Short Note (短 報)

Differences in the Utilization of Cultivated and Uncultivated
Paddy Fields as Hunting Grounds by the Grey-faced
Buzzard-eagle, *Butastur indicus*

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Abstract. Between April and June 1997, the hunting behavior of a Grey-faced Buzzard-eagle (*Butastur indicus*) pair was examined among three types of hunting ground in a *satochi-satoyama* (traditional Japanese rural landscape) area, Ibaraki Prefecture, central Japan. The proportion of time spent perching, and the frequency of perching and hunting per observation time in cultivated paddy fields were significantly greater than those in mixed paddy fields (both cultivated and uncultivated) and other areas (grassland, lawn grass fields, and park). Their food habits were also examined. Frogs were main prey item at 40.9% (N=18), followed by snakes (15.9%, N=7) and lizards (11.4%, N=5). Other prey items included freshwater crayfish (9.1%, N=4), grasshoppers (6.8%, N=3) and loaches (4.5%, N=2), which all inhabit paddy fields and the neighboring areas. Therefore, it appears that the presence of cultivated paddy fields is important for the conservation of Grey-faced Buzzard-eagles in a *satochi-satoyama* environment.

Key words: Food habits, Frequency of perching and hunting, Grey-faced Buzzard-eagle, Proportion of perching time, *Satochi-satoyama*.

キーワード: 食性, 止り回数と狩りの回数, サシバ, 止り時間の割合, 里地里山.

Introduction

In Japan, the Grey-faced Buzzard-eagle, *Butastur indicus*, breeds mainly in *satochi-satoyama* environments (Azuma 2004, Momose *et al.* 2005), which comprise the traditional Japanese rural landscape: the *satoyama* are forests managed for agricultural and living use, and the *satochi* are areas including the *satoyama*, farmlands and settlements (Takeuchi 2001).

Many breeding habitats of this species in Japan are suspected to have deteriorated due to changes that have occurred in the *satochi-satoyama* environment over the last two decades. Furthermore, some *satochi-satoyama* areas have been developed and converted to residential or industrial development sites (see Tsunekawa & Bessho 2001). Some paddy fields at valley bottoms in areas of low mountains and hills, known as *yatsuda*, have been abandoned and covered with tall perennial herbs such as the ditch reed, *Phragmites communis* (e.g. Kitagawa 2001). Such dense vegetation may prevent the Grey-faced Buzzard-eagle hunting on paddy fields because it prefers open hunting grounds (Azuma

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2004, Hirano *et al.* 2004). Therefore, it is necessary to determine whether hunting ground utilization by the Grey-faced Buzzard-eagle differs between cultivated and uncultivated paddy fields. However, there have been few reports on hunting ground utilization by this species (Azuma 2004, Hirano *et al.* 2004). We hypothesized that the frequency of perching and hunting, and the proportion of time spent perching by the Grey-faced Buzzard-eagle could be used as indicators to evaluate the extent of its utilization of different types of hunting ground. We examined these parameters among three types of hunting ground, focusing particularly on differences between cultivated and uncultivated paddy fields. We also investigated the food habits of the buzzard. Here we discuss the importance of paddy fields for conservation of the Grey-faced Buzzard-eagle in terms of hunting ground utilization and food habits.

Methods

Study site

The study site, Shishitsuka-Ohike ($36^{\circ}09'N$, $140^{\circ}10'E$, 14 m above sea level, about 100 ha), is located in Tsuchiura, Ibaraki Prefecture, central Japan (Fig. 1). It is a green tract isolated by an urban area of Tsuchiura City, and contains a large irrigation pond (Shishitsuka-Ohike), the surrounding hills being covered with naturally regenerated forest (mainly *Quercus acutissima* and *Q. serrata*) and artificial forest (e.g. *Cryptomeria japonica*), marshes and brooklets. Three paddy fields (*yatsuda*) are situated in narrow and shallow valleys between gently rolling hills. There are also several uncultivated narrow and shallow valleys covered with tall herbs (e.g. goldenrod, *Solidago gigantea*) between them. Yatsuda-A (about 1.12 ha) located on the southeastern side and Yatsuda-G (about 0.47 ha) located on the western side of the irrigation pond are cultivated paddy fields. Yatsuda-D, E and F (about 2.41 ha), located on the northern side of the irrigation pond, are mixed ones consisting of both cultivated (about 0.93 ha) and uncultivated (about 1.48 ha) paddy fields (Fig. 1).

Field observation

From early April to late June, 1997, we observed the hunting behavior of one Grey-faced Buzzard-eagle pair whose nest site was situated near Yatsuda-G, and tried to identify the sexes during our observations. To examine the difference in utilization among several types of hunting ground by this buzzard pair, we conducted simultaneous field observations by positioning several assistants at Yatsuda-A, D-E-F, G, park-B, lawn grass fields-H, grassland-I and narrow and shallow valleys-C, J (Fig. 1) where the buzzard-eagles were expected to hunt. This type of field work (Type I) was conducted ten times mainly at 9 : 00–12 : 00 throughout the study period.

We also conducted field observations at a single observation point primarily at Yatsuda-G without the participation of assistant workers. This type of field work (Type II) was carried out for 28 days at 6 : 00–18 : 00 daily.

We observed the buzzard-eagles' behavior using field scopes and/or binoculars. The flight passes and perch positions of the buzzard-eagles were traced on 1 : 5,000 national

Fig. 1. Location and outline of the study site. The convex polygon (solid line) represents the home range of the pair of Grey-faced Buzzard-eagles from April to June, 1997. Two main roads run along the north and west of the study site. Letters (A~J) on the map indicate observation points. Marsh: Area covered with the ditch reed, *Phragmites communis*. Paddy fields are situated in narrow and shallow valleys (*yatsuda*). Mixed paddy fields are those consisting of both cultivated and uncultivated fields. Forests consist of naturally regenerated forest (*Quercus acutissima* and *Q. serrata*) and artificial forest (*Cryptomeria japonica*). Narrow and shallow valleys are covered with tall herbs (e.g. goldenrod, *Solidago gigantea*). Residential area comprises newly developed residential areas and traditional settlements with groves and farm land.

land maps. The buzzard-eagles usually hunted from a perch, sometimes changing the perch site. The frequency and time (to within one minute) of perching were recorded for each perching bout. The frequency of hunting was also recorded. Behavior of buzzard-eagles that comprised descending to the ground from a perch was regarded as hunting.

We tried to identify prey items as strictly as possible when buzzards hunted successfully or delivered prey to their nest.

Data treatment

The home range of the Grey-faced Buzzard-eagle pair was drawn on the maps by connecting the outermost points of their flight passes and/or perch positions with a convex polygon. The area of the home range was then calculated using a planimeter. The data for the male and female were combined because we could not always distinguish the sexes during each observation.

Hunting grounds observed were divided into three groups: (1) paddy fields (Yatsuda-A and G), (2) mixed paddy fields consisting of cultivated and uncultivated ones (Yatsuda-D, E and F), and (3) other areas (e.g. grassland, lawn grass fields and park).

The differences in the proportion of time spent perching and the frequency of perching and hunting per observation time among the three types of habitat were analyzed by Kruskal-Wallis single-factor analysis, because it was inferred that the data would not show a normal distribution. Nonparametric Tukey-type multiple comparison test was conducted when the null hypothesis was rejected in the Kruskal-Wallis test (see Zar 1999). Only data from Type I field work were used for these analyses, and a three-hour observation at each point was treated as one sample.

Differences in food species composition among the three months (April-June) were analyzed by Fisher's exact test because they did not meet the assumption of chi-squared analysis from contingency tables where the average expected frequency was more than 6.0 (Zar 1999). A significance level of $P=0.05$ was employed in all statistical procedures.

Results

1) Number of Grey-faced Buzzard-eagle pairs and their home range

Only one pair of Grey-faced Buzzard-eagles inhabited the study site. Their home range covered 136.5 ha from April to June, which was almost the whole of the study site (Fig. 1).

2) Differences in utilization among the three types of hunting ground

A total of 49 perching bouts and 15 hunting attempts were recorded in cultivated paddy fields, and two and one, respectively, in mixed paddy fields. All of these perch sites were trees. No perching or hunting attempts were recorded in other areas. There were significant differences in the proportion of time spent perching, and the frequency of perching and hunting per observation time, among the three types of hunting ground (Kruskal-Wallis test, frequency of perching: $H=21.951$, $df=2$, $P<0.0001$; proportion of time spent perching: $H=21.590$, $df=2$, $P<0.0001$; frequency of hunting: $H=8.894$, $df=2$, $P<0.05$).

Nonparametric Tukey-type multiple comparison test followed to Kruskal-Wallis test showed that the proportion of time spent perching, and the frequency of perching and hunting in paddy fields, were significantly greater than those in mixed paddy fields and in other areas. There were no significant differences in the proportion of time spent perching and the frequency of perching and hunting between mixed paddy fields and other areas (Table 1).

3) Food habits

From April to June, frogs were the main prey items, accounting for 40.9% ($N=18$, Table 2), followed by snakes (15.9%, $N=7$) and lizards (11.4%, $N=5$). Other prey items were the freshwater crayfish *Procambarus clarkii* (9.1%, $N=4$), grasshoppers (6.8%, $N=3$), and the loach *Misgurnus anguillicaudatus* (4.5%, $N=2$). Prey item

Table 1. The proportion of time spent perching, and the frequency of perching and hunting per observation hour. Different letters indicate significant differences (nonparametric Tukey-type multiple comparisons test, $P < 0.05$; see Zar, 1999). N = number of three-hour observations at each point.

Hunting ground	The proportion of perching time (hr/hr)		The frequency of perching (/hr)		The frequency of hunting (/hr)		N	Total observation time (hr)
	Mean $\pm$ SD	Median	Mean $\pm$ SD	Median	Mean $\pm$ SD	Median		
Paddy fields	0.125 $\pm$ 0.095 ^a	0.131	1.087 $\pm$ 0.711 ^a	1.143	0.335 $\pm$ 0.437 ^a	0.000	13	43.850
Mixed paddy fields	0.008 $\pm$ 0.029 ^b	0.000	0.047 $\pm$ 0.168 ^b	0.000	0.023 $\pm$ 0.084 ^b	0.000	13	41.633
Other areas	0.000 $\pm$ 0.000 ^b	0.000	0.000 $\pm$ 0.000 ^b	0.000	0.000 $\pm$ 0.000 ^b	0.000	9	25.250

Table 2. Food habits of the Grey-faced Buzzard-eagle from April to June in 1997.

Prey items	Species	April	May	June	Total (%)
Frogs		8	8	2	18 (40.9%)
	<i>Hyla japonica</i>	5	0	1	6
	<i>Rhacophorus shulegelii</i>	1	1	0	2
	<i>H. japonica</i> or <i>R. shulegelii</i>	1	1	1	3
	<i>Rana japonica</i>	0	1	0	1
	unidentified frogs	1	5	0	6
Snakes		4	1	2	7 (15.9%)
	<i>Elaphe climacophora</i>	1	0	0	1
	<i>Amphiesma vibakari</i>	0	0	1	1
	unidentified snakes	3	1	1	5
Lizards		2	1	2	5 (11.4%)
	<i>Takydromus tachydromoides</i>	2	1	2	5
Squamata		0	1	0	1 (2.3%)
	unidentified snake or lizard	0	1	0	1
Grasshoppers		0	0	3	3 (6.8%)
	<i>Tettigonia orientalis</i>	0	0	2	2
	<i>Euconocephalus thunbergii</i>	0	0	1	1
Other insects		0	4	0	4 (9.1%)
	<i>Carabus insulicola</i>	0	1	0	1
	unidentified insects	0	3	0	3
Crayfish		0	0	4	4 (9.1%)
	<i>Procambarus clarkii</i>	0	0	4	4
Loaches		0	1	1	2 (4.5%)
	<i>Misgurnus anguillicaudatus</i>	0	1	1	2
Total		14	16	14	44

compositions differed significantly among the three months (Fisher's exact test, $N=44$, $P < 0.01$).

Discussion

The Red-tailed Hawk, *Buteo jamaicensis*, is a sit-and-wait predator similar to the Grey-faced Buzzard-eagle, and typically forages in areas with less cover (Order & Harrell 1977, Leyhe & Ritchison 2004), because it can search for and capture prey easily in such areas (Baker & Brooks 1981). The results of the present study showed that the Grey-faced Buzzard-eagle uses cultivated paddy fields as hunting grounds more frequently than uncultivated paddy fields. Therefore, we considered that the buzzard-eagle frequently uses cultivated paddy fields for a similar reason. Azuma (2004) and Hirano *et al.* (2004) also reported that Grey-faced Buzzard-eagles hunted most frequently at sites covered with shorter vegetation.

It is considered that perch sites are an important component influencing the quality of habitats for some raptors (Widén 1994). In the present study area, only trees were used as perch sites, and all three types of hunting ground were surrounded by forest. Therefore, it would be expected that the availability of perch sites would not have been responsible for

the difference in utilization among the three types of hunting ground.

In the present study, frogs were the main prey items of the Grey-faced Buzzard-eagle, followed by snakes and lizards, and grasshoppers. Crayfish and loaches were also prey items. Other studies (e.g. Azuma 2004, Momose *et al.* 2005) have revealed that similar prey items of buzzards foraging in paddy fields. These prey animals inhabit the paddy fields themselves and/or their neighboring areas. Therefore, the Grey-faced Buzzard-eagle is considered to occupy a high trophic level in the food chain in the *satochi-satoyama* ecosystem (Azuma 2004, Hirano *et al.* 2004, Momose *et al.* 2005). However, it has been documented that the abundance of frogs and snakes, which are the buzzard's main prey items, has decreased because of recent consolidation of paddy fields, including the *yatsuda* (Hasegawa 1995, Fujioka & Lane 1997).

It is suspected that the local population size of the Grey-faced Buzzard-eagle has decreased in number throughout Japan since the 1970s (Kawakami & Higuchi 2003), and the distribution of the buzzard in the period from 1997 to 2002 has been reduced compared to that in the period from 1974 to 1978 (Wild Bird Society of Japan 2004). These phenomena may be synchronized with the decrease of *satochi-satoyama* areas, and consequently the buzzard's prey.

Cultivated paddy fields are wet and open habitats, and consequently important for conservation of the Grey-faced Buzzard-eagle because they are frequently utilized by the bird as a hunting ground and provide a supply of prey.

Although the present study has provided useful data, there is a possibility that the utilization of hunting grounds and food habits of the Grey-faced buzzard-eagle were biased because the field data originated from only one pair of buzzards in one year. Therefore, we intend to examine the hunting behavior of several pairs of the buzzard over a period of several years in a future study.

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耕作水田と非耕作水田における狩場としてのサシバによる利用の違い

1997年の4月から6月まで茨城県の里地里山で繁殖する1つがいのサシバを対象として3タイプの狩場における狩猟行動を調査した。耕作水田における観察時間あたりの止り時間の割合、止り回数、狩りの回数の値は、混合水田（耕作地と非耕作地からなる水田）およびその他の地域（草地、芝畑、公園）よりも有意に大きかった。サシバの食性も調査した。カエルが最も多く（40.9%, N=18）、次いでヘビ（15.9%, N=7）、トカゲ（11.4%, N=5）の順であった。その他にザリガニ（9.1%, N=4）、バッタ（6.8%, N=3）、ドジョウ（4.5%, N=2）が捕食されていた。これらの餌動物は水田またはその周囲に生息する。このように、里地里山においては耕作水田の存在がサシバの保全に重要だと思われる。

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