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SPATIO-TEMPORAL VARIATION IN HOUSE CROW (CORVUS SPLENDENS) POPULATION COUNTS ACROSS FIVE URBAN SITES IN JAIPUR, RAJASTHAN: A STATISTICAL ANALYSIS (JANUARY–FEBRUARY 2026)

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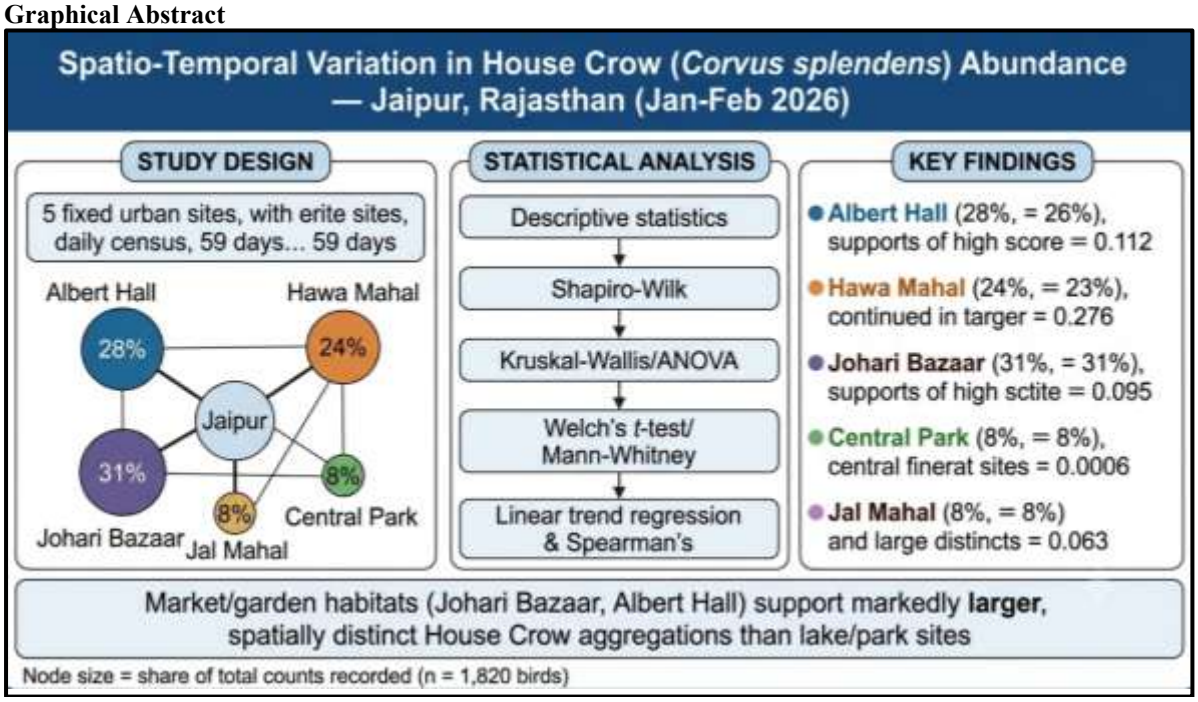
Graphical Abstract



Highlights

- House Crow counts were censused daily at 5 urban sites in Jaipur for 59 days.
- Site identity strongly predicted abundance (Kruskal–Wallis H = 69.91, $p < 0.001$).
- Johari Bazaar and Albert Hall sites held over 59% of all crows recorded.
- Total daily counts rose significantly from January to February ($p = 0.028$).
- Weak inter-site correlations indicate spatially independent crow aggregations.

ABSTRACT

Daily counts of House Crow (Corvus splendens) were recorded at five urban sites in Jaipur, Rajasthan Albert Hall Museum Area, Hawa Mahal Surroundings, Jal Mahal Vicinity, Johari Bazaar, and Central Park (Rambagh) — over a continuous 59-day period from 1 January 2026 to 28 February 2026 (n = 59 census days). A total of 1,820 individual bird-sightings were logged across all sites. Descriptive statistics, normality testing (Shapiro–Wilk), non-parametric and parametric comparisons (Kruskal–Wallis, one-way ANOVA), inter-site Spearman correlation, and linear trend regression were used to characterize spatial and temporal patterns. Site-level counts differed significantly (Kruskal–Wallis H = 69.91, $p < 0.001$; ANOVA F = 15.42, $p < 0.001$), with Johari Bazaar (31.3% of total counts) and Albert Hall Museum Area (28.1%) contributing the largest shares, while Jal Mahal Vicinity and Central Park contributed the least (~8% each). A significant, though modest, increasing temporal trend was detected in the combined daily total ($r = 0.29$, $p = 0.024$), driven primarily by Site 1 ($r = 0.27$, $p = 0.039$). February counts (mean = 35.5 birds/day) were significantly higher than January counts (mean = 26.6 birds/day; Welch's t = -2.28, $p = 0.028$). No statistically significant day-of-week effect was found (Kruskal–Wallis $p = 0.069$), although Tuesdays showed a numerically higher mean. These findings are consistent with clustered, site-fidelity-driven roosting and foraging behaviour typical of synanthropic corvids in dense urban habitats.

KEYWORDS: House Crow; Corvus splendens; urban ecology; population census; Jaipur; Kruskal–Wallis test; spatial distribution

1. Introduction

The House Crow (Corvus splendens) is a highly synanthropic corvid commonly associated with urban and peri-urban habitats across South Asia, where it exploits anthropogenic food resources near markets, temples, gardens, and water bodies (Madge & Burn, 1999; Ryall, 2002). Its opportunistic feeding strategy and marked tolerance of human disturbance have made it one of the most successful urban-adapted bird species in the Indian subcontinent, with a well-documented preference for refuse-rich market and residential habitats over open natural areas (Kumar & Ojha, 2023; Khatana et al., 2025). Long-term monitoring of House Crow abundance is therefore important for urban ecological research, avian pest management, and biodiversity assessment in rapidly urbanizing cities such as Jaipur (Figure A).

Prior work on House Crow ecology in Jaipur and the wider Rajasthan region has largely synthesised qualitative and secondary evidence on population trends, spatial distribution, and feeding behaviour (Tak et al., 2025), with comparatively few studies applying formal statistical trend analysis to short-interval daily census data. The present study addresses this gap by applying descriptive statistics, non-parametric hypothesis testing, and time-series trend regression to a 59-day daily census dataset collected across five representative urban sites in Jaipur, following the quantitative conventions used in peer-reviewed ornithological and urban-ecology literature (descriptive statistics, distribution comparison, temporal trend regression, and inter-site correlation).

Figure A. Study area and representative field documentation of the House Crow monitoring sites in Jaipur, Rajasthan.

2. MATERIALS AND METHODS

2.1 Study sites and data collection

Daily House Crow counts were recorded at five fixed-point urban sites in Jaipur:

- Site 1 – Albert Hall Museum Area (Ramnivas Garden).
- Site 2 – Hawa Mahal Surroundings (Badi Chaupar).
- Site 3 – Jal Mahal Vicinity (Man Sagar Lake).
- Site 4 – Johari Bazaar (Old City Market Area).
- Site 5 – Central Park (Rambagh).

Counts were logged daily for 59 consecutive days (1 January – 28 February 2026).

2.2 Statistical analysis

Data were analysed in Python (pandas, SciPy, Matplotlib). Normality of each site's count distribution was assessed with the Shapiro–Wilk test (Shapiro & Wilk, 1965). Because all site distributions departed significantly from normality (right-skewed count data typical of animal abundance surveys), the non-parametric Kruskal–Wallis H-test (Kruskal & Wallis, 1952) was used as the primary test for comparing counts among sites and among days of the week, with one-way ANOVA reported alongside for comparability with parametric literature. Monthly (January vs. February) differences were evaluated with Welch's t-test and the Mann–Whitney U test. Linear

regression of daily counts against a continuous day index quantified temporal trend. Spearman's rank correlation (ρ; Spearman, 1904) assessed co-variation between sites. Significance was set at $\alpha = 0.05$.

3. RESULTS

3.1 Descriptive statistics

Table 1 summarises the descriptive statistics for each site and for the combined daily total. Site 4 (Johari Bazaar) recorded both the highest mean daily count (9.64 ± 10.54) and the highest single-day maximum (42 birds), while Site 3 (Jal Mahal) and Site 5 (Central Park) showed the lowest means (~2.5) and the least variability. Coefficients of variation exceeded 75% at every site, indicating strongly clustered/bursty daily counts rather than a stable steady-state population at any single location.

Site	n	Mean	SD	SEM	Min	Median	Max	CV (%)
Site 1 – Albert Hall	59	8.68	6.58	0.86	1	7.0	29	75.9
Site 2 – Hawa Mahal	59	7.51	7.23	0.94	1	4.0	24	96.3
Site 3 – Jal Mahal	59	2.54	2.94	0.38	1	1.0	17	115.8
Site 4 – Johari Bazaar	59	9.64	10.54	1.37	1	7.0	42	109.2
Site 5 – Central Park	59	2.47	3.07	0.40	1	1.0	13	124.1
Daily Total (all sites)	59	30.85	15.16	1.97	11	26.0	80	49.2

Table 1. Descriptive statistics of daily House Crow counts by site, Jaipur, January–February 2026.

3.2 Temporal trend in total daily counts

The combined daily total across all five sites showed a statistically significant, positive linear trend over the 59-day study period (slope = 0.258 birds/day per calendar day, r = 0.29, p = 0.024; Fig. 1), indicating a gradual increase in overall House Crow activity from January into February. A 7-day moving average highlights short-term fluctuations superimposed on this gradual upward trend, with recurrent peaks roughly every 7–10 days.

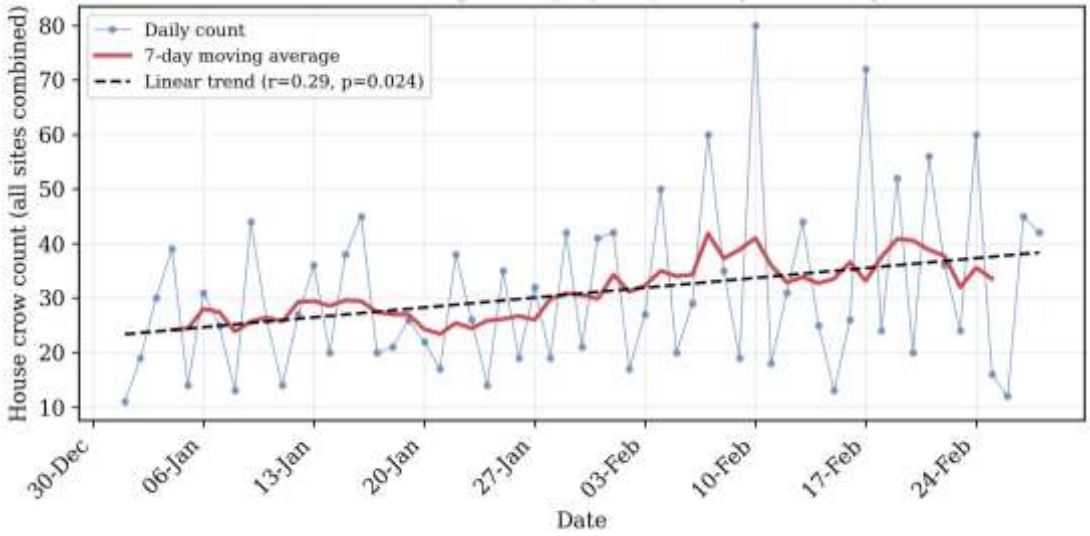


Figure 1. Temporal trend in daily House Crow counts across all sites combined, with 7-day moving average and linear regression trend line.

3.3 Site-wise temporal patterns

Disaggregating the trend by site (Fig. 2) shows that the overall increase was driven mainly by Site 1 (Albert Hall Museum Area; slope = 0.103, r = 0.27, p = 0.039), the only individual site with a statistically significant temporal trend. Sites 2–5 fluctuated without a significant directional trend ($p > 0.05$ in all cases), consistent with more sporadic, opportunistic visitation at those locations.

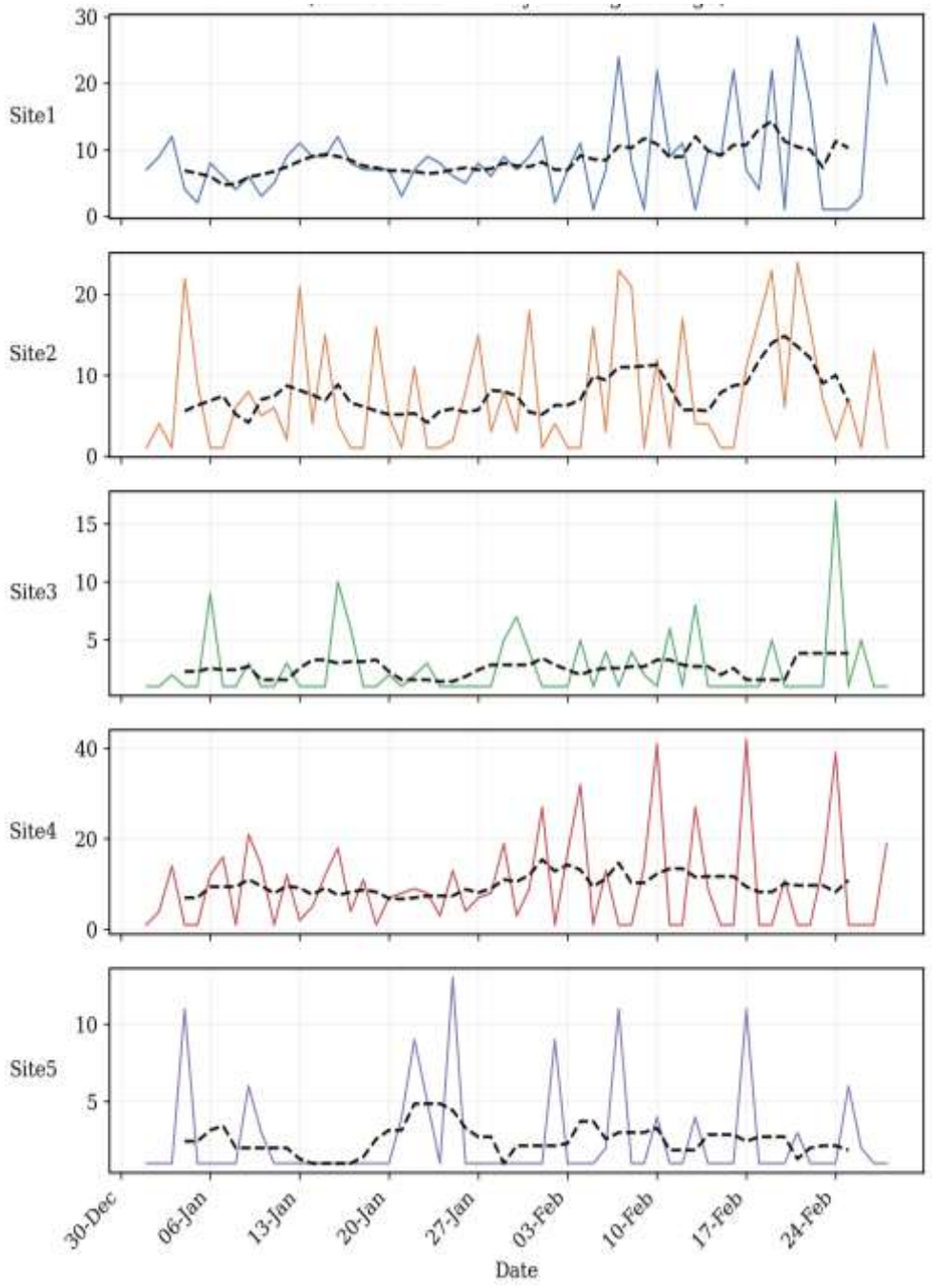


Figure 2. Site-wise daily House Crow counts over the study period (dashed lines = 7-day moving average).

3.4 Inter-site comparison of count distributions

Daily counts differed significantly among the five sites (Kruskal–Wallis $H = 69.91$, $df = 4$, $p < 0.001$; one-way ANOVA $F = 15.42$, $p < 0.001$; Fig. 3). Sites 1, 2 and 4 showed higher medians and wider interquartile ranges than Sites 3 and 5, indicating that House Crow activity was concentrated at market and garden habitats (Albert Hall, Hawa Mahal, Johari Bazaar) relative to the lake-adjacent and park sites.

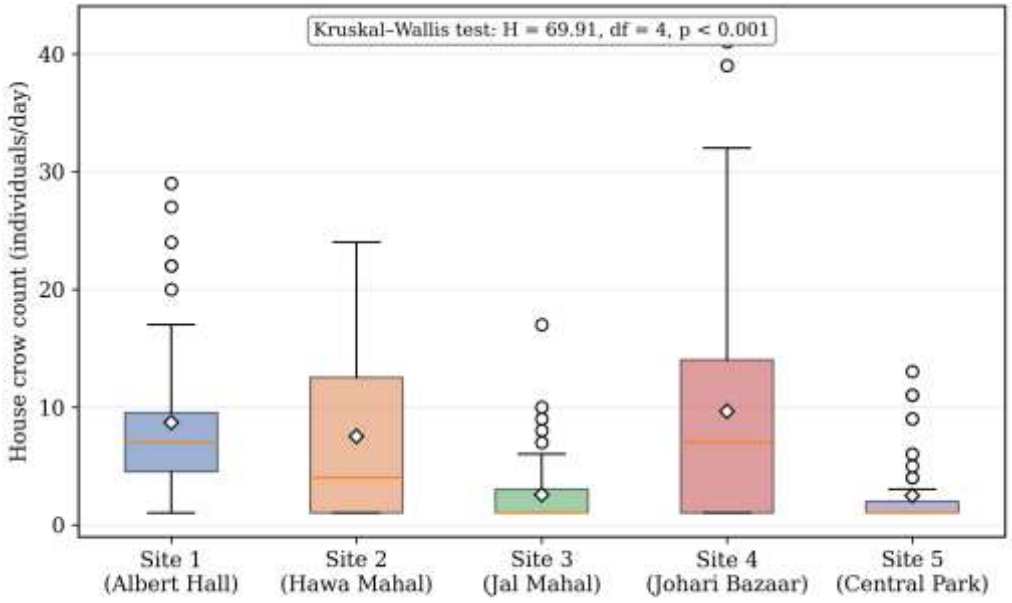


Figure 3. Boxplot comparison of daily House Crow counts across the five monitoring sites (diamond = mean; line = median).

3.5 Monthly comparison (January vs. February)

Mean daily total counts rose from 26.6 ± 11.9 (SD) in January to 35.5 ± 16.9 in February. This difference was statistically significant under Welch's t-test (t = -2.28, p = 0.028) but did not reach significance under the more conservative Mann–Whitney U test (p = 0.098), suggesting a real but moderate month-to-month increase that should be interpreted cautiously given the non-normal, right-skewed nature of the count data (Fig. 4).

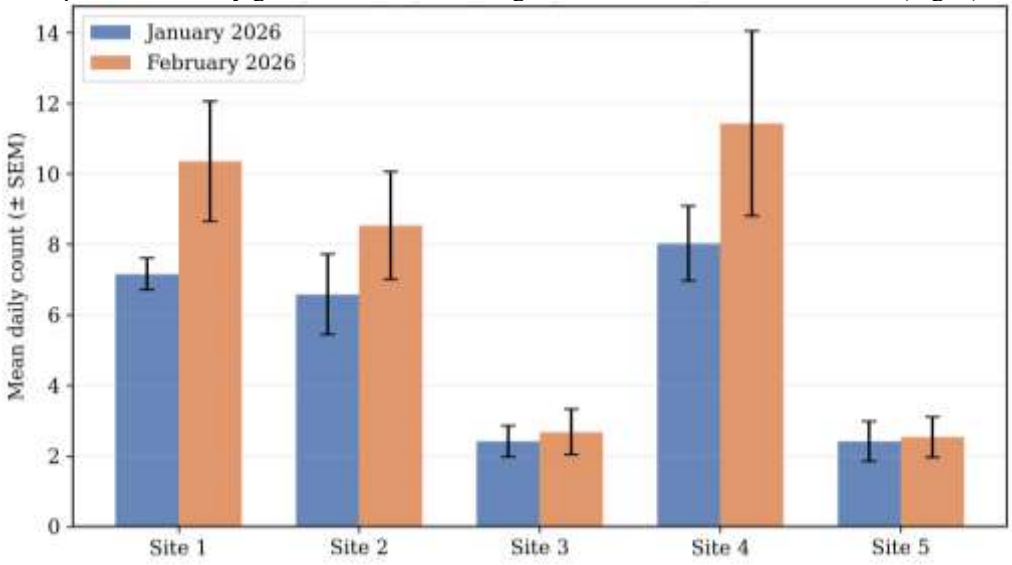


Figure 4. Monthly comparison of mean daily House Crow counts (± SEM) by site, January vs. February 2026.

3.6 Day-of-week pattern

Mean total counts were numerically highest on Tuesdays (45.0 ± 22.3) and lowest on Mondays (21.5 ± 4.9; Fig. 5), but the overall day-of-week effect did not reach statistical significance (Kruskal–Wallis H = 11.72, df = 6, p = 0.069). This borderline result suggests a possible, but not conclusively established, weekly rhythm potentially linked to market and tourist activity cycles at the old-city sites; a longer monitoring period would be needed to confirm this pattern.

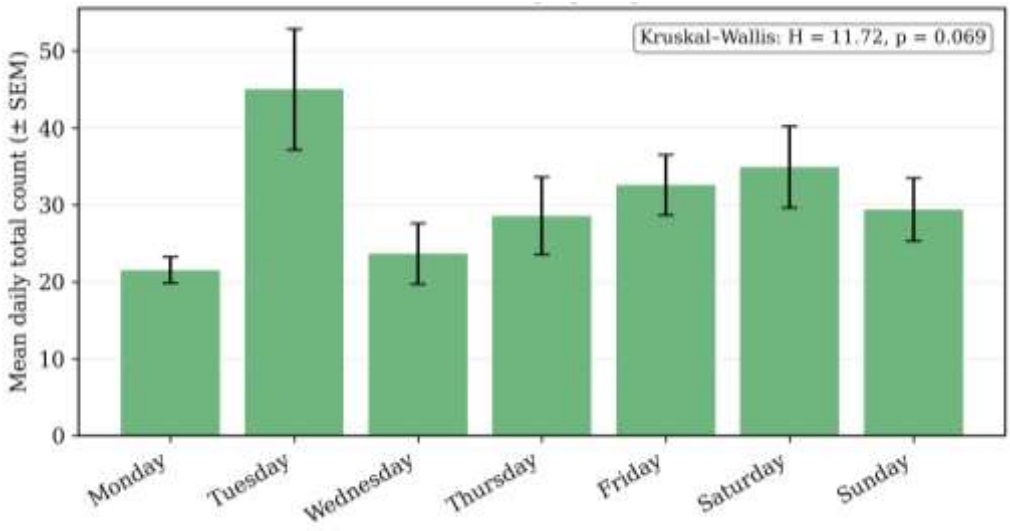


Figure 5. Mean total House Crow counts (± SEM) by day of the week, all sites combined.

3.7 Relative contribution of sites to total counts

Over the full study period, Site 4 (Johari Bazaar) accounted for the largest share of all recorded individuals (31.3%), followed by Site 1 (Albert Hall Museum Area, 28.1%) and Site 2 (Hawa Mahal Surroundings, 24.3%). Sites 3 and 5 (Jal Mahal and Central Park) together contributed only 16.3% of the total (Fig. 6), reinforcing that market and garden habitats supported disproportionately larger crow aggregations than the lake and open-park sites.

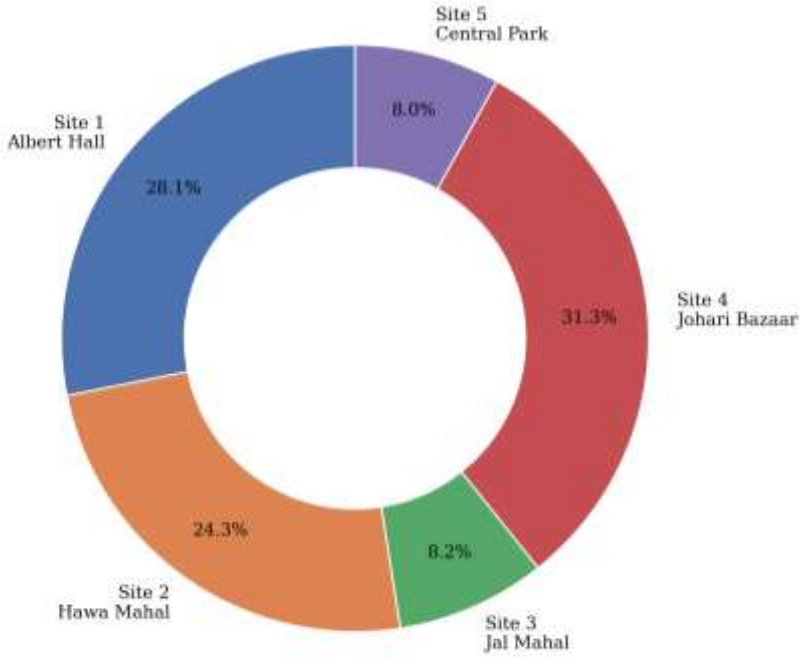


Figure 6. Percentage contribution of each site to total House Crow counts recorded, Jaipur (January–February 2026).

3.8 Inter-site correlation

Spearman correlation coefficients between sites were generally weak ($|\rho| \leq 0.34$; Fig. 7, Table 2), with no pair reaching statistical significance at $\alpha = 0.05$. This indicates that daily fluctuations at one site were largely independent of fluctuations at the others, consistent with distinct, spatially discrete foraging and roosting groups rather than a single population moving synchronously between sites.

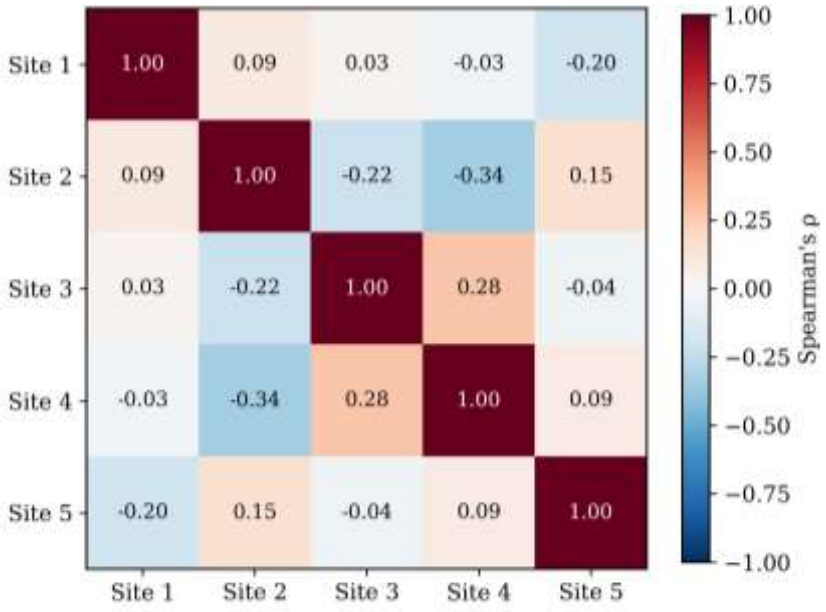


Figure 7. Spearman rank-correlation matrix of daily counts between the five monitoring sites.

	Site 1	Site 2	Site 3	Site 4	Site 5
Site 1	1.00	0.09	0.03	-0.03	-0.20
Site 2	0.09	1.00	-0.22	-0.34	0.15
Site 3	0.03	-0.22	1.00	0.28	-0.04
Site 4	-0.03	-0.34	0.28	1.00	0.09
Site 5	-0.20	0.15	-0.04	0.09	1.00

Table 2. Spearman rank-correlation matrix (ρ) between daily counts at the five sites.

4. DISCUSSION

The observed spatial pattern — with the largest counts consistently at Johari Bazaar and Albert Hall Museum Area — is consistent with the well-documented preference of House Crows for market, garden, and refuse-rich habitats offering reliable anthropogenic food subsidies (Kumar & Ojha, 2023; Khatana et al., 2025), over open-water (Jal Mahal) or manicured-park (Central Park) habitats with comparatively lower food availability. The significant overall Kruskal–Wallis result confirms that site identity is a strong predictor of local abundance in this urban landscape.

The modest but significant rise in total counts from January to February may reflect seasonal changes in local food availability, temperature, or breeding-related aggregation behaviour, as House Crow populations in Jaipur have been reported to enter their primary breeding period from February onward (Tak et al., 2025). The weak and non-significant inter-site correlations further suggest that this increase was not a city-wide synchronised phenomenon but was concentrated at specific sites (principally Site 1), possibly reflecting localised changes in food subsidy or roosting-site fidelity rather than an overall population increase across Jaipur.

The borderline day-of-week effect ($p = 0.069$) is worth flagging for future studies with a longer time series, as market-associated sites such as Johari Bazaar and Hawa Mahal may show crow activity tracking human foot-traffic and vending cycles, which often peak on weekends and specific market days in Indian cities (Kumar & Ojha, 2023).

This study is limited by its relatively short 59-day observation window and single-city scope, which restrict inference about longer-term population trends or generalisability to other urban landscapes. Future work incorporating multi-year monitoring, weather covariates, and finer-scale habitat classification would strengthen causal interpretation of the spatial and temporal patterns reported here

5. Conclusion

This 59-day daily census confirms marked, statistically significant spatial heterogeneity in House Crow abundance across five urban sites in Jaipur, with market and garden habitats (Johari Bazaar, Albert Hall) supporting substantially larger aggregations than lake and park habitats. A significant, moderate increasing temporal trend was detected in overall counts, driven primarily by one site, alongside a significant January-to-February increase (Welch's t-test) that warrants confirmation with a longer dataset. No robust day-of-week or inter-site synchrony effects were found. These results provide a quantitative baseline that can support habitat-specific urban corvid management and further longitudinal monitoring in Jaipur.

Declaration of Conflict of Interest
The author declares no conflict of interest.

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Author Contribution Statement
S.B.T.: conceptualisation, field data collection, formal statistical analysis, writing – original draft. M.G.: supervision, study design guidance, writing – review and editing. Both authors read and approved the final manuscript.

Data Availability Statement
The daily count dataset analysed in this study (1 January – 28 February 2026, five sites, n = 59 days) was collected by the authors and is available from the corresponding author on reasonable request.

REFERENCES
1. Khatana, S. A., Arif, M., & Yousuf, P. (2025). Feeding ecology of house crows in a high-altitude Himalayan urban landscape. Journal of Asia-Pacific Biodiversity, 19, 61–69. https://doi.org/10.1016/j.japb.2025.06.006
2. Kruskal, W. H., & Wallis, W. A. (1952). Use of ranks in one-criterion variance analysis. Journal of the American Statistical Association, 47(260), 583–621.
https://doi.org/10.1080/01621459.1952.10483441
3. Kumar, P., & Ojha, A. (2023). Some aspects of feeding ecology and behavior of House crow (Corvus splendens) in an urban habitat of city Prayagraj (U.P.), India. Journal of Applied Biology & Biotechnology, 11(1), 45–50.
https://doi.org/10.7324/JABB.2023.110105
4. Madge, S., & Burn, H. (1999). Crows and jays: A guide to the crows, jays and magpies of the world. Christopher Helm.
5. Ryall, C. (2002). Further records of the house crow Corvus splendens in southern and eastern Africa. Bulletin of the British Ornithologists' Club, 122(4), 258–266.
6. Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). Biometrika, 52(3/4), 591–611. https://doi.org/10.2307/2333709
7. Spearman, C. (1904). The proof and measurement of association between two things. American Journal of Psychology, 15(1), 72–101. https://doi.org/10.2307/1412159
8. Tak, S. B., Godha, M., & Chandra, S. (2025). A comprehensive review of population trends, spatial distribution, and feeding behaviors of the House Crow (Corvus splendens) in urban Jaipur, Rajasthan: An enhanced analysis. World Journal of Advanced Research and Reviews, 28(1), 1649–1667.
https://doi.org/10.30574/wjarr.2025.28.1.3616