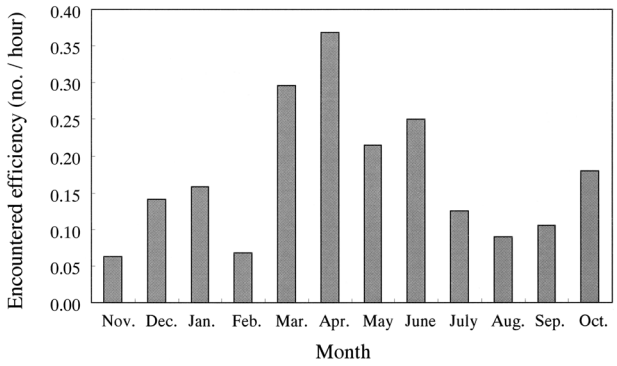

Fig. 3. Encountered efficiency in each month. Efficiencies were calculated from encounters per hour.

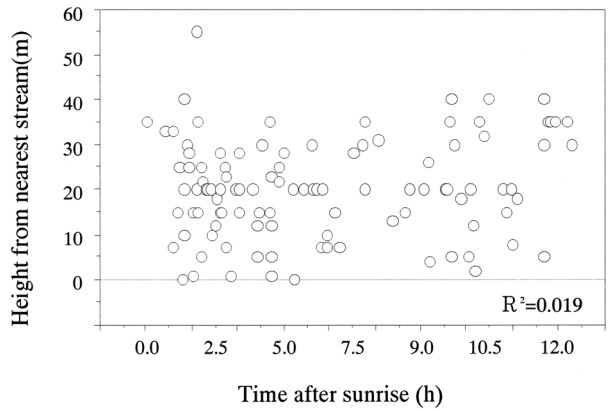

Fig. 4. Relationship between time after sunrise and level from the nearest stream at each observation point.

2. Habitat Use

There was a significant difference among vegetation types between the encountered place and the study area (χ^2=41.864, df=5, P<0.0001, Fig. 5). Frequency of broad-leaved trees in encountered places was by far the highest in the study area, while there was no observation at the cherry plantation. The mixed forest of broad-leaved trees and plantation area showed a slightly higher frequency of encounters than the overall study area. Thus, the Copper Pheasants prefer the area of broad-leaved trees in our study area.

Frequency of observation places was high in the shrub density of grades 1-3 (Fig. 6). The only observations of the Copper Pheasants in no shrub areas were of them crossing the road to other habitats. Except for this, the Copper Pheasants did not use habitats without shrub. We often observed pheasants walking along the steep slopes in the forest. Fig. 7 showed that the Copper Pheasants preferred the relatively high gradients. But, there was no significant difference between compass orientations (Fig. 8).

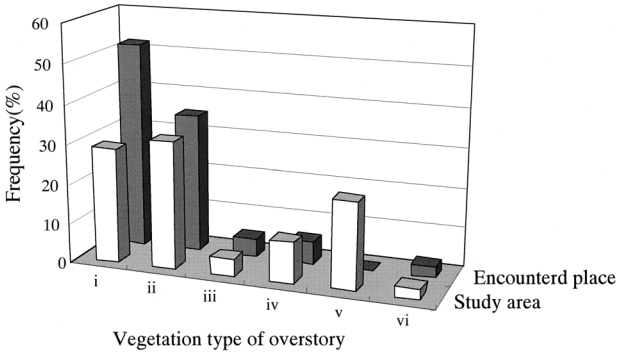

Fig. 5. Frequencies of overstory vegetation between the study area and encountered places. Vegetation were divided into six categories: i) broad-leaved trees, ii) combination of broad-leaved trees and planted *Cryptomeria japonica* and *Chamaecyparis obtusa*, iii) combination of broad-leaved trees and coniferous trees (*Abies firma* and *Pinus densiflora*) as natural vegetation, iv) miscellaneous plantation, v) cherry plantation, vi) no overstory.

Fig. 6. Density of shrub at observation points. The density was divided into six levels from 0 (no vegetation) to 5 (full cover).

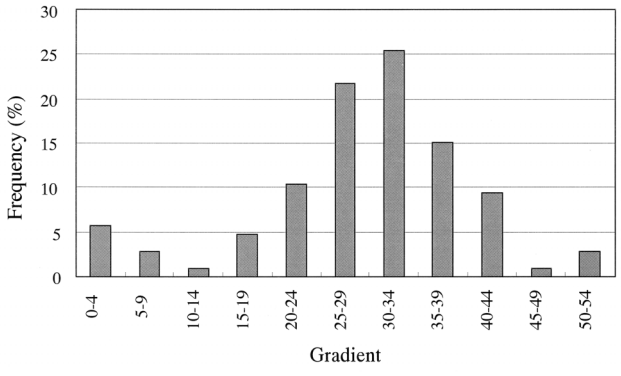

Fig. 7. Frequency of gradients at observation points.

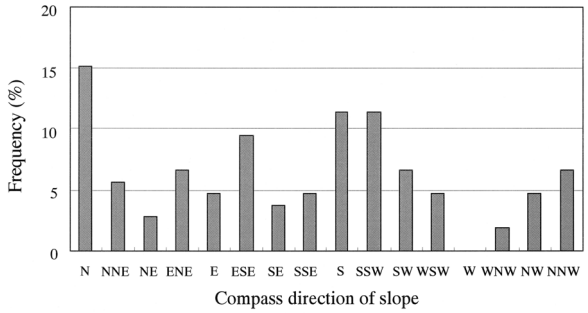

Fig. 8. Frequency of compass orientation of slopes at the observation points. There were 16 directions. (S: South; N: North; E: East; W: West)

Discussion

The seasonal changes in the encountered places suggests that the season might influence the movement and behavior of this species. While most of our observations were of males, this does not necessarily indicate the sex ratio of the species. It is likely that female and chicks showed more skulking behavior. In fact, we could observe females only fleetingly in the forest, while males sometimes walked calmly and fed for an hour. In the breeding season, males frequently showed wing-whirring display to observers. Because we found females hiding near the males after such displays, wing-whirring behavior may not have been sexual display, but rather territorial defense against other males or warning or threatening behavior toward other creatures too close to them. The pair formation period here should be mid March, but we observed a pair in June, which was likely the pair that had failed its first breeding. In June, the first chicks were observed with a female parent.

The Copper Pheasant appears to be polygamous as the Common Pheasant *Phasianus colchicus* (Yamashina, 1976). While we recorded two females with one male at one point in February, we could not get any other evidence of polygamous behavior in our study area. During the breeding season, we had many chances to observe pairs or single birds. This suggests that the basic mating system in our field was likely to be monogamous. We observed one pair in August, late in the breeding season (Fig. 2). We could not determine whether the male had acquired another female in the same breeding season or if he had repaired with the same female after the failure of their first breeding.

Though there were few chances for direct observation of the Copper Pheasant, the encountering rate was highest during the early breeding season such as March and April. Therefore, populations should be monitored in those periods. The direct observation of

the Copper Pheasants was affected by many factors, e.g. vegetation types, shrub layers, seasons, because they basically showed skulking behavior. So, we will confirm our results using radio tracking data, as has been done with other *Syrmaticus* species (Bridgman, 1994, Zhang and Sun, 2001).

We found that the Copper Pheasants preferred broad-leaved trees, especially mixed forests of broad-leaved trees and plantation area, and also preferred moderate density of shrubs. Broad-leaved trees produce nuts and berries that are the main foods of the pheasants. Moderate density of shrubs provide shelter and high gradients provide barrier against predators.

Based on data collected from hunters, Dainippon Ryoyukai (1984) reported that the Copper Pheasant preferred not only broad-leaved forests but also coniferous plantations. We found that they preferred broad-leaved forests with relatively dense undergrowth, but they were also observed in plantation areas. No individuals were found in the cherry plantation area, probably because it has little undergrowth. Some individuals were observed at undergrowth level 0, which is on the forest path. All five long-tailed pheasant species belonging to *Syrmaticus* prefer mountain forests of coniferous and deciduous trees (Delacour 1964, Johnsgard 1999).

Previous studies had noted that the Copper Pheasants normally came down to a stream just after dawn for foraging or drinking, then climbed up to the ridge for resting, and came back down to the stream for feeding before sunset (Kiyosu, 1978, Yamashina, 1976). Our data showed that the encountered points were not always concentrated around the stream in the early morning, and in daytime they were sometimes observed near streams. As a result, it appears that the diurnal behavior of the Copper Pheasants does not depend upon topological factors, but on the condition of the ground. That is, if they inhabit a moist area, they do not need to go far to drink.

The Copper Pheasant is the largest ground bird in the forests of Japan, and is also well known as one of main foods of Japanese large raptors such as the Golden Eagle *Aquila chrysaetos* and the Hodgson's Hawk Eagle *Spizaetus nipalensis* which inhabit these forests (Yamazaki, 1997). The population dynamics of the Copper Pheasants may affect the productivity of such large raptors. There are many reports that recent human activities have disturbed habitats of large raptors (e.g. The Society for Research of the Golden Eagle, 1991), so knowledge of the habitat selection of the Copper Pheasants will play an important role in the preservation of such raptors.

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中部日本におけるヤマドリ *Syrmaticus soemmerringii* の環境利用について

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要　旨

ヤマドリの森林環境利用様式を森林総合研究所多摩森林科学園（東京都八王子市）において調査した。調査は基本的に月に5日間、日の出から日没まで調査地内を歩き廻り、ヤマドリとの出会いの時間、行動、環境等を記録した。1997年11月から1998年10月までの1年間において、総観察約570時間におけるヤマドリの観察回数は106回であった。観察されたヤマドリは80％が雄であり、1年の中では3～6月に観察されることが多く、11月には最も少なかった。利用していた森林環境は、高木層では広葉樹林で最も多く、逆に針葉樹林やサクラ植栽林では少なかった。また低木層の少ない環境ではほとんど観察されなかったが、密な環境でも少なくなった。斜度が比較的高いところを好んでいたが、方位には特定の傾向は認められなかった。広葉樹林はヤマドリの主要食物である堅果や漿果類を多く産出し、適度な低木層は捕食者に対する隠れ場所を、斜面は捕食者への障壁を提供し、そのような場所をヤマドリは好むと考えられた。

キーワード：ヤマドリ、森林環境、広葉樹林、低木層、斜度

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