

Patterns of Nest-Site Selection and Breeding Performance of Paradise Flycatcher (*Terpsiphone paradisi*) in Islamabad, Pakistan

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SUMMARY

This study examines the distribution and nesting behavior of the Asian Paradise Flycatcher (*Terpsiphone paradisi*) in Margalla Hills National Park (MHNP), Islamabad. As a member of the Monarchidae family, this species is easily identifiable due to its distinct sexual dimorphism: males possess long, ribbon-like tails and bright blue eye-rings, while females are brown, have shorter tails, and gray eye-rings. Although classified as Least Concern, their breeding success is closely tied to habitat quality. The research involved 88 surveys across 40 sites, with the species most frequently observed in areas such as Dhoke Jouri, Kalinjer, Trail 5, Trail 6, Shahdara, and Bari Imam, all of which feature dense plant cover and minimal disturbance. Sex-specific analysis revealed that males dominated key breeding sites like Trail 5 and Dhoke Jouri, while female-biased populations were noted in Shahdara and Jori Ragan, indicating a strong site fidelity during nesting. A total of twelve nests were recorded, typically built within shrubs or medium-height trees using pine needles and grasses for concealment. Nesting activities occurred from March to August, peaking in May and June, with reproductive success highest in undisturbed habitats. The species displayed strong territorial behavior, with females actively alerting males to potential threats. Data on illumination demonstrate that Paradise Flycatchers are highly favored nesting in sunny locations, with most of the nest sites occurring in such conditions.

Keywords: Paradise Flycatcher, nest-site selection, nest success, Pakistan

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INTRODUCTION

Birds represent one of the most fascinating (Altaf, 2010; Altaf, 2016) and diverse groups of vertebrates (Rahman et al., 2023), with more than 9000 species recorded worldwide (Callaghan et al., 2021). They are not only admired for their beauty and song but also valued for their ecological roles as pollinators, seed dispersers, predators, and indicators of ecosystem health (Mariyappan et al., 2023). Their ability to thrive in habitats ranging from deserts and mountains to tropical forests makes them unique among terrestrial vertebrates. However, in many regions, rapid urbanization, deforestation, and other human-induced pressures continue to threaten avian diversity (Zaman et al., 2023).

Habitat selection is important for birds, as it directly affects their survival, reproductive success, and population trends. The choice of nest sites significantly influences the reproductive success and survival of territorial birds. Ideal nesting locations provide favorable microclimatic conditions that enhance offspring growth, thereby affecting birds' physiological adaptations, survival rates, and development. However, various factors can influence nest habitat preference, including intra- and interspecific competition, predation, parasitism, vegetation composition, and human activities. Severe natural events such as floods, droughts, wildfires, windstorms, and intense rainfall also play a role in shaping nest-site selection patterns, which, in turn, affect breeding success and population dynamics (Chalfoun and Schmidt, 2012; Rahman et al., 2021).

Understanding the characteristics that birds prioritize when selecting nesting locations can provide valuable insights into the behavioral and ecological processes underlying nest-site selection. This knowledge can also inform conservation planning for breeding birds of interest or those residing in threatened habitats. Numerous research projects have been conducted to investigate the traits of nesting locations and the selection strategies of various bird species, as these factors often influence breeding success (Gómez-Silva et al., 2024).

Among this diversity, the Asian Paradise Flycatcher (*Terpsiphone paradisi*) is a medium-sized passerine bird that holds a special charm. A member of the Monarchidae family, is distinguished by its remarkable sexual dimorphism—the long, flowing ribbon-like tails of the males contrasting sharply with the more subdued rufous-brown plumage of the females. Distributed widely across Asia, from dense woodlands to cultivated gardens, it is primarily insectivorous, feeding on a wide range of flying insects (Hou et al., 2020; Kabir, 2024). The breeding season runs from March to August, with peak activity in May and June. Nests are cup-shaped and built about 15 meters above the ground (Kabir, 2024). Its graceful appearance, coupled with unique breeding behavior such as cooperative nest building and strong territorial instincts, has long fascinated ornithologists (Reza and Hasan, 2024).

Despite its wide distribution and an IUCN status of Least Concern, information about the breeding ecology and distribution of *T. paradisi* in Pakistan is still limited. This gap in knowledge is particularly noticeable in protected areas such as Margalla Hills National Park (MHNP) in Islamabad, which is a crucial refuge for bird species. Therefore, this study aims to investigate the nesting ecology and distribution of this charismatic species within MHNP, providing essential baseline data for its ecological understanding and future conservation efforts.

MATERIALS AND METHODS

STUDY AREA

This study was carried out in Margalla Hills National Park (Figure 1) located in the Islamabad Capital Territory (ICT) at the foothills of the Himalayan range. MHNP has area of 17,386 hectares. The geographic coordinates of MHNP are 33°39'0" to 33°49'30"N latitude and 72°51'0" to 73°13'0" E. During the monsoon (July to September), the average monthly rainfall is 254 mm, with the heaviest rainfall occurring in August. The park's vegetation consists of sub-tropical pine forests at

higher elevations and dry tropical deciduous forests on lower slope. The climate is sub-humid monsoonic, with extremes from 42°C in summer to below 0°C in winter. Ecologically rich, the park sustains a diverse assemblage of mammals, reptiles, and birds, making it one of the most significant wildlife refuges in the region (Khan et al., 2020; Iftikhar et al., 2023).

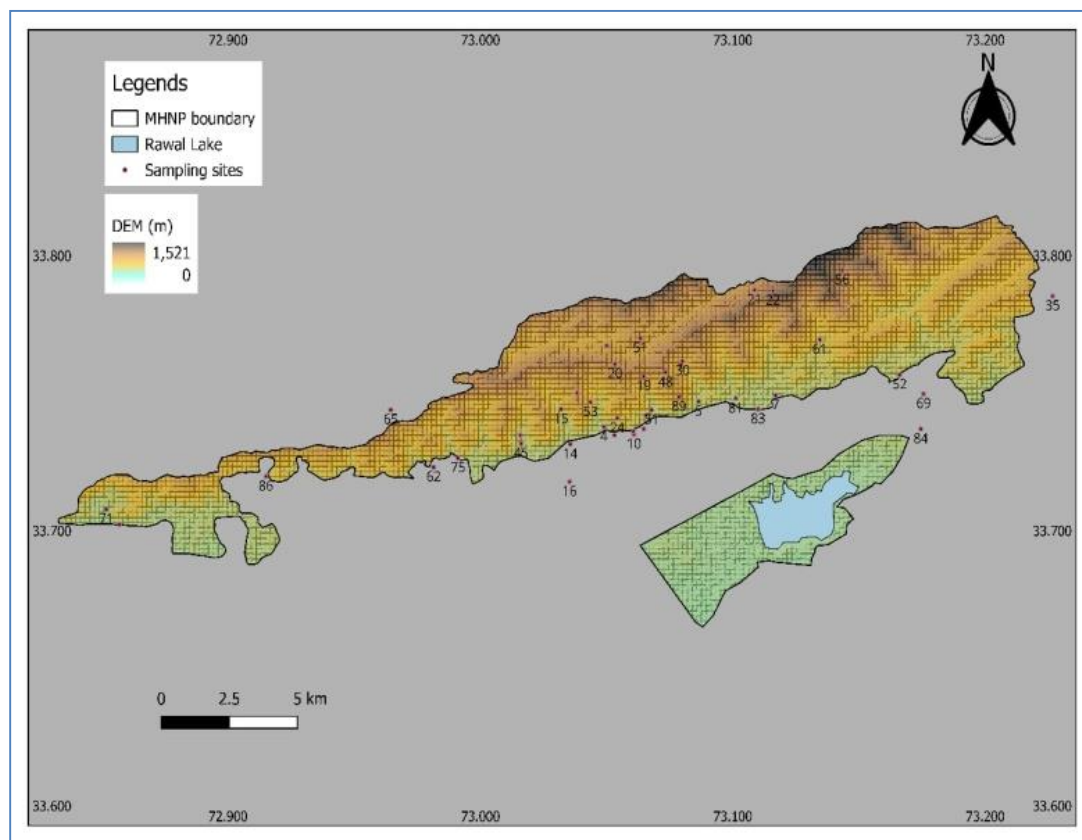


Figure 1: Map of the study area.

STUDY PERIOD

The present study was conducted over a period of approximately eight months, from November 2024 to June 2025. Fieldwork was concentrated during March, April, May, and June, coinciding with the peak breeding season of the Indian Paradise Flycatcher. This period provided ideal conditions for observing nesting behavior and habitat preferences (Figure 2). The remaining months were dedicated to data analysis, result interpretation, and thesis compilation. A total of 88 transects were surveyed across 40 sampling sites. These sites included a range of habitats such as cheer pine forests and deciduous shrublands, with varying patterns of Paradise Flycatcher presence and absence observed. Geographic coordinates, elevation, and habitat types were recorded for each location using a Garmin GPS device to ensure spatial accuracy. For distant and non-intrusive bird observation, Bushnell 10×42 binoculars were used, enabling researchers to monitor birds while minimizing disturbance. A Nikon D500 DSLR camera equipped with a Tamron 150–600mm G2 telephoto lens was employed to document birds, nests, and surrounding vegetation in high

resolution, aiding both species confirmation and ecological analysis. Vernier calipers and measuring tapes were used to obtain precise nest and egg measurements. To further minimize human interference, camouflage suits were worn during field observations, allowing researchers to remain unobtrusive in the birds' natural habitat. All observations, including behavioral notes, nest descriptions, and environmental data, were meticulously recorded in field notebooks and supported by photographic and GPS evidence to ensure the reliability and validity of the collected data.



Figure 2: Male (A) and female (B) Paradise flycatcher along with nest, eggs (C) and chicks (D).

DATA COLLECTION TECHNIQUES

As part of the data collection techniques employed in this study, the Line Transect Method was used as the primary field survey approach to assess the distribution and habitat use of the Indian Paradise Flycatcher in Margalla Hills National Park. This method, widely recognized in avian ecological research, enabled systematic coverage of varied habitats while minimizing observer bias. A total of 88 transects, each approximately 1.5 kilometers in length, were strategically laid across four stratified zones—Bara Kahu, Golra, Nurpur Shahan, and Saidpur—representing two main habitat types: chir pine forest and deciduous shrubland. Surveys were conducted on foot at a slow and steady pace (around 1.5 km/hour) during peak bird activity hours (07:00–12:00 and 04:00–06:30) to maximize detection probability. Observers

recorded detailed field data on species presence or absence, sex (if identifiable), behavior (perching, foraging, calling, territorial display), habitat features, vegetation type, weather conditions, and precise GPS coordinates using a Garmin device. Preliminary field visits conducted in November 2024 yielded no sightings, leading to the confirmation of seasonal migratory behavior and the formal commencement of data collection in March. Playback of pre-recorded calls was occasionally employed under ethical guidelines to enhance species detectability. Each site was visited multiple times throughout the study period to ensure consistency, detect temporal variation, and enhance the robustness of distributional assessments.

Nest Search and Monitoring

Nest search and monitoring were conducted from March to June to investigate the breeding ecology of the Indian Paradise Flycatcher in Margalla Hills National Park. Visual inspections focused on likely nesting sites—low branches, dense shrubs, and stream-side vegetation typically 2–5 meters above ground, particularly in high-activity zones like Trails 3 and 5 and the Saidpur stream valley. Surveys were carried out every 2–3 days, with input from experienced local birdwatchers. Data collected included nest height, tree species, clutch size, hatching and fledgling success, and nest dimensions using Vernier calipers and measuring tape.

STATISTICAL ANALYSIS

The data were analysis with the help of OriginPro software and MS Excel.

RESULTS AND DISCUSSION

To assess the distribution of the Indian Paradise Flycatcher in Margalla Hills National Park (MHNP), a total of 88 field surveys were conducted across 40 selected sites. The species was recorded at 24 sites, while no observations were made at the remaining 16, indicating a relatively broad but uneven distribution across the park. A total of 83 individuals were observed, comprising 48 males and 35 females, reflecting a male-biased population structure. Sex-specific distribution patterns revealed that females were more frequently observed at sites such as Trail-6, Kot Jandan, and Kalinjer, whereas a higher concentration of males was recorded at Trail-5, Dhok Jouri, and Bari Imam. Overall, the data indicate a patchy distribution with a noticeable skew towards male sightings, suggesting possible habitat-based or behavioral influences on detectability and site preference (Figure 3).

The study of the Paradise Flycatcher in MHNP revealed 12 nests across 11 sites, with higher density at Trail-3, reflecting preference for dense, less-disturbed habitats. Nests were small, cup-shaped, and concealed in shrubs or mid-canopy trees, built from pine needles, spider silk, and grasses—patterns consistent with regional reports (Reza and Hasan, 2024).

A total of 12 nests of the Paradise Flycatcher were documented across 11 sites in Margalla Hills National Park, showing an uneven distribution that reflects both habitat preference and territorial fidelity among breeding pairs. Trail-3 supported two nests, suggesting comparatively favorable conditions such as dense vegetation, greater food availability, and reduced disturbance, whereas sites like Dara Janglan, Shah Allah Ditta, Bari Imam, Ratta Hotar, Trail-5, Rumli, Dhok Jeevan, Kalinjer, Kot

Jandan, and Golra each hosted a single nest. This scattered nesting pattern highlights the specie's solitary and territorial breeding strategy, which likely reduces competition and predator attention. Despite variation in location, all nests exhibited striking uniformity in structure and materials. The nests were cup-shaped, carefully concealed within thick vegetation or small trees—most commonly Kachnar, Paper Mulberry, Amla, and Salix—at moderate heights from the ground. Nest composition was dominated by dry pine needles, bound with spider webs, and supplemented with dry grasses and small amounts of miscellaneous plant material or debris (Table 1). The surrounding vegetation, which included both native and invasive species such as Lantana, Phulai, Laukat, and Garanda, not only provided camouflage but also structural reinforcement.

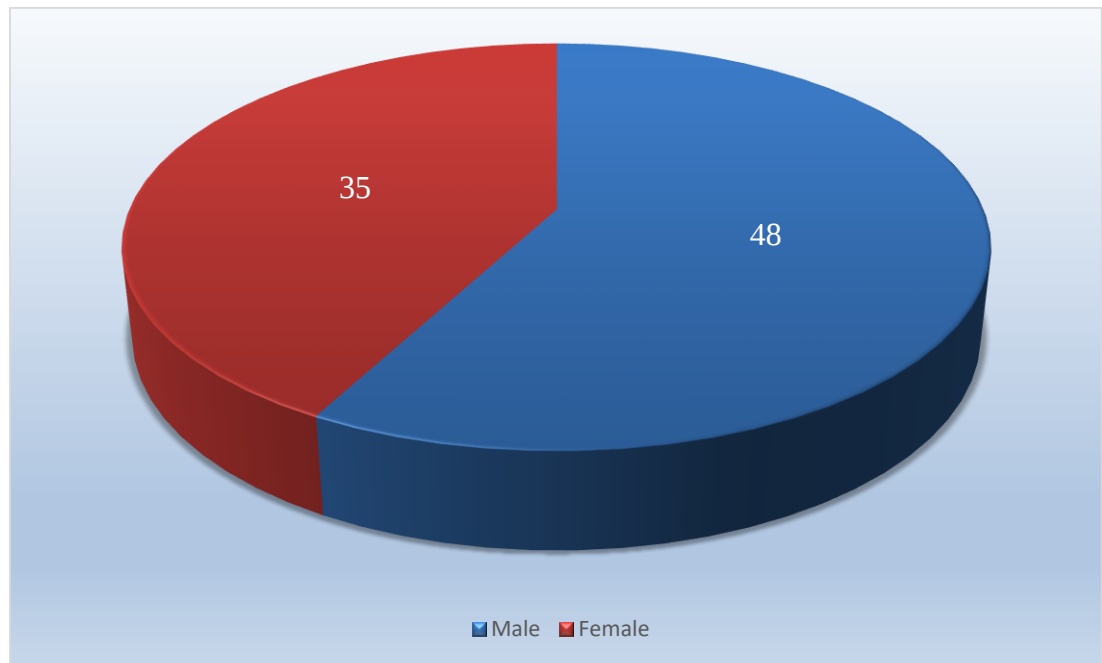


Figure 3: Male and female ratio of paradise flycatcher.

Data on illumination further demonstrate that Paradise Flycatchers are highly biased towards nesting in sunny locations, with most of the nest sites occurring in such conditions. A smaller number of nests were identified in partly cloudy and cloudy weather, implying that well-lit conditions are preferred during breeding. This bias towards sunny locations can be attributed to possibly improved visibility in detecting predators, better microclimatic conditions, and perhaps better food availability. On the contrary, cloudy or shady locations can be less favorable for nest selection, resulting in low nest selection in such locations. All in all, the study has highlighted that the level of illumination does contribute to the development of nest-site choice to some degree in Paradise Flycatchers (Figure 4). Pan et al. (2024) study offers insights into the nesting site preferences of the Amur Paradise Flycatcher. The findings indicate that these birds tend to choose nest sites that provide a wide visual range, some shelter, and lower levels of illumination.

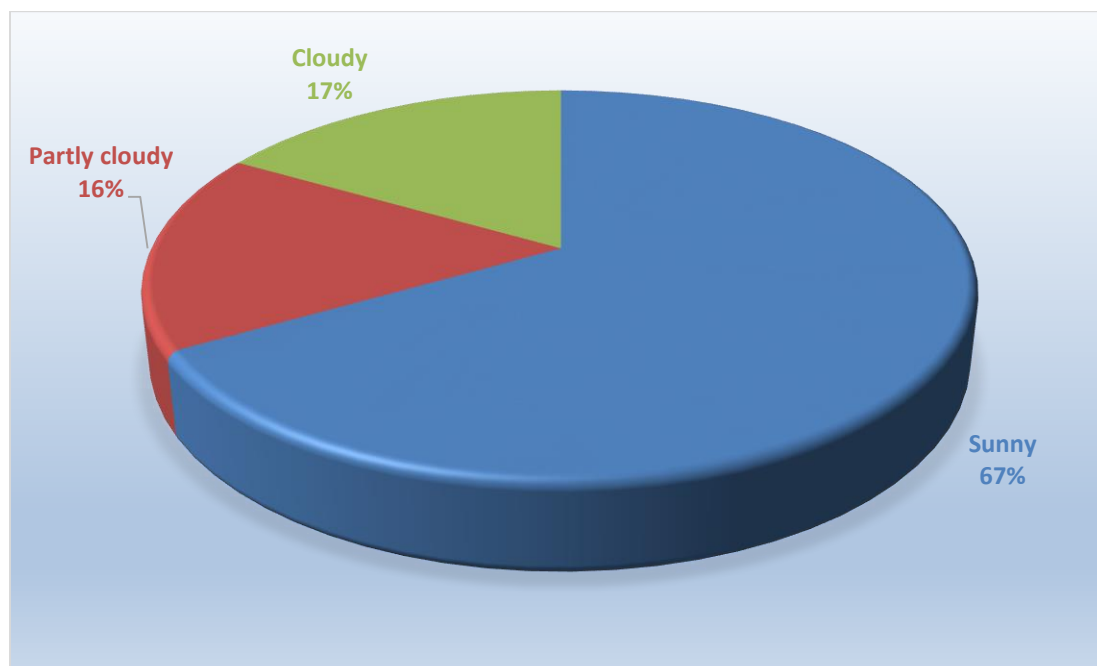


Figure 4: Illumination preferences of paradise flycatcher for selection of nests in study area.

The findings of the principal component analysis (PCA) show that the first principal component (PC1) describes 83.897% of the variation in total, while the second principal component (PC2) contributes 15.515%. Collectively, these two components account for 99.412% of the data collection's variance in total, indicating that the first two components may accurately represent the majority of the variability. PC1 loads positively onto clutch size (0.59494), the number of eggs hatched (0.61009), and the number of fledglings (0.5233), showing that the first principal component summarizes overall reproductive output. High and negative contributions from clutch size (-0.40251) and from number of eggs hatched (-0.33739) offset the PC2 association with the number of fledglings (0.85097), thereby identifying a secondary dimension that quantifies fledgling production relative to brood size and to hatching output (Figure 5).

The analysis of nest-site selection and breeding performance in the Paradise Flycatcher reveals distinct patterns in reproductive success. The first principal component shows a close relationship among clutch size, hatching success, and fledgling output, indicating that nests located in suitable habitats generally support all stages of breeding, from egg laying to fledging. This underscores the importance of nest-site quality, as well-chosen sites offer the resources and protection necessary to maximize overall breeding performance. In contrast, the second component highlights variability in fledgling success that is not strictly tied to clutch size or the number of eggs hatched. This suggests that, despite a strong start regarding clutch size and hatching, fledgling survival is also affected by additional ecological factors such as predation risk, food availability, and parental investment. Therefore, while nest-site selection significantly influences overall breeding outcomes, post-hatching survival introduces further complexity to reproductive performance in the Paradise Flycatcher.

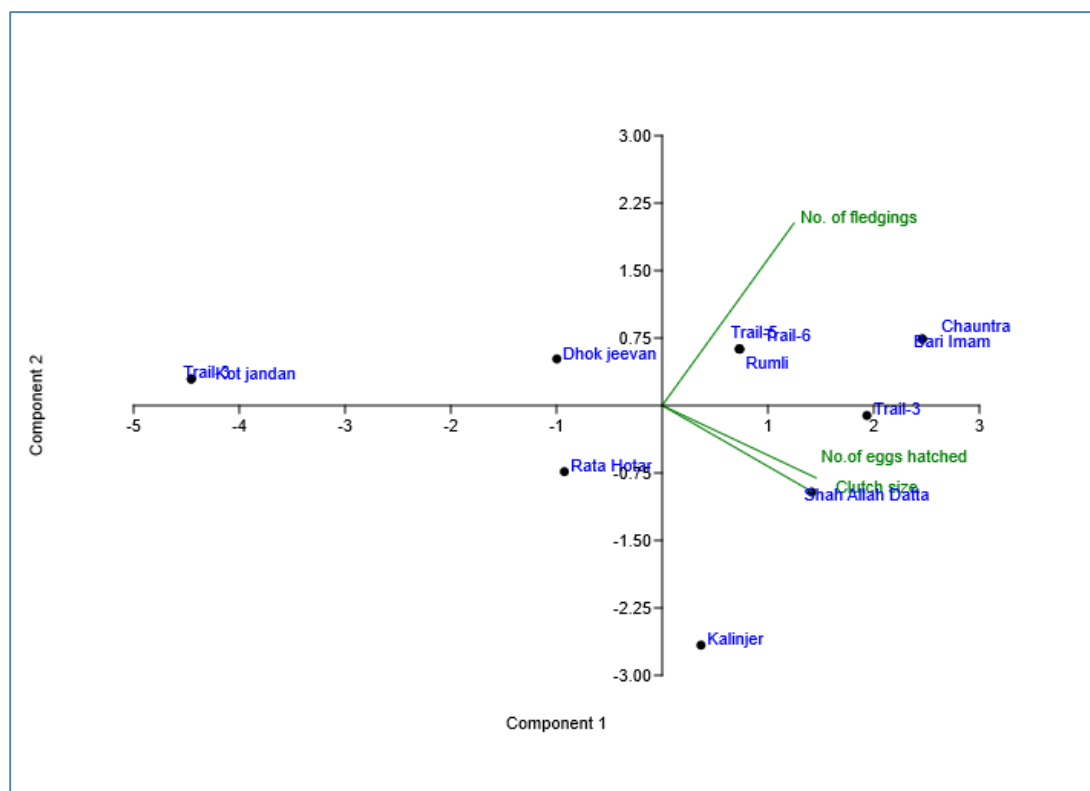


Figure 5: Principle Component Analysis for reproduction (clutch size, egg hatch and number of fledging).

Pan et al. (2024) found a low overall nest success rate of 36.36% for the Amur Paradise Flycatcher in 2021. This aligns with previous studies that reported similarly low rates in other locations, such as Dongzhai, Henan (34.5%) by Xi et al. (2020). The primary causes of nest failures were identified as nest predation and extreme natural events, which are consistent with our observations in this study. Notably, we discovered that the Amur Paradise Flycatcher relies on other bird species, such as the Ashy Drongo (*Dicrurus leucophaeus*) and the Black-naped Oriole (*Oriolus chinensis*), to fend off predators and protect their nests. This behavior underscores the significance of interspecies interactions in enhancing nest survival. Additionally, human disturbance was found to significantly impact nest success, sometimes resulting in nest desertion. In response to frequent disturbances, the species tended to build their nests at greater heights. During our field investigations, we observed instances where some farmers were unaware of environmental protection protocols, leading to the destruction of bird nests due to the cutting down of young trees for personal use (Hsu et al., 2019). Furthermore, human activities such as agriculture, construction, and other developmental projects have severely disrupted bird habitats through land and water exploitation (Altaf et al., 2018; Ali et al., 2020; Rahman et al., 2021).

Data on threats to Paradise Flycatcher nests reveal significant variation in threat types across different sites. In Chauntra and Trail-3, nests were found to be free

from threats, suggesting these areas provide safe habitats. In contrast, predation emerged as a major threat at several locations, including Trail-5, Bari Imam, Shah Allah Datta, Trail-6, Dhok Jeevan, Kot Jandan, and Kalinjer, indicating that nest loss due to predators is a widespread issue in the study area. Additionally, disturbance from human activities significantly affects nest success, as observed in Rata Hotar, Trail-3, and Rumli. Overall, while some locations offer safe nesting environments, the majority still contend with threats from predation and disturbances (Figure 6). Conservation should focus on minimizing disturbance, controlling invasive, and preserving native vegetation to sustain breeding habitats.

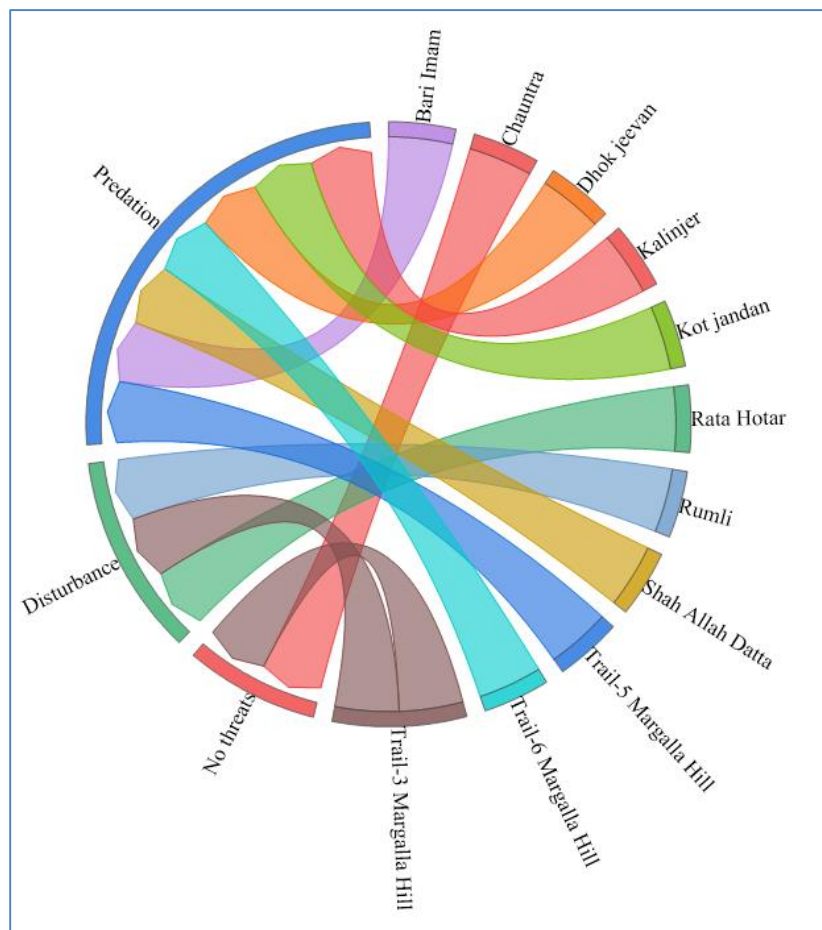


Figure 6: Threats to nests of paradise flycatcher in study area.

CONCLUSION

This study emphasizes the abundance and nesting characteristics of the Indian Paradise flycatcher. Though a number of threats were recorded but the Paradise flycatcher remains resilient and is somewhat thriving in the Margalla Hills National, Park. The analysis recorded a high nesting success rate along with an abundant distribution within the boundary of the national park. The paradise flycatcher plays an important role within the ecosystem is an important summer migrant to the national park. Active habitat management, local community involvement and biological knowledge should all be incorporated into long term conservation.

Table 1: Nests of paradise flycatcher characteristic in the study area.

Location	Nest material	Nest shape	Nest Diameter (cm)	Depth (cm)
Chauntra	Dry pine leaves, Spider webs	Conical	4	3
Trail-5	Dry grasses, Spider web	Conical	4	3.5
Rata Hotar	Dry grasses, Spider web	Conical	3.9	3.5
Bari Imam	Dry grasses, Spider web	Conical	3.8	3.2
Shah Allah Datta	Dry grasses, Spider web	Conical	4	3
Trail-6	Dry grasses, Spider web	Conical	4	3.5
Trail-3	Dry grasses, Spider web	Conical	4	3
Trail-3	Dry grasses, Spider web	Conical	4	3.2
Dhok jeevan	Dry grasses, Spider web	Conical	4	3
Rumli	Dry grasses, Spider web	Conical	3.8	3
Kot jandan	Dry pine leaves, Spider webs	Conical	3.9	3.3
Kalinjer	Dry grasses, Spider web	Conical	4	3

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