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Short Communication

ASSESSMENT ON THE PARENTAL CARE STRATEGY OF THE YELLOW-VENTED BULBUL *PYCNONOTUS GOIAVIER* IN PERAK, MALAYSIA

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ABSTRACT

The parental care strategy and diet requirements of the yellow-vented bulbul *Pycnonotus goiavier* chicks were studied. The assessment was conducted based on the (1) number of feeding bouts (bouts/hour), (2) average time intervals between each feeding (minutes/bouts) (3) feeding strategies (perch-go-in or direct-go-in) and (4) types of food items carried to the nest to feed the chicks. A total of 6000 minutes of direct observation from a close distance was performed for 10 days from 28th May 2016 until 6th June 2016 between 0700-1900 hours. Out of 816 independent feeding bouts, the parents preferred the perch-go-in (80.03%) as compared to the direct-go-in (19.97%) feeding strategy to feed the chicks in their nest. The average time spent for feeding was 7.50 ± 3.84 minutes / bout (7.50 ± 1.23 bouts/h), with the least number of bouts during the morning feeding time at 5.68 ± 3.09 bouts/h. The most frequent food items comprised ~~of~~ invertebrates such as dragonflies (16.15%) and grasshoppers (11.35%) and fruits including *Murraya koenigii* (14.02%). The success of raising both the chicks depended on the nest placement, feeding strategy, food availability, predation risk and commitment of both parents.

Keywords: life history, feeding bout, food types, chicks, activity pattern

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INTRODUCTION

Yellow-vented Bulbul is a common medium-sized passerine songbird. It belongs to the family Pycnonotidae which comprised 138 bulbul species worldwide (Fishpool and Tobias, 2005). The songbird is distributed widely in the parts of Africa, Asia and the Indian Ocean (Fishpool and Tobias, 2005). This species is found in various habitat types i.e., from mangrove to secondary forests, and from rural to urban areas (Wee, 2009) as well as in Southeast Asian regions (Davison and Aik, 2010; BirdLife International, 2012). The Yellow-vented bulbul is non-territorial and can often be seen in pair and solitary (Peh and Ong, 2002). There were 27 bulbul species recorded in Malaysia, in which two species are categorized as "Vulnerable" and seven species are under "Near Threatened" statuses (Davison and Aik, 2010; BirdLife International, 2012). The Yellow-vented bulbul *Pycnonotus goiavier* is one of the most common bulbul species and is categorized as the "Least Concern" (BirdLife International, 2012).

Yellow-vented bulbuls build their cup-shaped nest from twigs, dried leaves, leaf stalks and other plant materials (Wee, 2009). This species has been reported to build its nest in trees in various places such as gardens, parks and human residential areas (but see Dhamke, 1997; Wee, 2009). The nest, which takes about seven days to complete, is jointly built by both parents (but see Dhamke, 1997; Venkataswamappa and Chaitra, 1999; Wee, 2009; Balakrishnan, 2011). Like other species of bulbul (e.g. Dhamke, 1997; Hsu and Lin, 1997; Balakrishnan, 2010; Awais *et al.,* 2014; Zia *et al.,* 2014; Li *et al.,* 2015), the Yellow-vented Bulbul lays from one to four eggs in a single nest (Wee, 2009; Fishpool and Tobias, 2005). When the eggs were laid, the female will hatch the eggs while the male sits closely by the nest. To successfully hatch, the eggs must be maintained at a certain temperature to allow embryonic development (Balakrishnan, 2010a). The parents spare their time for incubating eggs to maintain the clutch temperature while continuing foraging activities to sustain their own survival (Balakrishnan, 2010a). However, it is still uncertain whether both parents took part in egg incubation behaviors as sexes are not visually distinguishable (Wee, 2009; Davison and Aik, 2010). Nonetheless, not all bulbul eggs will hatch successfully (Awais *et al.,* 2014). Even if they did, only the most successive offspring would remain alive while the weaker ones will be pushed out of the nest (Dhamke, 1997) or die due to parasitic infections (Li *et al.,* 2015).

The bulbul parental care strategies including egg incubation, brooding and feeding bouts are important for the survival of offspring (Balakrishnan, 2010a). Previous studies have shown that uni-parental and bi-parental care exists among bulbuls (e.g. Wee, 2009; Balakrishnan, 2010a; Li *et al.,* 2015) though the strategies varied among

bulbul species (e.g. Balakrishnan, 2010a). Still, the parental care strategies for many species of bulbul including the Yellow-vented Bulbul are poorly understood.

The ability to consume a large variety of food enables various species of bulbuls to survive in a wide range of habitats. Most pycnonotids are categorized as frugivorous but sometimes may augment their diets to invertebrates, hence a few numbers of bulbul species were categorized as insectivorous (Fishpool and Tobias, 2005). Some bulbul species such as the grey-headed bulbul (Balakrishnan, 2014) and the common bulbul (Okosodo *et al.,* 2016) consumed slightly more fruits in their diets. Although mixed-diets enable them to easily forage in a small home-range, the Yellow-vented Bulbul has one of the broadest foraging niches among the non-forest passerines (Ward, 1969; Fishpool and Tobias, 2005; Bettycopa *et al.,* 2015). So far, there is no detailed information about the diet items consumed by the Yellow-vented Bulbul offsprings. Therefore, this study investigated the parental care strategies and the diets of Yellow-vented Bulbul chicks in human residential areas in Malaysia.

MATERIALS AND METHODS

The study was conducted within the vicinity of a residential house at Seri Manjung, Perak (4°11'02.7" N 100°39'19.7" E) for 10 days beginning 28 May 2016 until 6 June 2016. This region experiences a tropical climate with an average temperature of 26.7 °C and 27.8 °C, and mean annual rainfall of 1922 mm (Climate data, 2016). In Seri Manjung, May is the hottest month of the year, with a temperature of 27.8°C, and receives the lowest rainfall in June, with an average of 87 mm (Climate data, 2016). The study area is a sub-urban area, where some plants were cultivated within the compound of the houses. A list of common plants in the close vicinity of the study site is listed in Table 1. Other plant species such as *Mikania micrantha*, *Momordica charantia*, *Passiflora foetida* and *Tetracera scandens* are primarily found on fences.

Table 1. List of some planted tree species within the housing area.

Family	Species	Common names	Malay name
Anacardiaceae	*Mangifera* x *indica*	Mango	Mangga
Annonaceae	*Annona muricata*	Soursop	Durian belanda
Arecaceae	*Cocus* x *nucifera*	Coconut	Kelapa
Malvaceae	*Durio* x *zibethinus*	Durian	Durian
Moraceae	*Ficus hispida*	Fig tree	Ara
Moraceae	*Ficus microcarpa*	Malayan banyan	Ara
Muntingiaceae	*Muntingia calabura*	Japanese cherry	Buah Cheri
Musaceae	*Musa* x *paradisiaca*	Banana	Pisang
Myrtaceae	*Syzygium aqueum*	Water cherry	Jambu air
Oxalidaceae	*Averrhoa belimbi*	Cucumber tree	Belimbing Besi
Poaceae	*Saccharum officinarum*	Sugarcane	Tebu
Rutaceae	*Citrus microcarpa*	Makrut lime	Limau kasturi
Rutaceae	*Murraya koenigii*	Indian curry tree	Daun kari
Sapindaceae	*Nephelium lappaceum*	Rambutan	Rambutan
Sapindaceae	*Nephelium rambutan-ake*	Pulasan	Pulasan

Two yellow-vented bulbul chicks were found in the nest located about 1.5 meters above ground on the fence within the house yard. The nest was placed among creeper plants identified as *Mikania micrantha* (Family: Asteraceae). The nest dimension was about 8 cm in diameter and 5 cm deep. Observations on the feeding bouts were made from 0700 hour until 1900 hour. The food items carried by the parents were photographed using a camera Nikon D90 with Nikkor 18-105 mm lens secured with a tripod.

The feeding strategies of the parents were depicted as (1) perch-go-in or (when the parents perch close at less than 1 meter) and (2) direct-go-in (when the parents enter the nest without perching) whether ~~by~~ individually or in pair.

The average feeding bouts for each hour interval were pooled from ten consecutive days starting at 0700 hour and ending at 1900 hour. The feeding bouts per hour (bout/hour) were calculated in percentage. Then, the mean time spent away between each feeding bout were calculated by averaging the time spent away (in minutes) for each feeding bout (minutes/bout) in the morning (0700-1100), afternoon (1100-1500) and evening (1500-1900) sessions. As the sexes were not visually distinguishable due to a lack of sexual dimorphism (Davison and Aik, 2010), the maximum role of the male and female individuals could not be confirmed. Therefore, each feeding bout was counted as an independent bout. Variation in the parental care pattern for the number of feeding bouts was tested for different

daylight hours (0700-1100, 1100-1500 and 1500-1900). The number of bouts for ten days of observations were pooled and analyzed with Kruskal-Wallis test.

The type of food items carried to the nest and fed to the chicks were identified wherever possible, and calculated in percentage, excluding the bout attempt without food. The number of invertebrates and fruits fed to the chicks were converted into proportion for each day and was tested using the Mann-Whitney U test. All graphs and statistical analyses were performed using GraphPad Prism version 5.0.

RESULTS

Many other birds' species have been observed to share the same area with the yellow-vented bulbul, as many bulbul species were not defensive towards their feeding territories (Peh and Ong, 2002). Those included the common tailorbird (*Orthotomus sutorius*), Eurasian tree-sparrow (*Passer montanus*), javan myna (*Acridotheres javanicus*), oriental magpie-robin (*Copsychus saularis*), oriental pied hornbill (*Anthracoceros albirostris*), pied fantail (*Rhipidura javanica*), scaly-breasted munia (*Lonchura punctulata*), white-throated kingfisher (*Halcyon smyrnensis*), zebra dove (*Geopelia striata*), and sunbird species. The common tailorbird, the scaly-breasted Munia and the Zebra Dove were seen perching as close as one meter from the nest of the studied species.

Of the total 6000 minutes of observation length, the longest duration of the parents staying with the chicks was on the 1st day (Figure 1). It constituted about 40% of the time spent in daily activities. As the chicks grew, the duration of the parent staying in the nest decreased, except on the 8th day. Eventually, the number of times the individual parent returned and stayed inside the nest decreased and the nest was totally abandoned on the 10th day.

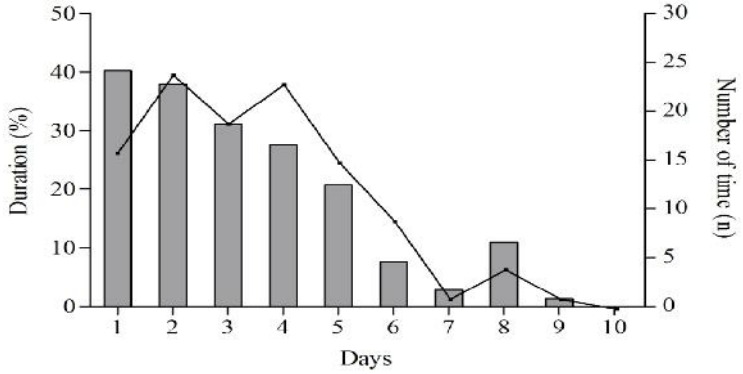

Figure 1. Duration of time the parent stayed inside the nest for each day.

A total of 816 independent bouts were counted during the 6000 minutes (100 hours) of observations. Due to the unequal number of hours of observations per day, number of bouts was averaged per hour for ten consecutive days of observations (Figure 2). The number of bouts was the lowest for the 1st and 2nd days, and increased from the 3rd day onwards. Then, the number of bouts decreased on the 7th and 8th days, before it increased again. Out of the total feeding bouts, the parents were observed to demonstrate perch-go-in (80.03%) or direct-go-in (19.97%) as their feeding strategy. They either went to search for food and return alone (91.34%) or together (8.66%) to feed the chicks.

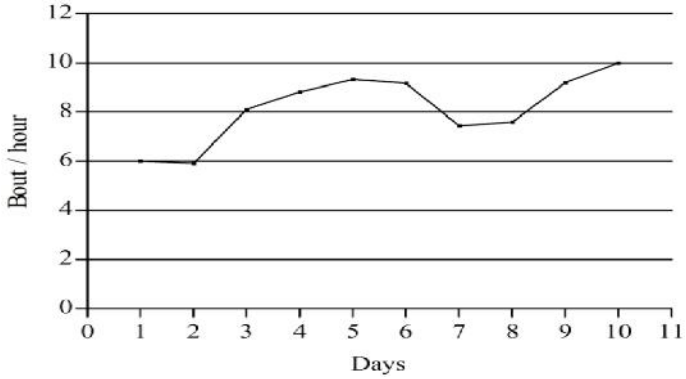

Figure 2. Feeding bout of the parent bulbul expressed as bout per hour for each day from 28 May 2016 to 6 June 2016 (N=816).

The mean time intervals between two feeding bouts at 0700-1900 was 7.50 ± 1.23 bouts/h (7.50 ± 3.84 minutes / bout). The minimum number of bouts was in the morning sessions, 0700-1100 (5.68 ± 3.09 bouts/h; range: 1.50 – 12.00 bouts/h), followed by the evening sessions, 1500-1900 (8.38 ± 1.98 bouts/h; range: 5.75 – 12.25 bouts/h) and the afternoon sessions, 1100-1500 (8.48 ± 2.00 bouts/h; range: 4.75 – 11.00 bouts/h). The average feeding bouts for each hour intervals were presented in percentage (bout/hour) (Figure 3). Two lowest feeding bout activities were observed during the first two hour of observations, i.e., 0700-0900. Then, the numbers of feeding bouts increased and remained almost constant until evening. Throughout the ten-day-period of observation, it was raining on five out of ten days during the night. The mean time intervals between each feeding bout was the shortest during the afternoon session (6.72 ± 1.65 minutes / bout), followed by the evening session (7.47 ± 1.92 minutes / bout) and the longest were during the morning session (9.24 ± 4.47 minutes / bout). The differences between the number of feeding bouts at different sessions were statistically significant ($H = 7.427$, $p = 0.024$).

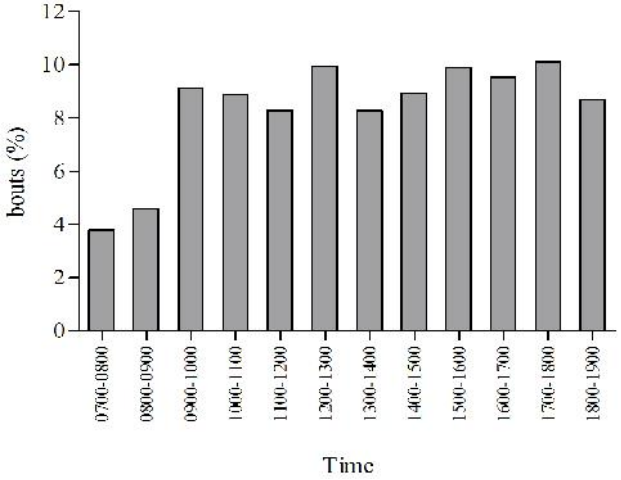

Figure 3. Percentage on the average of feeding bouts in each hour interval from the total number of feeding bouts during the ten days study period.

Large proportions of unidentified small items were fed to the chicks on the 1st and 2nd days. The chicks were fed with vertebrates from the 2nd day onwards (Figure 4). A significant number of invertebrates was fed from the 3rd until the 7th day and reduced from the 8th day onwards. The parents started to feed the chicks with fruits and reduced the small unidentified items from the 3rd day onwards. A substantial number of unknown items given to the chicks was between the 3rd and 6th day and on the 9th and 10th day.

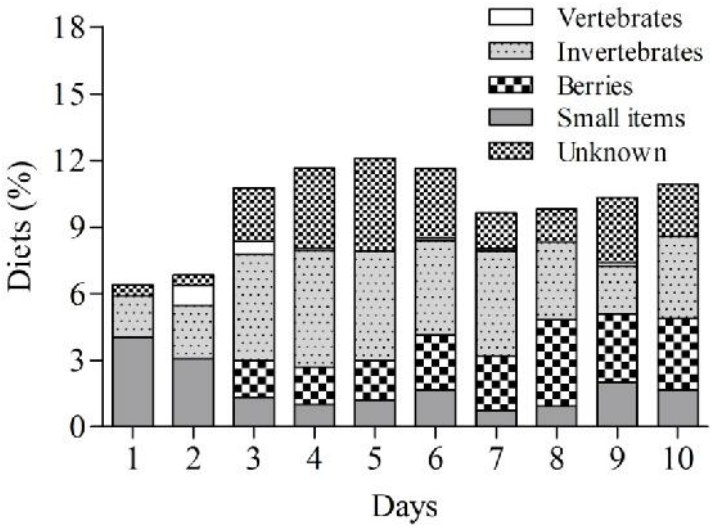

Figure 4. Daily diets (in percentage) fed to the chicks for ten consecutive days.

From a total of 816 independent bouts on the parent returning to the nest, 67 bouts (8.21%) returned with no food and 298 bouts with unidentified food items (36.51%). From the 451 identified food items, 152 items were from four types of berries (20.29%), 284 items were from 11 types of invertebrates (37.91%) and 15 items were from vertebrates (2.01%) (Table 2). Most food items were noted as unidentified due to the parents bringing the food by direct-go-in and not by perch-go-in feeding strategy. As such, the food items cannot be photographed, and verification was not possible. The time range for feeding the chicks was roughly estimated from three to 30 seconds to complete.

Table 2. Food items bought back by the parents and fed to the chicks during the period of study.

Class	Order / Species	Common names	Observations (N)	Observations (%)
Dicotyledonae	*Muntingia calabura*	Japanese cherry	39	5.21
	Murraya koenigii	Curry tree	105	14.02
	Ficus microcarpa	Malayan banyan	8	1.07
Insecta	Dictyoptera	Mantids	1	0.13
	Hymenoptera	Bee	1	0.13
	Hymenoptera	Wasp	6	0.80
	Lepidoptera	Caterpillar	19	2.54
	Lepidoptera	Butterfly	2	0.27
	Odonata	Dragonfly	121	16.15
	Orthoptera	Grasshopper	85	11.35
	?	Larva	5	0.67
	Unidentified	Insect	39	5.21
Arachnida	Araneida	Spiders	4	0.53
	Opiliones	Harvestman	1	0.13
Reptilia	Squamata	Gecko	15	2.01
Unidentified	?	Small items	127	16.96
?	?	Unknown	171	22.83
Total			749	100

Dragonflies and grasshoppers had the highest count, i.e., 121 (16.15%) and 85 (11.35%) of invertebrate feed items, respectively. From 152 items of fruits, *Murraya koenigii* was the most favorable fruits fed to the chicks i.e., 105 times (14.02%) (Table 2). From the vertebrate group, only gecko was seen being fed to the chicks. The differences between the number of invertebrates (37.91%) and fruits (20.29%) fed to the chicks within 10 days of observations ($U = 16.50$, $p = 0.013$) was statistically significant.

DISCUSSION

Breeding bulbuls foraged far away from the nest to reduce nest predation risks (Balakrishnan, 2014). The frequent flying in-and-out of the nest when feeding the chicks might attract the attention of potential predators. Some studies have noted that the predation rates for different bulbul species varied depending on the number of potential predators within the nesting sites (e.g. Wee, 2009; Balakrishnan, 2010b; Balakrishnan, 2011; Zia *et al.,* 2014). In this study, cats, civets, monkeys and snakes are considered ~~as~~ potential predators to the chicks in the nest.

Bi-parental care is a common habit seen in most bulbul species (Balakrishnan, 2010a). Wee (2009) indicated that there was no coordination between the two adult feeding bouts, as both will leave the nest in search of food and return to the nest with or without a meal for the chicks. The developmental stage of the bulbul chicks increased food demands, therefore the number of bouts per hour also increased towards the end of the nestling period (Balakrishnan, 2010a; Li *et al.,* 2015). Hence, the amount of time resting inside the nest decreases as the demand for food increases.

The feeding bouts of the parent bulbul were the least frequent in the early morning, and then increased and remained almost constant throughout the day. Both the parents might probably take a longer time between each feeding bout in the morning to forage and feed themselves to sustain enough energy for parenting activities (Bhatt and Kumar, 2001; Peh and Ong, 2002).

Previous studies on bulbul species' diet were conducted on adult birds. Adult bulbul diets constituted 60-90% of plant species i.e., fruits, leaves, nectar (e.g. Bhatt and Kumar, 2001; Mandon-Dalger *et al.,* 2004; Milla *et al.,* 2005; Linnebjerg *et al.,* 2010; Kerdkaew *et al.,* 2014; Bettycopa *et al.,* 2015; Oksodo *et al.,* 2016) while invertebrates and vertebrates (if any) constitute about 10-35% of their diets (e.g. Bhatt and Kumar, 2001; Okosodo *et al.,* 2016). In this study, the Yellow-vented Bulbul predominantly hunts invertebrates with a higher preference on dragonflies and grasshoppers to feed the chicks (but see Wee, 2009). The Yellow-vented Bulbul fed a significant number of invertebrates rather than plant

items to their chicks. As the chicks age, the parents would shift by providing more plant food items (Li *et al.,* 2015).

Other studies have reported fledging success in other bulbul species (Hsu and Lin, 1997; Fishpool and Tobias, 2005; Balakrishnan, 2010b; Rao *et al.,* 2013; Zia *et al.*, 2014; Li *et al.,* 2015). In this study, the Yellow-vented Bulbul successfully raised the chicks until they fledged. It took about 11 days, almost similar to other bulbul species (Hsu and Lin, 1997; Manju and Sharma, 2013; Awais *et al.,* 2014). The fledging success rate depended on the feeding strategy, predation, and the nest withstanding heavy rainfall and high wind velocity (Rao *et al.*, 2013).

Conclusion: The parental care patterns, diets of the chicks and feeding strategy of the Yellow-vented Bulbul have been observed in this study. A total of 6000 minutes (100 hours) of observation duration comprised 816 independent bouts. The longest bout intervals were in the morning sessions (9.24 ± 4.47 minutes/bout) and were statistically different from the afternoon and evening feeding sessions ($H = 7.427$, $p = 0.024$). The parents preferred perch-go-in (80.03%) feeding strategy while carrying varied feed items, switching from small feed items to larger feed such as fruits and small invertebrates or vertebrates as the chicks grew. The bi-parental care has succeeded in raising both chicks until they fledged on the 11th day. Factors that may contribute to the success of nestling and fledging include the strategic placement of the nest, feeding strategy, food availability, predation risk and the commitment of both the parents. A More detailed information on the dietary items for the chicks of the Yellow-vented Bulbul is needed for future comparative studies on their feeding behaviors.

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