

**Breeding status of the four *parid* species (family Paridae)
in Kofu-en (Sapporo, Hokkaido) in 2016
and the result of the 2017 preliminary nest box survey**

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Abstract

Nest boxes have widely been used to study various aspects of bird ecology and behavior. The extensive use of nest boxes is mostly due to the fact that they are relatively safe for the birds that breed in them. The provision of nest boxes to a new environment, where population sizes have been dictated by the availability of resources, i.e. the limited number of nest holes, possibly lead to increases in population size of cavity-nesting species which may have further implications for ecological or community structure changes. However, the studies on the baseline conditions of the target species and the substrate environment prior to providing nest boxes are rare. In light of this, we studied the baseline condition of the bird fauna of Kofu-en before and after adding new resources to its environment. We recorded 57 species, 16 of which were confirmed and/or highly likely to breed in 2016, when nest boxes for small passerines, i.e. *parids*, had not been provided. *Parids* were not among the confirmed/likely breeders, although they were observed to forage. The 2016 survey also revealed that *parids* nested in artificial cavities such as utility poles. In 2017, when 16 such nest boxes were provided, and three boxes were determined to have been used by *parids* based on nest material remains. One of the three boxes was observed to be visited frequently by a pair of Japanese Tit *P. minor* in June. This study should provide a baseline information on the avifauna breeding in Kofu-en.

Key words : nest boxes, breeding status, cavity nesters, secondary forest

Introduction

The use of nest boxes has been a widely employed method to study various aspects of bird behavior, ecology, physiology and behavior¹⁾²⁾³⁾⁴⁾. Nest boxes are also used for the conservation purposes⁵⁾. The reasons for their extensive use are that they are fairly easy to build and put up, that birds readily, and in most cases safely, occupy such boxes once provided, and that they facilitate researchers to obtain a large

amount of data.

While there are many reports on both positive and negative effects of nest box provisions⁶⁾⁷⁾, studies on the baseline conditions of the habitats themselves prior to such provisions are extremely rare and sketchy. When we are to grasp the characteristics of the environment in a true sense, such as community structure, species richness and relative dominance, we need to understand the background conditions

which may have influences on them. Without this understanding, we would be prone to incorrectly evaluate the environment, which might lead to subsequent conservation measures and/or research plans that are potentially inappropriate to the given habitat.

In addition, we may have to keep in mind that the provision of extra nesting sites can affect not only the target bird species but also all the other organisms, directly and/or indirectly through predation and competition. For example, the number and density of arthropods have been documented to decline when hole-nesting birds increased because of the nest boxes provided⁸⁾. It is also possible that those "nest-box-using new-comers", when given opportunities to breed, compete with the other sympatric breeders over resources such as food and space.

For these reasons, the baseline information of Kofu-en should be necessary and useful for future research and management practices of the area. Thus, the purpose of this study was to provide such baseline conditions of the *parid* species recorded prior to putting up nest boxes in the campus woods, Kofu-en, and to report the evidence of their nesting there in the year when the boxes were provided. As baseline data, nest records of *parid* species outside Kofu-en as well as the species records of the other bird species for 2016 are also provided.

Study area, materials and methods

Study area

The study area was an isolated forest, called Kofu-en, which is a part of Tokai University Sapporo Campus (42° 59' 29' ' N, 141° 19' 6.5' ' E) in Minami-ku, Sapporo, Hokkaido (Fig.1). It has an area of about 15ha, surrounded by residential areas, a shrine, and roads. It is basically a secondary forest, where most of the trees grew back after the World War II. Since its ownership was transferred to the university in late 1960's to be used as an educational and research forest, it has been actively utilized for undergraduate field experiments and theses as well

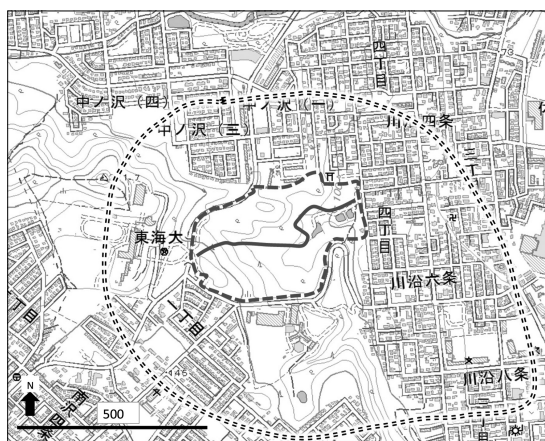


Fig.1 Map of the study area. The thick broken line shows the boundary of Kofu-en. The line transect route is shown in a solid line. The double broken line is the area in which parid nest site survey outside Kofu-en was conducted.

as for casual walking paths by the local residents. Japanese Birch *Betula platyphyla* and Japanese Oak *Quercus mongolica* are the dominant tree species .

Bird and nest box surveys in 2016

The surveys were conducted for 6 months between mid-April and mid-October, 2016. One transect route was set to traverse the center of the woods (Fig. 1). We walked along the transects at a slow and even speed and recorded the birds which appeared, sang or gave off calls within 25m on both sides of the transect line. The length of the route was 600m. The line transect survey was conducted once or twice a week, starting around sunrise. The starting time for April-July period was between 4:00 and 5:00 a.m. and that for August-October period was 5:00-6:00 a.m.. In order to avoid bias due to the starting time of each survey, the direction of walking along the transect was randomly changed.

In addition to the line transect surveys, we conducted spot census surveys between April and June, which was the peak breeding period for most birds. We selected several points for spot surveys along the transect route, which had high visibility to look through the stands to observe of bird behaviors.

During the spot surveys, we focused primarily on the breeding-related behaviors, including singing, territorial aggressions, courtship, nest building, incubation relief, feeding young, and the presence of newly-fledged young. The determination of breeding status was in accord with the categories of breeding bird status⁹⁾.

We recorded all the birds observed in Kofu-en in as much details as possible, while the main purpose was to determine the breeding status of the five *parid* species, the Marsh Tit *Poecile palustris*, the Willow Tit *P. montanus*, the Varied Tit *P. varius*, *Parus minor*, the Japanese Tit *Parus minor*, and The Coal Tit *Periparus ater*, that are common residents in Hokkaido¹⁰⁾.

Three to four nest boxes with a nest hole diameter of 4.5cm, intended for the Chestnut-cheeked Starling *Agropser philippensis*, were provided along the eastern edge of the forest (Fig. 2). Inside the nest boxes were checked a few times a week throughout their breeding period between May and July. In addition to these checks, the small patch of land of about 20 × 10m, where the nest boxes were put up were monitored using binoculars every morning to check and monitor the presence of nest hole breeders, including Chestnut-cheeked Starlings, the *parids*, and Tree Sparrows *Passer montanus*.

In addition to the above surveys, we conducted a search roughly in a concentric oval of 200-500m in width surrounding Kofu-en to determine where the *parids* nested outside the forest (Fig.1).

Preliminary nest box survey for *parids* in 2017

As a preliminary study to see whether *parids* would utilize nest boxes, a total of 16 boxes suitable for small passerines were put up in Kofu-en. The diameter of the nest hole was 2.5cm. In addition to those, four boxes for the Chestnut-cheeked Starling were also put up on the eastern edge (Fig. 2). On November 1, 2017, The contents of the 16 small nest boxes was checked for the nest material typical of *parids*. The larger starling boxes were checked at



Fig.2 The map of the locations where nest boxes were hung. Circles indicate nest boxes for *parids* and triangles those for Chestnut-cheeked Starlings (solid triangles for 2016 and 2017 and open one for 2017 only). The area where we visited 2-3 times a week to check nest boxes of Chestnut-cheeked Starlings is indicated by a double broken line.

least twice a week between May and July. Thus, the small patch of land, where the nest boxes (three *parid* boxes and four starling boxes) were provided, was scanned in the same manner as in 2016 (Fig. 2.).

Results

Bird and nest box surveys in 2016.

The list of the bird species recorded in the 2016 line transect and spot surveys combined is shown in Table 1. A total of 57 species were recorded, of which 15 were confirmed to breed in Kofu-en. While the summer migrants such as Narcissus Flycatchers and White Crowned Warblers were determined to be in higher breeding categories, indicating that they were more likely to be breeding in Kofu-en, the four *parid* species ranked in the lowest categories, an indication that they probably did not breed there. Furthermore, Willow Tits were not observed in our study area throughout the survey period, which strongly suggests that the species did not inhabit there.

In Fig. 3, the sightings per census for the four *parid* species, Narcissus Flycatchers, White Crowned Warblers, Asian Stubtails, and Black-

Table 1. The bird species recorded in Kofu-en in 2016 surveys. Note that all the status apply only to Kofu-en and not necessarily reflect the status outside the forest. R = Resident, T = Transient, S = Summer migrants, W = Winter migrants, B = Breeding confirmed, PB = Breeding likely.

Family/Sub-family	English Name	Japanese Name		Status in Kofu-en in 2016
Anatidae カモ	Mandarin Duck	オシドリ	<i>Aix galericulata</i>	R-T
	Mallard	マガモ	<i>Anas platyrhynchos</i>	R
Columbidae ハト	Oriental Turtle Dove	キジバト	<i>Streptopelia orientalis</i>	S-B
	White-bellied Green Pigeon	アオバト	<i>Treron siebodii</i>	S
Ardeinea サギ	Grey Heron	アオサギ	<i>Ardea cinerea</i>	T
Culuidae カッコウ	Oriental Cuckoo	ツツドリ	<i>Cuculus optatus</i>	S-T
Scolopacidae シギ	Eurasian Woodcock	ヤマシギ	<i>Scolopax rusticola</i>	S-T
Accipitridae タカ	Black Kite	トビ	<i>Milvus migrans</i>	R
	Mountain Hawk-Eagle	クマタカ	<i>Nisaetus nipalensis</i>	T
Picidae キツツキ	Japanese Pygmy Woodpecker	コゲラ	<i>Dendrocopos kizuki</i>	R
	White-backed Woodpecker	オオアカゲラ	<i>D. leucotos</i>	R-B
	Great Spotted Woodpecker	アカゲラ	<i>D. major</i>	R
	Black Woodpecker	クマゲラ	<i>Dryocopus martius</i>	R-PB
	Grey-headed Woodpecker	ヤマゲラ	<i>Picus canus</i>	R
Falconidae ハヤブサ	Peregrine Falcon	ハヤブサ	<i>Falco peregrinus</i>	R
Laniidae モズ	Bull-headed Shrike	モズ	<i>Lanius bucephalus</i>	S-T
Corvidae カラス	Eurasian Jay	カケス	<i>Garrulus glandarius</i>	W
	Carion Crow	ハシボソガラス	<i>Corvus corone</i>	R-B
	Large-billed Crow	ハシブトガラス	<i>C. macrorhynchos</i>	R-B
Regulidae キクイタダキ	Goldcrest	キクイタダキ	<i>Regulus regulus</i>	W
Paridae シジュウカラ	Marsh Tit	ハシブトガラ	<i>Poecile palustris</i>	R
	Varied Tit	ヤマガラ	<i>P. varius</i>	R
	Japanese Tit	シジュウカラ	<i>Parus minor</i>	R
	Coal Tit	ヒガラ	<i>Periparus ater</i>	R
Pycnonotidae ヒヨドリ	Brown-eared Bulbul	ヒヨドリ	<i>Hypsipetes amaurotis</i>	R
Cettiidae ウグイス	Japanese Bush Warbler	ウグイス	<i>Cettia diphone</i>	S-PB
	Asian Stubtail	ヤブサメ	<i>Urosphena squameiceps</i>	S-B
Aegithalidae エナガ	Long-tailed Tit	エナガ	<i>Aegithalos caudatus</i>	R-B
Sylviidae ダルマエナガ	Dusky Warbler	ムジセッカ	<i>Phylloscopus fuscatus</i>	T
	Kamchatka Leaf Warbler	オオムシクイ	<i>P. examinandus</i>	T
	Ssakhlin Leaf Warbler	エゾムシクイ	<i>P. borealoides</i>	S-T
	Eastern Crowned Warbler	センダイムシクイ	<i>P. coronatus</i>	S-B
Zosteropidae メジロ	Japanese White-eye	メジロ	<i>Zosterops japonicus</i>	S
Locustellidae センニュウ	Gray's Grasshopper Warbler	エゾセンニュウ	<i>Locustella fasciolata</i>	S-T
Sittidae ゴジュウカラ	Eurasian Nuthatch	ゴジュウカラ	<i>Sitta europaea</i>	R-B
Troglodytidae ミソサザイ	Winter Wren	ミソサザイ	<i>Troglodytes troglodytes</i>	W
Sturnidae ムクドリ	Chestnut-cheeked Starling	コムクドリ	<i>Agropsar philippensis</i>	S-B
Muscicapidae ヒタキ	Japanese Thrush	クロツグミ	<i>Turdus cardis</i>	S
	Eyebrowed Thrush	マミチャジナイ	<i>T. obscurus</i>	T
	Dusky Thrush	ツグミ	<i>T. naumanni</i>	W
	Japanese Robin	コマドリ	<i>Luscinia akahige</i>	S-T
	Red-flanked Bluetail	ルリビタキ	<i>Tarsiger cyanurus</i>	T
	Asian Brown Flycatcher	コサメビタキ	<i>Muscicapa dauurica</i>	S-T
	Mugimaki Flycatcher	ムギマキ	<i>Ficedula mugimaki</i>	T
	Narcissus Flycatcher	キビタキ	<i>F. narcissina</i>	S-B
	Blue-andWhite Flycatcher	オオルリ	<i>Cyanoptila cyanomelana</i>	S-B
Passerinae スズメ	Eurasian Tree Sparrow	スズメ	<i>Passer montanus</i>	R-PB
Motacillidae セキレイ	Grey Wagtail	キセキレイ	<i>Motacilla cinerea</i>	S-T
	White Wagtail	ハクセキレイ	<i>M. alba</i>	R
	Olive-backed Pipit	ビンズイ	<i>Anthus hodgsoni</i>	S-T
Fringillidae アトリ	Brambling	アトリ	<i>Fringilla montifringilla</i>	W
	Oriental Greenfinch	カワラヒワ	<i>Chloris sinica</i>	R-B
	Eurasian Siskin	マヒワ	<i>Carduelis spinus</i>	W
	Hawfinch	シメ	<i>Coccothraustes coccothraustes</i>	W
Emberizidae ホオジロ	Meadow Bunting	ホオジロ	<i>Emberiza cioides</i>	S
	Black-faced Bunting	アオジ	<i>E. spodocephala</i>	S-B
	Grey Bunting	クロジ	<i>E. variabilis</i>	S-T

Breeding status of the four *parid* species (family Paridae) in Kofu-en (Sapporo, Hokkaido) in 2016 and the result of the 2017 preliminary nest box survey

facéd Buntings are shown. We observed several adult *parids* come into Kofu-en and go out with caterpillars in their bills. However, no *parids* were observed to go in and out of particular tree cavities or crevices. Fig. 4 shows the seasonal change in the observed behaviors which were indicative of breeding activities for some of the bird species recorded in Kofu-en .

In Kofu-en, *parids* were less numerous in the peak

period of the breeding season for most birds, but we began to spot grown fledglings with reduced gape flange and considerably elongated tail feathers in Kofu-en from early June on. It was also apparent that *parid* species were observed more often in late summer and fall (Fig. 3).

No *parids* were observed to use the vacant starling nest boxes provided within Kofu-en. On the other hand, the nest site search outside Kofu-en revealed

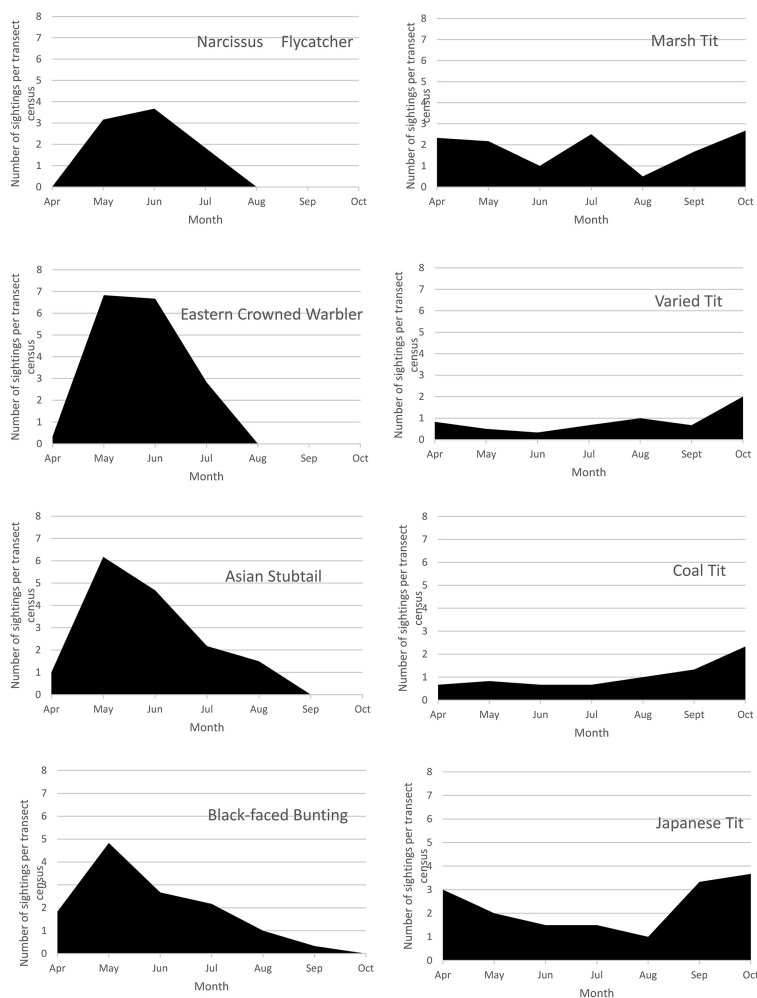


Fig.3 Number of sightings per line transect census for the breeding-confirmed summer migrants and resident (Narcissus Flycatchers, Eastern Crowned Warblers, Marsh Tits, Asian Stubtail, and Black-faced Bunting) and for four species of *parids* (Marsh Tit, Varied Tits, Coal Tit, and Japanese Tit).

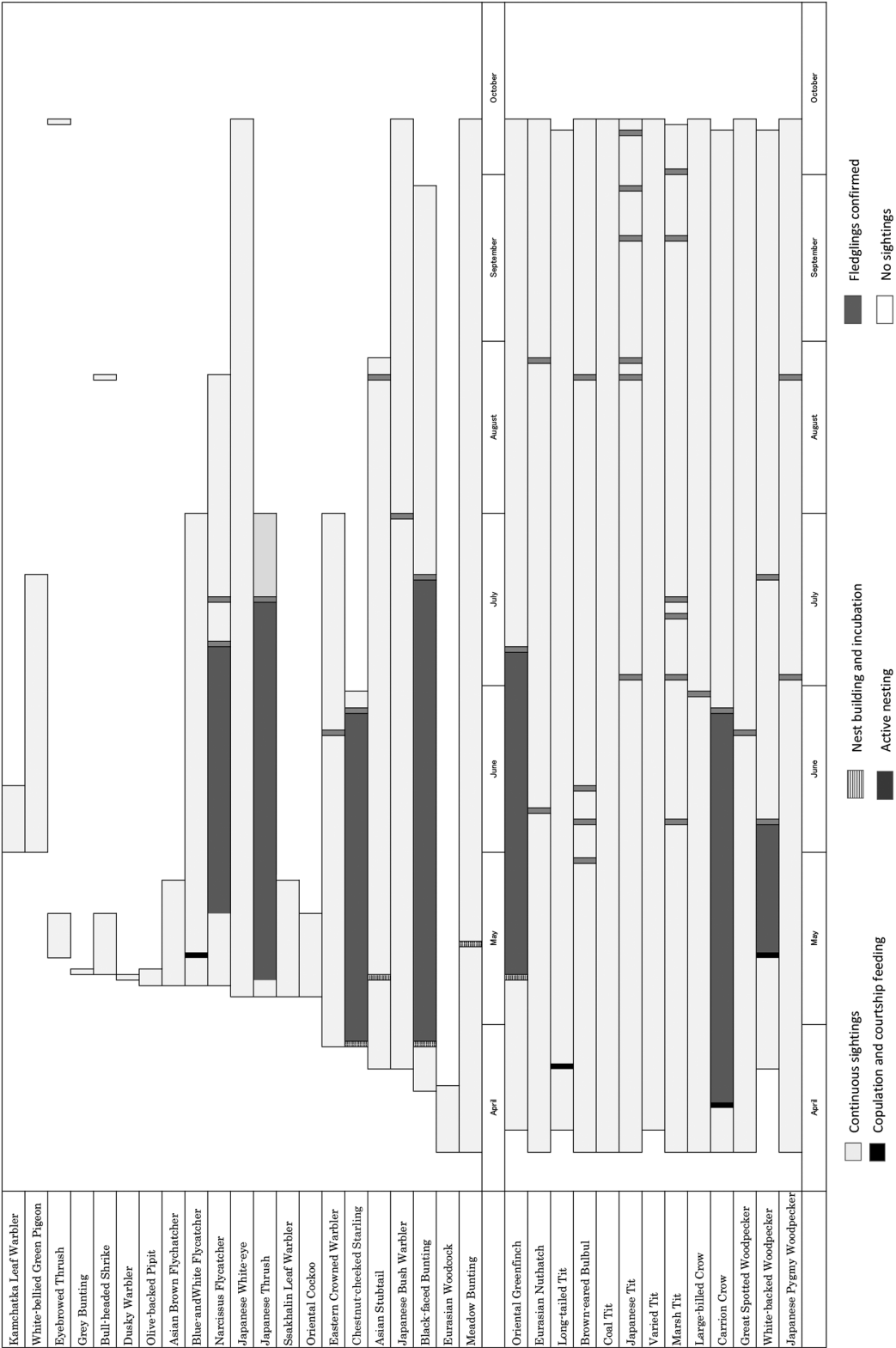


Fig.4 Seasonal changes in the sightings and observed behaviors which were indicative of breeding activities for some of the bird species recorded in Kofu-en. The upper 21 species are the summer migrants and the lower 13 residents recorded in Kofu-en. The right end of each bar indicates the final day of sighting.

Table 2. Types of artificial nest substrate used by *parids* outside Kofu-en in 2016

species	nest substrate		
	metal bar on utility pole	starling nest box	ventilator duct
<i>Poecile palustris</i>	1		
<i>P. varius</i>	1		
<i>Parus manor</i>	2	2	1

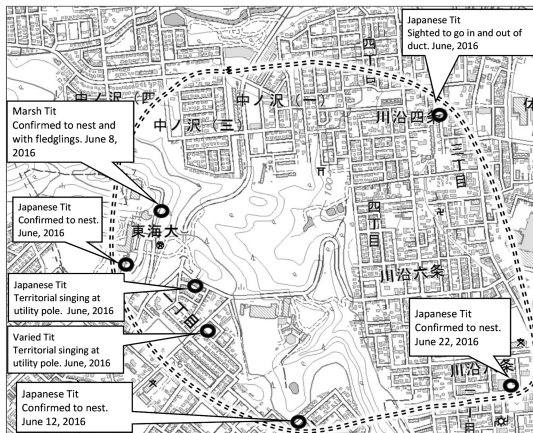


Fig.5 Locations of nest sites of parid species outside Kofu-en in 2016.

that several *parid* pairs, namely Japanese Tits, Varied Tits and Marsh Tits, had nested in the hollow rectangular bars near the top of utility poles (Fig. 5, Table 2). The bars had, at both ends, narrow slits of about 2cm. These bars were used as the grids for holding electric lines, ceramic insulators and transformers. A pair of Japanese Tits was found to nest in the vacant starling nest box hung on the fence of the university building. When the box was retrieved for cleaning later, the nest was found to have been robbed most likely by Tree Sparrows. Another Japanese Tit pair was seen to nest inside a ventilator duct with a broken plastic cover.

Preliminary nest box survey in 2017

Although we were not able to determine either their nest success or the species that occupied, for the nest boxes were retrieved and checked in November, three of the 16 *parid* nest boxes had traces of nesting, namely nest materials and feathers typical of *parid*

species. A vacant starling nest box did not contain any of such traces. Thus, as in 2016, the starling boxes in Kofu-en were not used by *parids*, despite of the fact that those boxes remained vacant from the onset of breeding season to late summer.

Discussion

The bird species recorded in Kofu-en were similar to those recorded in other similar sites in Sapporo¹¹⁾ and most of the summer birds recorded seemed to have bred there.

The 2016 surveys revealed that the *parids* species probably did not breed in Kofu-en. They did not choose to breed the starling nest box, either, even though it remained vacant throughout the breeding season. On the other hand, several *parid* pairs were found to nest in artificial nest sites, most of which were in the hollow metal bars on utility poles (71.4%) (Table 2). Since the adult *parids* such as Varied Tits, Japanese Tits and Coal Tits were recorded in Kofu-en in breeding season, it is possible that they bred elsewhere, i.e. artificial nest sites near Kofu-en and came in just to forage, as described before. In fact, several adult *parids* were observed to come into Kofu-en and flew off with caterpillars in their bills.

In 2017, three *parid* nest boxes provided had traces indicating use by *parids*, while the vacant starling boxes did not. The occupation rate of the those *parid* boxes was 18.8%, which was some what less than the range of occupation reported in other studies⁴⁾¹²⁾.

Our observations in 2016-2017 suggest that the *parid* species tended to avoid the nest boxes with a larger entrance size, even when they were vacant and available. In fact, one such nesting attempt

in a campus building was probably halted by Tree Sparrows in 2016. It is, thus, suggested that naturally-occurring cavities and crevices suitable for small-sized cavity nesters such as *parids* were scarce in Kofu-en. This may be true for Chestnut-cheeked Starlings which nest in cavities with somewhat larger entrance than the *parids*, as the starlings were not observed to breed in natural tree cavities in Kofu-en.

Although there have been very few written records of felling forest trees for firewood in Sapporo area between Taisho era and shortly after the World War II¹³⁾, many elderly Sapporoites said that they would cut down trees in nearby forests, often adjacent to their homes, to be used as firewood particularly during and several years after the war when there was an extreme shortage of fuels such as kerosene and gas. They also told that some forests became virtually treeless as the result of felling. This is possibly the reason why the trees in now-protected forests are relatively young and all seem to be uniform in age, around 60–80 years old. The uniform appearance of the today's forests, including Kofu-en, located near Sapporo's residential areas may be a reflection of the timber and firewood collection of several decades ago.

The DBHs (Diameters at breast height) of most of those trees are still around 20–40cm. There are very few old trees, which luckily escaped felling because they had grown on steep hills or at higher elevations. Kofu-en also has such very small number of old and large trees with DBH exceeding ca. 50cm only on steep inclinations along a creek and on the hill tops.

Although there have been sporadic woodpecker holes, Kofu-en's virtual absence of old trees may have been one of the limiting factors for the resident woodpeckers, such as the Japanese Pygmy Woodpecker *Dendrocopos kizuki*, the White-backed Woodpecker *D. leucotos*, the Great Spotted Woodpecker *D. major* and the Black Woodpecker *D. martius*, so that the forest cannot serve as their core breeding areas. Small and medium-

sized woodpeckers such as the Japanese Pygmy Woodpecker and the the Great Spotted Woodpecker could nest in younger trees with DBHs between 20 to 50cm¹⁴⁾ and the White-backed Woodpecker did indeed breed in Kofu-en (Fig.4). On the other hand, the reasons for very few nesting woodpeckers may merely be due to the size of the forest, the area of 15ha not being large enough for them to hold territories and/or to contain sufficient snags for foraging¹⁵⁾. These factors might, in turn, result in few cavities available for secondary cavity nesters.

There was an observation of Marsh Tits going in and out of a small opening in a tree in Kofu-en on May 9, 2017 (M. Nagase, pers. comm.). Prior to the occupation by the Marsh Tit pair, Varied Tits had also been seen to visit the opening. This opening was not a hole made by a woodpecker but seemed to be a natural crack from breaking or rotting of the tree trunk. The vocalization of the nestlings was confirmed (M. Nagase, pers. comm.). This observation shows that *parids* can nest in natural cavities in Kofu-en, when such an opportunity arises. However, we should conclude that such is still a rare occurrence in Kofu-en under the current conditions.

It is interesting that the *parid* pairs that nested outside Kofu-en in 2016 used artificial nest sites, most of which were in the hollow metal bars with a narrow opening on utility poles. When *parid*-size nest boxes were provided there in 2017, three were used by them. On the other hand, the starling nest boxes provided in Kofu-en were not used by *parids* in both 2016 and 2017, even though they were vacant and available throughout the breeding seasons. These results may show that the nest hole size is crucial in nest site selection among *parids*. Larger nest holes probably increase the risks of predation and takeover by other species such as the Tree Sparrow. In 2015, one Japanese Tit nest built in a starling box, hung adjacent to the university building was preyed upon by a snake *Elaphe climacophora* (T. Shimada, pers. comm.).

In this study, more *parids* were found to nest in artificial sites than we had expected. This phenomenon is possibly more common and much more widespread in Sapporo, which we have hardly noticed because of their size, agility and short breeding period, while Tree Sparrows seem to be observed more frequently to nest in artificial sites such as utility poles¹⁶⁾.

The future provision of nest boxes in Kofu-en will be a good experiment opportunity to see whether and how various ecological aspects such as species composition and abundance would change.

At the same time, it should be necessary to monitor when and how primary and secondary cavity nesters begin to occupy naturally-occurring cavities as the trees grow and reach maturity.

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