Environment and Ecology 44 (2A) : 449—457, April—June 2026
Article DOI: https://doi.org/10.60151/envec/EMUR2487
ISSN: 0970-0420 (Print), ISSN: 3049-3625 (Online)

Population and Distribution of House Crow (*Corvus splendens* Vielliot, 1817) and Jungle Crow (*Corvus macrorhynchos* Wagler, 1827) across Urban Gradients in the Barak Valley, Assam, India

Debasmita Purkayastha, Eliza Basumatary, Sandeep Das, Jatin Sarmah, Hilloljyoti Singha

Received 2 April 2026, Accepted 9 June 2026, Published on 23 June 2026

ABSTRACT

House Crow (*Corvus splendens*) and Jungle Crow (*Corvus macrorhynchos*) are ecologically ideal models for understanding urban adaptation and habitat use. We studied population density and seasonal dynamics of both the bird species across three district headquarters (Silchar, Karimganj and Hailakandi) in the Barak Valley, Assam, representing different levels of urbanisation. A 500 m × 500 m grid-based sampling design was employed, with one randomly selected point per grid, and population data were collected using the point count method (30 m radius, 5-minute duration) from March 2022 to March 2025. Population densities were estimated across commercial, residential and semi-urban habitats. A highly significant difference in densities between House Crow (16.23 ± 15.28 ind/ha) and Jungle Crow (2.73 ± 4.67 ind/ha) was observed ($Z = 25.33$, $p < 0.001$), indicating strong dominance of House Crow across the study area. House Crow densities were the highest in commercial zones of Silchar during the non-breeding season (36 ± 22 ind/ha) and the lowest in semi-urban areas of Hailakandi (6 ± 5 ind/ha). In contrast, Jungle Crow was more abundant in less disturbed habitats, with the highest densities recorded in residential areas of Hailakandi during the non-breeding season (9 ± 3.5 ind/ha) and the lowest in Silchar during the breeding season (0.31 ± 1.0 ind/ha). Seasonal variation revealed significantly higher House Crow densities during the non-breeding season ($p < 0.001$). These findings highlight the role of urbanisation and habitat complexity in shaping corvid community structure in the Barak Valley.

Keywords Urbanisation, House crow, Jungle crow, Population density, Seasonal variation.

INTRODUCTION

Urbanisation is an enormous shift in the environment around the world that impacts both natural habitats

Debasmita Purkayastha[1], Eliza Basumatary[2] , Hilloljyoti Singha[5]*
[1,2]PhD Research Scholar, [5]Professor
Department of Zoology, Bodoland University, India

Sandeep Das[3], Jatin Sarmah[4]
[3,4]Professor
Department of Biotechnology, Bodoland University, India

Email: singha.hilloljyoti@gmail.com
*Corresponding author

and biodiversity. Rapid urban growth results in habitat destruction and biotic homogenisation, thereby modifying species composition within urban areas. Birds are highly sensitive to environmental changes and are extensively utilized as bioindicators of urban ecosystems. The family Corvidae is considered to be the most suitable one for studying how birds adapt to urban areas since they are flexible in their behavior and can live in a wide range of environments (Benmazouz *et al.* 2021).

The House Crow (*Corvus splendens*) is one of the most effective bird species living in urban environments with intermixed habitats. Its success is largely due to its ability to change its behavior and its intimate relationship with human-made food sources. Previous research indicates that House Crows utilize human refuse and establish adaptable foraging groups, allowing them to thrive in altered habitats (Kumar and Ojha 2023). Jayapal *et al.* (2022) reported an overall occupancy of 77% for House Crow in human-modified ecosystems, with markedly higher occupancy in urban areas (96%) than in rural landscapes (72%). These findings highlight the strong positive influence of urbanization variables, including human population density, night-light intensity, and built-up area, on the distribution of House Crows. This has made it easier for them to expand beyond their natural range, which has led to their being called an invasive bird species in some parts of the world (Benmazouz *et al.* 2021).

On the other hand, the Jungle Crow also known as Large-billed Crow (*Corvus macrorhynchos*) is less adapted to urban environments and prefers areas with more plants and less human activity. Urbanization leads to habitat structure simplification and heightened competition, potentially detrimental to species less tolerant of urban environments, such as the Jungle Crow (Tryjanowski *et al.* 2017, Sol *et al.* 2020). Moreover, urban habitats serve as ecological filtering that promote species exhibiting great behavioral flexibility while eliminating those with limited ecological tolerances (Callaghan *et al.* 2019, Santini *et al*. 2019).

Interspecific competition and resource availability are two more major things that affect how adaptable Corvids are. House Crows can compete with other bird species, even closely related Corvids, since they are aggressive and good at using human-made food sources. The dominance in urban Corvids is significantly correlated with the resource availability and behavioral flexibility (Szala *et al.* 2020, Benmazouz *et al.* 2021). Although several studies have examined urban bird communities and corvid ecology, comparative studies focusing on sympatric crow species across different levels of urbanisation, particularly in Northeast India, has not been done yet. The Barak Valley, located in Southern Assam, represents a rapidly urbanising region with heterogeneous habitat structures, providing an ideal landscape to examine species-specific responses to urbanisation gradients.

The present study aims to: (i) Estimate and compare the population density of House Crow and Jungle Crow across different habitats and district headquarters ; (ii) Examine seasonal variation in their population dynamics ; and (iii) Evaluate the influence of urbanisation on their distribution patterns.

MATERIALS AND METHODS

Study area

The current study was carried out in the Barak Valley (24°08′ and 25°08′ N and longitudes 92°15′ and 93°15′ E) in district headquarter towns in Southern Assam, India (Fig. 1). Cachar, Karimganj and Hailakandi are the three administrative districts which constitute the region. The valley is bordered to the North by the Barail Range, to the South by the Mizo Hills, and to the West and Southwest by an international border with Bangladesh. The Barak Valley is having high human population density, rapid urban expansion, and diverse habitat structure. The Barak River and its many tributaries, which are vital in forming the terrain and sustaining human settlements, drain the valley. Its land-use patterns are a mosaic of densely populated urban centers, semi-urban transitional zones, peri-urban/rural habitats, and agricultural fields, wetlands and scattered vegetation.

Our present study primarily focused on the district headquarters of Cachar (Silchar), Karimganj

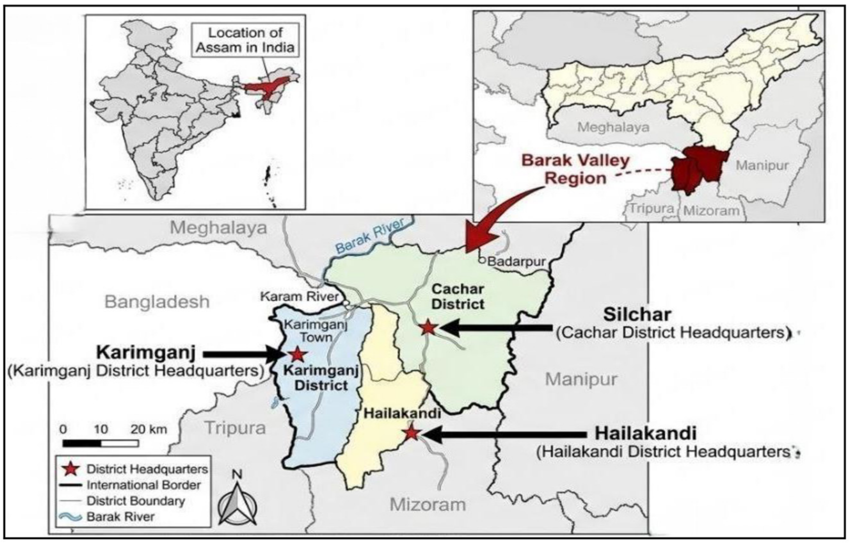

Fig. 1. Map of District headquarter towns of Barak Valley, Assam, India.

(Karimganj), and Hailakandi (Hailakandi) districts, which represent varying levels of urbanization within the valley. The largest and most urbanised of these is Silchar, which serves as Southern Assam's main administrative and commercial center. Karimganj and Hailakandi, on the other hand, are relatively smaller towns with lower population densities and moderate urban development. As per the 2011 human population Census, the population of Silchar was 172,830, while that of Karimganj and Hailakandi was 56,854 and 33,637, respectively.

The urban landscape was divided into three habitat categories for the purposes of this study: Commercial Areas (CAs), which are characterised by intense human activity, dense infrastructure, and high food availability associated with anthropogenic waste and market activities (Kumar and Ojha 2023). Residential Areas (RAs), which are dominated by mixed housing clusters with RCC and traditional Assam-type houses, home gardens, and moderate vegetation providing nesting opportunities. Semi-Urban Areas (SUAs), which represent transitional, outskirt regions, open fields with limited residential and vegetative cover (McDonnell and Hahs 2008). This classification represents a gradient of urbanisation intensity, enabling systematic comparison of crow population dynamics across habitats with differing levels of human disturbance and resource availability (Jayapal *et al.* 2022). For opportunistic and synanthropic bird species, such as Corvids, such heterogeneity offers a variety of ecological niches.

Data collection

A systematic grid-based sampling design was used in three major urban centres of the Barak Valley (Fig. 2) to estimate the population density and distribution of the sympatric House Crow (*Corvus splendens*) and Jungle Crow (*Corvus macrorhynchos*). Sampling effort was adjusted according to spatial extent and habitat heterogeneity (Blair 1996, Sutherland 2006). To guarantee consistent geographic coverage, a 500 m × 500 m (0.25 km²) grid overlay was created using high-resolution satellite imagery (Google Earth) (Gregory *et al.* 2004). Silchar had the highest number of grids (n = 72) as it is the largest town (now has been declared as city) having main administrative and economic center of Southern Assam. Comparatively, the smaller district headquarter towns, Karimganj and Hailakandi had less number of grids: n = 44 and n = 34, respectively. One point of 30 m radius was randomly chosen within each grid, and the Point Count Method (Buckland *et al.* 2001) was applied.

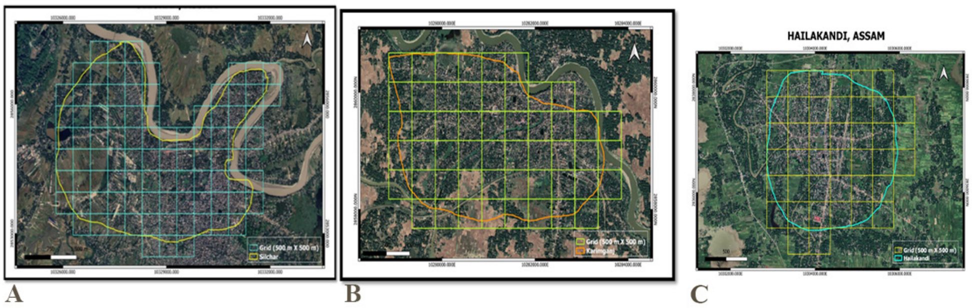

Fig. 2. Systematic grid-based map of study sites: a) Silchar, b) Karimganj and c) Hailakandi.

The surveys were carried out during the peak activity window, starting one hour after sunrise (06:00 to 09:00 hors) (Bibby 2000). A 5-minute observation bout was conducted at each point, and thus eight grids per day were counted. Birds flying overhead and not interacting with the specific grid habitat were excluded from the primary data set to avoid over estimation. We collected the data seasonally during the Breeding season (BS) (March to August) and Non-Breeding season (NBS) (September to February) for both the crow species from March 2022 to March 2025 (Anjum *et al.* 2021; Ojha and Kumar 2024) based on regional field observations and standard avian breeding patterns in Northeast India. Each point was visited once per season, resulting in two surveys per year to assess seasonal variation in population. Thus irrespective of seasons, a total of 432 of points were surveyed in Silchar, and 264 and 204 points were surveyed in Karimganj and Hailakandi, respectively, with a grand total of 900 sample sizes in the Barak Valley.

Statistical analyses

The population data of the Crows collected across the three-district headquarters of the Barak Valley, Assam, were analyzed using PAST 4.03 statistical software. The population density (D) of each species was calculated for each habitat type (Commercial Area, Residential Area, and Semi-urban Area) using the standard formula: $D = N/A$; where N is the total number of individuals observed in the particular point, and A is the area of that sampling point ($\pi r^2 = 2827$ m² for a 30 m radius) (Nath *et al.* 2019, 2022). Population densities were expressed as Mean ± standard deviation (SD) to represent variability among replicate observations. Density values (individuals/m²) were converted to individuals per hectare (ind/ha) by multiplying by 10,000, as 1 hectare equals 10,000 m². The data had been first tested for normality before undergoing the statistical analysis. When the data were not normally distributed, we applied log transformation. After transforming the data, if the data were still not normally distributed, we used non-parametric tests. To check if there was significant difference of population between the crows in the Breeding and Non-Breeding Seasons in all the habitats, the Z test ($n > 30$, assuming large sample approximation) and Mann-Whitney U test for SUA of Hailakandi was applied. We found that there was no significant difference of population densities among the three years, so the data of both the seasons were combined separately of three years for the subsequent analysis. The Kruskal-Wallis H test was used to examine to test for significant difference in population of both the crow species separately between the two seasons in the three consecutive years in all the habitats i.e., CA, RA and SUA. Finally, differences in population density between the two species across habitats, seasons, and the entire observation period were evaluated.

RESULTS

Population density estimation

House Crows exhibited a significantly higher overall mean density (16.23 ± 15.28 ind/ha) than Jungle Crows (2.73 ± 4.67 ind/ha) across Barak Valley, indicating its dominance in entire study site throughout the observation period ($Z = 25.33$, $n_1 = n_2 = 900$, p

< 0.001). The mean population densities of House Crow and Jungle Crow across different habitats in three district Headquarter towns are shown in Tables 1.1 & 1.2. Mean values are expressed as individuals per hectare (ind/ha).

Table 1.1. Mean population density per hectare of House Crows among three habitats across the three District Headquarter Towns (DHQT) in the Barak Valley, Assam during 2022–2025.

DHQTs	Season	Habitat	Mean ± SD (ind/ha)
	BS	CA	25 ± 13
	BS	RA	10 ± 7
	BS	SUA	15 ± 8
SILCHAR	NBS	CA	36 ± 22
	NBS	RA	16 ± 13
	NBS	SUA	26 ± 14
	BS	CA	9 ± 10
	BS	RA	12 ± 12
	BS	SUA	9 ± 5
KARIMGANJ	NBS	CA	12 ± 12
	NBS	RA	13 ± 7
	NBS	SUA	11 ± 9
	BS	CA	7 ± 5
	BS	RA	10 ± 11
	BS	SUA	6 ± 5
HAILAKANDI	NBS	CA	7 ± 4
	NBS	RA	6 ± 5
	NBS	SUA	6 ± 4

Table 1.2. Mean population density per hectare of Jungle Crows among three habitats across the three District Headquarter Towns (DHQT) in the Barak Valley, Assam during 2022–2025.

DHQTs	Season	Habitat	Mean ± SD (ind/ha)
SILCHAR		CA	0.9 ± 2.1
	BS	RA	0.31 ± 1.0
		SUA	0.9 ± 2.1
		CA	1.1 ± 2.7
	NBS	RA	0.39 ± 1.12
		SUA	1.2 ± 1.9
KARIMGANJ		CA	1.3 ± 1.8
	BS	RA	2.0 ± 2.0
		SUA	1.8 ± 2.2
		CA	2.5 ± 2.4
	NBS	RA	2.6 ± 2.3
		SUA	2.7 ± 2.2
HAILAKANDI		CA	6.4 ± 4.5
	BS	RA	5.0 ± 9.4
		SUA	5.2 ± 3.5
		CA	8.2 ± 5.2
	NBS	RA	9.7 ± 3.5
		SUA	5.4 ± 4.1

Table 2. Difference in House Crow population in DHQTs between Breeding and Non- Breeding Seasons in different Habitats during March 2022 through March 2025 in the Barak Valley, Assam.

DHQTs	Habitats	Test statistics	Sample size (n_1, n_2)	Significance
Silchar	CA	Z= 4.69	105, 105	P < 0.001
	RA	Z= 3.48	81, 81	P < 0.001
	SUA	Z= 3.10	30, 30	P < 0.01
Karimganj	CA	Z= 4.17	48, 48	P < 0.001
	RA	Z= 3.27	54, 54	P < 0.01
	SUA	Z= 9.50	30, 30	P < 0.001
Hailakandi	CA	Z= 0.24	36, 36	NS
	RA	Z= 1.59	42, 42	NS
	SUA	U= 275.5	24, 24	NS

The highest density of House Crow (36 ± 22 ind/ha) was recorded in Silchar (CA) during the non-breeding season, while the lowest density (6 ± 5 ind/ha) was observed in Hailakandi (SUA) during the breeding season.

In the case of Jungle Crow, the highest density (9 ± 3.5 ind/ha) was recorded in Hailakandi (RA) during the non-breeding season, whereas the lowest density (0.31 ± 1.0 ind/ha) was observed in Silchar (RA) during the breeding season.

Population variations during breeding and non-breeding seasons

There was a significant difference in population of House Crow between breeding and non-breeding season in all the habitats in Silchar and Karimganj, while no significant difference was seen in Hailakandi (Table 2). However, no significant difference in population of Jungle Crow between breeding and non-breeding season was observed in all the habitats and district Headquarter towns.

Population variation between house crow and jungle crow

There was a significant difference found for the population between House Crow and Jungle Crow in Silchar and Karimganj in both breeding and non-breeding season ; however, there was no signif-

Table 3.1. Difference in House Crow and Jungle Crow population in different habitats during breeding season during March 2022 through March 2025 in the Barak Valley, Assam.

District HQs	Habitats	Test statistics	Sample size (n_1, n_2)	Significance
Silchar	CA	Z= 18.3	105, 105	P < 0.001
	RA	Z= 16.32	81, 81	P < 0.001
	SUA	Z= 12.05	30, 30	P < 0.001
Karimganj	CA	Z= 5.03	48, 48	P < 0.001
	RA	Z= 5.89	54, 54	P < 0.001
	SUA	Z= 6.33	30, 30	P < 0.001
Hailakandi	CA	Z= 8.58	36, 36	P < 0.001
	RA	Z= 0.65	42, 42	NS
	SUA	U= 251.5	24, 24	NS

Table 3.2. Difference in House Crow and Jungle Crow population in different habitats during non-breeding season during March 2022 through March 2025 in the Barak Valley, Assam.

District HQs	Habitats	Test statistics	Sample size (n_1, n_2)	Significance
Silchar	CA	Z= 16.31	105, 105	P < 0.001
	RA	Z= 10.77	81, 81	P < 0.001
	SUA	Z= 9.33	30, 30	P < 0.001
Karimganj	CA	Z= 4.56	48, 48	P < 0.001
	RA	Z= 27.05	54, 54	P < 0.001
	SUA	Z= 4.31	30, 30	P < 0.001
Hailakandi	CA	Z= 0.57	36, 36	NS
	RA	Z= 0.29	42, 42	NS
	SUA	U= 248	24, 24	NS

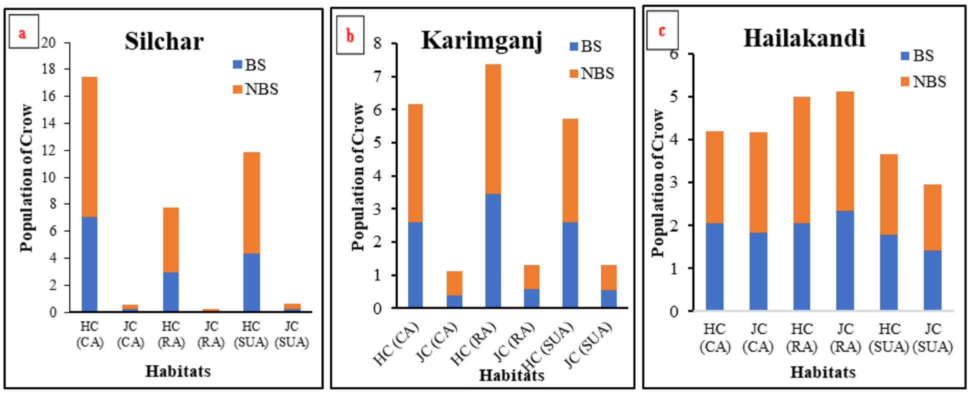

Fig. 3. Comparative analysis of mean number of individuals of House Crow (*Corvus splendens*) and Jungle Crow (*Corvus macrorhynchos*) in commercial (CA), residential (RA), and sub-urban (SUA) habitats during breeding (BS) and non-breeding seasons (NBS) during our entire study period (2022–2025) in Silchar, Karimganj, and Hailakandi districts of Barak Valley, Assam.

icant difference found in Hailakandi, except for CA during breeding season (Tables 3.1 & 3.2 and Fig. 3).

DISCUSSION

Our study is the pioneer study about the population distribution of crows in the Barak Valley. Therefore, density of House Crow (16.23 ind/ha) and Jungle Crow (2.73 ± 4.67 ind/ha) is the baseline data for future relevant studies. However, this can be compared with other similar studies have been conducted in India and abroad. A study from Delhi reported densities of up to 40 ind/ha in certain urban areas, which are higher than the present estimates, and likely reflect intense urbanisation and concentrated resource availability (Khera *et al.* 2009). House Crow populations exhibit considerable spatial variation as a study from Jaipur, Rajasthan reported a density ranging from (15.37–34 birds/km², with peaks >50 birds/km²), indicating comparable population levels under favorable urban conditions (Tak *et al.* 2025). This study further highlights the species' strong behavioral plasticity and reliance on anthropogenic resources, scavenging behavior, supporting the present findings that urban resource availability and habitat conditions primarily drive variations in crow density, which remains lower than the density observed in the present study, indicating comparatively higher abundance in the Barak Valley. Localized population declines of House Crows have been observed in parts of India such as Punjab, suggesting that population trends may also be influenced by habitat alteration and changing urban dynamics (Kaur and Khera 2020). These contrasting values suggest that House Crow populations can vary widely depending on urban intensity, food availability, and habitat structure.

In Singapore, densities of House Crow declined from approximately 1.9 ind/ha (~130,000 individuals in 2003) to 0.134 ind/ha following long-term management interventions (Tan *et al.* 2020). This contrast clearly highlights the role of sustained population control measures, whereas the high density observed in the Barak Valley reflects favorable ecological conditions and absence of such regulatory efforts. Globally, population trends of House Crow vary depending on environmental and management conditions. In Japan, studies have reported an increase in crow populations linked to climatic factors such as rising temperatures and changes in precipitation patterns, which enhance food availability and survival in urban environments (Yoda 2019).

Overall, the high density of House Crows observed in the Barak Valley reflects a combination of abundant anthropogenic food resources, suitable nesting habitats, and lack of control measures, aligning with global patterns of urban exploitation by this species. However, it is important to note that no definitive conclusion regarding long-term population trends in the Barak Valley can be drawn, as the present study represents a baseline assessment. Continued monitoring and repeated population estimation are therefore essential to understand future trends and ecological dynamics in the region.

A clear pattern of ecological dominance of the House Crow over the Jungle Crow was seen across the urban gradient of the Barak Valley, with dominance being strongest in highly urbanised areas of Silchar. This pattern is consistent with urban ecological theory, which suggests that highly urbanized environments tend to favor a limited number of adaptable, generalist species capable of efficiently exploiting anthropogenic resources (Callaghan *et al.* 2019). The significantly higher density of House Crows in commercial areas, particularly in Silchar, reflects their strong synanthropic behavior and dependence on human-derived food resources. Urban ecosystems provide predictable and concentrated food subsidies, including waste from markets, households, and commercial establishments, which enhance the success of opportunistic species. Such conditions promote aggregation and increased local abundance of species with high behavioral flexibility (Kumar and Ojha 2023). The least population of House Crows in the Semi-urban area suggests about the habitat selection in urban corvids which is strongly influenced by food availability and human activity, leading to aggregation in resource-rich areas and reduced densities in less productive habitats (Szala *et al.* 2020). In contrast, Jungle Crows exhibited comparatively lower densities, especially within highly urbanized areas such as Silchar. This observation tells about less tolerance to intense urban conditions, likely due to their reliance on semi-natural habitats, tree cover, and suitable nesting substrates. Urbanization is known to simplify habitat structure, reduce vegetation cover, and limit nesting opportunities, thereby disproportionately affecting species with narrower ecological niches (Sol *et al.* 2020).

The near absence of Jungle Crows in commercial zones indicates that only species with high ecological variability are able to persist in highly modified landscapes. The intermediate patterns of density of both the species observed in Hailakandi further highlight the role of urbanization intensity in shaping species distribution. Transitional landscapes often support coexistence between urban exploiters and less adaptable species, although dominance typically remains skewed toward generalists such as the House Crow (Santini *et al.* 2019). The relatively stable but lower abundance of Jungle Crows in Karimganj indicates limited competitive ability in resource-rich urban environments. The comparatively higher abundance of Jungle Crows in residential areas during the non-breeding season in Hailakandi suggests that less urbanized environments with greater vegetation cover and reduced anthropogenic disturbance provide more suitable conditions for this species. Semi-urban and residential habitats often act as ecological shelters, maintaining higher habitat heterogeneity and supporting species that are otherwise excluded from highly urbanized cores (Morelli *et al.* 2021). In Hailakandi, it was observed that in comparison to the residential areas, the semi-urban areas have been transformed with the establishment of new built up areas. This highlights the importance of landscape complexity in sustaining the corvid diversity.

Seasonal variation revealed higher abundance of House Crows during the non-breeding season, which can be attributed to increased movement, flock formation, and expanded foraging ranges and roosting behavior (Jokimäki *et al.* 2022 ; Ojha and Kumar 2024 ; Feng *et al*. 2025). Moreover, nesting and chick-rearing pairs are territorial, have restricted home ranges, and attempt to drive conspecifics from their territory throughout the breeding season. On the other hand, families with fledged young congregate and usually travel in groups following the breeding season (Paládi *et al.* 2026). The significant seasonal variation in House Crow populations in Silchar reflects their high behavioral flexibility. Urban-adapted species are known to exhibit behavioral plasticity that enables efficient exploitation of fluctuating anthropogenic resources (Sol *et al*. 2020), which likely contributes to the observed increase during the non-breeding season. During the breeding season, House Crows concentrated in nesting areas of the town, and they spread out during the non-breeding season. As point-count surveys were conducted at randomly selected locations within grids, this may explain the observed differences in density between seasons. In contrast, Jungle Crows showed relatively stable population densities across seasons, indicating limited seasonal fluctuation. This suggests a more resident and territorially stable ecological strategy, characterized by higher site fidelity and dependence on consistent habitat conditions. Such stability reflects lower behavioral plasticity and reduced reliance on fluctuating anthropogenic resources, as also reported in studies examining species-specific responses to urbanization (Sol *et al.* 2020). The absence of significant seasonal differences in Jungle Crow populations, related with their restricted distribution in highly urbanized habitats, further emphasizes their sensitivity to urban environmental change.

The lack of significant differences between the two species in residential and semi-urban habitats of Hailakandi suggests a relatively balanced ecological system. The heterogeneous habitat structure, characterised by moderate vegetation cover and lower building density, likely reduces competitive exclusion and facilitates the coexistence of both species. Such environments represent transitional ecological zones where the intensity of urban layering is insufficient to exclude less adaptable species, supporting a more functionally diverse avian community compared to highly urbanised centers such as Silchar (Morelli *et al.* 2021).

CONCLUSION

Few studies about Jungle Crow population in particular have been done in India. We compared distribution of both House Crow and Jungle Crow in the Barak Valley for the first time. Urbanization significantly affects Crow assemblages in the Barak Valley, favoring the synanthropic House Crow, while limiting the distribution of the Jungle Crow. Seasonal variation further highlights the role of resource availability and behavioral flexibility in shaping population dynamics, emphasizing the importance of habitat heterogeneity in maintaining balanced crow populations. Regular population monitoring of both the species following the same methods is necessary for the population dynamics of corvid community in the Barak Valley, Assam.

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