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Patterns of daily activities frequencies of Common Kingfisher (*Alcedo atthis*) in Nikunja-1, Dhaka

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Abstract
A non-intrusive study on Common Kingfisher was carried out at the waterbodies of Nikunja-1 located in Dhaka Metropolitan, Bangladesh, to investigate daily, monthly and seasonal patterns in key diurnal activities frequencies. Percentage of daily activity frequency was found highest for flying 22.17±3.51 followed by scanning 18.32±1.37, diving 14.63±0.70, local movement 11.51±2.15, resting 9.75±1.94, preening 8.83±1.17, calling 7.67±2.03 and feeding 7.12±1.34. Activity frequencies were significantly higher in morning than afternoon. Feeding, flying and calling varied significantly in different months and scanning, diving, flying and calling varied in different season. There was positive correlation among monthly average scanning and resting with temperature; scanning and flying with precipitation; calling with wind speed. Increased human's presence and high traffic noise along waterbodies during afternoon were noticeable factors affecting day time variation in activities. Increased precipitation, temperature, high water depth and prey species abundance were apparent reasons for monthly and seasonal variations in activities.

Keywords: Common Kingfisher, scanning, feeding, activity pattern, activity frequency, daily variation, monthly variation, seasonal variation, Dhaka

1. Introduction
Bird's activity study is significant in understanding its life history, physical condition, food availability, social structure, as well as ecological condition [1-5]. Since, Common kingfishers (*Alcedo atthis*) are considered as important members of ecosystems and indicators of freshwater community health, presence of this bird species in an area confirms the standard of the water [6]. So, detail information on activities of Common Kingfisher would be supportive to understand behavior and movements of this individual bird species across its habitats, as well as to recognize the fitness of waterbodies and ecosystems within the territory of this species. Common Kingfisher (*Alcedo atthis*) is a small water bird under family Alcedinidae (Order: Coraciiformes) and found world-wide [7-9]. Present investigation on this species was focused to study the pattern of its diurnal activities in an urban site of Dhaka. The major objectives were i) to measure frequency of each key diurnal activity per day in different months and ii) to analysis any daily, monthly and seasonal variation by means of activity frequencies.

Daily activity patterns in passerine birds are mostly influenced by food availability and predator activity, however also modified according to environmental conditions and type of habitat [10]. A global concern nowadays is to birds and other wildlife species often adjust to urban ecosystems behaviorally, for example, through changes in foraging behavior, dietary habits, and temporal activity patterns [11, 12]. So, this study was also intended to understand the typical urban factors as well as other apparent aspects behind any variability in patterns of daily activity frequency of Common Kingfisher during observation period.

2. Materials and Methodology
The study was conducted, at Nikunja-1, Khilkhet in Dhaka Metropolitan, Bangladesh, during July'09 to June'10. The area was small in size comprising waterbodies in close proximity. GPS position of selected waterbody sites for this study were Lat 23º49′26′′N - Long 090º25′11′′E, Lat 23º49′30′′N - Long 090º24′51′′E, and Lat 23º49′20′′N – Long 090º24′56′′E (Map 1). The study area was surrounded in the East by a highway road (known as Dhaka-Gazipur/ Kuril-Bishsho road), in West by Shahzalal International Airport, in South open ground of Dhaka Golf Club (Image-1) and in North the major residential area. Few typical urban factors like high traffic noise and increased human presence were noticeable as the day time increased during field observation.

The number of total individuals of Common Kingfisher species in this area was only about four. The area was found suitable for this study as this bird species was easily traceable due to the nearby presence of healthy waterbodies.

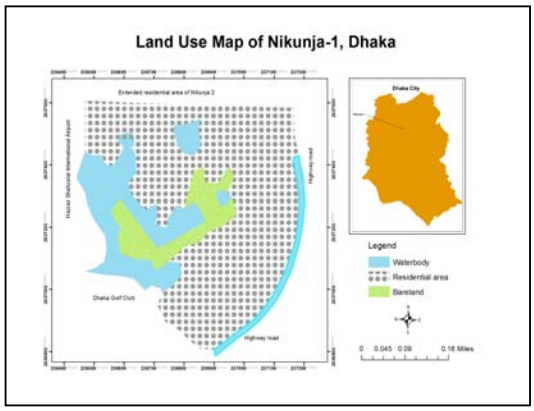

Image 1: Land use map of Nikunja-1 showing the waterbody sites considered for this study.

A total of 36 days (three days in each of 12 months) and 432 hours (12 hours in each day) were spent in the field. Selection of days was made as one day in every first, middle and last week of each month. Total day hours of each field day was divided into two periods and allocated as morning (06h00 to 12h00) and afternoon (12h01 to 18h00). Typical field work was started at 06h00 and carried out on foot from morning till afternoon. Ad libitum Sampling' [14] was used during data collection. While walking along the waterbodies, as soon as one individual of Common Kingfisher species was sighted, it was selected at once for observation. Following Ad Libitum method of continuous monitoring, as much information as possible about its each activities were recorded until the bird become invisible from eyesight. Each sampling period was designed as continuous two hours observation time with 15 minutes break in between. During field observation, most of the time only one individual of Common Kingfisher was available for data collection. However, in case more than one individual of this bird species was available to observe, focal animal sampling method was used to select one individual at a time for observation and collection of activity data. Any overlapping in collection of data was avoided carefully. A record on average temp., humidity, precipitation, wind speed was also kept as weather forecast per day and per month.

Eight key diurnal activities of common kingfisher were selected for this study and characterized as following: i) scanning: perching in an upright position waiting and searching for prey; ii) diving: performed for feeding and bathing purpose, plunging into the water from a height, either from a perch or a hovering position,; iii) feeding: one full feeding included catching, killing and swallowing a prey whole; iv) flying: very swift flying adjacent to water level to change perching position, flying to another nearby feeding territory and hovering, v) preening: bill cleaning, scratching most often after bathing, diving, and feeding, Vi) calling: loud, continuous calls while sitting and flying, vii) resting: sitting like drowsy for a long period of time without any other body movement, viii) local movement: flying away from one waterbody to another nearby waterbody in searching of food and again returning to the previous one after some time. Some other activities were also found however have not been considered for current study, for example, head bobbing and tail shaking, bathing, fighting. Three seasons during this data collection period were considered as i) the cool dry season (November to February), ii) the pre-monsoon hot season (March to May), and iii) the rainy monsoon season (June to October) [13].

Frequencies of all activities were collected daily basis and were calculated per month and season. From this, percentages of each activity frequency per day were also measured for each month and season. Two tailed t-test was used to compare all activities between two time periods of a day, morning and afternoon. One way analysis of variance (ANOVA) was conducted to analysis the variation in activities frequencies in different months and seasons. All comparisons have been tested at t stat> t critical value for t-test and F>F critical for ANOVA, and $P<0.05$. MS Excel analysis tools have been used for statistical analysis. Results have been interpreted statistically and explanations for any daily, monthly and seasonal variation in studied months were discussed with a reference to previous studies along with calculated correlation coefficient among different activities frequencies and climate conditions in different season.

3. Results

Total observed frequency of all activities was 105.28±25.01 (range 170-69) per day. Highest percentage in activity frequency was found for flying followed by scanning, diving, local movement, resting, preening, calling and feeding (Figure-1). Per day average frequency for scanning was 21.81±7.07 (range 45-12), diving 17.22±4.09 (range 32-11), feeding 8.22±2.54 (range 12- 3), flying 26.78±10.55 (range 58-14), preening 10.36±2.53 (range 16-5), Calling 9.11±3.88 (range 16-2), resting 11.78±2.43 (range 17-7) and local movement 13.25±3.07 (range 22-9). All activities frequency varied significantly ($p<0.05$) in two parts of day and was higher in morning than afternoon (Figure 2, Table 1).

Through ANOVA single factor, analysis of monthly variance among all observed activities frequencies in different month was F (11, 24) =4.37, $P<0.05$ (calculated as 0.0012), which referred to significant difference in at least one means of activity frequencies across different months (Figure 3). Further analysis results showed significant monthly variation for feeding, flying and calling frequency (Table 1, Figure 4). Average feeding frequency per day was highest in June and lowest in October; flying was highest during August, lowest during November; Calling was highest in July and lowest in September (Figure 4). Seasonal variance analysis with ANOVA found significant variation for scanning, diving, flying and calling (Table 1). Percentage of activity frequency per day showed scanning and flying highest in rainy monsoon season and lowest in cold dry season (Figure 5).

Correlation coefficient analysis of average activities frequencies with monthly average climate conditions found strong positive correlation for i) scanning and resting with temp., ii) flying with humidity, iii) scanning, diving, flying with precipitation, and iv) calling with wind speed. Positive correlation was also found among different activities, such as i) scanning with diving and flying, ii) diving with flying and iii) feeding with preening and calling.

Table 1: Daily, monthly and seasonal variance analysis of daily activities frequencies of Common Kingfisher

Activity	Significant variance analysis of daily frequency Morning Vs Afternoon (Two tailed T-test)		Significant monthly and seasonal variance analysis of daily activities frequency (ANOVA- single factor analysis)			
			Monthly variance		Seasonal variance,	
			df=(11,24), Number of Group=12		*df= (2,33), Number of Group=3*	
	df	***P-value***	***F***	***P-value***	***F***	***P-value***
Scanning	54	0.00278*	1.931	0.0862	7.394762	0.002221*
Diving	51	4.9E-23*	1.648	0.148	5.439012	0.009087*
Feeding	53	4.1E-10*	3.648	0.0039*	1.382466	0.265114
Flying	43	0.00035*	4.337	0.0013*	15.36519	1.92E-05*
Preening	58	1.33E-12*	2.267	0.0454	1.8235	0.177356
Calling	54	1.79E-05*	3.853	0.0028*	3.434866	0.044143*
Resting	68	8.61E-16*	0.63	0.7856	1.199176	0.314239
Local Movement	22	0.00097*	0.495	0.8881	2.086174	0.140233
* *P*<0.05 refers to significant difference in means of activity frequency						

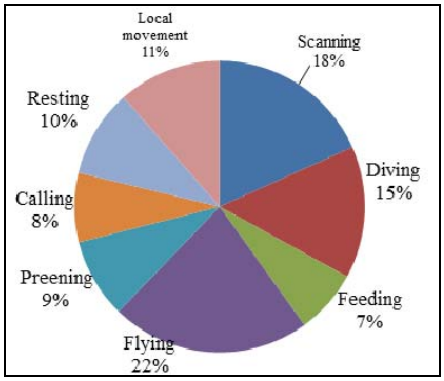

Fig 1: Percentage of per day activity frequency of Common Kingfisher

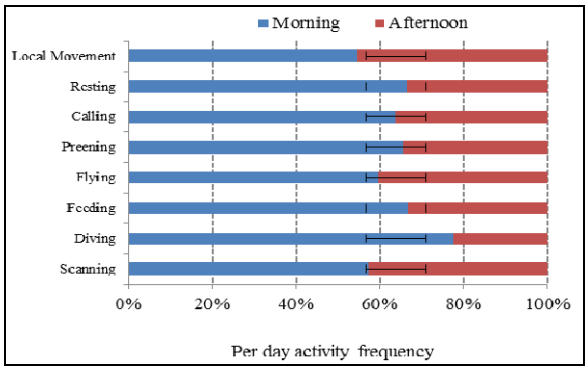

Fig 2: Morning versus afternoon variation in activity frequencies per day. *(Error bars series with 1 standard deviation; Significant variance, P<0.05 for all activities with two tailed T-test)*

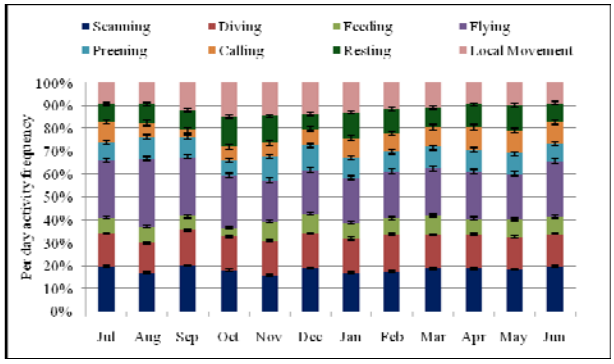

Fig 3: Percentage of daily activity frequencies of Common Kingfisher in different month **(***Error bars displayed for this chart series with standard error)*

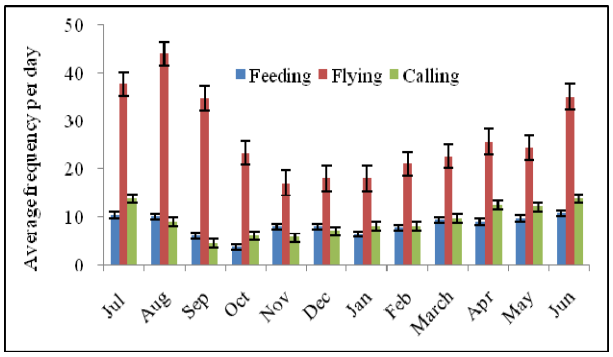

Fig 4: Monthly variation in feeding, flying and calling per day (*Error bars displayed for this chart series with 5% of value)*

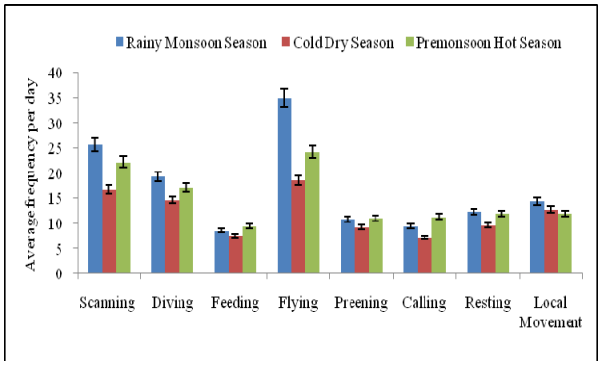

Fig 5: Seasonal variation in percentage of daily frequency of different activities of Common Kingfisher (*Error bars displayed for this chart series with 5% of value)*

4. Discussions

Many researchers reported resting as the major midday activity of birds, e.g., Yellow-billed Magpie [15], Green-winged Teal [16], doves [17], wintering mallards [18], Great Bustards [19] which might have occurred as a mechanism to minimize the heat load on a bird at high environmental temperatures [20]. However, during this study, flying was observed as highest activity of Common Kingfisher (Figure 1). Scanning or searching for prey was found as second most frequent activity in common kingfisher, also reported earlier by many other researchers for some predator birds, e.g., Willow Flycatcher [21], Indian Myna [22], Great Bustards [19], Indian Roller [23], and White-breasted Kingfisher [4]. Common Kingfisher uses a broader area for its all activities and frequently moves from one waterbody to another [24]. This fact is also apparent from the observed high frequency of local movement per day during this study.

Earlier researchers reported feeding and territorial display of bird are concentrated during the early morning and late afternoon and reduced around midday [25-29]. Few other past studies on bird species (e.g., Jacanas, Common Loon, Southern Crow-pheasant, Green Bee-eater and Indian Roller) also stated the same feeding pattern [30, 3, 31-33] which often might have occurred due to food availability [33, 34] and for a purpose to avoidance of higher temperatures at midday, especially in warm areas [35-38]. Asokan and Ali (2010) [4] also reported feeding activity of White-breasted Kingfisher varied in different time periods of a day. Similarly, during this study, all activity ratios of Common Kingfisher varied between different periods of a day, however found significantly higher in morning than afternoon (Figure 2). Two apparent reason for this might be i) increased intensities of human presence' and ii) high traffic noise' during afternoon, as the study site was located in a city area adjacent to a busy highway road. These factors were also reported by earlier researchers, i.g., 'increased intensities of human presence' can be a modulating factor affecting wildlife responses [39] and 'high traffic noise' can affect bird's activity pattern, density and breeding [40-42].

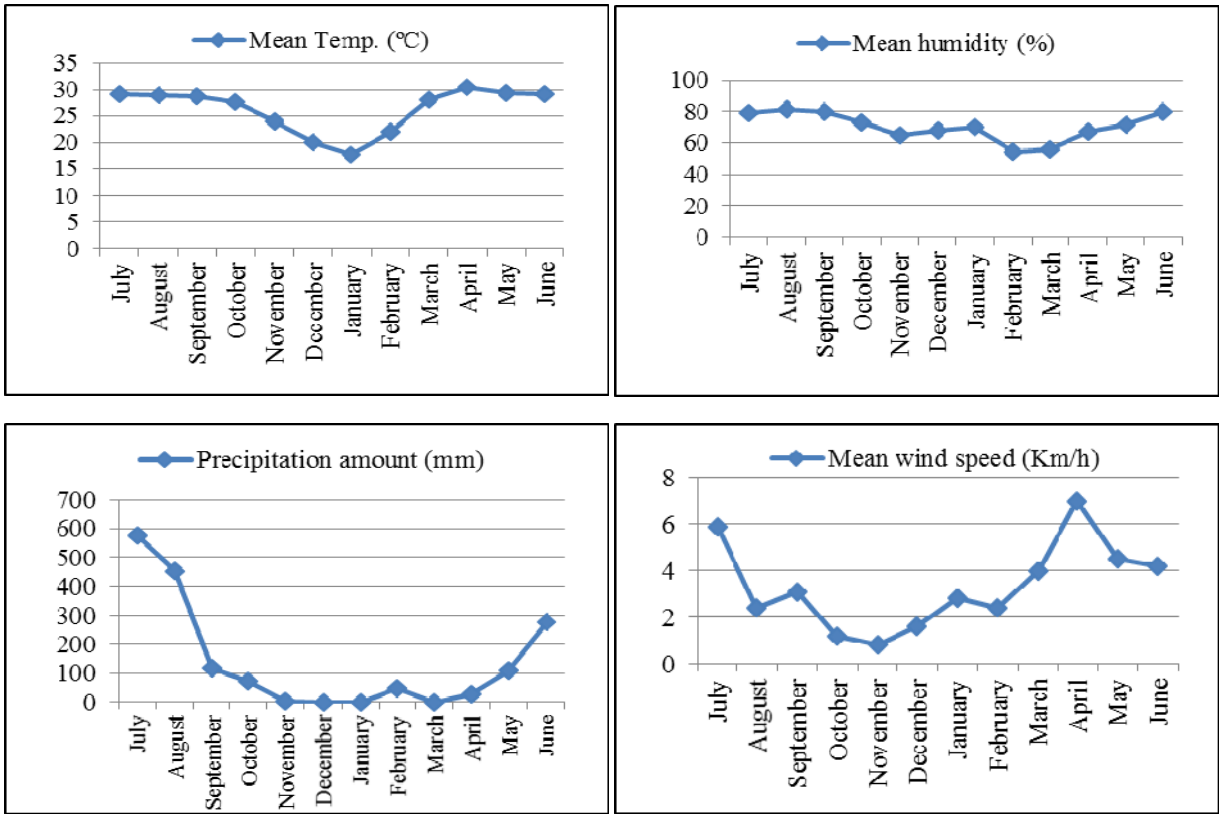

Fig 6: Pattern in temperature, precipitation, humidity and wind speed throughout the study period

Calculated average value of feeding per day was highest in pre-monsoon hot season (Figure 5) which might be due to abundant prey species during summer as assumed in one previous study on White Throated Kingfisher [4]. In the earlier months of rainy monsoon season (June, July and August), average feeding frequency was also found comparatively higher (Figure 4) which might be due to increased precipitation (average 435.87 mm) (Figure 6) and induced prey availability. However, feeding frequency per day was observed lowest in the last month of rainy monsoon season (October, also considered as post monsoon month) when in nature water level remains high due to high precipitation during monsoon which might have created difficulties in fishing of this Kingfisher sp. These findings might be relevant for the fact that Common Kingfisher has a tendency to avoid territories with higher depths [43] as higher depth is unsuitable for fishing [44].

Average frequencies of all most all activities except calling were found highest in rainy monsoon season and lowest during cold dry season (Figure 5). Calling activity was observed highest in cold dry season and showed a positive correlation with wind speed (Figure 5, 6). Scanning, diving, flying, resting was significantly higher in rainy monsoon season might be due to positive correlation with temperature and precipitation (Figure 5, 6).

5. Conclusions

This study on Common Kingfisher species have measured and analyzed pattern in different key activities frequencies per day as well as recorded apparent reasons for any daily, monthly and seasonal variation. Future study need to concentrate more on the drivers of behavior and activities of this bird species focusing diverse land use sites and variability among different climatic parameters. Nowadays, alteration of waterbodies due to urbanization is affecting this bird species enormously. So, wildlife conservation and protection initiatives also need to focus this species in city areas to ensure ecological benefits not only for this species but also for all water birds present in those areas.

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activities of Common Kingfisher (*Alcedo atthis)'*, permitted and conducted at Wildlife Biology Division in Department of Zoology, University of Dhaka, Bangladesh.

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