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Vocal Communication in Sooty-headed Bulbul; *Pycnonotus aurigaster*

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***Abstract*—**Studies of vocal communication in Sooty-headed Bulbul were carried out from January to December 2011. Vocal recordings and behavioral observations were made in their natural habitats at some localities of Lampang, Thailand. After editing, cuts of high quality recordings were analyzed with the help of Avisoft-SASLab Pro (version 4.40) software. More than one thousand element repertoires in five groups were found within two vocal structures. The two structures were short sounds with single element and phrases composed of elements, the frequency ranged from 1-10 kHz. Most phrases were composed of 2 to 5 elements that were often dissimilar in structure, however, these phrases were not as complex as song phrases. The elements and phrases were combined to form many patterns. The species used ten types of calls; i.e. alert, alarm, aggressive, begging, contact, courtship, distress, exciting, flying and invitation. Alert and contact calls were used more frequently than other calls. Aggressive, alarm and distress calls could be used for interspecific communication among some other bird species in the same habitats.

Keywords—Vocal communication, Call, Bird, Sooty-headed Bulbul

I. INTRODUCTION

BIRDS use a variety of vocal signals in their communication. These signals may be long and complex or short and simple, and they may occur in particular contexts. On the basis of physical characteristics and functional context, these signals can be classified into calls and songs [1]. However, songs and calls are not always easily distinguished [2]. Vocalizations uttered in a single articulation and generally made up of single elements (an element is a continuous sound, preceded and followed by a silent gap) are known as calls, while a typical song may include a continuous series of phrases [3].

Generally, male birds use songs for territorial advertisement and mate attraction [3]. In some cases, birds use songs for other purposes, such as to coordinate nest exchanges between mates [4], inform females that there is no immediate threat of predation [5], and distract potential predators [6]. In some bird species, females also sing [7] such as in the Superb Fairy-Wren (*Malurus cyaneus*) [8] and Oriental Magpie-Robin (*Copsychus saularis*) [9]. Bird song sometimes occurs outside the breeding season [10]. Calls are used in all seasons and play important roles in the sociobiology of birds; namely social contact, parent-offspring interactions, cohesiveness among flock/family members, threat and danger [11].

Bulbuls such as Red-vented Bulbuls; *Pycnonotus cafer* also use variety of vocal signals in their communication. The Red-vented Bulbuls are the tropical passerines, widely distributed throughout the Indian sub-continent, and common in gardens and light scrub jungle. [12]. It has been reported that they use six types of calls, namely for contact, roosting, alarm, twittering, distress and begging [13]. The calls were composed of phrases with minor structural variations of elements. Some type of calls were composed of complex phrases, like song, but were short and used for proximate functions [12].

Sooty-headed Bulbuls are very common residents in northern Thailand [14]. They are classified into the same family and genus (family Pycnonotidae, genus *Pycnonotus*) as Red-vented Bulbuls. Sooty-headed Bulbuls and Red-vented Bulbuls are not only closely related species, they are also tropical non-territorial passerines that live in similar types of habitats and exhibit quite similar social organization. Therefore, these two species may probably have the similar patterns of vocal communication.

The objective of this research was analysis of the vocal communication in Sooty-headed Bulbuls; element repertoires, vocal structures, vocal signals and the results from playback experiments were analyzed.

II. MATERIAL AND METHODS

Studies of vocal communication in Sooty-headed Bulbul were carried out from January to December 2011. Vocal recordings and behavioral observations were made from the early morning (05:00 a.m.) to the late afternoon (07:00 p.m.) in the natural habitats of Sooty-headed Bulbuls at some localities of Lampang (18°15'N, 99°30'E), Thailand. Sounds were recorded using Zoom H4n handy recorder. The birds were usually familiar with humans and allowed close recordings. They always nested in bushes near human settlements and, with their nests at only 1-5 meter height, studying parents-offspring signaling behavior was not difficult. Behavioral correlates were used to infer the possible meanings of vocal signals [15]. After editing, cuts of high

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quality recordings were analyzed as sonagrams with the help of Avisoft-SASLab Pro (version 4.40) software. The analysis was focused on element repertoires, vocal structures and vocal signals. In addition, playback experiments of contact, alarm, distress calls in Sooty-headed Bulbuls and cockcrows (control) were performed to test responses of the birds both in Sooty-headed Bulbuls and some other species that live in the same habitats and twenty repetitions of the experiments of each call were performed in each species at different times and locations to avoid habituation. Statistical analysis (Chi-square Test) was used in comparison of responses of the birds to alarm and distress calls in Sooty-headed Bulbuls.

III. RESULTS AND DISCUSSION

A. ElementRepertoires

In the consideration of structure, length (second) and frequency (kHz) of elements; I found more than one thousand of element repertoires in five groups. The five groups of elements (as the sample in Fig. 1) consist of wave-like elements with frequency 3-4 kHz (Fig. 1A), short elements (not longer than 0.2 seconds) with frequency not higher than 5 kHz (Fig. 1B), long elements (0.2 seconds or longer) with frequency not higher than 5 kHz (Fig. 1C), harmonic elements with frequency 4-10 kHz (Fig. 1D) and band shape elements with frequency 4-10 kHz (Fig. 1E). Among these, harmonic elements were used the most frequently (40 % of all) and always found in courtship calls, invitation calls, some type of alert calls, some type of contact calls, and some type of flying calls.

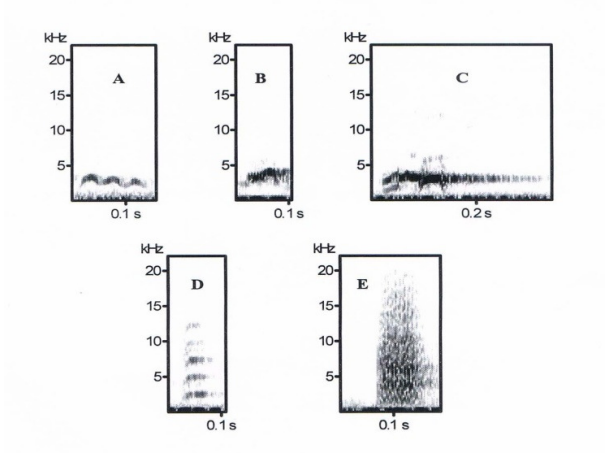

Fig. 1 Sonagrams of the samples from five groups of elements emitted by the Sooty-headed Bulbuls. A: wave-like element, B: short element. C: long element, D: harmonic element and E: band shape element.

B. Vocal Structures

The two vocal structures were found, i.e. short sounds with a single element (as the sample in Fig. 2A) and phrases composed of elements, the frequency ranged from 1-10 kHz. These phrases were divided into four groups; i.e. short phrases with 2-5 similar elements, short phrases with 2-5 dissimilar elements, long phrases with many similar elements and long phrases with many dissimilar elements (as the sample of sonagrams in Fig 2B, 3, 4 and 5, respectively). Among these, short phrases with 2-5 dissimilar elements were used the most frequently, especially in contact calls. However, these phrases were not complex, like song, as some phrases that were found in the Red-vented Bulbuls's vocal structures [12]. The above mentioned elements and phrases were combined to form many patterns.

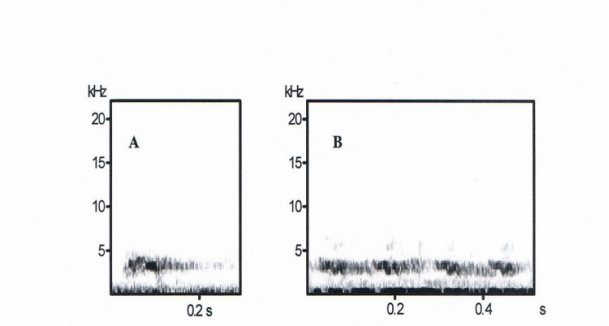

Fig. 2 Sonagram of a short sound with single element (A) and a short phrase with 4 similar elements (B).

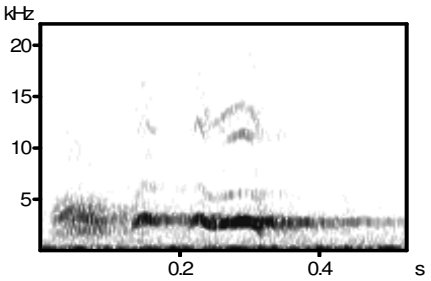

Fig. 3 Sonagram of a short phrase with 3 dissimilar elements.

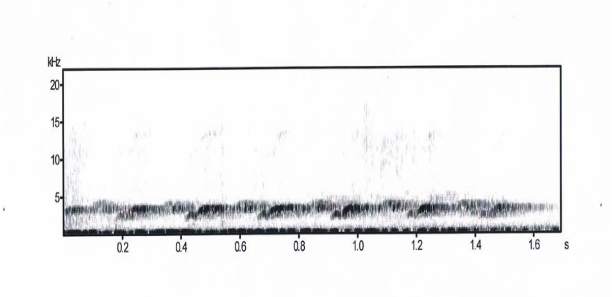

Fig. 4 Sonagram of a long phrase with 6 similar elements.

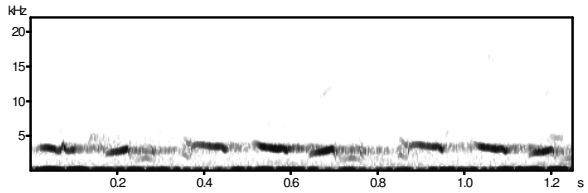

Fig. 5 Sonagram of a long phrase with many dissimilar elements.

C. Vocal Signals

Sooty-headed Bulbuls used ten types of calls; i.e. alert, alarm, aggressive, begging, contact, courtship, distress, exciting, flying (flight) and invitation. Among these, alert and contact calls were used more frequently than other calls.

1. Alert Calls: The birds used alert calls to identify their positions. Alert calls were not usually loud and not as piercing as alarm calls (as the sample of sonagram in Fig. 6)**.**

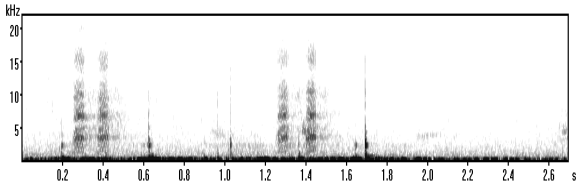

Fig. 6 Sonagram of alert call in the Sooty-headed Bulbul with two phrases; each phrase composed of two similar narrow band elements with frequency 5-7 kHz.

2. Alarm Calls: These loud, sharp and piercing calls were used to warn other birds of predators, and the birds used them when they feel threatened. Alarm calls promoted survival by allowing the receivers of the alarm to escape from the source of peril. Alarm calls were used differently for terrestrial predators such as cats and aerial predators such as Crested Serpent-Eagles; *Spilornis cheela*. Therefore, the alarm calls were divided into two types, namely terrestrial and aerial alarm calls (as the sample of sonagrams in Fig. 7A and 7B, respectively). The aerial alarm calls were usually very fast (330 elements per minute in average). Like the Sooty-headed Bulbuls, many avian species also used more than one type of alarm call [16] and the alarm calls were significantly related to predator type [17], according to a previous study in Great Tit; *Parus major*, it was found that differential use of parental alarm calls in Great Tits functioned to elicit different predator-avoidance behaviors in altricial nestlings: Great Tit parents produced acoustically distinctive alarm calls for the two main nest predators, the Jungle Crow; *Corvus macrorhynchos*) and the Japanese Rat Snake; *Elaphe climacophora*. Nestling crouched down inside their nest cavity in response to alarm calls given for a crow, whereas they fled the cavity in response to alarm calls given for a snake. The two responses help nestling to selectively evade those predators because crows snatched nestlings from the nest entrance, whereas snakes invaded the nest cavity [18].

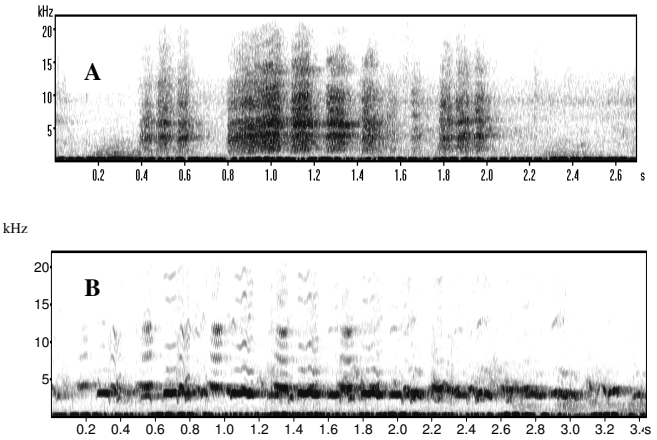

Fig. 7 Sonagram of two types of alarm call in the Sooty-headed Bulbul. A: terrestrial alarm call was composed of 3 phrases; each phrase composed of 3-5 similar narrow band shape elements with high frequency range 5-10 kHz, and B: aerial alarm call was composed of a long phrase with many dissimilar elements and frequency 4-5 kHz.

3. Aggressive Calls: These calls were used for driving predators or other birds both in the same species (from other flocks) and other species that had the same or similar ecological niche, such as Streak-eared Bulbuls (*Pycnonotus blanfordi*), away from the habitats. Aggressive calls (as the sample of sonagram in Fig. 8) were usually loud, piercing and also very fast (300 elements per minute in average) as alarm calls. In the behavioral observations, I found that Streak-eared Bulbuls also responded to aggressive calls in Sooty-headed Bulbuls by emitting their aggressive calls back to Sooty-headed Bulbuls (as the sample of sonagram in Fig. 9). Therefore, the result indicated that aggressive calls played a role as interspecific communication.

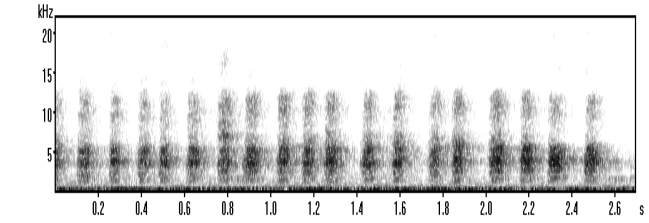

Fig. 8 Sonagram of aggressive call in the Sooty-headed Bulbul. The call was composed of a long phrase with many similar narrow band elements and frequency 5-7 kHz.

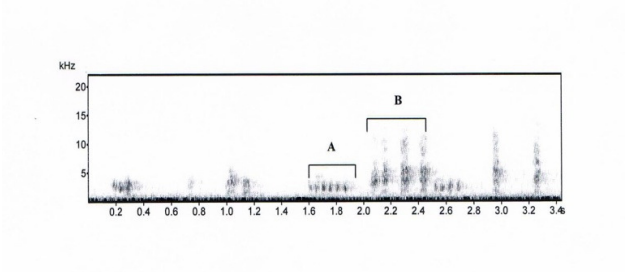

Fig. 9 Sonagram of aggressive call in the Streak-eared Bulbul with frequency 3-4 kHz (A phrase) and aggressive call in the Sooty-headed Bulbul with higher frequency (B phrase).

4. Begging Calls: Nestlings produced these vocalizations when the parents arrived at the nest to beg for food. These plaintive calls were designed to draw attention and might include small peeps, whines and chirps. Begging calls (as the sample of sonagram in Fig. 10) were not loud, but could be heard clearly in the vicinity of a nest.

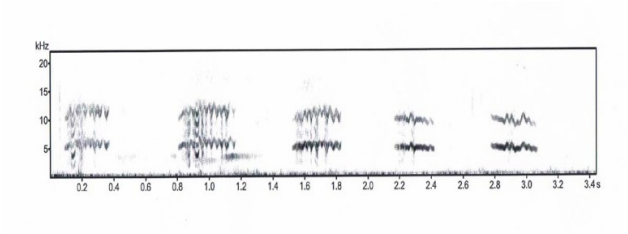

Fig. 10 Sonagram of begging call in a 3-dayed nestling. The call was composed of a long phrase with many dissimilar wave-like elements and frequency 5-7 kHz.

5. Contact Calls: The birds used contact calls (as the sample of sonagram in Fig. 11) for keeping in touch with the flock members or their mates. Contact calls might be also used to alert other birds to a good food source.

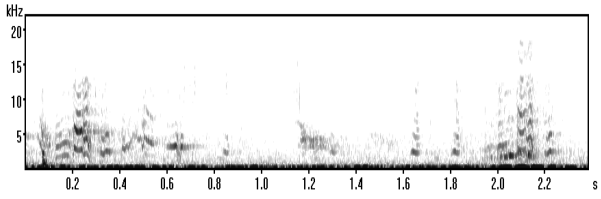

Fig. 11 Sonagram of contact call in the Sooty-headed Bulbul. The call was composed of two phrases, each phrase compounded by 2-5 dissimilar harmonic elements with frequency 3-8 kHz.

6. Courtship Calls: The male birds used courtship calls (as the sample of sonagram in Fig. 12) while displayed courtship behavior to females, and, they also touched their bills to each other. The calls were usually found in the breeding season (March to June).

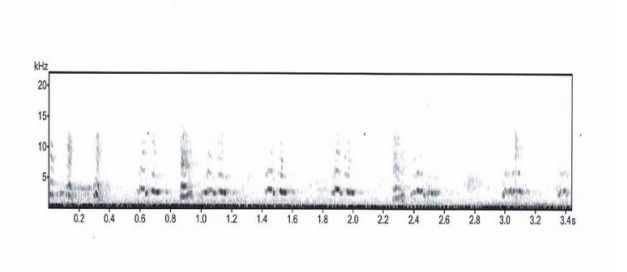

Fig. 12 Sonagram of courtship call in the Sooty-headed Bulbul. The call was composed of a long phrase with many dissimilar harmonic elements and frequency 3-4 kHz.

7. Distress Calls: Distress calls (as the sample of sonagram in Fig. 13) were emitted by the birds when they were captured by a predator. The calls were louder and more piercing than alarm calls. The birds used distress calls for startling and distracting the predators [19].

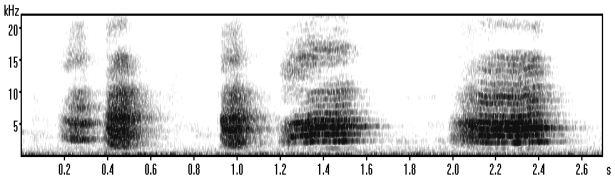

Fig. 13 Sonagram of distress call in the Sooty-headed Bulbul. The call was composed of five dissimilar broad band elements with high frequency 5-10 kHz.

8. Exciting Calls: The birds emitted exciting calls (as the sample of sonagram in Fig. 14) when they were excited by the appearances or the movements of other birds nearby or something else in the surrounding environment, the calls were also fast (290 elements per minute in average). In other words, exciting calls might be the lower level of alarm calls.

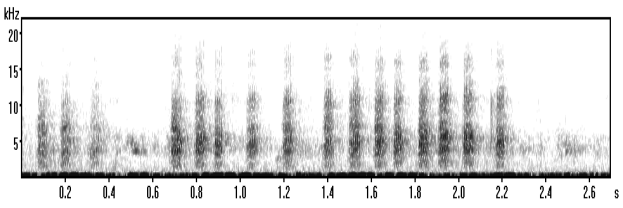

Fig. 14 Sonagram of exciting call in the Sooty-headed Bulbul. The call was composed of a long phrase with many similar narrow band elements and high frequency 5-10 kHz.

9. Flying Calls: Flying calls (as the sample of sonagram in Fig. 15) were vocalizations made by the birds while flying, often serving to keep flocks together.

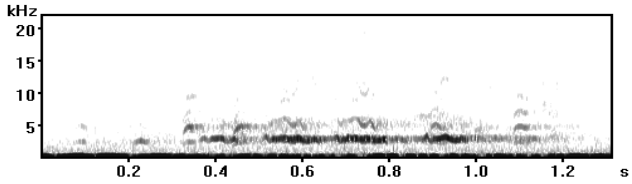

Fig. 15 Sonagram of flying call in the Sooty-headed Bulbul. The call was composed of four similar wave-like elements and frequency 3-4 kHz.

10. Invitation Calls: The female birds used invitation calls (as the sample of sonagram in Fig. 16) to beg food from their mates. The calls were usually found in the breeding season as well.

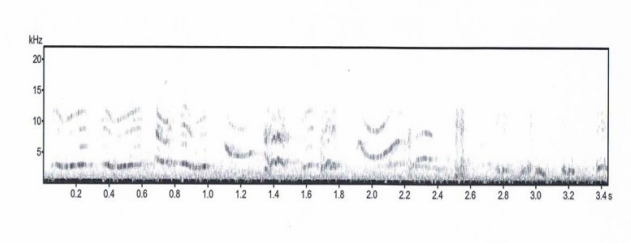

Fig. 16 Sonagram of invitation call in the Sooty-headed Bulbul. The call was composed of a long phrase with dissimilar harmonic elements and frequency 5-7 kHz.

D. Playback Experiment

Playback experiments of contact, alarm, distress calls in Sooty-headed Bulbuls and cockcrows (control) were performed to test responses of the birds both in Sooty-headed Bulbuls and other species that live in the same habitats especially Streak-eared Bulbuls, Red-whiskered Bulbuls (*Pycnonotus jocosus*) and Common Mynas (*Acridotheres tristis*). In twenty repetitions of playback experiments of each call in each species, it was found that only Sooty-headed Bulbuls moved toward to the playback speaker every time after hearing their own contact calls. On the contrary, Sooty-headed Bulbuls, Streak-eared Bulbuls, Red-whiskered Bulbuls and Common Mynas moved quickly away from the playback speaker after hearing Sooty-headed Bulbuls alarm and distress calls. In this study, the above mentioned birds responded to alarm calls 20, 17, 18 and 15 times, respectively, whereas, responded to distress calls 20, 18, 18 and 16 times, respectively. But, every species did not respond to cockcrow at all. Chi-square Test was used in comparison of responses of the birds to alarm and distress calls in Sooty-headed Bulbuls, Asymp. Sig. = 0.86 and 0.93, respectively (α = 0.05). Therefore, the result indicated that Sooty-headed Bulbuls, Streak-eared Bulbuls, Red-whiskered Bulbuls and Common Myna responded significantly to alarm and distress calls in Sooty-headed Bulbuls; alarm calls and distress calls in Sooty-headed Bulbuls could be used for interspecific communication among some other bird species in the same habitats as well. The above mentioned results corresponded to many previous studies; namely both White-browed Scrubwrens (*Sericornis frontalis*) and Superb fairy-Wrens (*Malurus cyaneus*) fled to the cover after playback of either their own or the other species alarm calls [20], Ashy-headed Laughingthrushes (*Garrulax cinereifrons*) moved away from the playback speaker after hearing Greater Racket-tailed Drongo (*Dicrurus paradiseus*) alarm calls [21]. Furthermore, It was also found that Streak-eared Bulbuls and Red-whiskered Bulbuls responded to Sooty-headed Bulbuls distress calls due to their distress calls were similar in vocal structure (as the sample of sonagrams in Fig. 17 A, B and C), but, the birds did not responded to cockcrows due to the vocal structures were different and cockcrows did not play a role as interspecific communication. The results corresponded to a previous study in Song Sparrows (*Melospiza melodia*), Swamp Sparrows (*Melospiza Georgiana*) and White-throated Sparrows (*Zonotrichia albicollis*) distress call; Song and Swamp Sparrows responded to each other distress calls, which were similar in vocal structure, but not to those of White-throated Sparrows, which were different [22]. Learning and behavioral adaptation of birds caused interspecific communication that benefited their survival in the nature and reproductive success.

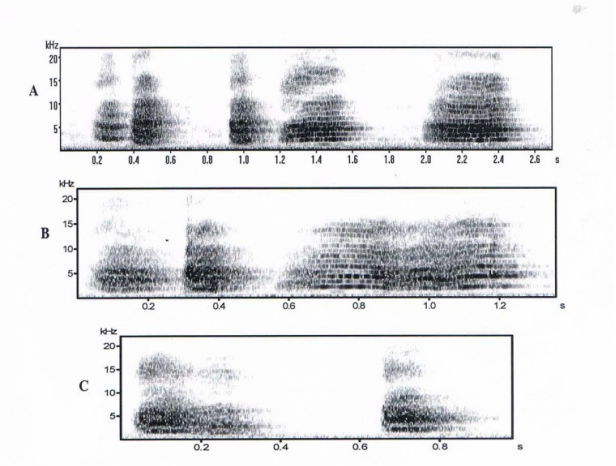

Fig. 17 Sonagram of distress call in Sooty-headed Bulbul (A), Streak-eared Bulbul (B) and Red-whiskered Bulbul (C) which were similar in vocal structure.

IV. CONCLUSION

More than one thousand element repertoires in five groups were found within two vocal structures. The two vocal structures were short sounds with single element and phrases composed of elements, the frequency ranged from 1-10 kHz. Most phrases were composed of 2 to 5 elements that were often dissimilar in structure, however, these phrases were not as complex as song phrases. The elements and phrases were combined to form many patterns. The species used ten types of calls; i.e. alert, alarm, aggressive, begging, contact, courtship, distress, exciting, flying and invitation. Alert and contact calls were used more frequently than other calls. Aggressive, alarm and distress calls could be used for interspecific communication among some other bird species in the same habitats.

ACKNOWLEDGEMENT

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