

PROVISIONED FOOD TO THE NESTLINGS OF COMMON KINGFISHER (*ALCEDO ATTHIS*) AND WHITE-THROATED KINGFISHER (*HALCYON SMYRNENSIS*) BY THEIR PARENTS

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Abstract

A study was done on ‘Provisioned food items to the nestlings of Common Kingfisher (*Alcedo atthis*) and White-throated Kingfisher (*Halcyon smyrnensis*) by their parents’ at Nikunja-1 and Madhabchala Union of Savar Upazilla in Dhaka District from September 2010 to September 2011 following focal animal sampling method with 5 minutes interval. During nesting period, the Common Kingfisher provisioned double (20.1 times/day/ nest or brood) than White-throated Kingfisher (10.7 times/ day/ nest or brood). A total of 8 species of foods (freshwater fishes only) were provisioned by the parents of Common Kingfisher while 9 species (4 species of arthropods, 3 freshwater fishes, one amphibian and one reptile) by White-throated Kingfisher. The Common Kingfisher highly preferred to provision the fry of Cichlid (49.8%, n= 80, numerical value) whereas the White-throated Kingfisher preferred fry of Rohu (40.4%, n= 80, numerical value) which were fresh water fishes and belonging to the Order Cypriniformes and Family Cyprinidae. The length and breadth of the food items of Common Kingfisher ranged from 2.3 to 6.2 cm (3.8 ± 0.8 , n=80) and 0.7 to 2.9 cm (1.7 ± 0.4 , n=80) respectively. This study was important to know the food items needed for the nestlings of Common and White-throated Kingfishers.

Keywords: Provisioned food, nestling, common and white-throated kingfishers

Introduction

The Common Kingfisher (*Alcedo atthis*) and White-throated Kingfisher (*Halcyon smyrnensis*) are very common resident birds among 12 species of kingfishers found in Bangladesh (IUCN Bangladesh, 2015). They are distributed throughout much of the Indian subcontinent, except parts of the northwest (Grimmett *et al*, 1998). They are found throughout Bangladesh with a wide variety of habitats along with water bodies (IUCN Bangladesh, 2015). The Common Kingfisher feeds on small fishes, tadpoles, aquatic insects, mudskippers, crabs, etc. and White-throated Kingfisher feeds on fishes, crabs, insects, mice, snakes, earthworms, cockroaches, young birds, etc. (IUCN Bangladesh, 2015). Detail information on diets of White-throated Kingfisher is available both in Bangladesh (e.g., Naher and Sarker, 2015a) and abroad (e.g., Mukherjee, 1975; Yahya and Yasmin, 1991; Oommen and Andrews, 1998; Asokan *et al.*, 2009). Some works have been done on the diets of Common Kingfisher in Bangladesh (Naher and Sarker, 2018) and in

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Europe (Raven, 1986; Reynolds and Hinge, 1996; Campos *et al.*, 2000; Cech and Cech, 2011; Vilches *et al.*, 2013). Cech and Cech (2017) reported the effect on brood size of food provisioning rate in Common Kingfisher. They mentioned the provisioned food items of Common Kingfisher in Czech Republic through analyzing undigested pellets. Except this, no published information is available on provisioned food items to the nestlings of the Common Kingfishers. Thus, an attempt has been taken to study the provisioned food to the nestlings of the Common and White-throated Kingfishers.

Material and Methods

The study was carried out at Nikunja-1, Uttara, Dhaka North City Corporation, Dhaka, Bangladesh and Savar Upazilla ($23^{\circ}50'45.11''$ to $24^{\circ}40'14.09''$ N and $90^{\circ}23'34.13''$ to $91^{\circ}20'34.03''$ E) during September 2008 to September 2011. In Nikunja-1 residential area, there are two Lakes, one on the eastern side ($23^{\circ}49'14.81''$ to $23^{\circ}49'36.04''$ N and $90^{\circ}25'02.38''$ to $90^{\circ}25'12.30''$ E), measuring 668.5 X 17.07 m and the other on the western side ($23^{\circ}49'26.33''$ to $23^{\circ}49'30.77''$ N and $90^{\circ}24'55.60''$ to $90^{\circ}24'59.82''$ E), measuring 218.13 X 75.05 m. These lakes are used for fish culture (Tilapia, *Oreochromus mozaambicus*; Rohu, *Labeo rohita*; Mirror carp, *Cyprinus carpio*; and Silver carp, *Puntius gonionotus*). The northern and southern sides of Nikunja-1 are surrounded by Nikunja-2 residential area and Dhaka Cantonment Golf field respectively. At the western bank of eastern lake there are different species of trees like *Dalbergia sisoo*, *Albizia procera* and *Morus indica* and some aquatic weeds. The western lake supports Dholkolmi (*Ipomoea fistulosa*), aquatic weeds at the banks and some pecked bamboo sticks both in water and soil. The land grabbers placed several signboards in the water. At the southern side of western lake, there is a platform (loft) made by bamboo used for resting of fishermen and temporary storage of fish foods.

In Savar site, the paddy field was 59.97 ± 48.3 m far away from the opposite of the nests. The western and south-western sides of the nest were surrounded by a bamboo grove containing 56 bamboo poles (0.9 to 1.2 m height, mean 1.04 ± 0.13 m). The eastern side have two Mandar (*Erythrina variegata*) trees of 3.5 and 4.5 m high. Preying frequency of the Common and White-throated kingfishers were observed at least once in a week. The birds were observed from 07:00 to 19:00 h as the species are diurnal. The study time was fluctuated depending on the seasonal variation. The study was carried out from September 2010 to August 2011. Behavioural data were collected using the focal animal sampling technique of Altmann (1974). There were three 15-minute continuous monitoring periods in each hour followed by a 5-minute break. During each 15-minute period (block), only one bird was monitored. A total of 300 hours in 40 days were spent in the field and 900 blocks were recorded. During preying, the food species especially fishes were identified immediately by a pair of binoculars (Bushnell 20 × 280 mm) and telescope (Celestron-21035, 70mm), a camera (Sony Digital Cybershot DSC-W55, 7.2 Mega pixels, 3X

Optical Zoom and digital SLR Sony α 100, 18-70 mm lens). A digital Video camera (Sony DCR-SR 47, HDD) was used to record different activities and later examined in the laboratory. In case of arthropods, direct observations were made and video records were used to identify the species and to count the time and frequency. The regurgitated undigested food remains in the nests were also examined to know the food items provisioned to the nestlings. The size (length and breadth) of the food was assumed visually. The habitat, feeding habits and breeding seasons of the arthropods and fishes were noted down from Border *et al.* (1981) and Rahman (1989) respectively.

Results and Discussion

As soon as the first hatchling hatched out, both the parents of Common Kingfisher (CK) and only one bird (one of the parents) of White-throated Kingfisher (WK) started to collect food and took care of the hatchlings. When one of the parents of CK entered into the nest with food, the other bird waited and guarded the nest by sitting on a nearby branch of the tree or any other support on the opposite side of the nest. Before entering into the nest hole, both the species sat at the nearby substrate and observed carefully around the nest and then entered into the nest with food. During leaving the nest, they looked around from the nest and suddenly flew straight far away from the nest. After 1 to 3 minutes, one of the parents of CK came again with food and did the same. Sometimes both the parents left together from the nest although they did not come back together. After 2 to 30 minutes (median 15.8 min, n=35) one of the parents of WK came back with or without food and sat on the branch or substrate at the opposite side of the nest. During leaving and entering the nest, both the parents of both species followed the same direction.

Frequency of provisioned food

Both the species provisioned foods to their nestlings throughout the day. But they supplied food at the lowest rate at noon. The CK had four food supplying bouts (morning, around noon, afternoon and late afternoon), whereas WK had only two bouts (one at morning and the other at afternoon) (Figure 1). The frequency of food collection varied insignificantly at different day periods (CK: $\chi^2 = 3.4$, df = 5, p > 0.05; WK: $\chi^2 = 5.4$, df = 5, p > 0.05). The highest preying frequency of adult CK was recorded in the 11:00-12:00h and 16:00-17:00h (Naher and Sarker, 2015) but it was 09:00-10:00h and 15:00-17:00h for WK. (Naher and Sarker, 2015a). The adult WK had a typically bimodal feeding pattern, one during morning (6:00-9:00) and the other during the evening (15:00-18:00) (Naher and Sarker, 2015a) as noted in other species (Ali *et al.*, 2010; Sivakumaran and Thiyyagesan, 2003; Ramachandran, 1998; Rodway, 1998; Asokan, 1995; Evers, 1994; Natarajan, 1991). During breeding, the WK highly preferred to prey at 08:00-09:00 h and 15:00-17:00 h (Naher and Sarker, 2015a).

During nesting period, on an average, the provisioned food of CK was double (20.1 times/ day/nest or brood) than WK (10.7 times). CK preferred to collect food from those aquatic bodies

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which were nearby or besides the nest but WK avoided those sites, it might be for unavailability of fishes.

In case of both species, the frequency of provisioned food to the nestlings increased with the increasing of age of the nestlings (Figure 2), which was statistically significant (CK: $r = 0.961$, $df = 8$, $p < 0.001$; WK: $r = 0.965$, $df = 7$, $p < 0.001$), because the nestlings need more and more food for their growth and development as the age increased. It was the lowest at the hatching day and the highest at the end of nesting day. The frequency of food collection also varied significantly at different days in case of both species (CK: $\chi^2 = 29.3$, $df = 8$, $p < 0.001$; WK: $\chi^2 = 17.4$, $df = 7$, $p < 0.01$).

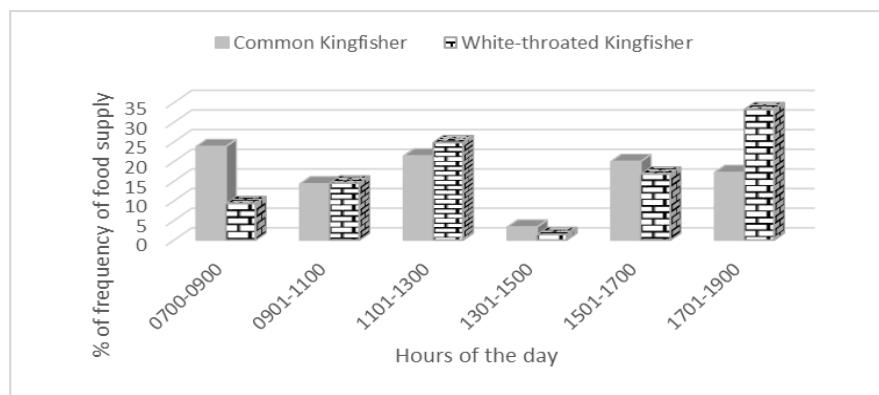


Figure 1. Provisioned food supplied in one nest of each of Common and White-throated Kingfisher at different day hours of the day during nesting period.

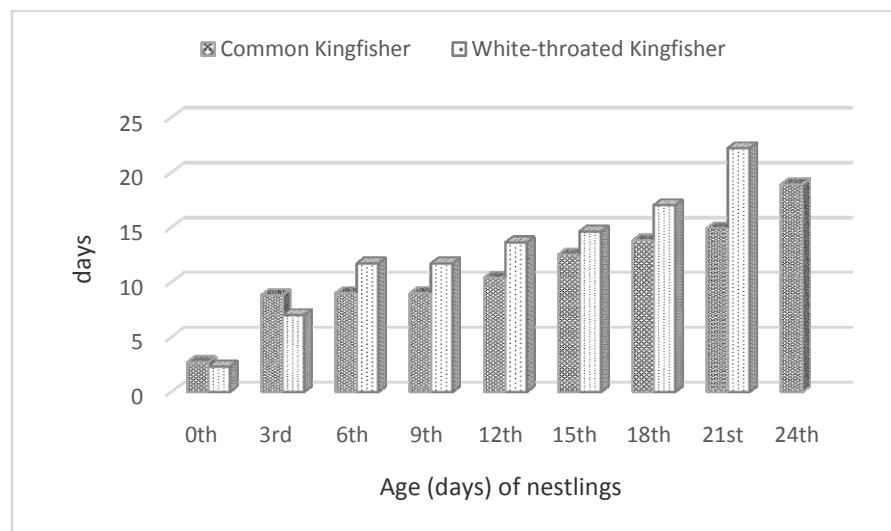


Figure 2. Frequency of provisioned food supplied in one nest of each of Common and White-throated Kingfisher during nestling period.

The food was provisioned to both species with increasing of the brood size. When the young were large enough, they would come near to the nest entrance to be fed and calling *chick-chick-chick* continuously. The larger young stood first by crossing the smaller ones away and took food from its parent as quickly as possible and grew healthier earlier and become able to stand, fly and being mature earlier than other nestlings.

After nest leaving, in about two weeks, both the parents of CK accompanied nestlings, and taught the nestlings how to hunt and placed food crisscross in the beak and engulf it. At this time the parents used floating aquatic vegetation to train the nestlings and they offered food to the nestlings in between the training. When one bird went to collect food, the other sat beside the nestlings and trained them. Both the parents did not go together for food collection during this time. Such type of training behaviour did not seen in WK.

Provisioned food items to the nestlings

Eight species of foods were provisioned by the parents of CK and 9 species by WK. All the provisioned food items of CK were various species of freshwater fishes but WK provisioned 4 species of arthropods, 3 species of freshwater fishes, one amphibian and one reptile (Figure 3). Food items varied significantly throughout the year (CK: $\chi^2 = 158.2$, df = 7, p < 0.001; WK: $\chi^2 = 106.7$, df = 8, p < 0.001). Naher and Sarker (2015a) mentioned that they preferred fishes during breeding season. Cech and Cech (2017) identified 24 species of fishes from six nest residues in Czech Republic. The adult Common Kingfisher fed on 11 species of fishes, 5 species of insects, spider and freshwater shrimps (Naher and Sarker, 2018; see Table 1). While the adult WK fed on fishes, crustaceans, insects, spider, frog and lizard (Naher and Sarker, 2014; see Table 1). Nestlings of WK has been described as feeding on the small insects in Pakistan (Roberts, 1991), also being fed upon frogs, fishes and crabs in Sri Lanka. The nestlings are being fed primarily on freshwater crabs and less frequently on frogs and fish (Cramp, 1985) which form only a part of the diet of their large food range (Burton, 1998). Parasharya *et al.*, (2016) recorded Striped Keelback, *Xenochrophis vittatus* as a food of WK in Kumbharwada Sewage marsh on the outskirts of Bhavnagar City of Gujrat, India. Soud *et al.* (2010) reported the Common Wolf Snake *Lycodon aulicus* was supplied in Assam University Campus, India. They also reported that they supplied those food items which were available around them.

Preference of the provisioned food items

The CK highly preferred to provision the fry of Cichlid which comprised 49.8% (n=80) of total but the WK preferred fry of Rohu which constituted 40.4% (n=80) of total diet (Table 1 & 2). The CK provisioned the fishes belonging to Cypriniformes (49.8%), Perciformes (45%) and Clupeiformes (5.2%) but WK provisioned only Cypriniformes (40.4%) and Perciformes (22.2%) fishes (Table 1 & 2). Cech and Cech (2017) recorded five species of fishes which comprised

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Table 1. Name and size of provisioned food items to the nestlings' by the parents of Common Kingfisher (*A. atthis*).

| English common name | Scientific name | Order | Family | Habitat | Feeding habits | Breeding season | Frequency (%) | Length (cm) | Avg ± SD | Breadth (cm) | Avg ± SD |
|--------------------------|--------------------------------|---------------|------------|-----------------------|----------------|-----------------|---------------|-------------|------------|--------------|------------|
| Pale carplet | <i>Amblypharingodon mola</i> | Cypriniformes | Cyprinidae | Surface dweller | Omnivorous | May-October | 8.5 | 2.3 – 4.4 | 3.52 ± 0.7 | 0.8 – 1.6 | 1.32 ± 0.3 |
| Cotio | <i>Osteobrama cotio</i> | | | | | Rainy months | 2.3 | 2.6 – 3.9 | 3.32 ± 0.5 | 1.2 – 2.9 | 2.1 ± 0.5 |
| Blackline rasbora | <i>Parluciosoma daniconius</i> | | | | | Rainy months | 3.6 | 3.1-3.2 | 4.2 ± 0.8 | 0.7 – 1.4 | 1.1 ± 0.3 |
| Barb | <i>Puntius spp.</i> | | | | | July-October | 12.1 | 2.5 – 4.2 | 3.5 ± 0.6 | 1.3 – 2.8 | 2.2 ± 0.5 |
| Fry of rohu | <i>Labeo rohita</i> | | | Middle layer | Middle layer | Culture fish | 23.3 | 3.5-6.2 | 5.04 ± 1.1 | 1 – 1.7 | 1.4 ± 0.2 |
| Fry of spotted snakehead | <i>Channa punctatus</i> | Perciformes | Channidae | Predator | Predator | April-June | 16.1 | 3.8 – 5.3 | 4.7 ± 0.6 | 1.2 – 1.9 | 1.64 ± 0.2 |
| Fry of cichlid | <i>Oreocromis spp</i> | | Cichlidae | Bottom dweller on mud | Carnivorous | Culture fish | 28.9 | 2.8-3.5 | 3.18 ± 0.2 | 1.5 – 2.2 | 1.9 ± 0.2 |
| Fry of indian river shad | <i>Gudusia chapila</i> | Clupeiformes | Clupeidae | | | May-October | 5.2 | 2.3-3.2 | 2.9 ± 0.3 | 1.4 – 2.1 | 1.8 ± 0.2 |

Table 2. Name and size of provisioned food items to the nestlings' by the parents of White-throated Kingfisher (*H. smyrnensis*).

| English common name | Scientific name | Order | Family | Habitat | Feeding habits | Breeding season | Frequency (%) | Length (cm) | Avg ± SD | Breadth (cm) | Avg ± SD |
|--------------------------|----------------------------------|---------------|---------------|----------------------------|-----------------|--|---------------|-------------|------------|--------------|------------|
| Grasshopper | <i>Poecilocerus sp.</i> | Orthoptera | Acrididae | Terrestrial | Herbivorous | Rainy months | 8.8 | 3.2 – 3.9 | 3.5 ± 0.2 | 0.7 – 1.1 | 0.9 ± 0.2 |
| Freshwater shrimp | <i>Macrobrachium sp.</i> | Decapoda | Astacidae | Surface dweller | Plankton feeder | Throughout the year (Parween 2003) | 14.6 | 2.5 – 3.2 | 2.8 ± 0.2 | 1.1 – 1.3 | 1.2 ± 0.1 |
| Crab | <i>Spiralocephalus sp.</i> | Brachyura | Potamidae | Bottom dweller at the bank | Omnivorous | Throughout the year (Ahmed 2003) | 2.3 | 1.9-2.4 | 2.2 ± 0.2 | 4.1-5.2 | 4.9 ± 0.6 |
| Cockroach | <i>Periplanata americana</i> | | Dictyoptera | Blattidae | | March-September (Azmol and Asmat 2012) | 1.8 | 2.7-5.8 | 4.7 ± 1.7 | 1.7-2.1 | 1.9 ± 0.2 |
| Barb | <i>Puntius spp.</i> | Cypriniformes | Cyprinidae | Surface dweller | Omnivorous | July-October | 11.7 | 2.3-3.8 | 3.1 ± 0.5 | 0.6-1.2 | 1.3 ± 0.3 |
| Fry of rohu | <i>Labeo rohita</i> | | | Middle layer | Middle layer | Culture fish | 28.7 | 2.1-5.4 | 3.8 ± 1.01 | 1.2-2.2 | 1.6 ± 0.03 |
| Fry of spotted snakehead | <i>Channa punctatus</i> | Perciformes | Channidae | Predator | Predator | April-June | 22.2 | 1.4-4.8 | 3.8 ± 1 | 1.1-1.7 | 1.5 ± 0.2 |
| Skipper frog | <i>Euphlyctis cyanophlyctis</i> | Anura | Dicoglossidae | Amphibious | Insectivorous | At any time of the year (McCann 1932) | 6.4 | 2.8-3.6 | 3.1 ± 0.3 | 2.1-2.9 | 2.4 ± 0.2 |
| House lizard | <i>Hemidactylus flaviviridis</i> | Lecertilia | Gekkonidae | Terrestrial | | March-May (Sanyal and Prashad 1967) | 3.5 | 2.2-2.9 | 4.7 ± 2 | 1.1-1.9 | 1.6 ± 0.3 |

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84.6% (by mass) of the diet of Common Kingfisher in Czech Republic. In the present study, the CK highly preferred to provision the freshwater fishes belonging to four families (Cyprinidae, Channidae, Cichlidae and Clupeidae) and WK preferred the fishes were two families (Cyprinidae and Channidae), of which both species highly preferred to provision the fishes of Cyprinidae family (Table 1 & 2). In Czech Republic, the Common Kingfisher provisioned fishes were of six families (Cyprinidae, Balitoridae, Salmonidae, Escocidae, Cottidae, Percidae).

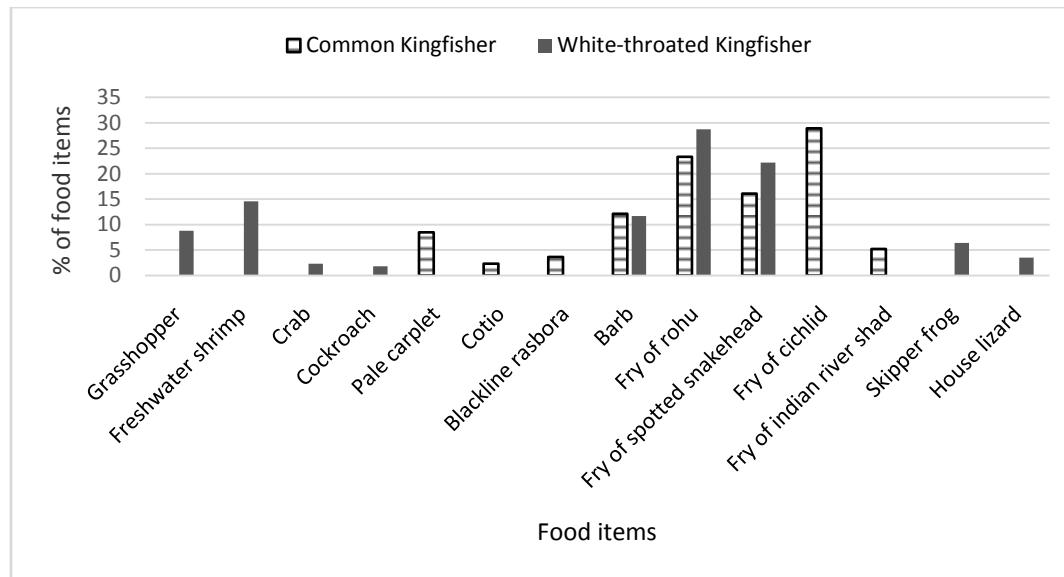


Figure 3. Preference of the provisioned food items by Common and White-throated Kingfisher during nestling period.

The length of the food items of CK ranged from 2.3 to 6.2 cm (3.8 ± 0.8 , n=80) and the breadth from 0.7 to 2.9 cm (1.7 ± 0.4 , n=80) (Table 1). The length and breadth of the provisioned food items did not vary significantly (length: $\chi^2 = 1.3$, df = 7, p > 0.05; breadth: $\chi^2 = 0.64$, df = 9, p > 0.05). On the other hand, the WK was seen taking comparatively bigger food items, where the length was 1.4 to 3.9 cm (3.5 ± 0.8 , n=100) and the breadth was 0.7 to 5.2 (1.9 ± 1.2 , n=100) (Table 2). The length of the provisioned food items varied significantly ($\chi^2 = 26.1$, df = 9, p < 0.01) but insignificant for breadth ($\chi^2 = 6.5$, df = 9, p > 0.05). The prey items given to the young did not seem to be appreciably different from those taken by the adults, which were also observed consuming small lizards (4 to 6 cm in length), ants and other small insects (Burton, 1998).

The length and breadth of the provisioned food items were divided into two categories, such as the length was divided into- longer than 5 cm and smaller than 5 cm whereas the breadth was longer than 2 cm and smaller than 2 cm. The highest preference of length of provisioned food items by both species was shorter than 5 cm (CK: 87.5%; WK: 93%) while the breadth was shorter than 2 cm (CK: 82.5%; WK: 81%). Cech and Cech (2015), Hallet (1982), Reynolds and

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Hinge (1996) has shown that 97% of the diet of Kingfishers is composed of fish ranging in size from 2 to 10 cm. Swallowing of larger fish may be problematic, or even dangerous especially in cases of very young chicks and when prey have an atypical body shape (frog like head in bullhead, humped body in European perch), ctenoid scale (percidae), thorns on opercular bones (Bullhead, Percidae) or sharp hard rays in fins (Percidae) (Cech *et al.*, 2008; 2011). Parasharya *et al.* (2016) recorded the approximate length of a food of WK was 30-35 cm and Soud *et al.* (2010) recorded 30cm long food item. Hallet (1982) stated that nestlings are fed with fish in a size ranged from 2 to 5 cm within first ten days, larger preys are provided when chicks are ready to ingest them. A 3-day old chick could swallow a torpedo-shaped fish (Roach) at a size of 6.4 cm and that 7-day old chicks are routinely fed with fish of 7 to 8cm (Cech and Cech, 2011). They concluded that parents feed their young with fish as large as they are able to swallow (safely) in order to optimize their foraging behaviour and to maximize their breeding success (Cech and Cech, 2017). Chicks fed with larger fish are more satiated and for that reason less aggressive to their siblings compared to chick provided with smaller prey (Drummond and Chavelas, 1989; Cech and Cech, 2013). Chicks fed with smaller fish had the longest fledging period although in absolute numbers the brood size provided with the largest amount of fish (five chicks fed with 1297 fishes, 3155 g), these chicks were more aggressive to their siblings compared to chicks from other nests (Cech and Cech, 2017).

Both of the birds provisioned those fishes as the food of nestlings' that had different habitats. They preyed on fishes by inserting beak only or half of their body or head full. They did not dive full to prey a fish. Thus, both of them highly preferred to provision surface dweller species (CK: 60.6%; WK: 48.5%), in comparison to bottom dwellers (CK: 16.1%; WK: 2.3%), middle layer (CK: 23.3%; WK: 28.7%) and terrestrial species (WK: 20.5%) According to feeding habits, both of them highly preferred to provision the food items which had omnivorous feeding habits (CK: 92.2%; WK: 82.3%) in comparison to predator (CK: 8.8%), herbivorous (WK: 8.8 %) and insectivorous (WK: 9.9%).

The breeding season of the provisioned food items (Tables 1) coincided with the breeding season of the both kingfishers. The parents preferred to provision those foods to their nestlings which were available at that period. Thus the breeding season of those species found timed to coincide with the availability of the provisioned food items. The availability of suitable food for nestlings is widely accepted as the main factor controlling the timing of avian breeding seasons (Lack, 1950; Thompson, 1950). The ripening of paddy crops and subsequent preparation of the field for the next crop resulting in flushes of insects from March to July coincided with the breeding activities of the WK at Tamil Nadu in India (Ali *et al.*, 2010a). Timing of breeding season in relation to food availability in some insectivorous birds were also reported by Asokan *et al.*, 2009, 2009a).

Conclusion

The Common and White-throated Kingfishers prey on not only the fishes but also some other species of animals. The former species provisioned fry of different freshwater fishes to the nestlings which they can handle but the later preferred to provision any type of animals, which they can catch opportunistically. Hence, the kingfishers play an important role in the health of fishes and controlling insects and other animal population by swiping out regularly the unhealthy, diseased and weak fish in fish farms and many other aquatic bodies and insects or small animal population from nature.

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