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Research Article

Feeding Patterns and Breeding Behaviour of Indian Robin (*Saxicoloides fulicatus*) in the Agricultural Landscape of Bahawalpur

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Abstract

The Indian Robin is a member of the Muscicapidae family of insectivorous birds. Males are distinguished by a characteristic white patch on their shoulders and a somewhat longer tail, but females have all brown top plumage and lack the white shoulder patch of the male. Typically, this species' reproductive season lasts from April to July. Indian Robins are frequently found in environments close to populated areas, as well as in rocky, dry regions with bushes and agricultural borders. For feeding and behavioral observations, a study on breeding and eating behavior was carried out in year 2024. In the vicinity of Sadiq Public School in Bahawalpur, a six-month study on the feeding patterns of the Indian Robin was conducted, first from February to April and then from September to November. For feeding and behavioral observations, a variety of instruments were used, such as notepads, binoculars, cameras, and measuring devices. In agricultural areas, six Indian Robin nests were found at locations such as the Model Primary School, Pesticide Control Laboratory, and Jhangi Wala. April, May, and June were the three months that the study was conducted. The results showed that grains and flower seeds, as well as a variety of insects, including common species and agricultural pests, make up the Indian Robin's main diet. The varied diet of Indian Robins comprises a variety of fruits, cereals, and flower seeds. Other bird species frequently share their feeding sites with them. Information on their eggs was gathered, including weight, length, width, and nest parameters. The average dimensions were 2.16±0.05 g in weight, 19.85±0.21 mm in length, and 14.40±0.12 mm in breadth. Incubation period, chick length, and fledgling duration had mean values of 11.80±0.10 days, 80.14±0.94 mm, and 13.71±0.10 days, respectively. The aim of this study was to investigate the feeding patterns and breeding behavior of the Indian Robin in Bahawalpur, Pakistan. The objectives were to observe and record the dietary composition, nest parameters, egg dimensions, and incubation period of the Indian Robin, as well as to document its coexistence with other bird species at feeding sites.

Keywords: Insectivorous, reproductive, pests, dimensions, patterns.

1. Introduction

Indian Robin (*Saxicoloides fulicatus*) is a lowland bird of the Indian subcontinent and has a broad distribution range. Its diet includes all kinds of insects and it feeds them with various techniques. This species, which is a member of the Muscicapidae family, constitutes a notable fraction of the fauna, serving as a fundamental component in the balancing of insects and providing numerous ecological services [1]. Indian Robin does not migrate and remains in areas occupied by humans. Some of such places include rugged rocky areas, dense vegetation, open grasslands, and even cities. The tiny birds are agile, and can often be seen flying around rooftops, shrubs and trees looking for prey in the form of insects. In most gardens, the little birds are common and can often be seen looking for food in places filled with stones and bricks. The diet of the Indian Robin mainly consists of crop pests therefore, they assists in the preservation and maintenance of agriculture

by controlling the insect population [2].

Indian Robins were consistently seen searching in cultivated fields and among feral shrubs in all research locations, mostly after insects and caterpillars. In addition, it was also observed that these birds feed on bread crumbs and grains, an indication of their omnivorous nature that helps them adjust effectively to cityscapes.The results of this research point towards the fact that human presence and construction operations do not remarkably affect the habitat choices of Indian Robins. These birds prefer to live in areas near human habitation [3]. The Indian Robin's reproductive cycle starts at the onset of the first rains and extends from September to December [4]. The outstanding reproductive surge is highlighted in June which is the month in the middle of this season [5]. However, in Southern India, this phase begins first due to the increased latitude of the region [4].

Most likely, the Indian Robin can be found in areas with some amount of vegetation and active agricultural practices going on. This indicates the presence of several agricultural systems that correspond with the habitat needs of the Indian Robin [6]. The Indian crop growing practice has rendered these systems favorable for numerous species. In farming regions, birds have good chances of survival because there are plenty of suitable environments. However, certain species of birds may choose to reside elsewhere, provided that such places are better. Such choices arise from the selective availability of resources among different habitats [7]. The most conspicuous breeding activities of the Indian Robin are between March and July. Previous works always show that breeding activities commence from March [8].

The Indian Robin generally builds its nest in stones, shrubs, or cavities. This species has several methods of reproduction, thus, choosing a mate and nesting location requires thorough consideration [9, 10]. There is ongoing work directed toward aiding the research of the Brown-backed Indian Robin. Additionally, there is a need to study the impacts of urbanization on the Indian Robin in conjunction with other ecological studies [11]. For improved conservation and population management of the species, information on breeding, territorial behavior, and the variables impacting breeding success is required. There are very few studies on the breeding habits of birds in Sri Lanka. Few research conducted recently have confirmed the significance of breeding biology [12, 13].

The study on the Indian Robin in Bahawalpur, Pakistan, has significant future implications for conservation and management of bird populations. The findings can inform strategies for habitat preservation, particularly in agricultural areas and urban environments, to ensure the long-term survival of the species. Additionally, the study's results can guide sustainable agricultural practices, such as reducing pesticide use, to minimize harm to Indian Robins and other bird species that share their habitats. Furthermore, the research can serve as a baseline for monitoring population trends, behavioral changes, and ecological shifts in response to climate change and human activities. This study contributes to our understanding of the Indian Robin's behavior and ecology in Bahawalpur.

2. Materials and methods

2.1. Study details and location

Research on feeding and breeding behaviour of Indian Robin was carried out more than half of year 2024. This investigation commenced in April near Sadiq Public School and continued till September to assess their dietary choices. The study area encompassed open fields characterized by wheat and sugarcane farming, orchards, and a field dedicated to millet cultivation. Despite the presence of road traffic, the agricultural landscape flourished with a variety of crops, including wheat, sugarcane and other crops. Figure 1 demonstrates the location of study area.

Nesting locations for Indian Robins were identified in the agroecological zones on the periphery of the city. Three nests were located in Model Primary School, two were found at the Pesticide Control Laboratory, and one nest was discovered near Jhangi Wala (Table 1).

The research location is defined by the geographical coordinates of 29°37'02’N and 71°65'48’E, located on the western edge of the city. This area is encircled by numerous

markets, residential neighborhoods, and an educational facility. The site for experimentation is situated adjacent to Sadiq Public School, prominently positioned at a key intersection within the urban environment. Agricultural areas near to human settlements were selected for purpose of research.

A study examining the breeding behavior of the Indian Robin was conducted over three distinct months following the beginning of summer season. Table 1 details the breeding sites, nest measurements, and geographical coordinates of various nests discovered in agricultural landscapes. Six breeding locations for the Indian Robin were identified across multiple settlements, particularly within older human-made structures. The existing body of literature demonstrates a significant gap in comprehensive historical documentation and limited insights into the breeding behavior of Indian Robins [14].

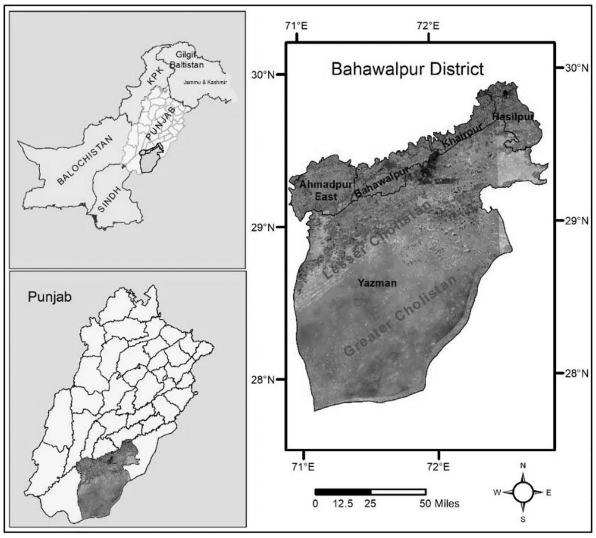

Figure 1. Location of study area is marked in western area of Bahawalpur.

2.2 Climate

The study area in the Punjab plains experiences elevated summer temperatures, particularly in May and June, with evening temperatures peaking at 38°C. The average temperature is 35°C in September and reduces to 29°C in November. The region's climate is primarily terrestrial, with annual precipitation levels not exceeding 100 mm. The Indian Robin breeds during the peak breeding period, with summer temperatures reaching 36°C and spring temperatures around 33°C.

2.3 Notepad

It was used to document the feeding patterns of Indian Robin. All Insects eaten by Indian Robin were documented in Notepad. This notepad was also used to document breeding measurements of Indian Robin. Then whole data was shifted to MS Excel sheet.

2.4 Bird and Insect Identification Guide

A reconnaissance survey was conducted in the area to enhance the team's understanding of the local ecosystem and avian species. The field guide "Birds of Pakistan" [15] served as a reference for recognizing and familiarizing the team with the Indian Robin, as well as other bird species inhabiting the same foraging environment. All insects fed by Indian Robin were recorded on notepad and then displayed in Results.

2.5 Binocular

The Nikon 8x42 Monarch M7 Binocular was employed to examine the feeding and breeding habits of the Indian Robin. The binoculars provided the capability to observe the Indian Robin from a significant distance. Additionally, they were used to explore various nests and to analyze the reproductive behaviors of the Indian Robins. Number of insects fed by Indian Robin was also recorded with binocular.

2.6 Camera

The Indian Robin was documented in its natural habitat using the Canon EOS 90D model. This camera was employed to capture clear picture of the Indian Robin from a considerable distance. Pictures of the breeding sites of the Indian Robins were captured using camera. Pictures of nests and eggs were also taken to facilitate the study of the nests.

2.7 Camera Trap

Bushell camera trap was used to detect motion of Indian Robin when feeding on insects. This camera was installed in fields and detects Indian Robin when they prey on pests of crops.

2.8 Inch Tape

The inch tape proved to be an effective tool for the straightforward measurement of nest lengths, yielding crucial preliminary data.

Table 1: Table demonstrating different breeding sites of Indian Robin in Agricultural land.

Nest No.	Breeding Area	Month of Study	Nesting Place	Coordinates	Length of Nest (cm)
1	Model Primary School in the Agricultural Fodder Field	April	Top of roof	29◦40'51'N, 71◦76'80'E	23
2			In bricks	29◦40'51'N, 71◦76'80'E	28
3			In wall hole	29◦40'51'N, 71◦76'80'E	28
4	In Pesticide Control Laboratory near the Agricultural Fodder Field	June	In wall hole	29◦38'61'N, 71◦65'01'E	26
5			In the window shed	29◦38'64'N, 71◦65'04'E	24
6	In Store of Sugarcane Field near the Jhangi Wala	May	In metal box	29◦42'70'N, 71◦76'38'E	22

This instrument was particularly useful for measuring larger items that could not be accurately evaluated with a vernier caliper.

2.9 Vernier Caliper

This device was used to measure the dimensions of eggs, including their length and width, as well as the length of chicks. Its accuracy exceeds that of a standard inch tape, rendering it essential for such precise measurements. A vernier caliper was used to measure the length of the egg [16].

2.10 Weighing Balance

The weighing balance was employed to determine the mass of eggs, providing precise measurements expressed in grams.

2.11 GPS for Locating Nests

GPS device Garmin eTrex 10 was used to locate nests. It also aided in demonstrating coordinates of nests.

2.12 Line Transect Method

In the initial phases of identifying the nesting sites of the bird, data collection was conducted with precision along each transect utilizing the line transect method. To guarantee comprehensive coverage of the study area, observations were systematically recorded while traversing the transects at a consistent pace. All observations occurred during the peak breeding season of the Indian Robin [17,18]. The analysis of the data involved determining the population of Indian Robins within each transect and evaluating the sex ratios.

2.13 Breeding Parameters

Breeding parameters, including egg length and size, were evaluated after the eggs were laid. In this research, the incubation period was defined as the number of days from the laying of the initial egg to the hatching of the final egg in a clutch [19-21]. The durations for egg hatching and fledging were calculated based on the total number of 16 consecutive days necessary to complete each respective process [22]. We closely watched seven Indian Robin breeding attempts from start to finish, either until the nest or eggs failed or the chicks learned to fly. We visited each nest daily, taking care not to disturb the birds or their chicks. Except for a quick, five-minute visit to collect egg and nest data, our subsequent visits were brief, lasting only a few seconds, to minimize our impact on the birds [23].

2.14 Statistical Analysis

Mean values and standard errors were computed utilizing Statistix 8.1 software. The analysis of egg and chick data was conducted through a Microsoft Excel spreadsheet. Then this data was shifted to MS Word after applying Statistics.

3. Results

3.1. Feeding Behaviour of Indian Robin

Feeding Site demonstrated the presence of thirteen Indian Robins, highlighting their omnivorous nature, which encompasses both animal and plant-based food sources. The

primary diet of the Indian Robin consists of prevalent insects, including grasshoppers, caterpillars, ground beetles, and crickets, with a significant emphasis on animal matter. Grasshoppers thrive in grassy and open field habitats, while this bird also feed on various agricultural pests such as aphids, armyworms, jassids, leafhoppers, and thrips (Table 2)

Agricultural practices in Bahawalpur specify that Indian Robin also feeds on grains of wheat, maize, rice and sunflower (Table 3). This bird also feeds upon pests of these crops. Indian Robin is adaptable to agricultural landscape near human settlements due to wide array of feed and pests that are available in farm areas adjacent to urban areas.

The most significant findings about the diet of the Indian Robin demonstrates that this bird species is omnivorous, consuming both animal and plant-based food sources. .

Table 2. Different kind of Insects consumed by Indian Robin in Agriculture field.

Sr No.	Name of Species	Order	Family	Feeding Spot
1	Grasshoppers	Orthoptera	Acrididae	In grasses and weeds
2	Caterpillars of butterfly	Lepidoptera	Papilionoidea	Crops
3	Ants	Hymenoptera	Formicidae	Soil
4	Aphids	Hemiptera	Aphididae	Leaf of wheat crop
5	Armyworms	Lepidoptera	Noctuidae	Leaf of wheat crop
6	Sugarcane borer	Lepidoptera	Noctuidae	Sugarcane
7	Leaf hoppers	Hemiptera	Cicadellidae	Leaf of crops
8	Thrips	Thysanoptera	Thripidae	Sugarcane
9	Moths	Lepidoptera	Burnet	Leaf of different plants
10	Earthworms	Heplotaxids	Lumbricidae	Soil
11	Stalkborer	Lepidoptera	Noctuidae	Leaf of Sugarcane crop
12	Ladybirds	Beetles	Coccenedillidae	wheat crop
13	Ground Beetles	Coleoptera	Carabinae	In soil
14	Crickets	Orthoptera	Grylloidea	Near store

Table 3. Kind of Grains and Flower Seeds consumed by Indian Robin.

Nutriment	Name of Species	Scientific Name	Order	Family
Grains	Wheat	*Triticum aestivum*	Poales	Graminae
	Maize	*Zea mays*	Poales	Poaceae
	Rice	*Oryza sativa*	Poales	Graminae
Flower Seeds	Sunflower	*Helianthus annuus*	Asterales	Daisy

Table 4. Berry and fruit consumed from Tree species

Tree	Scientific Name	Family	Agricultural Place
Ber	*Ziziphus mauritiana*	Rhamnaceae	Side of fodder crop field
Pomegranates	*Punica granatum*	Punicaceae	Side of fodder crop field

Table 5. Birds sharing feed with Indian Robin in Agricultural field

Sr No.	Name of Species	Scientific Name	Order	Family
1	Red vented Bulbul	*Pycnonotus cafer*	Passeriformes	Pycnonotidae
2	Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae
3	Jungle Babbler	*Turdoides striatus*	Passeriformes	Leiothrichidae
4	Common Babbler	*Turdoides caudatus*	Passeriformes	Timaliidae
5	Brown rock chat	*Corcomela fusca*	Passeriformes	Muscicapidae
6	House Sparrow	*Passer domesticus*	Passeriformes	Passeridae
7	Ring necked Dove	*Streptopelia capicola*	Columbiformes	Columbidae
8	Crow	*Corvus splendens*	Passeriformes	Corvidae

The primary diet of the Indian Robin consists mainly of insects, including grasshoppers, caterpillars, ground beetles, and crickets, which are significant agricultural pests. Figure 2 shows Indian Robin foraging in wheat harvested field. Additionally, the Indian Robin feeds on various grains, such as wheat, maize, and rice, as well as sunflower seeds. The bird also consumes fruits, including berries from trees like Ber and Pomegranates (Table 4). Furthermore, Indian Robin also shares its feed with other avian species as mentioned in table 5. Notably, the Indian Robin's diet encompasses a wide range of food sources, highlighting its adaptability to agricultural landscapes near human settlements. Overall, the Indian Robin plays a crucial role in controlling agricultural pests, reducing the dependence on synthetic pesticides and insecticides.

3.2. Breeding Behaviour of Indian Robin

The reproductive behavior of the Indian Robin was examined during the months of April, May, and June. The study disovered a variety of nesting locations, including residential structures near open spaces, agricultural fields, and vacant lots, with rooftops, bricks, and walls being the most commonly utilized sites. Total population of Indian Robin at study site near Jhangi Wala was four with one nest located in the sugarcane field at that area. In vicinity of the Pesticide Control Laboratory, situated in the agricultural area, only two nests were recorded, which collectively housed nine Indian Robins. .

Figure 2: Female Indian Robin foraging in wheat harvested field.

Additionally, at the Model Primary School within the agricultural fodder zone, three nests were discovered where total population of Indian Robin was twelve.

Table 6. This table shows length, width and weight of eggs of Indian Robin

Nest No.	Length of Nest (cm)	Egg No.	Length of egg (mm)	Width of egg (mm)	Weight of egg (g)
1	23	1	18.6	13.6	1.7
1	23	2	18.5	13.4	1.8
1	23	3	18.7	14	1.86
1	23	4	18.4	14	2
2	28	5	19.6	14.3	2.25
2	28	6	19.8	14.4	2.2
3	28	7	19.3	13.8	1.9
3	28	8	19	13.9	1.95
3	28	9	19.4	14	2
4	26	10	19.6	14.1	2.05
4	26	11	20.8	15	2.3
4	26	12	21.2	15.2	2.35
4	26	13	21.2	15	2.4
5	24	14	20	14.5	2.2
5	24	15	19.8	14.6	2.35
5	24	16	19.9	14.6	2.4
5	24	17	20.4	14.6	2.36
6	22	18	20.4	15	2.3
6	22	19	21.3	14.9	2.44
6	22	20	21.2	15.2	2.4
Mean			**19.85±0.21**	**14.40±0.12**	**2.16±0.05**

3.3. Egg Data

The initial nest exhibits reduced dimensions and mass, attributable to the interconnected influences of length and width. In contrast, the second nest presents marginally larger measurements regarding length, width, and weight. The third nest maintains comparable dimensions and weight to the previous ones. The fourth nest demonstrates enhanced measurements across all three parameters: length, weight, and width. Nests five and six possess analogous characteristics. A mean value was computed for all parameters, resulting in an average egg length of 19.85±0.21 mm, width of 14.40±0.12 mm, and weight of 2.16±0.05 g. The eggs are distinguished by a white background adorned with brown speckles. All this data is demonstrated in table 6 and figure 3 shows nests of Indian Robin with eggs.

Figure 3. Nest of Indian Robin including eggs.

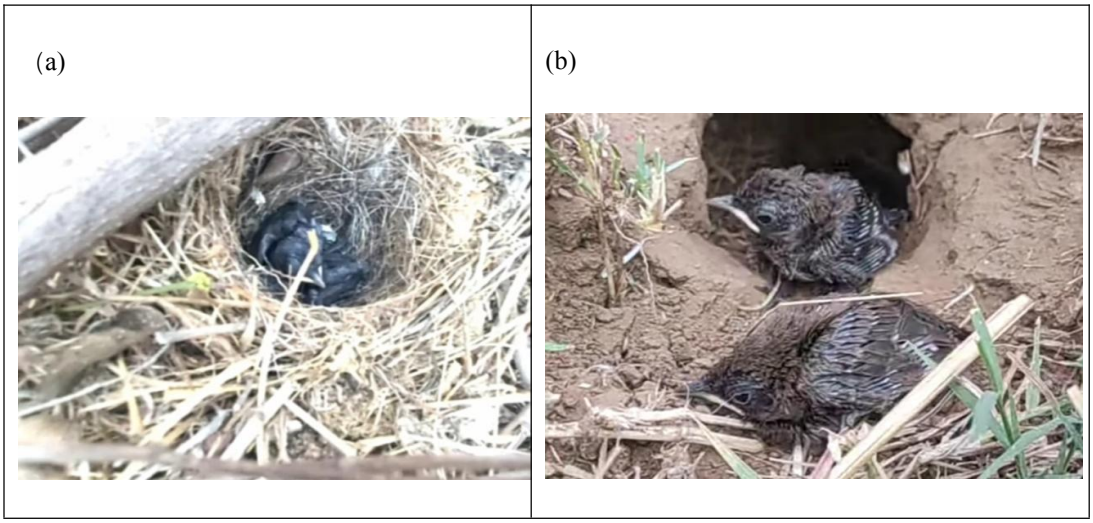

Figure 4. (a) Nest of Indian Robin and its chicks and (b) Indian Robin near fledgling.

Table 7. This table demonstrates incubation period, chick length and fledgling of Indian Robin.

Nest No.	Egg No.	Incubation period (days)	Length of Chick (mm)	Fledgling (days after hatching)
1	1	11.3	78	14.1
1	2	10.9	75	14
1	3	11.6	74	13.9
1	4	11.5	75	13.9
2	5	11.65	82	14
2	6	12.4	82	14.2
3	7	11.6	83	14
3	8	11.8	82	13.6
3	9	11.95	83	13.7
4	Nest destroyed by predators	-	-	-
4	-	-	-	-
4	-	-	-	-
4	-	-	-	-
5	14	11.9	80	13.8
5	Defective egg did not hatched	-	-	-
5	16	11.65	82	13.3
5	17	11.95	78	12.9
6	18	12	83	13.2
6	19	12.2	85	13.4
6	Defective egg did not hatched	-	-	-
Mean		**11.80±0.10**	**80.14±0.94**	**13.71±0.10**

***Chick* Data**

The fourth nest experienced predation, whereas the fifteenth and twentieth eggs were found to be non-viable. The incubation duration for the initial clutch was notably shorter, with a gradual increase observed in the following clutches. The average incubation period was recorded at 11.80±0.10 days, with the mean length of the chicks measuring 80.14±0.94 mm and the average fledgling length at 13.71±0.10 mm. During the breeding season, male Indian Robins took on the role of nest protectors, while the female was tasked with incubating the eggs. Additionally, the data on chick development indicated variations in both chick lengths and overall growth. Table 7 demonstrates the chick data. Figure 4 shows chicks.

4. Discussion

Importantly, all nests observed were located in close proximity to human settlements, suggesting that these birds tend to inhabit such regions for prolonged durations. The Indian Robin is classified as a non-migratory species that flourishes in areas adjacent to human habitation [24]. Indian Robins display a remarkable adaptability to different climatic conditions, which facilitates their ability to hunt insects and obtain sufficient food. Changes in agricultural methodologies are crucial for promoting the growth of agroecosystems. These bird species are closely associated with the vegetation found in agricultural settings. Given the uneven distribution of resources within ecosystems, certain avian species tend to favor particular habitats over others [7].

The findings indicate that Indian Robins flourish in agricultural environments where there is a significant abundance of insects. Furthermore, these birds frequently build their nests near such regions to secure a reliable food source for their young. The variety of insect species found in agricultural fields also plays a crucial role in pest control [6]. According to Cody and Robertson, Indian Robins consistently select nesting locations that are free from predators and offer an adequate food supply [25]. Grasshoppers, in particular, are abundant in agricultural areas and gardens that border cultivated fields. These agricultural landscapes generally support a substantial population of grasshoppers. For example, Indian Robins often hunt grasshoppers, which are usually found in proximity to plant life; these birds are known to consume a considerable quantity of them. Grasshoppers can be found inhabiting various shrubs and other forms of vegetation [26].

The average measurements of Indian Robin eggs, derived from the nest data, were determined to be 19.85±0.21 mm in length and 14.40±0.12 mm in width, based on 20 specimens. These results are in close agreement with those documented by Whistler in 1941, who noted egg dimensions of 20.06×14.98 mm and 21.1×14.9 mm, respectively [27]. Singh and coauthors identify predation and hatching failure as the primary factors contributing to nest degradation. In our study, the fourth nest was compromised by predators, while one egg from both the fifth and sixth nests exhibited defects, resulting in failure to hatch. These observations align with the conclusions drawn by Singh and coauthors [28].

Breeding represents a critical stage in the life cycle of birds, during which they invest considerable time and energy in various activities, including the selection of nest sites, construction of nests, incubation of eggs, and the care of their young. The Indian Robin prefers to establish its nests in rock crevices, tree hollows, and on rooftops. The population of secondary cavity nesters is closely linked to the availability of appropriate nesting locations. To enhance conservation efforts and manage populations effectively, it is essential to gather data on nesting success and to monitor the factors that influence this success among cavity-nesting species. Research on the breeding habits of secondary cavity nesters, particularly in artificial nest boxes, has a well-documented history, especially within the temperate forests of Europe and North America [29, 30].

Importantly, all nests observed were located in close proximity to human settlements, suggesting that these birds tend to inhabit such regions for prolonged durations. The Indian Robin is classified as a non-migratory species that flourishes in areas adjacent to human habitation [31]. Indian Robins construct their nests in a variety of environments, including trees, rocks,

and bricks. Typically, these birds favor nesting locations that are well-suited to their habitat. Furthermore, the findings suggest that Indian Robins frequently establish their nests in proximity to bricks and stones [32]. A common, territorial insectivorous bird, the Indian Black Robin can be found in household gardens, along agricultural boundaries, in dry rocky places, and in shrub habitats [33].

This could be because they are protected from predators, particularly snakes and mongooses. According to earlier research, the mating season begins in March and lasts through June, followed by July and September [34]. The same study also demonstrated that the Indian Robin's breeding season lasted from early March to late September. The male Indian black robin's sounds signal the beginning of the breeding season [35]. This study has noted a reduction in the incubation duration. Furthermore, our results show that young Indian Robins fledged after an average of 13.71±0.10 days, which is longer than the 13.09 ± 0.30 days documented by Singh. Thus, the data implies an extension in the fledging period [36]. Singh and coauthors identify predation and hatching collapse as the primary factors contributing to nest degradation. In our study, the fourth nest was compromised by predators, while one egg from both the fifth and sixth nests exhibited defects, resulting in failure to hatch. These observations align with the conclusions drawn by Singh and coauthors [37].

5. Conclusion

In conclusion, this study provides valuable insights into the feeding patterns and breeding behavior of the Indian Robin in Bahawalpur, Pakistan. The findings highlight the species' adaptability to different environments and its role in controlling insect populations. The study's results can inform conservation efforts and promote sustainable coexistence between humans and Indian Robins. They often nest in bricks, wall cavities, or windows to enhance their breeding operations. Their adaptability to human modified environments and diversified food highlight their ecological relevance, making them an important subject of research in bird biology and conservation efforts. The findings of this study have significant implications for agricultural practices in Bahawalpur. Therefore, farmers in Bahawalpur can adopt bird friendly farming practices, such as planting bird friendly crops, maintaining ecological corridors, and reducing habitat destruction, to encourage the presence of Indian Robins and other beneficial bird species. By gathering data on the dietary composition, nest parameters, egg dimensions, and incubation period of the Indian Robin, this study provides valuable insights into the ecological role of this species. The findings of this study can inform conservation efforts aimed at protecting the Indian Robin and its habitat, ultimately contributing to the preservation of biodiversity in the region.

Data availability statement

The data supporting the results of this study can be obtained from the corresponding author upon request.

Conflicts of interest

All authors declare that they have no conflicts of interest.

Ethical approval

Not applicable (N/A)

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Authors Contribution

Jawad Ali Akhtar contributed to the research work, carried out field analysis, methodology and writing of draft.Irfan Ashraf carried out conceptualization, supervision and review of manuscript. Junaid Naseer contributed by giving additional data, statistical analysis and adding of tables. Abdul Wadood carried out formal analysis and editing.

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