Short Note (短 報)

Some Aspects of Seasonal Migration of the Bush Warbler *Cettia diphone* at Niigata City on the Coast of Central Japan, as Revealed by Banding

Yoshizoh Komatsu*, Hiroshi Satoh**, Mikiko Fujisawa*** and Akira Chiba****

Abstract. This paper describes the seasonal migration of the Bush Warbler *Cettia diphone*, at a coastal forest in Niigata City, Central Japan, based on the results of long-term banding. Over a 14-year period, 1988–2001, a total of 1,959 birds (810 males and 1,149 females) were banded in the spring (early April to middle May). Spring migrants showed a tendency towards a female-biased sex ratio ($58.6 \pm 6.1\%$) and a sex-biased time lag; i.e., the males tended to migrate earlier than the females. In the autumns of the same 14-year period, a total of 7,860 birds (4,201 males and 3,659 females), about four times more birds than were captured in the spring, were banded; and the major peaks of migration were seen in late October and early November. The number of males and females changed similarly, and no sex-biased time lag was recognized in the autumn migration. The recovery data suggest that the study area constitutes a pivotal location for migrating flyways of the Bush Warbler in Japan.

Key words: Banding, Bush Warbler, Migration, Sex ratio, Time lag.

キーワード: 標識調査, ウグイス, 渡り, 性比, 時間的ずれ.

Introduction

The Bush Warbler *Cettia diphone*, the best-known passerine bird in Japan, is a polymorphic species living along the eastern rim of the Eurasian continent and the Japanese islands (Baker 1997, CCJB 2000, Kajita 2002). Among nominal subspecies, *C. d. cantans* is widely distributed in Japan from Hokkaido south to Kyushu, Yakushima, Tanegashima, Izu Is., and Tsushima; it is mainly sedentary and winters in warmer regions and lower elevations (CCJB 2000). In Hokkaido, it is a migrant breeder, but in Honshu and southern Japan it is a resident or a short-distance migrant breeder (CCJB 2000). In early spring, the males begin to sing a characteristic song in wintering sites and most, if not all, birds of both sexes migrate to the highlands or northern districts for breeding (spring migration). After breeding, adults and juveniles migrate toward the wintering grounds (autumn migration; Baker 1997, CCJB 2000). In spite of its common status in the avifauna of Japan, little is known about the biology of this species. As to the migration in general, scientific information is meager; and only fragmentary data on banding and its

Received 10 November 2003, Revised 18 March 2004, Accepted 14 April 2004.

* 145 Hamamatsu-cho, Niigata 951-8166, Japan.

** 3-8-32 Satsukino, Niitsu 956-0022, Japan.

*** 607, 1-3-15 Shimogawara-machi, Niigata 951-8127, Japan.

**** Department of Biology, Nippon Dental University School of Dentistry at Niigata, Niigata 951-8580, Japan. E-mail: chiba@ngt.ndu.ac.jp

recovery have been documented (BMRC 1988, 1990, 1992, 1993, 1996–1999, Hamao 1992, Yamashina Institute for Ornithology 1996). Our own data collected from 1987 to 1998 in Niigata showed that the study area, i.e., a coastal forest in Niigata City, constitutes a pivotal location in the migratory flyways for passerines in the Japanese islands: we have banded more than 80,000 birds of 83 species there (Chiba *et al.* 1991, Komatsu *et al.* 1993, Komatsu & Chiba 1999). Here, the Bush Warbler is neither a breeder nor a resident, but a seasonal migrant, and is occasionally seen even in mid winter. Nevertheless, very little is known about the migration of the Bush Warbler.

This study was conducted to provide basic information on the seasonal migration of the Bush Warbler, on the basis of the results of long-term and periodic bird banding at a forest in Niigata City, a coastal city on the Japan Sea of Central Japan. In this study, our main interest was focused on the difference between the spring and autumn migrations, especially sex-biased time lag found in the spring migration.

Methods

Study site and capture technique

The study site is a part of an artificial conifer (pine) forest, Yachoh-no-Mori (100 m × 150 m), located in the West Coast Park in Niigata City (37°55'N, 139°01'E; 5 m a.s.l.), on the Japan Sea coast of middle Honshu (main island) in Japan. Black Pine (*Pinus thunbergii*), 10–20 m in height, predominates the vegetation of the study area and is mixed with deciduous broad-leaved trees such as False Acacia (*Robinia pseudoacacia*) and Chinese Hackberry (*Celtis inensis*). The forest floor is densely covered with bushes and grasses. The annual rainfall in Niigata City is 1,778 mm, and the mean monthly temperatures range from 2.1°C (January) to 26.2°C (August). The maximum snow depth during the last 10 years has been 53 cm.

Wild birds including the Bush Warbler were captured with mist nets, 6 nets of the ATX type (36-mm mesh, 4 panels, 12-m width) and 6 nets of the HTX type (30-mm mesh, 4 panels, 12-m width), which were set around a small pond (12 m²) in the forest. Tape-recorded voices of passerines including this species (reproduced from a commercial source) were played back to attract birds to the net site. The banding was performed as frequently as possible and throughout the daytime except on days of bad weather during the period from March to November every year of the study. In the spring survey (from April 1 to May 15), we worked mean 22.4 days (range, 10–31 days) in every year, whereas mean 30.7 days (25–38 days) in the autumn survey (from October 5 to November 18).

The sexual difference in the density of the migrants was assessed in terms of the male or female daily catch index (DCI) in each season. This index was designed originally by ourselves and given as the number of males (or females) divided by the number of days on which the males (or the females) were captured in each season (Table 1). Furthermore, the mean daily catch number of males or females during 14 years, 1988–2001, were calculated and its seasonal changes were compared to assess the sexual difference in the migrating population (Fig. 2). The numerical data were statistically analyzed by Student's *t* test.

Fig. 1. Seasonal changes in the number of banded Bush Warblers *Cettia diphone*, at Niigata City coast during a recent 14-years period, 1988–2001. Top two graphs: spring migration in the period from Apr. 1 to May 15. Bottom two graphs: autumn migration in the period from Oct. 5 to Nov. 18. Note the sex-biased time lag in the spring migration.

External examination and sexing

All birds were removed from the mist nets by regular checking (at about 1-hour intervals) in every workday and identified by examination of external features. They were then banded, measured, and released back in the wild. Sexing of the Bush Warbler was

Fig. 2. Seasonal changes in mean daily catch number of the male (M, solid line) or female (F, broken line) Bush Warbler during 14 years at Niigata City coast.

performed according to the criterion concerning the sexual size dimorphism, i.e., the wing length (Abe 1984). Hamao (1992) also pointed out that males are larger than females by 18.8% in wing length and 70.4% in body mass. Estimation of the age of the birds followed also the known criteria (Abe 1984). Then, the juvenile ratio (%) in either sex was calculated, based on the data concerning recent 8 years from 1994 to 2001 (Table 1).

Results and Discussion

We analyzed the data collected over a recent 14-year span, 1988–2001, and present here mainly the results obtained during the period from April 1 to May 15 (45 days) and that from October 5 to November 18 (45 days) in each year (Table 1, Figs. 1 & 2).

In the spring, we banded a total of 1,959 individuals of the Bush Warbler, 810 males and 1,149 females (Table 1). The number of birds varied from year to year, probably depending on various factors, e.g., annual fluctuation of the population, weather conditions, and frequency of banding work. The maximum number of the banded birds was 254 (males plus females) in 1998; and the minimum, 35 in 1988. Furthermore, we recognized a tendency of sexual difference in the density of the birds; the mean DCI of the females during 14 years was 3.8 ± 0.9 (mean $\pm$ SD, $n = 14$, range 2.5–5.2) and that of the males, 3.1 ± 0.9 ($n = 14$, range 1.5–4.4), although the difference is not statistically significant. This tendency appeared to be reflected on the sex ratio studied in most of the years (Table 1); the mean female ratio of the spring migrant was $58.6 \pm 6.1\%$ ($n = 14$, range 43.8–65.1%)

Table 1. Summary of banding data on the Bush Warbler *Cettia diphone* in Niigata City coast (1988–2001).

Year	Spring migration (Apr. 1–May 15)			Autumn migration (Oct. 5–Nov. 18)				
	Number (DCI)		Sex ratio (%)	Number (DCI)		Sex ratio (%)	Juvenile ratio (%)	
	Male	Female		Male	Female			
1988	15 (1.5)	20 (2.5)	42.9	254 (9.8)	148 (5.9)	63.2	NE	
1989	43 (2.9)	37 (3.4)	53.8	165 (7.5)	118 (4.5)	58.3	NE	
1990	30 (1.9)	56 (3.1)	34.9	165 (5.5)	131 (4.1)	66.3	NE	
1991	45 (2.5)	49 (3.1)	47.9	203 (7.2)	198 (6.2)	50.6	NE	
1992	47 (3.4)	58 (2.6)	44.8	195 (6.5)	171 (5.7)	53.3	NE	
1993	53 (2.4)	97 (4.4)	35.3	145 (5.4)	163 (5.8)	47.1	NE	
1994	65 (2.6)	114 (5.2)	36.3	256 (9.8)	195 (7.2)	56.8	68.8	81.9
1995	47 (2.4)	82 (4.6)	36.4	393 (14.6)	352 (11.0)	52.8	66.5	79.2
1996	96 (4.2)	125 (5.2)	43.4	350 (10.4)	338 (9.1)	50.9	87.0	86.6
1997	56 (4.0)	66 (2.8)	45.9	372 (12.0)	415 (13.0)	47.3	85.0	90.0
1998	67 (3.7)	120 (4.3)	35.8	718 (19.9)	626 (16.5)	53.4	89.3	92.5
1999	80 (4.4)	93 (3.9)	46.2	354 (12.2)	318 (9.4)	52.7	93.1	96.3
2000	73 (3.3)	116 (4.6)	38.6	210 (7.5)	192 (6.6)	52.2	79.8	82.4
2001	93 (3.6)	116 (3.6)	44.5	421 (15.6)	294 (10.9)	58.9	80.1	84.9
Total	810	1,149		4,201	3,659			
Mean±SD	(3.1±0.9)	(3.8±0.9)	41.2±5.6	(10.5±4.1)	(8.5±3.4)	54.6±5.4		

Numerals are presented as the mean±SD. DCI (daily catch index) is designated as the number of males (or females)/the number of days on which the males (or the females) were captured. NE, not examined.

and was significantly higher than that of the autumn migrant ($45.5 \pm 5.4\%$, $n=14$, range 36.8–52.9%, $P<0.001$). In addition, we found a tendency of a sex-biased time lag in the active stage of the spring migration; i.e., the males tended to migrate earlier than the females (Figs. 1 & 2). Active migration of the male was observed over the period from April 5 to 28 (24 days), whereas that of the female was obviously later than that of the male and occurred during the period from approximately April 16 to May 13 (28 days). Thus, the sexual time lag in the active stage of the migration was roughly estimated to be about 10 days to 2 weeks. Similar phenomenon was observed in other places of Japan, especially in some islands on the Japan Sea (BMRC 1988, 1989, 1990, 1991) and also in other passerine species, e.g., *Emberiza spodocephala* and *Luscinia cyane* (BMRC 1990).

In the autumn, we banded a total of 7,860 birds, 4,201 males and 3,659 females (Table 1), 4 times as many as the birds captured in the spring of the same years. Obviously, this is ascribed to the recruitment of offspring into the migrating population; i. e., the juvenile birds exceeded in number and attained 66.5–93.1% (mean 81.1%) of the total number of the male, whereas the value for the females was shown as 79.2–96.3% (mean 86.7%; Table 1). These data at Niigata Coast cover the previous findings at Otayama, Central Japan (Abe 1984). The number of autumn migrants changed remarkably from year to year and varied from 249 (males plus females, the minimum) in 1990 to 1,344 (the maximum) in 1998. However, factors involved in the changes of the migrant population and in the ratio of the juveniles remained unknown. The mean DCI was 10.5

± 4.1 ($n=14$, range 5.4–19.9) in the male and 8.5 ± 3.4 ($n=14$, range 4.1–16.5) in the female, but this difference was not significant. In general, the autumn migration occurred during the period from early October to middle November, and major peaks of migration were observed in late October and early November, being nearly coincided with the previous observation at Otayama (Abe *et al.* 1978). The number of the males or females changed similarly, and the sex-biased time lag seen in the spring was not observed in the autumn (Figs. 1 & 2).

Our study in collaboration with local banding groups throughout Japan provided the data useful for analysis of the migratory course and extent of Bush Warbler population in Japan (BMRC 1988, 1990, 1992, 1993, 1996–1999, Yamashina Institute for Ornithology 1996). Concerning the present study site, we have 11 recovery records (Table 2, Fig. 3). These data support the view that the Bush Warbler migrates regularly from Hokkaido to middle or southwest Japan and *vice versa*, passing through Niigata Coast in the middle of Honshu, especially along the Japan Sea Coast. Among others, the records of 02G-95316 and 02M-72007 (Table 2) strongly support this view. Accordingly, these recovery data suggest that the majority of the autumn migrants originated from northern Japan, typically from Hokkaido.

This study based on long-term and periodic bird banding has provided basic information to confirm the general aspect of the migration of the Bush Warbler in Japan (CCJB 2000) and has extended our knowledge on the migration habits of this species. Of the present findings, a tendency of the sex-biased time lag found in the spring migration is of particular interest, because this phenomenon seems to be involved in the reproductive strategies of the male, e.g., earlier establishment of the territory. However, future studies

Table 2. Data on banding recovery of the Bush Warbler *Cettia diphone* at Niigata City coast and relevant locations in Japan.

Birds released at Niigata City coast and recaptured at other places						
Ring No.	Sex/Age	Release date	Recovery date	Recovery place	Distance (km)	
025-50874	F/J	Oct. 26, 1985	Apr. 28, 1987	Tobishima, Yamagata	170	a
01A-31785	F/J	Nov. 01, 1991	Oct. 20, 1996	Hakodate, Hokkaido	451	b
01B-12026	F/J	Oct. 19, 1995	Oct. 21, 1995	Kurosaki, Niigata	6	c
01B-12347	F/J	Oct. 21, 1995	Apr. 26, 1996	Shiunji, Niigata	29	d
02G-95316	M/J	Oct. 22, 1995	Nov. 24, 1995	Hamada, Shimane	710	e
Birds released at other places and recaptured at Niigata City coast						
Ring No.	Sex/Age	Release date	Release place	Recovery date	Distance (km)	
02B-33536	M/J	Nov. 20, 1988	Kyoto, Kyoto	Apr. 15, 1989	437	f
02B-71260	M/U	Oct. 07, 1989	Hamatonbetsu, Hokkaido	Nov. 02, 1991	851	g
02E-28000	F/A	Mar. 09, 1992	Matsumae, Hokkaido	Oct. 27, 1992	431	h
02K-77390	M/J	Sep. 16, 1997	Hamatonbetsu, Hokkaido	Oct. 22, 1998	851	i
02L-40158	M/J	Oct. 07, 1997	Hakodate, Hokkaido	Oct. 22, 1997	463	j
02M-72007	M/J	Oct. 17, 1998	Otaru, Hokkaido	Oct. 27, 1998	612	k

F, female; M, male; A, adult; J, juvenile; U, unknown; a–k letters, corresponding to lines indicated in the map of Figure 3. Our original data were cited from official records (BMRC 1988, 1990, 1992, 1993, 1996–1999).

Fig. 3. Map of Japan showing the location of the study site, Niigata City coast (arrow) and relevant locations (dots) of the banding and recapture of the Bush Warbler. Lines marked by letters a–k connect the relevant release and recapture sites (c.f., Table 2).

should be focused on a possible relation between the arrival timing of the arrival of males at the breeding ground and the process of territory establishment.

Acknowledgments

This study was carried out under license from the Ministry of the Environment and supported by Yamashina Institute for Ornithology, Abiko City in Chiba Prefecture. We thank Dr. S. Hamao, National Science Museum, Mr. M. Kajita, Kyoto University, and Mr. S. Komeda, Yamashina Institute for Ornithology, for their critical reading of the manuscript. We also thank the following members of Niigata Group of Bird Banding Association for their assistance in the field work: Y. Itoh, R. Honma, S. Seo, N. Seo, K. Mitomi, Y. Furukawa, N. Watanabe, S. Itoh, H. Takatsuji, Y. Shirai, T. Kinoshita, M. Shibuya, and M. Onojima.

References

- Abe, N. 1984. The wing length as a sexing criterion of *Cettia diphone cantans* in autumn routine ringing. *Journal of the Yamashina Institute for Ornithology* **16**: 151–158. (in Japanese with English summary)
- Abe, N., Mano, T., Kurosawa, O. & Fujimura, H. 1978. A five-year bird ringing at Otayama Bird-observatory from 1973 through 1977. *Journal of the Yamashina Institute for Ornithology* **10**: 142–171. (in Japanese with English summary)
- Baker, K. 1997. *Warblers of Europe, Asia and North Africa*. Christopher Helm, London.
- BMRC (Bird Migration Research Center Yamashina Institute for Ornithology) 1988. *Report of the Bird Banding Research Center 1987*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1989. *Report of the Bird Banding Research Center 1988*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1990. *Report of the Bird Banding Research Center 1989*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1991. *Report of the Bird Banding Research Center 1991*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1992. *Report of the Bird Banding Research Center 1991*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1993. *Report of the Bird Banding Research Center 1992*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1996. *Report of the Bird Banding Research Center 1995*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1997. *Report of the Bird Banding Research Center 1996*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1998. *Report of the Bird Banding Research Center 1997*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- BMRC 1999. *Report of the Bird Banding Research Center 1998*. Yamashina Institute for Ornithology, Abiko. (in Japanese with English summary)
- CCJB (Committee for Check-List of Japanese Birds) 2000. *Check-list of Japanese Birds, 6th ed.* Ornithological Society of Japan, Obihiro.
- Chiba, A., Komatsu, Y. & Itoh, Y. 1991. A record of the Pallas's Willow Warbler *Phylloscopus proregulus* in Niigata Prefecture, with histological notes on some organs. *Japanese Journal of Ornithology* **40**: 27–31.
- Hamao, S. 1992. Lack of pair-bond: A polygynous mating system of the Japanese Bush Warbler, *Cettia diphone*. *Japanese Journal of Ornithology* **40**: 51–65. (in Japanese with English summary)
- Kajita, M. 2002. Biogeography and infraspecific phylogeny of the Bush Warbler. *Iden* **56**: 42–46. (in Japanese)
- Komatsu, Y. & Chiba, A. 1999. Recent progress of the bird banding at Sekiya Kaigan in Niigata City.

- Kurotsugumi. In *Kurotsugumi* (ed. N. Seo), pp. 33-45. Yoshida Insatsusho, Gosen. (in Japanese)
- Komatsu, Y., Itoh, Y., Chiba, A., Furukawa, Y., Itoh, S., Watanabe, N., Takatsuji, H., Shirai, Y., Fujisawa, M., Shibuya, M., Satoh, H., Seo, N. & Seo, S. 1993. An aspect of bird migration in a pine forest of Niigata City coast, the Sea of Japan, as revealed by banding research. *Bulletin of the Niigata Prefectural Biological Society for Education* 28: 41-52. (in Japanese with English summary)
- Yamashina Institute for Ornithology 1997. *Atlas of Japanese Migratory Birds (Passerines 1961-1995)*. Yamashina Institute for Ornithology, Abiko.

標識調査の結果からみた新潟市におけるウグイスの渡りの様相

本州中部日本海沿岸におけるウグイスの渡りの様相を解明するため、新潟市の関屋海岸において 1988 年から 14 年間標識調査を実施した。関屋海岸の西海岸公園（北緯 37°55′東経 139°01′）のクロマツ林内に調査地（約 100 m×150 m）を設け、カスミ網 12 枚を用い、小鳥類の声をプレーバックしながら作業を行った。調査結果を便宜上、春季（4 月 1 日～5 月 15 日：45 日間）および秋季（10 月 5 日～11 月 18 日：45 日間）に大別し、各季の捕獲数を雌雄別に整理・比較した。また、雄または雌が捕獲された日について、1 日当たりの雄または雌の捕獲数を DCI (daily catch index) として求め、この数値の各季節平均値と性比を指標にして移動時期の性差を検討した。その結果、次のことが明らかになった。春の渡りでは総計 1,959 羽のウグイスが捕獲され、そのうち雄は 810 羽、雌は 1,149 羽であった。春の渡りにおける雌の性比は平均 $58.6 \pm 6.1\%$ ($n=14$) で秋の渡りにおける該当値（平均 45.5 ± 5.4 , $n=14$ ）より有意に ($P<0.001$) 高かった。また、有意差は認められないものの、春の渡り 14 シーズンにおける雌の平均 DCI 値 (3.8 ± 0.9) は雄の該当値 (3.1 ± 0.9) よりやや高い傾向が示された。一方、移動時期は雄が雌より早い傾向が認められ、その移動盛期は 4 月上旬～下旬、雌のそれは 4 月中旬～5 月中旬であった。秋の渡りでは、春の数より約 4 倍多い総計 7,860 羽（雄 4,201 羽、雌 3,659 羽）が捕獲され、移動の盛期は 10 月下旬から 11 月上旬であった。これは、秋の移動群において幼鳥が占める高い割合（雄で 66.5～93.1%；雌で 79.2～96.3%）を反映した結果と推察された。秋の渡りでは、春に見られたような性比の偏り傾向や移動時期の性差は認められなかった。また、関屋海岸に関する国内回収記録 11 例を見ると、新潟の海岸は、本種の渡りにおいて北海道と近畿ないし山陰を結ぶ中継地として利用されていることが示唆された。

小松吉蔵：〒951-8166 新潟市関屋浜松町 145.

佐藤 弘：〒956-0022 新潟市さつき野 3-8-32.

藤沢幹子：〒951-8127 新潟市関屋下川原町 1-3-15 関屋ハイツ 607.

千葉 晃：日本歯科大学新潟歯学部生物学教室。〒951-8580 新潟市浜浦町 1-8.