

BioScientific Review (BSR)

Volume 2 Issue 1, 2020

ISSN_(P): 2663-4198 ISSN_(E): 2663-4201

Journal DOI: <https://doi.org/10.32350/BSR>

Issue DOI: <https://doi.org/10.32350/BSR.0201>

Homepage: <https://journals.umt.edu.pk/index.php/BSR>

Journal QR Code:



Article:

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Article DOI:

<https://doi.org/10.32350/BSR.0201.04>

Article QR Code:



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Yousaf MA, Noreen M, Maqbool MF, Irfan A, Ahmad I, Memoona. Foraging behavior of birds at morning and evening times: a preliminary study. *BioSci Rev.* 2020;2(1): 28–39.

To cite this article:

[Crossref](#)



A publication of the
Department of Life Sciences, School of Science
University of Management and Technology, Lahore, Pakistan

Foraging Behavior of Birds at Morning and Evening Times: A Preliminary Study

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Abstract

Birds exhibit a wide variety of behaviors including foraging behavior which could vary both inter- and intra-specifically. The current study was aimed to investigate different aspects of the foraging behavior of birds in different fields situated at the Quaid-e-Azam Campus, University of the Punjab, Lahore. The said campus covers an area of about 721 ha and has a stable ecosystem which supports a diverse range of birds. Three fields were selected for study purposes. The first field (F1) was characterized by dense vegetation. The second field (F2) contained relatively less vegetation and the third field (F3) was situated near the premises containing the hostel and the shopping center. Observations were recorded during December 2019 for a week at morning (0800-0900 h) and evening (1500-1600 h) times. The observations were based on the assumptions that an abundant availability of food will increase the stay time and vice versa. Moreover, number of pecks by birds also correlate with stay time. A total of 10, 8 and 5 bird species were observed in the above mentioned three fields, that is, F1, F2 and F3, respectively. Different patterns of bird frequency, pecking rate and search time were observed in all fields at morning and evening times which could be associated with the nature of the microhabitat, vegetation, predator risk, food availability, group size and various environmental factors such as temperature. Spearman's correlation revealed a significant ($p < 0.01$) association between search time and number of pecks of birds in all three fields.

Keywords: birds, foraging behavior, pecking rate, search time

1. Introduction

Birds (Class Aves) are endothermic vertebrates that exhibit a variety of behaviors [1]. About seven hundred and sixty-seven species of birds have been reported in Pakistan [2]. All birds exhibit foraging behavior for survival in the ecosystem [3] and this indicates how they are able to change their habits during their search for food. To a large extent, their behavior is determined by the type of food available. Different types of techniques and strategies may be applied by them to acquire the same food depending upon the situation [4].

Stealing of food from other birds, klepto-parasitism and mutual food searching with birds of the same or other species comprise these different strategies [5]. Foraging behavior could also be influenced by factors such as antipredator vigilance, group size and habitat selection [6, 7]. The selection of microhabitat may vary among different species of birds as well as within the same species. Individuals of the same species exposed to different types of habitats have been observed to exhibit different behaviors related to foraging [7]. The availability of food suitable for

a particular bird species along with its distribution and abundance mainly determines habitat selection [1].

Vigilance is another important behavior exhibited by birds. This behavior may diminish depending on group size due to the ease in the detection of predators and the resulting decrease in predator risk for large groups. So, group size is an effective factor that determines bird behavior [8]. The corresponding reduction of individual vigilance with the increase in group size has been reported previously [9]. Animals generally abstain from feeding while scanning their surroundings. Scanning is regarded as vigilance which serves many purposes, such as the detection of any threat or predator and/or the assessment of feeding competition within group [8]. To avoid the predation risk, birds usually consider dense vegetation for foraging because it provides safety. Vegetation structures in a habitat provide opportunities as well as constraints which determine how and where a bird detects and captures its prey. Vegetation structures include leaf morphology, foliage height and architecture which largely influence foraging behavior in a particular habitat [10]. Birds spend little time for scanning as they are shielded by dense vegetation structures [11]. Studies have indicated that just one meter distance from vegetation cover increases predator risk [12].

The combined influence of scanning, vigilance and foraging behavior determines the selection of field and habitat for a bird [1]. Schulenberg [13] reported that *Vidua macroura* (pin-tailed whydah) prefers fields of grass with some patches of soil for foraging. House sparrows have been adapted to forage on almost all kinds of fields where they may find food but especially prefer fields,

farms, lodges, parks and other human habitations [14]. Large feeding groups use fields where plentiful food is available [15] and this helps them to spend maximum time in a microhabitat. Solitary birds often call for the attraction of conspecifics to the feeding site to reduce predator risk [16].

A previous study conducted at the Quaid-e-Azam Campus, University of the Punjab, Lahore, reported only the avian diversity in relation to changes in local habitat. The current study aims to evaluate the various aspects of the foraging behavior of birds in different areas of the Quaid-e-Azam Campus, University of the Punjab, Lahore.

2. Methodology

2.1. Study Area

Quaid-e-Azam Campus (also known as New Campus), University of the Punjab (31° 30' 15" N; 74° 18' 23" E) covers a large area of about 721 ha. 426.5 ha of the total area have been leased out for cultivating different types of crops including rice and wheat. The infrastructure at the said campus includes teaching departments, roads and residential colonies which cover an area of 294.2 ha. The campus contains a wide range of habitats such as constructed areas, agricultural fields and waste water ponds. Teaching departments also have large lawns with many types of vegetation. There are also roadside plantations and rose gardens which are the habitats of many bird species, herbs and small mammal species. There is a botanical garden which covers a large area and it has diverse species of plants and animals. Hostels and other residential facilities also have many grounds and fields with much vegetation. The master plan and Google Earth view of the university are shown in Figures 1 and 2.



Figure 1. Master plan of the University of the Punjab, Quaid-e-Azam Campus, Lahore, Pakistan (2002)



Figure 2. Map of the University of the Punjab, Quaid-e-Azam Campus, Lahore, Pakistan (source: Google Earth)



Figure 3. Birds foraging in their microhabitat in selected fields

Three fields were selected in the said campus to investigate the foraging behavior of birds. The first field (F1) is located in the botanical garden which is characterized by dense vegetation and contains many small trees. The second field (F2) contains less vegetation. The third field (F3) is situated near the premises containing hostels and the shopping center. Birds foraging in their microhabitat is shown in Fig. 3.

2.2. Assumptions

This study is based on three major assumptions given below:

- i. If food is readily available then stay time should increase.
- ii. If stay time increases then the number of pecks should also increase.

- iii. If food is not easily available then search time should increase.

2.3. Observation

Observations of bird species and their foraging activities at the three selected fields were recorded on a daily basis for a week during December 2019. Data were collected in mornings (0800-0900 h) and evenings (1500-1600 h). A pair of binoculars was used to observe birds. Observations were carried out while sitting at a distance from the birds to avoid causing any disturbance to their foraging behavior. Other tools used for observation included a stop watch, digital camera, notebook and field guides, such as Grimm et al. [17] and Mirza [18]. The following parameters were recorded: time of the day, bird

species, bird's arrival time, bird's departure time, and number of pecks.

The search time for each bird was calculated using the following equation:

Bird's search time = bird's departure time - bird's arrival time

All times were noted in seconds (sec).

2.4. Statistics

Descriptive statistics of the data were calculated. Since Shapiro-Wilk test indicated the recorded data as non-parametric, hence Spearman's correlation was applied to find the hypothesized associations. Correlation was set significant at the level of 0.05 (2-tailed). The analysis was performed using IBM SPSS Statistics (version 20) and Microsoft Excel 2019.

3. Results

3.1. Bird Species

At F1, a total of 9 bird species were observed foraging, while at F2 and F3, 8 and 5 species were recorded, respectively (Table 1).

3.2. Bird Frequency at Morning and Evening Times

Fig. 4 depicts that the overall frequency of visiting birds was highest (151) for F1 in the morning and it was the lowest (47) in the evening for the three selected fields. Considering F2, more birds visited it in the evening as compared to morning. Considering F3, birds visited the field more frequently in the morning time.

Table 1. Observed Bird Diversity at the Three Fields

Fields	Common name	Scientific name
F1	House Sparrow	<i>Passer domesticus</i>
	House Crow	<i>Corvus splendens</i>
	Red-vented Bulbul	<i>Pycnonotus cafer</i>
	Common Myna	<i>Acridotheres tristis</i>
	Blue Rock Pigeon	<i>Columba livia</i>
	Common Hoopoe	<i>Upupa epops</i>
	Little Brown Dove	<i>Streptopelia senegalensis</i>
	Indian Robin	<i>Saxicoloides fulicata</i>
	Common Babbler	<i>Turdoides caudatus</i>
F2	Jungle Babbler	<i>Turdoides striatus</i>
	Rufous Tree Pie	<i>Dendrocitta vagabunda</i>
	Little Brown Dove	<i>Streptopelia senegalensis</i>
	Common Myna	<i>Acridotheres tristis</i>
	House Sparrow	<i>Passer domesticus</i>
	House Crow	<i>Corvus splendens</i>
	Indian Grey Horn Bills	<i>Ocyrceros birostris</i>
	Common Hoopoe	<i>Upupa epops</i>
F3	House Crow	<i>Corvus splendens</i>
	House sparrow	<i>Passer domesticus</i>
	Common Hoopoe	<i>Upupa epops</i>
	Common myna	<i>Acridotheres tristis</i>
	Blue Rock Pigeon	<i>Columba livia</i>

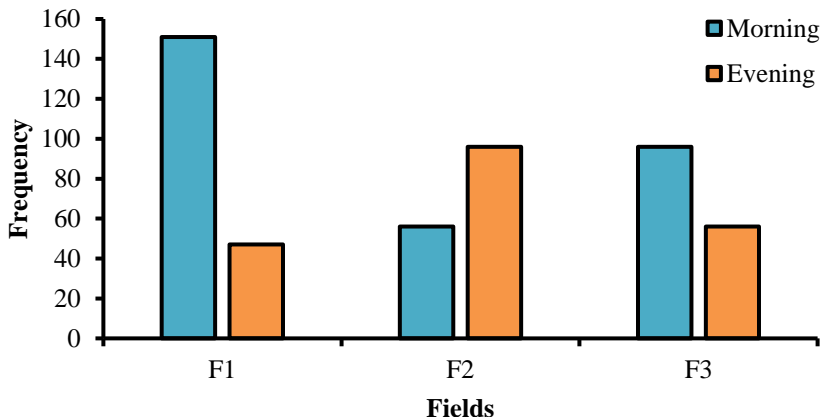


Figure 4. Frequency of birds visiting the fields

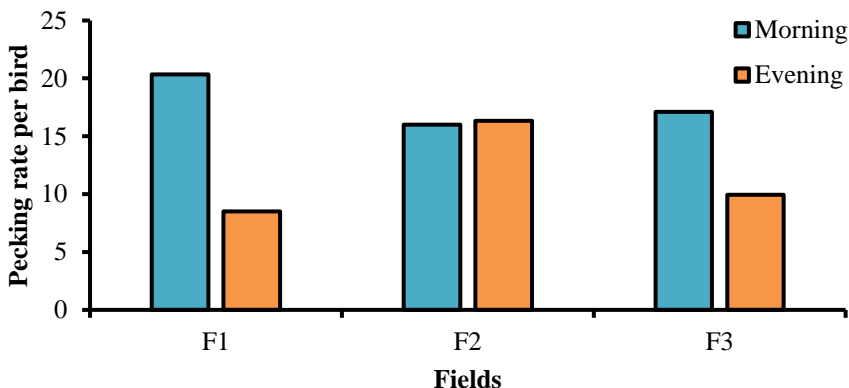


Figure 5. Pecking rate of birds in fields

3.3. Pecking Rate at Morning and Evening

The rate of pecking by birds can be related to the frequency of visiting birds (Figure 5). The highest mean pecking rate was observed as 20.4 for F1 in the morning time, while the minimum mean value was 8.5 in the evening. However, for F2, the mean pecking rate was almost the same at both morning and evening times.

3.4. Search Time at Morning and Evening

At F1, search time was comparatively lower than all other fields at both times of observation. The highest search time (188.57 sec) was observed at F2, while the lowest time, that is, 50.79 sec was observed at F1 in the morning. Clear differences were found between the duration of search time at morning and evening for the first two fields, while at F3 the duration of search time was almost the same at both times of the day (Fig. 6).

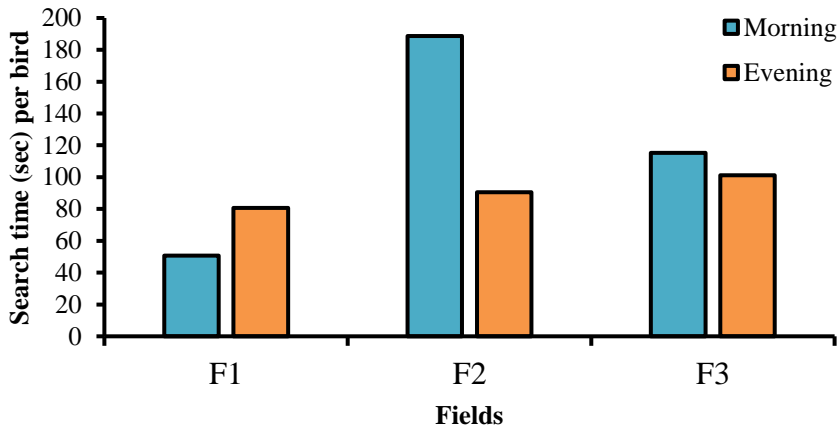


Figure 6. Search time (sec) per bird at fields

Table 2. Association (Spearman's Correlation) between Search Time and Number of Pecks by Birds

Fields	Time of Observation	Search Time vs. No. of Pecks (r _s)	Significance (p)
F1	Morning	0.702**	<0.01
	Evening	0.477**	<0.01
F2	Morning	0.699**	<0.01
	Evening	0.837**	<0.01
F3	Morning	0.895**	<0.01
	Evening	0.854**	<0.01

**Correlation is significant at the 0.01 level (2-tailed)

3.5. Association between Search Time and Number of Pecks

There was a direct relationship between search time and number of pecks by birds. The data collected from all the three fields indicated the presence of a significant ($p < 0.01$) correlation between search time and number of pecks (Table 2). Correlation scores were interpreted following Cohen [19], who described the scores for weak correlation (0 to 0.25), fair correlation (0.25 to 0.5), good correlation (0.5 to 0.75) and excellent correlation (more than 0.75). For F1, good correlation was present between both parameters at the morning

time, while at the evening time there was a fair correlation between them. Data depicted good and excellent correlation between search time and number of pecks at morning and evening times, respectively for F2. While for F3, data for both times showed an excellent correlation.

4. Discussion

Quaid-e-Azam Campus (New Campus), University of the Punjab, Lahore is a stable ecosystem that houses a wide diversity of birds [20, 21]. In F1, F2 and F3 a total of 9, 8 and 5 bird species (Table 1) were observed respectively, as reported previously by Tanveer et al.

[21] and Sidra et al. [20]. Overall, it was observed that the majority of birds visited F1 in the morning as compared to other fields. The high number of bird visits could be due to dense vegetation which provided them with cover against predators [1, 10, 12]. However, no predator species were observed during the study which could be due to the short observation time. Habitat selection is mainly influenced by food availability and the nature of feeding site [1]. Evidence from Strong and Sherry [22] and Fayt [23] also indicated food availability and distribution as principle factors behind habitat selection. The complexity of F1 vegetation supports a variety of food [24, 25], as leaf litter provides support to communities of different arthropods used as food by various types of birds [25].

Various foraging patterns opted by birds greatly depend on exposure to different foraging constraints, predation pressure and vegetation characteristics [26]. Two types of foraging patterns were observed in the current study. For F1 and F3, feeding rate (indicated by the number of pecks by birds) was high in the morning in comparison with the evening time. Farine and Lang [27] also found that rate of food search was higher in the morning as compared to other day times. This distinctive morning foraging pattern allows them to avoid predators and to exploit food sources successfully in the first part of the day [28]. Silva et al [29] studied the foraging behavior of song birds and described that two species of song birds, that is, blue tit and great tit mostly preferred foraging in the earlier part of the day. Contrary to our findings, in some studies the peak in feeding activity was found to be two hours before dusk at the known food sources [30]. Bonter et al. [30] documented in their study that most bird species start

foraging before sunrise, continue it throughout the day and terminate it before sunset. These studies indicate that species perform a trade-off between predation and starvation. Therefore, the feeding behavior of various species varies according to the presence of predators and their level of energy depletion [31].

Fair correlation was found between search time and number of pecks in F1. A large number of pecks corresponding with a short search time indicate an abundance of food in that particular patch as well as a low risk of predation at dawn. Along with abundance, accessibility and detectability of food play a major role in determining patch selection and search time of birds for foraging [32]. For F2, search time showed a remarkable difference from the number of pecks that indicated that birds spent more time on exploration as compared to feeding to minimize predation. It was also found by Van Oers et al. [33] that great tits exhibited latency in foraging activity because of a behavioral syndrome known as exploratory behavior. The increase in the length of stay time corresponding with a low number of pecks in F2 supported the fact that birds behaved according to the dynamic risk assessment theory and preferred to increase their vigilance over feeding [34]. Complex habitat also affects the feeding behavior of birds. Stay time of birds also depends on snow cover and temperature and the number of pecks is reduced in the presence of predators. The visiting of birds to foraging sites is influenced by the type of predator present at these sites. Bird visits decline sharply in the presence of more dangerous predators [35]. The complexity of the foraging area reduces the feeding rate and increases the stay time. Baker et al. [36] described that the

feeding rate of seed eating passerines decreased in stubble crops because of the complexity of feeding materials and due to an increased distance covered to attack the food. In the study site F3, search time and number of pecks exhibited a good correlation with each other and foraging behavior did not differ significantly at both morning and evening times. Similar results were documented by Wolf and Hainsworth [37]. They observed the constant feeding behavior of humming birds throughout the day and did not find any peaks in the feeding activity in the morning or before dusk.

5. Conclusion

In summary, our investigation demonstrated that the foraging behavior of birds is not constant; indeed, they depict a diversified feeding behavior that depends on the nature of the microhabitat, predation risk and the abundance of vegetation. More food, dense vegetation and less predation risk are responsible for a longer span of stay time that leads to an increased pecking rate. Further research is still required to explore the effect of the abundance of prey, rate of predation, starvation risk, environmental factors and seasonal variations on the foraging behavior of free living birds in long-term experiments.

6. Conflict of Interest

Authors declare no conflict of interest.

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