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Courtship Behavior, Clutch Sizes and Fledgling Survival Rates in Nesting Phase of the Indian Robin

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***Abstract*-- The reproductive cycle of the Indian Robin (Copsychusfulicatus) is extremely susceptible to variations in the climate as a consequence of alterations in the time of mating, the beginning of nests, the size of clutches, incubation behavior, and, lastly, the success of fledging. The reproductive success of the Indian Robin is adversely affected by extreme weather events, including as heat waves and sudden rains. This is mostly due to the negative impacts on the survival of nestlings, physical condition, and food availability. Nest types varied significantly across habitats influenced by microclimatic conditions. In drier, hotter regions, smaller nests (Type-4) with reduced dimensions were constructed, possibly improving temperature regulation and reducing predation risks. Nests in more humid zones or shaded habitats were larger and structurally complex, reflecting adaptation to different climatic pressures. This indicates behavioural plasticity influenced by microclimatic conditions, allowing individuals to optimize reproductive success within their territories. Reproductive patterns of Indian Robins showed distinct variability across climatic conditions. The study documented that in years with balanced temperature ranges and timely rainfall, nesting activity began earlier, clutch sizes were larger, and fledgling survival rates were significantly higher. Abundant insect availability ensured better parental feeding, faster chick growth, and increased fledgling fitness.**

***Keywords*-- Courtship, Behavior, Indian, Robin fledgling, survival, rates, Nesting, Phase**

I. INTRODUCTION

The use of acoustic signals plays a crucial role in their daily communication and survival tactics (such as breeding and foraging). According to Marler and Slabbekoorn (2004), the vocalizations of birds serve as a crucial means of communication and provide a valuable source of information. Bird calls and bird songs are both components of the vocalizations that birds make. The vast majority of bird species possess between five and fourteen diverse vocalizations that have varied acoustical structures and related functions.

In general, birds sing for a number of reasons, including marking territories, attracting mates for the purpose of nesting, and broadcasting their personal characteristics; they call for a myriad of reasons, such as establishing and maintaining social contact, recruitment, movement (e.g., coordinating the direction of a flock), and food-related purposes (Kroodsma, 2005; Gill, 2007).

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Courtship Behavior of the Indian Robin

During the courtship ritual, the male Indian Robin will display a puffed-out chest, a stretched posture, and a strutting motion, all of which are accompanied by the fluffing of his undertail coverts and the fanning of his tail. In order to attract a mate, the male sings a song that is more complex, but when it is necessary to protect his territory, he sings a different song that is simpler. The male will frequently provide the female with food over the course of their contacts and courtship.

Male courtship behaviors

- *Vocalizations:* When it is mating season, males sing in order to attract females and drive other males away. For each of these two applications, they produce a unique version of their song

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- *Visual displays:* The male will attempt to attract a female by puffing out its chest, extending its tail feathers, and stretching to the highest height that it is able to achieve. Another alternative is to go around the girl and show his sides to her.
- *Territorial defense:* Males actively guard their area from other males by displaying their dominance with slow wing beats and aggressive displays, which might include pecking at their own reflections.
- *Courtship feeding:* There is a belief that the act of feeding each other contributes to the strengthening of the pair connection, and this activity can continue even during the time when the couple is constructing their nest or laying eggs.

Female courtship behaviors

- If the female wants to ensure that the connection between the two of them remains strong, she will do things such as the following:
- Ask the male to mate with her;
- Assist him with the construction of the nest; and
- Go in search of him if he does not return to the nest immediately after she has deposited her eggs.

Ecological Knowledge of the Semi-Arid and Subtropical Regions of Northern India Formulate Conservation Strategies for Avian Species Sensitive to Climate Change.

During the three-year period of 2021 to 2023, a study of Indian Robins in the foothills of the Himalayas revealed a downward trend in the rate of successful hatchings. It is probable that this decline was caused by the growing intensity of extreme weather conditions during this time frame. The fact that these findings bring to light the enormous sensitivity of bird reproduction to unanticipated fluctuations in weather patterns on a small scale that are caused by climate change is an important point.

The reproductive cycle of the Indian Robin (Copsychusfulicatus) is extremely susceptible to variations in the climate as a consequence of alterations in the time of mating, the beginning of nests, the size of clutches, incubation behavior, and, lastly, the success of fledging. The reproductive success of the Indian Robin is adversely affected by extreme weather events, including as heat waves and sudden rains. This is mostly due to the negative impacts on the survival of nestlings, physical condition, and food availability.

Specific Impacts of Climatic Fluctuations:

- *Nesting Initiation:* When the temperatures of spring are higher, birds start their mating season at an earlier time. The initiation of nesting for the Indian Robin is often influenced by the local climate, and it generally begins at the end of winter or the beginning of spring in northern India. The commencement of mating may be brought forward as a result of the effects of climate change, which include the acceleration of the melting of snow and the growth of vegetation. Although there is natural selection that is pushing for the most optimal time to lay eggs, extreme weather conditions that occur around this time, such as abrupt cold snaps and flooding, can increase the probability that a nest will fail or may even encourage parents to abandon their nests.
- *Clutch Size:* According to the findings of the research, there is a possibility that clutch size and temperature are associated. The average clutch size is known to remain within a particular range, which is typically between two and four eggs, according to available research. However, there is also some evidence to suggest that there is a negative association between the production of eggs and higher temperatures. The peak availability of food resources, which is typically related with the optimal clutch size, is one aspect that can be affected by climate change.
- *Incubation Behaviour:* Higher temperatures can have an effect on the way that the parents behave when they are incubating. If parent birds reduce the frequency and duration of their visits to the nest in order to incubate or brood in response to heat stress, this might potentially have an influence on the growth and survival of the young. For certain species, warmer temperatures in the spring may result in a shorter period of incubation.
- *Fledgling Success:* The amount of fledglings that are produced is greatly influenced by the weather conditions. When ambient temperatures are greater during the nestling period, there may be a reduction in the probability of nest failure. Heavy or increasing rainfall during the nestling phase is associated with an increased likelihood of brood failure due to the fact that it has the potential to reduce the pace at which parents visit the nest and the efficiency of their foraging activities.

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This gives rise to worries that there might be a "phenological mismatch" due to changes induced by climate change, which could result in the time of the peak feeding demand and availability of chicks diverging from one another.

The Indian Robin is faced with a significant threat as a result of the increasing frequency and intensity of extreme weather events, which jeopardizes the bird's capacity to reproduce successfully and maintain a stable population. In spite of this, the bird demonstrates a great deal of versatility during its reproductive cycle in order to adjust to the existing circumstances.

Objectives of the Study

1. To study on Ecological Knowledge of the Semi-Arid and Subtropical Regions of Northern India Formulate Conservation Strategies for Avian Species
2. To study on Courtship Behavior of the Indian Robin

II. Research Method

Research Sites and Behavioural Sampling Procedures

The research was carried out on the borders of the Doon Valley at three places that were chosen specifically for the purpose of this study. The locations are as follows: Location I (30°21'23.36"N; 77°59'24.38"E), Location II (30°21'19.58"N; 77°59'0.30"E), and Location III (30°22'7.65"N; 77°58'48.76"E). These locations are located at an elevation of around 450 meters above sea level.The Indian Robin (Copsychusfulicatus L.), which is a small-sized passerine bird that belongs to the family Muscicapidae, was the reason for the selection of the research region (Ali and Ripley, 1998).

In order to investigate the behavior of the Indian Robins, researchers used the focal-animal sampling method, which was introduced by Altmann in 1974.

The chosen birds were nesting, and their behavior was monitored for a duration of no more than four hours for each sample. Any observations that lasted less than one hour were disregarded. There is documentation of mating behaviors, which include singing behavior, courting displays, song postures, and fights between mates. The following nest-building activities were meticulously monitored and recorded: the gathering of materials for the nest, the protection of the nest, the number of days spent nesting, the number of days spent incubating, clutch size, and hatching success.

During the breeding season, which took place from the year 2021 to 2023, breeding behavior was observed from the second fortnight of February to the second fortnight of August. The following factors related to reproduction were recorded: the nesting phase, the fledgling period, the size of the clutch, the kind of nest, the material used in nesting, and the success of hatching.

III. Result And Discussion

There are a number of elements that may impact the time it takes for young birds to leave the nest and become independent. These factors include the weight of their bodies (Kouba et al., 2015), the danger of being preyed upon (Chiavacci et al., 2015), the behavior of their parents, and the development of their wings (Martin et al., 2018). The regular trends that can be seen in the development and fledging of Indian Robins throughout the course of the research years are supported by these findings. In order to avoid being attacked by predators, bird species prefer to deposit their eggs and take care of them in a safe area (Lima, 2009). When it comes to choosing locations for nests, there are a number of different strategies that may be used for different species. In certain species, the female takes on a leadership role in the process of selecting a location, but in other species, both individuals work together in order to make this decision (Collias, 1997).

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Table 1
Year wise nesting variable (clutch size- hatching success) of Indian Robin

Nesting Variable	2021 (n=15)	2022 (n=18)	2023 (n=17)
Clutch size	3.26 ± 0.18	3.27 ± 0.13	3.47 ± 0.12
Egg hatched	2.8 ± 0.17	2.61 ± 0.11	2.47 ± 0.12
Egg lost	1.33 ± 0.12	0.72 ± 0.15	0.82 ± 0.12
Successful fledging	2.13 ± 0.16	2.38 ± 0.14	1.94 ± 0.16
Hatching success	0.91 ± 0.10	0.81 ± 0.03	0.71 ± 0.02

Table 2
Number of days spent (year-wise) in different phases of breeding in Indian Robin

Reproductive Phase	2021 (n=15)	2022 (n=18)	2023 (n=17)
Nesting (Days)	10.06 ± 0.66	10.41 ± 0.51	13.47 ± 0.37
Incubation period (Days)	12.16 ± 0.33	11.47± 0.50	12.35 ± 0.32
Fledgling (Days)	13.7± 0.38	12.80± 0.37	12.79 ± 0.31

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Table 3
Variations in morphometric parameters of nests in Indian Robin

Nest Parameter	Type-I	Type-2	Type-3	Type-4	Chi- Square value	F	Sig.
Outer diameter(cm)	15.77 ±0.58	8.22 ±0.32	9.58 ±0 .41	6.71 ±0.37	36.12	82.68	≤ 0.001
Inner diameter(cm)	13.55 ±0.55	6.60 ±0 .29	8.18 ±0.40	6.50 ±0.38	31.76	58.28	≤ 0.001
Outer depth(cm)	4.09±0.30	2.80±0.25	2.83±0.08	2.37 ±0.06	24.90	16.05	≤ 0.001
Inner depth(cm)	2.70 ±0.25	1.98 ± 0.22	1.50±0 .08	1.98 ±0.07	18.32	8.65	≤ 0.001
Cup thickness(cm)	2.22 ±0.15	1.62 ±0.11	1.40 ± 0.09	0.21±0 .01	39.63	83.89	≤ 0.001
Cup volume (cu cm)	384.18 ±36.45	68.75 ±8.43	81.40 ±9.31	68.84 ±8.00	26.01	70.69	≤ 0.001
Total volume(cm3)	803.68 ±67.53	151.54 ±18.23	207.62 ±18.02	88.88 ±10.26	37.33	97.14	≤ 0.001
Material Volume (cm3)	419.50 ±41.60	82.77 ±10.38	126.22 ±10.78	20.03 ±3.11	43.17	78.43	≤ 0.001

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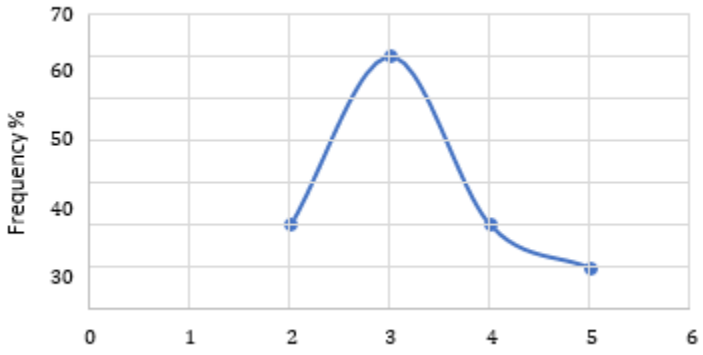

Figure 1: Clutch size and frequency of Indian Robin

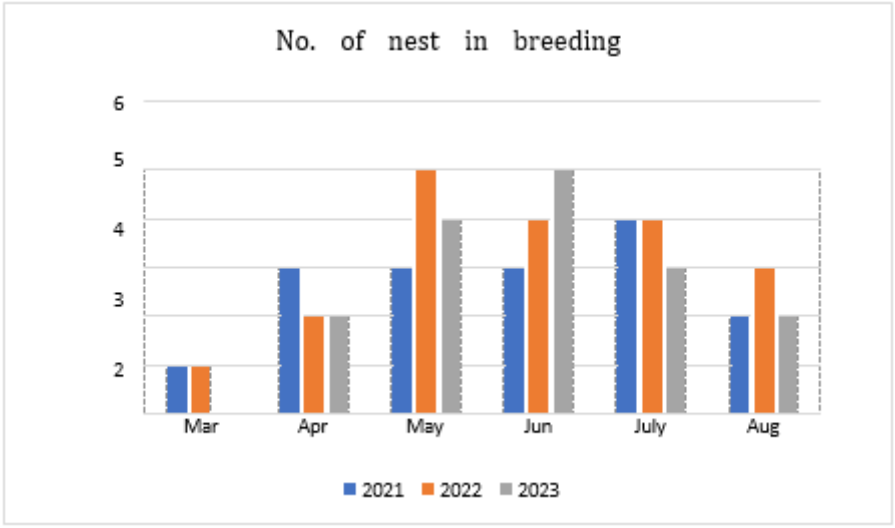

Figure 2: Nests found in different months during the breeding season in the Indian Robin

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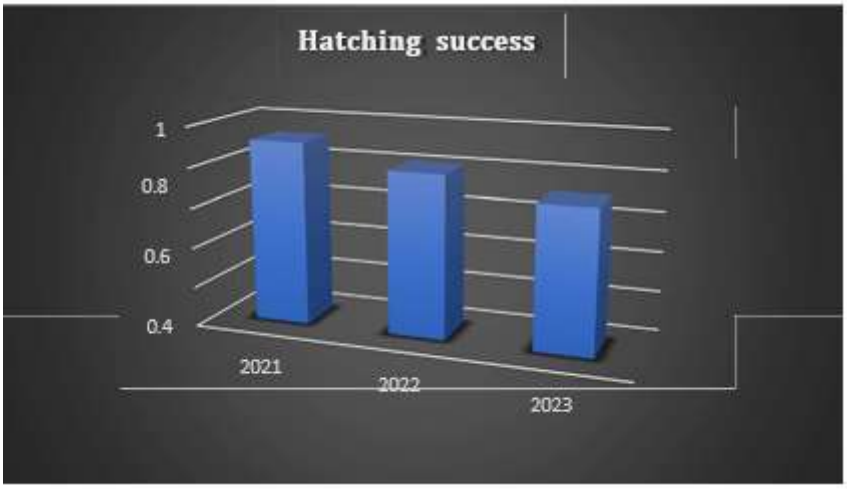

Figure 3: Year-wise hatching success in Indian Robin

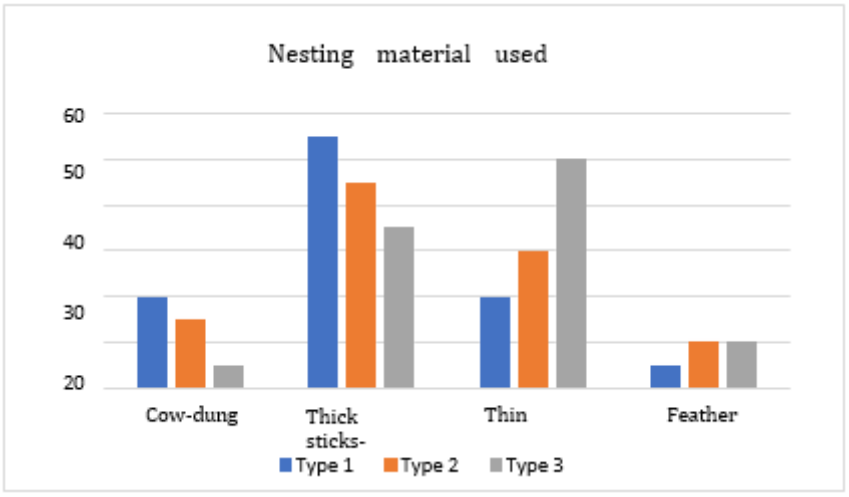

Figure 4: Showing nesting material percentage used in Different type of nest in Indian Robin

Nesting Phase

Over the course of the three years, the nesting phase, which is the period that is connected with the construction and preparation of a nest, shown small changes. The average length of the nesting period for Indian Robins was 10.06 ± 0.66 days in the year 2021.In the years 2022 and 2023, on the other hand, the length of stay increased to 10.41 ± 0.51 days and 13.47 ± 0.37 days, respectively. The extended period that was seen in the year 2023 suggests that there may be discrepancies in the behaviors associated with the building of nests or the availability of resources during that specific breeding season.

Over the course of the three years, the incubation period—which is defined as the amount of time that the female spends incubating the eggs—displayed constant lengths. In the year 2021, the average incubation time for Indian Robins was 12.16 ± 0.33 days, but in the years 2022 and 2023, the durations were 11.47 ± 0.50 and 12.35 ± 0.32 days, respectively (see Table 1).

Fledgling phase

There were slight changes noted between the years during the fledgling phase, which is the period that starts from the time the birds hatch and ends when they leave the nest.

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The average length of the fledgling period was 13.7 ± 0.38 days in 2021, 12.80 ± 0.37 days in 2022, and 12.79 ± 0.31 days in 2023. The number of nests that were discovered during the months of May and June, which coincide with the mating season, was the largest, as shown in Figure 4.7.

Clutch size and hatching success

A succinct description of the results that were derived from three successive years—2021, 2022, and 2023—can be seen in Table 4.5. During the course of the three-year period, the clutch sizes of the Indian Robins displayed reasonably stable patterns, with mean values that ranged from 3.26 ± 0.18 to 3.47 ± 0.12. This indicates that, in the region that was analyzed, Indian Robins generally lay clutches that consist of between three and four eggs when they are breeding. The hatching rates, egg loss rates, and successful fledging rates were all taken into consideration in order to assess the degree to which the Indian Robins were successful in reproducing. The research found that the rates of hatching success decreased during the course of the whole investigation. The mean values were 0.91 ± 0.10 for the year 2021, 0.81 ± 0.03 for the year 2022, and 0.71± 0.02 for the year 2023, respectively (see Figure 4.9). The first rise in the number of clutches, together with the related frequency of that increase, is as follows: the greatest frequency was recorded when the clutch size was 03, and this accounted for 60 percent.

1. Nesting material

Among the materials used for the nest were thick lantana bushes, thinner bushes, and a combination of feathers and cow manure. There are several kinds of nests, and each of these types makes use of a distinct set of ingredients for nest-making.

2. Hatching Success

The total number of eggs that successfully hatched was 131, which amounted to a hatching success rate of 81% This was determined based on the monitoring of 167 eggs over the course of three years. The chicks had bulging abdomens, were naked, and were quite weak when they first hatched. After the chicks hatched, the parent that was taking care of them immediately removed the empty eggshells from the nest.

3. Young and parental care

The two parents took part in the construction of the nest and alternated in the role of protecting it. Until they were able to take flight, the parents supplied them with little lizards and soft larvae of arthropods to eat. The fledging phase has a duration of about 13.09 ± 0.02 days. According to these results, there is a possibility that the general reproductive success of Indian Robins has seen a decrease over the course of the last several years. There are reasons for worry about the reported reduction in hatching success rates, and there is a need for more inquiry. The sizes of the clutches produced by Indian robins was fairly constant, with average values ranging from 3.26 ± 0.18 to 3.47 ± 0.12. Findings that were comparable to these were reported by Kaur and Kler (2018). There has been a negative link that has been shown to exist between the intensity of urbanization and clutch size in the case of various species of passerine birds, including the blue tit and the great tit (Vaugoyeau et al., 2016). According to the findings of Kaur and Kler (2018), the average incubation time in the Punjab area was determined to be 11.5 ± 0.22 days. Nevertheless, an increased duration of the incubation period was observed in the current investigation. A number of different environmental circumstances, including temperature (Hermann and Ar, 1974), might be contributing factors to this difference. The incubation time for Indian Robins in the region where the research was conducted is reasonably consistent, according to these data.

IV. CONCLUSION

The fledgling period also displayed slight year-to-year climatic variation. Slightly shorter fledging durations were observed in 2022 and 2023 compared to 2021, possibly due to warmer conditions accelerating chick growth and increased arthropod abundance. Clutch size remained largely stable (3.26–3.47 eggs), but hatching success revealed a declining trend from 2021 to 2023 (0.91 to 0.71). This decline is likely influenced by climatic instability, particularly irregular rainfall patterns and increased temperature extremes that can negatively affect egg viability, parental incubation efficiency, and nest microclimate regulation. The negative trend in hatching success may also reflect increasing climatic stressors in the region, pointing to emerging ecological threats for this species.

Nest types varied significantly across habitats influenced by microclimatic conditions. In drier, hotter regions, smaller nests (Type-4) with reduced dimensions were constructed, possibly improving temperature regulation and reducing predation risks. Nests in more humid zones or shaded habitats were larger and structurally complex, reflecting adaptation to different climatic pressures. This indicates behavioural plasticity influenced by microclimatic conditions, allowing individuals to optimize reproductive success within their territories. Reproductive patterns of Indian Robins showed distinct variability across climatic conditions. The study documented that in years with balanced temperature ranges and timely rainfall, nesting activity began earlier, clutch sizes were larger, and fledgling survival rates were significantly higher. Abundant insect availability ensured better parental feeding, faster chick growth, and increased fledgling fitness. Adverse climatic events, however, disrupted breeding schedules. High-temperature stress led to dehydration and reduced feeding frequency, while erratic rainfall patterns increased chick mortality. Nests built during unstable climatic phases were more prone to collapse, predation, and abandonment. These findings underscore the vulnerability of avian reproduction to climatic disturbances, even in species considered behaviourally adaptable.

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