Korean J. Ecol., 20(6):405~411, 1997

Feeding Behavior of the Russet Sparrow *Passer rutilans* in Two Different Habitats

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다른 두 서식지에서 섬참새의 채식행동

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ABSTRACT

Feeding behavior of the Russet Sparrow *Passer rutilans* was studied in two different types of habitats, shelter belts and isolated forests, in south-eastern Hokkaido, Japan, during the breeding seasons of 1995 and 1996.

Predominant foods were determined as Caterpillar, Coleoptera, Diptera, Ephemeropera, Odonate and some other insects. The composition of the nestling foods were not the same by season, region, and year. Larger foods in size were used by birds in isolated forests more frequently than in shelter belts. Amount of food per feeding was significantly larger in isolated forests than in shelter belts. Although food supply were more abundant in isolated forests than in shelter belts, the feeding frequency did not significantly differ between these two habitats. The nest density was higher in isolated forests than in shelter belts.

Results of this study indicate that when the feeding condition is poor, birds tend not show specific food selection behavior, the feeding range is therefore larger, and the feeding interval is longer. Contrarily, the birds show a specific food selection behavior when they are in good feeding condition, the feeding range is therefore smaller and the feeding interval decreases.

Key words: Feeding behavior, Habitat, Isolated forests, Russet Sparrow, Shelter belts.

INTRODUCTION

In many bird species, the number and quality of young produced depends in large degree on the availability of food (Gibb and Betts 1963, Lack 1968, Van Balen 1973, Martin 1987, Lundberg and Alatalo 1992, Dias and Blondel 1996). Feeding habits of the bird allow to understand the life cycle of a given species. Feeding conditions during the breeding season are affected by various fact ors (Kluyver 1951, Gibb and Betts 1963, Lack 1967) in which food supply available in environmental conditions is one of important factor (Lack 1967, Van Balen 1973).

Russet Sparrows *Passer rutilans* migrate to Hokkaido at the last week of April (Fujimaki 1984),

and inhabit various forest types including isolated woods in agricultural lands (Fujimaki 1984, 1986, 1994, 1996, Fujimaki and Takami 1986). In deciduous forest foods for nestling is more abundant than in coniferous forest (Van Balen 1973, Lundberg and Alatalo 1985, Chae 1997a, 1997b). Krebs *et al.* (1977) described that food selection is related to the amount of food available to the birds within their habitats. Thus, it is expected that feeding habits of adult birds may be affected by the difference in their habitats.

The purpose of this study is to compare the feeding behavior of Russet Sparrows in the two different habitats, and to derive the cause of differences in feeding behavior of Russet Sparrows.

STUDY AREAS AND METHODS

This study was conducted in three wooded areas surrounded by agricultural lands in Obihiro, south-eastern Hokkaido, Japan during the breeding seasons of 1995 and 1996. A total 213 nest boxes were examined in 1995 and 1996. Of which 107 nest boxes were used by the sparrow in both habitats (shelter belts, 57; isolated forests, 50). Nest boxes were visited every day from late April to late July in both study areas.

Fifty-eight feed samples were obtained from 6 nests in shelter belts, and 50 samples from 6 nests in isolated forests. Collected insects were preserved in 70% alcohol, dried at 100℃ for 24hr., and then weighed nearest to 0.1 mg. The insects were identified the taxonomic Order level with a binocular microscope.

The number and interval of feeding times per hour during the nesting period were recorded by 8 mm video camera and time laps video camera (EVT-820) positioned the inside and in front of twenty nests for a duration of 280 hours. Video photographs were taken for 10 nests in each habitat with the same brood size (3, 5 and 6 brood sizes) and the same age (3 and 8 days after hatching) in two study areas. Amount of food per feeding visit was determined by collar (Summers-Smith 1995) and net method (Chae 1997a).

Adult birds in both study areas were captured using "in-open out-lock system" and net method and were individually marked with three colored plastic leg bands and numbered leg bands. Furthermore, attached the dyed feather of chickens was also attached on the back. Since the entrance of "in-open out-lock system" of the nest hole were installed by a U-wire, the birds can come in the nest-box but can not get out the nest-box. In the net method, the nest was coverd by a mist net, which allows the bird enter the nest-box for feeding nestlings (Chae 1997b). During the nestling period, feeding ranges of marked adults were located on a 1:5000 map.

Weather data was obtained from the Farm of the Obihiro University of Agriculture and Veterinary Medicine, which is in the study area.

RESULTS

The total samples of insects obtained by collar and net methods in both habitats were 232 and 210 for shelter belts and isolated forests respectively. Predominant foods were determined as Caterpillar, Coleoptera, Diptera, Ephemeroptera, and Odonate and some other insects (Table 1). Caterpillar and Coleoptera decreased in the diet from 1995 to 1996, while Diptera, Hymenoptera and Ephemeroptera increased. The food composition of nestlings changed considerably during the breeding season. Ephemeropteras were not recorded in the nestling diet in 1995, but comprised a substantial portion in 1996. Caterpillars were the most important food of nestlings in May and June but decreased in July in the two years. Coleopteras were not found in the nestling diet in May, a few in June, but a large proportion to the total food volume in July in the two years (except for isolated forests in 1996). In 1995, 41.0% of all prey items in shelter belts was Caterpillar, and 55.3% of those prey items in isolated forests was Caterpillar. In 1996, 29 samples or 34.9% contained Caterpillar, and 20 samples or 20.8% contained Diptera (Table 1). In the early-May mean temperatures

Table 1. Seasonal changes in number of nestling foods collected by collar and net methods in isolated forests(IF) and shelter belts(SB)

Item	1995						1996						Total	
	IF			SB			IF			SB				
	May	June	July	May	June	July	May	June	July	May	June	July	IF	SB
Lepidoptera	2	42	3	6	49	6	2	17	1	1	21	7	67	90
Coleoptera	0	7	18	1	18	43	2	12	6	2	5	11	45	80
Diptera	0	2	1	0	6	8	2	24	0	1	14	0	29	29
Odonata	0	0	0	0	1	1	1	5	0	0	0	0	6	2
Hymenoptera	0	0	0	0	1	1	1	1	0	0	1	1	2	4
Ephemeroptera	0	0	0	0	0	0	12	18	4	0	3	1	34	4
Hemiptera	0	0	0	0	0	0	0	0	0	0	0	4	0	4
Plecoptera	0	0	0	0	0	0	0	2	0	0	0	0	2	0
Dermaptera	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Spider	0	0	0	0	0	1	0	7	0	0	0	1	7	2
Egg-shell	0	0	0	0	0	1	0	0	0	0	1	0	0	2
Grain	0	0	0	0	0	1	0	1	0	0	0	1	1	2
Unknown	0	0	0	0	0	3	1	5	1	0	4	3	17	12
Total	2	58	25	7	77	65	21	92	12	4	49	30	210	232

and precipitations (included snowfall) were slighty higher in 1995 (9.9℃, 29 mm) than in 1996 (5.9℃, 70.5 mm) (Fig. 1).

The size of foods given to nestlings ranged widely.

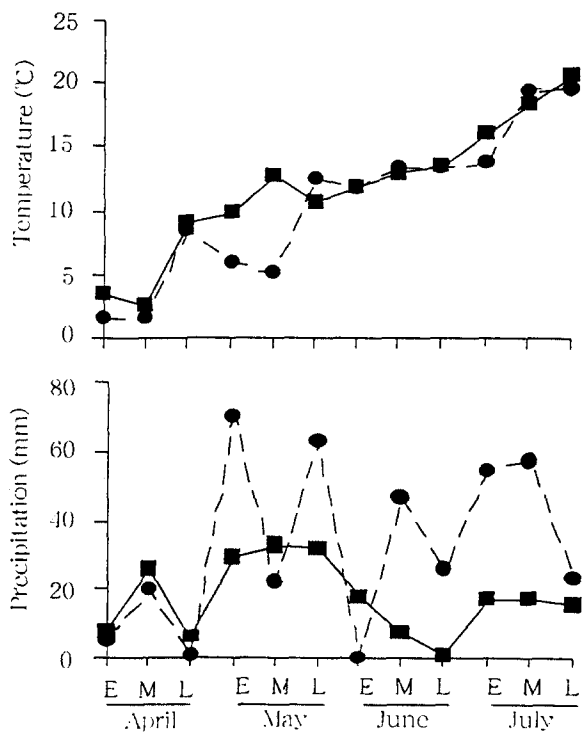

Fig. 1. Temperature and precipitation in Obihiro, southeastern Hokkaido, in 1995(■) and 1996(●).

Table 2. Numbers(%) of nestling foods classified by size in isolated forests(IF) and shelter belts(SB).

	1995			1996		
	≤9	10~19	≥20 mm	≤9	10~19	≥20 mm
IF	8(23.5)	23(67.6)	3(8.8)	27(37.0)	39(53.4)	7(9.6)
U-test		<0.01			<0.01	
SB	41(62.1)	23(34.8)	2(3.0)	45(59.2)	30(39.5)	1(1.3)

In shelter belts, the food was often less than 9 mm, but in isolated forests, the food of 10 to 19 mm were fed mainly. The size of the food was significantly larger in isolated forests than in shelter belts (Table 2, Mann-Whitney U-test, $Z=-4.31$, $P<0.01$ for 1995; $Z=-6.53$, $P<0.01$ for 1996).

The feeding area in early breeding was smaller in 1995 than in 1996 in both habitats, but in late breeding it was similar in both habitats. The feeding range was larger in shelter belts than in isolated forests in both breeding seasons, and was smaller in early breeding than in late breeding. The feeding range in early breeding was larger in 1995 than in 1996 in both habitats, but in late breeding it was similar in both habitats (Table 3).

Average feeding frequencies were 10.5 to 20.8/h in shelter belts and 4.5 to 19.0 in isolated forests, and there was no significant difference between the two

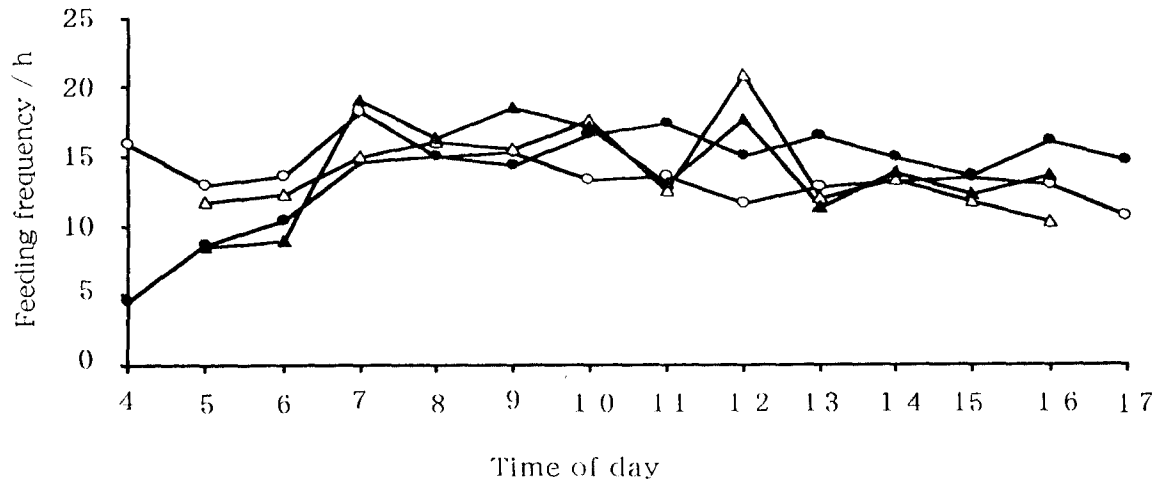

Fig. 2. Average feeding frequency of adults in isolated forests (IF) and shelter belts(SB). Solid symbols represent IF, open symbols SB, circles 1995, and triangles 1996.

habitats (Fig. 2, Wilcoxon signed-ranks test, 1995, $Z=-0.31$, $P>0.05$; 1996, $Z=-0.04$, $P>0.05$). Average feeding frequency per hour in nestling periods of early breeding was siginificantly larger than that was in nestling periods of late breeding in both habitats (Wilcoxon signed-ranks test, shelter belts, $Z=-2.45$, $P<0.05$; isolated forests, $Z=-2.54$, $P<0.05$) (Fig. 2).

Average feeding interval was a similar pattern in both habitats, but it was observed that 5 minute longer in shelter belts than in isolated forests. The feeding interval in isolated forests was observed that than that was in shelter belts (Fig. 3).

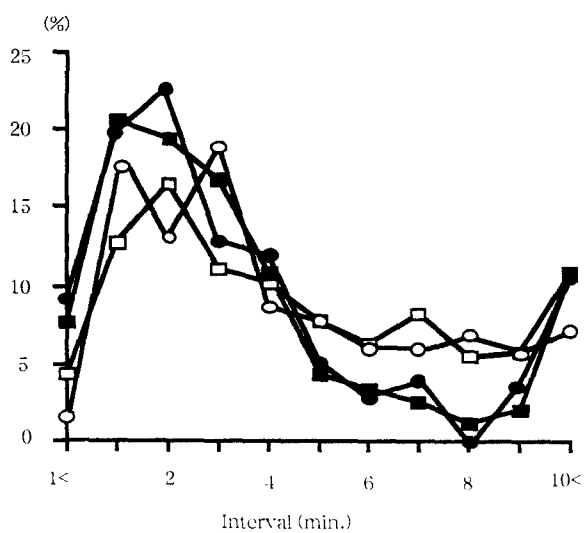

Fig. 3. Feeding intervals in isolated forests(IF) and shelter belts (SB). Solid symbols represent IF, open symbols SB, rectangles 1995, and circles 1996.

Table 3. Foraging areas(ha, mean±SD) in isolated forests(IF) and shelter belts(SB), with sample size in parentheses

Year	Early breeding		Late breeding	
	IF	SB	IF	SB
1995	0.4(1)	3.1±0.5(2)	0.4(1)	8.4(1)
1996	0.7(1)	4.6(1)	0.6±0.1(2)	7.3±1.1(2)

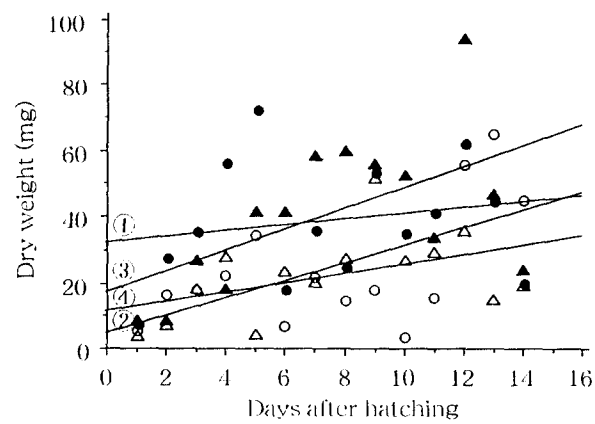

Fig. 4. Average food weight(in dry matter) per feeding in isolated forests(IF) and shelter belts(SB). Solid symbols represent IF, open symbols represent SB, circles represent 1995, triangles represent 1996. [1] IF, 1995, $y=31.747+0.89x$; $R^2=0.042$ NS; [2] SB, 1995, $y=4.450+2.659x$; $R^2=0.351$ $P<0.05$; [3] IF, 1996, $y=16.680+3.15x$; $R^2=0.322$ $P<0.05$, [4] SB, 1996, $y=10.942+1.45x$; $R^2=0.22$ NS.

Table 4. Nest density (number of nests/ha) in isolated forests(IF) and shelter belts(SB)

Period	1995		1996	
	IF	SB	IF	SB
Early breeding	4.4	0.8	3.8	0.4
Late breeding	1.9	0.5	1.4	0.2
Mean density	3.1	0.6	2.6	0.3

Amount of food per feeding was significantly larger in isolated forests than in shelter belts (Fig. 4, Wilcoxon signed-ranks test, 1995, $Z=-2.23$, $P<0.05$; 1996, $Z=-2.86$, $P<0.01$) Amount of food per feeding showed gradual increase with the age of the nestling.

Nest densities in shelter belts and isolated forests were 0.20 to 0.79 nests/ha (mean 0.48) and 1.37 to 4.38 nests/ha (mean 2.85) respectively. The nest density was higher in isolated forests than in shelter belts. The nest density in early breeding was higher than that in late breeding, and it was higher in 1995 than in 1996 in both habitats (Table 4).

DISCUSSION

In this study, the Caterpillar is represented as to be the most important food during the breeding season. However, Haneda and Kumagai (1972) reported that the food of Russet Sparrow nestlings in Nagano Prefecture were solely animal matter, the bird mainly used Hemiptera. Several papers reported that nestling foods in some species varied by regions (Spaana 1971, Lack 1967, Trapp 1979, Vermeer 1982, Dunning Jr and Watts 1990, Summers-Smith 1995). Furthermore, the number of insects Order available as the nestling food was more in 1995 than in 1996. Iwasa (1981) reported that in the poor food availability, the bird used many kinds of prey species, but in good food availability, the bird seemed to prefer to a few kind of prey. A very low temperature in May 1996 and high precipitation (including snowfall) were recorded in Hokkaido. The occurrence of insects was reported to be delayed in the cold temperature (Yoshida 1980, 1985, Hotta 1996). A composition of the food for nestlings changes considerably during the breeding season. In general, it is known that foraging habits of parental birds shift as to the progression of breeding phases (Robinson and Holmes 1984). Yoshida (1985) interpreted seasonal changes in the abundance and the species composition of macrolepidopterous larval community on oak *Quercus mongolica* var. *grosseserrata* as being related to the change in the leaf characteristics of host plant. The seasonal shift in foods probably resulted from the interrelated between availability of food supply and the abundance of food items (Best 1977). The changes in food items may be caused by the changes in abundance of these food types. Results of this study indicate that the diets of nestling foods of Russet Sparrows are not the same by season, region, and year.

Large food sizes were used by birds in isolated forests more frequency than in shelter belts. This may be due to higher food supply in isolated forests compared to shelter belts (Chae 1997b). This indicates that when the food is abundant, the birds tend to select a large food rather than small one. Contrarily, when the food is rare, the bird has no choice for selecting prey in both size and quality (Krebs *et al.* 1977).

On the other hand, although food suppy were more abundant in isolated forests than in shelter belts, the feeding frequency did not significantly differ between these two habitats. Feeding interval was a similar in pattern in both habitats, but the interval was about 5 minute longer in shelter belts than in isolated forests. Furthermore, feeding range was larger in shelter belts than in isolated forests. Summers-Smith (1959) suggested that in poor feeding areas where the colonies are much further apart, the foraging range increases. There may be due to the encounter rate of the preferable prey was lower in shelter belts than in isolated forests. However, the feeding interval was 10 minute longer in isolated forests than in shelter belts. Arcese and Smith (1988) reported that high population density changes sufficient social disruption and causes stress to breeders,

resulting to depression in reproduction. Furthermore, Inter- and intra- specific competition for food is a negative relationship in the breeding densities of Blue Tit, *Parus caeruleus* and Great Tit, *P. major* (Minot 1981). Food has been shown to be the ultimate factor in regulating many birds populations (Lack 1967). Interspecific density was higher in isolated forests than in shelter belts. Results of this study indicate that there would have been much competition for food intake due to higher species richness in isolated forests. The result also shows, if the feeding condition is poor, the behavior of birds does not show in specific food selection, the feeding range is therefore larger, and the feeding interval is shorter. As a contrast, birds show a behavior specific of food selection in good feeding condition, the feeding range is smaller and the feeding interval decreases.

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to Professor Y. Fujimaki for rivising the manuscript, and Dr. K. Onoyama, Dr. H. Yanagawa and the students of Laboratory of Wildlife Ecology, Obihiro University of Agriculture and Veterinary Medicine.

적 요

섬참새의 채식행동에 관하여 1995년과 1996년의 번식기에 일본 동남북해도의 방풍림과 고립림의 2개 다른 서식지에서 연구되었다. 새끼의 먹이로 가장 많이 이용된 것은 나비목, 딱장벌레목, 파리목, Ephemeropera, 잠자리목 등이었다. 이용된 먹이는 계절, 지역, 해에 따라 변화하였다. 이용된 먹이의 크기는 방풍림보다 고립림에서 더욱 컸고, 먹이의 채식량은 방풍림보다 고립림이 많았다. 먹이의 현존량이 방풍림보다 고립림에서 많았지만 給餌頻度는 서식지간에 유의차가 없었다. 둥지 밀도는 방풍림보다 고립림이 높았다.

이 연구의 결과로부터 서식지의 채식조건이 나쁘면, 먹이의 선택성이 보이지 않고, 채식범위는 넓어지고, 채식간격은 길어졌고, 반대로 채식조건이 좋으면, 먹이의 선택성이 보이고, 채식범위는 좁아지고, 채식범위는 짧아진다는 것을 알게 되었다.

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(*Received September* 29, 1997)