



DOI: <https://doi.org/10.71317/kjard.2.10.2026.874>

Kashmir Journal of Academic Research and Development

Journal homepage: <https://rjsaonline.org/index.php/KJARD>



Effect of Plantation Habitat on the Abundance and Breeding Ecology of Passer Species in District Sargodha, Punjab, Pakistan

Rukaya Rani

Department of Biological Sciences, Faculty of Science, Superior University Lahore, Sargodha Campus, Pakistan

Mumtaz Akhtar

Department of Biological Sciences, Faculty of Science, Superior University Lahore, Sargodha Campus, Pakistan; AG Niazi University Sargodha, Pakistan

Email: profdrumtaziqbal@gmail.com

Nida Riaz

Department of Biological Sciences, Faculty of Science, Superior University Lahore, Sargodha Campus, Pakistan

Rubab

Department of Biological Sciences, Faculty of Science, Superior University Lahore, Sargodha Campus, Pakistan

Sajida Gull

Department of Biological Sciences, Faculty of Science, Superior University Lahore, Sargodha Campus, Pakistan

Ahmad Waqas

Department of Biological Sciences, Faculty of Science, Superior University Lahore, Sargodha Campus, Pakistan

Muhammad Iqbal Chaudhry

AG Niazi University Sargodha, Pakistan

ARTICLE INFO

ABSTRACT

Received:

September 07, 2026

Revised:

September 30, 2026

Accepted:

October 10, 2026

Available Online:

October 19, 2026

Keywords:

Passer domesticus; Passer montanus; House Sparrow; Eurasian Tree Sparrow; plantation habitat; citrus orchards; nesting ecology; breeding success; Sargodha; Pakistan

Corresponding Author:

Mumtaz Akhtar

Email:

profdrumtaziqbal@gmail.com

Habitat structure and human management may vary the importance of plantation-associated habitats for birds as a source of food, cover, perches, and nesting substrates. The abundance, site-level composition, nesting distribution and breeding performance of House Sparrow (*Passer domesticus*) and Eurasian Tree Sparrow (*Passer montanus*) has been evaluated in six plantation associated sites of District Sargodha, Punjab, Pakistan. At each site, 10 100m×50m line transects were set up and surveyed twice per week throughout the breeding season (February-July 2026). A total of 3,303 Passer individuals were recorded, comprising 2,246 *P. domesticus* (68.0%) and 1,057 *P. montanus* (32.0%). Kot Momin Citrus Orchards recorded the highest total abundance (698) while the lowest (458) was recorded from the University of Sargodha campus. Species composition differed significantly among sites ($\chi^2 = 217.682$, $df = 5$, $p < 0.001$). The abundance of Total Passer also varied by citrus-orchard, roadside/shelterbelt and urban/institutional habitat groups ($F_{2,57} = 3.958$, $p = 0.02456$); the adjusted pairwise difference was between urban/institutional and citrus-orchard habitats (Bonferroni-adjusted $p = 0.03728$). Sixty-nine nests were recorded, including 46 *P. domesticus* and 23 *P. montanus*. Nest initiation was concentrated from March to May ($\chi^2 = 26.391$, $p < 0.001$). Mean clutch size was 4.20 ± 0.78 eggs for *P. domesticus* and 4.09 ± 0.79 eggs for *P. montanus*. The estimated success of the nests was 55.9% overall, ranging from 38.9% in Company Bagh to 82.0% on the Sargodha-Bhalwal Road, with apparent success at 56.5%. In total, House Crow predation caused 43.3% of all failed nests. Results show high level of plantation associated landscapes used by both Passer species, and significant spatial variation in abundance and reproductive success. The study does not demonstrate causal relationships between the habitat characteristics of the plantations and the results, as the study is observational.

Introduction

A growing number of species are associated with human-dominated landscapes and the survival of many species is dependent on interactions among vegetation, buildings, food sources, disturbance and landscape configuration. When land cover is

unevenly patterned, including farmland and urban green spaces, they can support a high proportion of avian diversity; however, when land cover is intensified and simplified, suitable resources and niches can become scarce (Li et al., 2020; Rurangwa et al., 2022; Liao et al., 2024; Guerrero et al., 2024; Kasten et al., 2026). It is also not just the quantity of vegetation that affects the ecological value of agricultural landscapes, but also habitat configuration and habitat heterogeneity (e.g., of the various elements) (Brüggeshemke et al., 2022; Tassin de Montaigne & Goulson, 2023; Frank et al., 2024).

House Sparrow (*Passer domesticus*) is a highly adaptable passerine, which is found in urban, suburban, rural and agricultural areas, and are human associated. The abundance can fluctuate depending on the vegetation, food availability, built structure, traffic and other characteristics of the local environment (Behera & Mishra, 2019; Bernat-Ponce et al., 2018; Choudhary et al., 2019; Hanson et al., 2020; Patel et al., 2024; Torres-Alba et al., 2026). The species is able to use anthropogenic resources, but there is not necessarily a uniform provision of suitable conditions by urbanization. European studies have reported significant declines and spatial variation in abundance of the House Sparrow with changes in habitat structure, green space quality, food resources, and urban form (Peach et al., 2018; Mohring et al., 2021; Bernat-Ponce et al., 2020, 2022).

The Eurasian Tree Sparrow (*Passer montanus*) also inhabits human modified and agricultural habitats, but direction of response to habitat structure and agricultural context may vary with respect to occurrence and reproductive performance. The number of agricultural habitats and their configuration have been linked to Tree Sparrow fledging success, and breeding research shows variation in clutch size, hatching, fledging, and reproductive success among populations and environments of birds (e.g., McHugh et al., 2018; Lee et al., 2020; Ciebia et al., 2022). In recent years, further research has highlighted the importance of habitat heterogeneity for farmland bird assemblages and the need to consider species-specific habitat associations when formulating conservation initiatives (Havlíček et al., 2021; Rurangwa et al., 2022; Bosco et al., 2024).

Nesting ecology can also be used as a complementary measure of habitat use since birds do not necessarily mean successful reproduction. House Sparrows are highly adaptable and have been seen nesting in natural vegetation as well as anthropogenic structures (Maxmellion & Rajendran, 2021; Pandian, 2023; Kukreti, 2024). Breeding opportunities can be affected by the availability of cavities and/or other nesting sites, but the role of nest-site limitation can vary depending on the different urban contexts (Angelier & Brischoux, 2019). Food supply, environmental stressors, pollution and predation also are able to influence reproductive outcomes (Peach et al., 2018; Peralta-Sánchez et al., 2020).

In Pakistan there are large areas of humanized agricultural fields representing a diverse human environment where orchards, shelter belts, roadside trees, parks and institutional plantations are found integrated with cropland and built-up areas. Although there is considerable diversity and environmental response of passerines registered in studies conducted in Punjab and other parts of Pakistan, little published work has focused on the abundance and breeding ecology of both *Passer* species in plantation associated habitats within contrasting environments in District Sargodha, Pakistan (Bibi et al., 2019; Sial, 2026; Yasin et al., 2025). Sargodha is significant due to the presence of citrus plantation, which makes a significant contribution to the agricultural landscape and roadside, shelterbelt, park and institutional plantations that offer further vegetated habitat.

The present study, therefore, aimed to: (1) quantify abundance and species composition of *P. domesticus* and *P. montanus* in the six plantation associated sites in District Sargodha; (2) compare *P. domesticus* abundance among citrus-orchard, roadside/shelterbelt and urban/institutional habitat groups; (3) document nest distribution, nesting substrates, nest position and seasonal initiation of new nests; and (4) estimate clutch size, hatching success, fledging success and nest success, and record causes of nest failure. The study was observational, and so differences between sites and habitat categories are not considered experimental treatment effects of plantation type.

Materials and Methods

Study area and sampling sites

The study was carried out in District Sargodha (32.0836°N, 72.6711°E) of Punjab, Pakistan. Six plantation-associated sites, representing citrus orchards, roadside/shelterbelt vegetation and urban/institutional plantation settings were surveyed. These were the University of Sargodha Campus (32.1260° N, 72.6850° E), Company Bagh (Jinnah Park), Sargodha (approx. 32.080° N, 72.670° E), Bhalwal Citrus Orchards (approx. 32.267° N, 72.898° E), Kot Momin Citrus Orchards (approx. 32.190° N, 73.030° E), Roadside Plantation along Sargodha–Bhalwal Road and Agricultural Shelterbelts near Sillanwali.

The plantation sample comprised (neem, shisham, eucalyptus, amaltas, mulberry, kikar (*Vachellia nilotica*), Sukh Chain (*Conocarpus erectus*) etc.) and citrus plantation comprises of kinnow, sweet orange, grapefruit, lemon, guava etc. The size of each site was about 1 km². The study article specifies that Bhalwal and Kot Momin were commercial citrus landscapes with shelterbelt and agricultural-field components, the roadside site was a mature plantation of trees (linear plantation), and the Sillanwali site was agricultural shelterbelts associated with wheat field, fodder field and seasonal vegetable field.

Field sampling

There were 60 transects in total: 10 line transects (100m long x 50m wide) at each of the 6 sites. The transects were surveyed twice a week from February to July, 2026, while the breeding season is the time of year when these surveys take place. Observations of passer birds in the transect sampling areas were noted and identified as either *P. domesticus* or *P. montanus*.

The monitoring of active nests was carried out in orchards, public parks, institutional areas, roadside plantations and agricultural shelter belts. Sixty-nine nests were observed. The nesting characteristics were nesting plant/substrate, nest height above the ground, nest position (terminal, middle, fork, or other), and nest dimensions. A digital Vernier Caliper was used to measure the nest diameter (outer and inner), the cup height and the depth of the nest. Where possible, clutch size, nest failure, dates of first and last egg laying, hatching and fledging were recorded.

One methodological point that needs to be confirmed prior to submission is the frequency of nest checking: active nests were checked every 2-3 days, and nests were checked daily after the onset of breeding activity was recorded in the supplied manuscript. This discrepancy should be clarified prior to the final journal submission with the help of the original field records. Rainfall during the data collection is also noted and will be stated in the supplied article, but the number of data collection rain events should not be highlighted in the manuscript.

Breeding metrics

Hatching and fledging success were determined using the formulas provided in the provided manuscript by Murray (2000): Fledging Success (%) = number of chicks fledged / number of chicks hatched $\times$ 100 and Breeding Success (%) = number of chicks fledged / number of eggs laid $\times$ 100. The estimated nest success and apparent nest success were reported separately.

Statistical analysis

Descriptive information was summarized in the form of percentages, means and standard deviations. A chi-square test of independence was used to compare species composition among sites. Differences in abundance among the three habitat groups were tested by one-way ANOVA with Bonferroni pairwise comparisons (with Welch correction). Nest heights were compared between species using Welch's independent-samples t-test, and the distribution of months in which nests were initiated was tested using chi-square goodness-of-fit test. The level of statistical significance was set at $\alpha = 0.05$.

Results

Abundance and species composition

Overall a total of 3,303 Passer individuals were recorded on the 60 transects. The total number of *P. domesticus* was 68.0% of the total individuals, while the total number of *P. montanus* was 32.0% of the total individuals. The mean abundance per transect was: 37.43 ± 14.21 individuals for *P. domesticus*, 17.62 ± 9.55 individuals for *P. montanus* and 55.05 ± 15.23 individuals for Passer.

Site	<i>P. domesticus</i>	<i>P. montanus</i>	Total	% of total
University of Sargodha Campus	392	66	458	13.87
Company Bagh (Jinnah Park)	393	132	525	15.89
Bhalwal Citrus Orchards	420	121	541	16.38
Kot Momin Citrus Orchards	472	226	698	21.13
Roadside Plantation (Sargodha-Bhalwal Rd)	283	268	551	16.68
Agricultural Shelterbelts, Sillanwali	286	244	530	16.05

The overall composition of species was found to be significantly different between the various sites ($\chi^2 = 217.682$, df = 5, $p < 0.001$). The highest total abundance (698) was recorded in Kot Momin Citrus Orchards and the lowest total abundance (458) was recorded in the University of Sargodha Campus.

Abundance among habitat groups

Habitat group	n transects	<i>P. domesticus</i> mean $\pm$ SD	<i>P. montanus</i> mean $\pm$ SD	Total mean $\pm$ SD
Citrus Orchard Plantation	20	44.6 ± 12.7	17.35 ± 7.82	61.95 ± 15.64
Roadside/Shelterbelt Plantation	20	28.45 ± 11.59	25.6 ± 7.78	54.05 ± 12.51
Urban/Institutional Plantation	20	39.25 ± 13.75	9.9 ± 5.65	49.15 ± 15.20

Total Passer abundance significantly varied between habitat groups ($F_{2,57} = 3.958$, $p = 0.02456$). *P. domesticus* abundance also differed among habitat groups ($F_{2,57} = 8.378$, $p < 0.001$), as did *P. montanus* abundance ($F_{2,57} = 24.086$, $p < 0.001$). The only significant pairwise comparison for abundance of total Passer was between urban/institutional and citrus-orchard habitats ($t = -2.625$, raw $p = 0.01243$, adjusted $p = 0.03728$).

Seasonal nesting activity and nest distribution

69 nests were recorded including 46 *P. domesticus* nests and 23 *P. montanus* nests. The peak of nest initiation occurred in March, April, and May. Six nests (8.7%) were initiated in February, 20 (29.0%) in March, 16 (23.2%) in April, 18 (26.1%) in May, nine (13.0%) in June, and none in July. The difference in the distribution of the months is significant ($\chi^2 = 26.391$, $p < 0.001$).

Site	Nests
Agricultural Shelterbelts, Sillanwali	10
Bhalwal Citrus Orchards	14
Company Bagh (Jinnah Park)	10
Kot Momin Citrus Orchards	16
Roadside Plantation (Sargodha-Bhalwal Rd)	11
University of Sargodha Campus	8

Nesting substrate	N	%
Guava	10	14.5
Sweet orange	9	13.0
Neem	8	11.6
Mulberry	7	10.1
Kikar	7	10.1
Shisham	5	7.2
Grapefruit	4	5.8
Lemon	4	5.8
Building crevice/eave	3	4.3
Ornamental shrub	3	4.3
Kinnow (citrus)	3	4.3
Eucalyptus	3	4.3
Sukh Chain	2	2.9
Shelterbelt eucalyptus	1	1.4

The most common nest location was terminal (23; 33.3%), followed by middle (22; 31.9%) and fork (22; 31.9%) location with 2 nests (2.9%) other cavity/crevice locations.

Nest height, clutch size, and nest dimensions

Mean nest height was 4.33 ± 1.26 m for *P. domesticus* ($n = 46$) and 4.78 ± 1.31 m for *P. montanus* ($n = 23$). This difference was not statistically significant (Welch's $t = -1.366$, $p = 0.179$). The clutch size varied between 3-6 eggs in both species, the average being 4.20 ± 0.78 eggs for *P. domesticus* and 4.09 ± 0.79 eggs for *P. montanus*.

Nest measurement	Mean (cm)	SD (cm)
Outer diameter	13.98	1.67
Inner diameter	6.95	0.92
Nest cup height	10.25	1.52
Nest depth	5.98	1.03

Breeding success

The estimated egg stage daily survival rate was 0.9698, the hatching success was 69.3%, the nestling stage daily survival rate was 0.9859, the fledging success was 80.8%, estimated overall nest success was 55.9%, and the apparent nest success was 56.5% across all 69 nests. The Roadside Plantation recorded the highest success of nests at the site level (82.0%) and Company Bagh the lowest (38.9%). The estimated nest success of *P. domesticus* was 50.9% and the apparent nest success of *P. montanus* was 65.2%, while the apparent nest success of *P. domesticus* was 52.2%.

Site	n nests	Egg DSR	Hatching %	Nestling DSR	Fledging %	Overall success %	Apparent %
University of Sargodha Campus	8	0.9608	61.9	1	100	61.9	62.5
Company Bagh (Jinnah Park)	10	0.9692	68.7	0.9627	56.6	38.9	40.0
Bhalwal Citrus Orchards	14	0.9636	64.1	0.982	76.1	48.8	50.0
Kot Momin Citrus Orchards	16	0.9696	69.0	0.9779	71.5	49.3	50.0
Roadside Plantation (Sargodha– Bhalwal Rd)	11	0.9922	91.0	0.9931	90.1	82.0	81.8
Agricultural Shelterbelts, Sillanwali	10	0.957	59.0	1	100	59.0	60.0

Nest failure

Thirty of the 69 monitored nests failed (43.5%). The most common failure category was House Crow predation (13 failed nests, 43.3% of failures). Six failures (20.0%) were due to unknown/weather-related causes, six (20.0%) due to feral cats, three (10.0%) due to rodents and two (6.7%) due to snakes.

Cause of failure	Failed nests	% of failures
House Crow	13	43.3
Unknown/weather	6	20.0
Feral cat	6	20.0
Rodent (rat)	3	10.0
Snake	2	6.7

Discussion

The higher proportion of *P. domesticus* (68.0%) from the sampled landscape is similar to what has been previously reported for the species' ability to invade human-associated habitats. House Sparrows are able to be found in urban, suburban and rural areas, though their abundance depends on local vegetation, food resources, built structure and disturbance (Behera & Mishra, 2019; Bernat-Ponce et al., 2018; Choudhary et al., 2019; Hanson et al., 2020; MacGregor-Fors et al., 2019; Vicente et al., 2024; Patel et al., 2024). This finding thus suggests a wide distribution of *P. domesticus* in plantation habitat in Sargodha and not exclusive to any particular habitat.

The overall abundances of total Passer species were significantly higher in citrus-orchard group (61.95 ± 15.64 individuals per transect) and significantly lower in urban/institutional plantations (49.15 ± 15.20 individuals per transect). The Bonferroni adjusted analysis, however, indicated only that the comparison of urban/institutional and citrus-orchard was significant. This separation is important as an overall ANOVA does not show that all habitat pairs are different. The observed pattern is consistent with the overall literature indicating that the structure of the vegetation, the characteristics of green space, the degree of agricultural heterogeneity, and the intensity of land use by humans can affect the abundance and composition of birds (Li et al. 2020; Brüggeshemke et al. 2022; Rurangwa et al. 2022; Frank et al. 2024; Bosco et al. 2024; Guerrero et al. 2024; Kasten et al. 2026).

It is noteworthy that the relatively high representation of *P. montanus* in the roadside and agricultural shelterbelt habitats. The number of *P. montanus* and *P. domesticus* individuals in the roadside plantation were 268 and 283 respectively and in the shelterbelts in Sillanwali, they were 244 and 286 respectively. This pattern mirrors evidence of the ability of Tree Sparrows to utilize agriculture and semi-natural habitat mosaics and that reproductive or population measures could relate to the quantity and quality of agriculture (McHugh et al., 2018; Ciebiera et al., 2022). However, the habitat preference was not directly tested here and the observed distribution can be interpreted as “differential representation” between sampled habitats, not as “preference.”

69 nests were found in the six study sites, and both species nested on a variety of anthropogenic and vegetative substrates. The most common nesting substrates were guava, sweet orange, neem, mulberry and kikar. Flexible nesting of House Sparrow in various plant species and building crevices is similar to previous reports of it nesting in rural and urban areas (Maxmellion & Rajendran, 2021; Pandian, 2023; Kukreti, 2024). Experimental studies on nest-site availabilities in urban areas also revealed that the importance of cavities varies with the urban context and that nesting resources need to be understood within the wider habitat context, rather than as a general limitation (Angelier & Brischoux, 2019).

Nest initiation was highly skewed towards March-May and 78.3% of all nests were started during these three months. The general seasonality of the Passer breeding is in broad agreement with other areas, but differs somewhat geographically. For instance, the breeding season of Tree Sparrows in Korea was mostly between mid-April and mid-August while a population in

western Poland began laying in early to mid-April (Lee et al., 2020; Ciebiera et al., 2022). Variations between regions may be due to climate, photoperiod, food availability, and local habitat conditions. The mechanisms described above have not been specifically proven or quantified in the present study and should not be interpreted as a result of the study.

The clutch size of both species was similar with a mean of 4.20 ± 0.78 eggs in *P. domesticus* and 4.09 ± 0.79 eggs in *P. montanus*. Similar clutch sizes have been found in other populations of Passer species, but there are some variation among sites and years (Bibi et al., 2019; Lee et al., 2020; Ciebiera et al., 2022). The similarity in Sargodha indicates overall similar clutch-size patterns in the sampled nests; however, no formal statistical analysis of clutch size between species was reported, and so no clause of similarity can be claimed.

The overall nest success was estimated at 55.9 % and apparent nest success at 56.5 %. The difference between the two measures is not large but it is important because the former is a simple outcome measure while the latter also includes nest-survival information. There was significant variation from site to site: Roadside Plantation was the most successful (82.0%) and Company Bagh the least (38.9%). This spatial heterogeneity is supported by research which has demonstrated that reproductive success can be influenced by habitat composition and conditions on agriculture lands, and local habitat context (McHugh et al., 2018; Lee et al., 2020; Ciebiera et al., 2022).

Although *P. montanus* was observed to have higher estimated nest success (66.0%) than *P. domesticus* (50.9%), there is a need for caution in comparing the two because 23 nests were monitored in *P. montanus* and 46 nests were monitored in *P. domesticus*, and no inferential test was reported to compare species-level nest success. Parental condition, environmental condition, nest-site condition and other factors can cause variation in reproductive performance (Studies of House Sparrow reproduction also suggest that individual and environmental characteristics can affect reproductive outcomes, Peralta-Sánchez et al., 2020).

Nest failure caused by House Crow predation was the most common (43.3%) cause of nest failures. Predation is an important potential cause of nest loss in passerines, yet the influence of predators may be strong or weak and may be positive or negative depending on habitat and landscape context. Some habitat factors may be influenced by the presence of predators and disturbances, but there was no attempt to quantify predator abundance in the present study and predator access was not manipulated. The present study noted House Crow predation, but did not quantify the abundance of House Crow or manipulate predator access, so the data do not allow assessment of the causal importance of House Crow predation to population limitation.

The ecological interpretation of plantation habitats should be kept also on guard. Because the present study was observational, differences among orchards, roadside/shelterbelt habitats and urban/institutional sites may have been due to multiple correlated factors, such as the land-use context, food availability, nest-site availability, vegetation structure, management intensity and disturbance. Recent landscape studies indicate that there are more effects on farmland birds from a mix of habitat types within a landscape than from a single vegetation component (Li et al., 2020; Rurangwa et al., 2022; Frank et al., 2024; Kasten et al., 2026). Thus, the most defensible conclusion is that plantation related habitats in the sampled Sargodha landscape were favorable for abundance and breeding activity of passer and the habitat suitability was variable across space.

Lastly, the manuscript should not contain the above mentioned relationships (canopy-cover, tree-density, tree-species-richness or insect-abundance) as empirical ecological results, since these variables were mentioned in the article provided as proxy/simulated and not as independent field observations. By eliminating those claims the manuscript becomes more defensible and an observation study is not interpreted as a vegetation experiment.

Conclusion

The use of plantation-associated habitats by *P. domesticus* and *P. montanus* was also reported in District Sargodha in significant amounts. The dominant species was *P. domesticus* (68.0% of the total 3,303 individuals). The mean total abundance varied among the habitat groups, with the highest in citrus-orchard plantations. The two species nested over a spectrum of various vegetation and anthropogenic substrates, and nesting initiation occurred mainly between March and May. Overall estimated nest success was 55.9% with significant site-level variation and maximum nest success was on the plantation on the roadside of Sargodha-Bhalwal. The most common cause of nest failure was predation by House Crow. The results from this work indicate that the conservation value of preserving plantation associated habitat diversity is supported and observational design renders the findings unsuitable for inferring that any specific plantation type resulted in any increase in abundance or breeding success.

Management Implications and Recommendations

1. Cultivate a plantation structure of diverse age groups (mature trees, shrubs and vegetation layers that may offer nesting and shelter resources).

2. Maintain appropriate natural nesting materials and trees that are suitable for safety and management.
3. Minimize unnecessary vegetation removal and disturbance during the main nesting season (March-May).
4. Use standardized nest survival protocols to monitor nest losses, particularly by House Crow.
5. Future research should focus on the direct measurements of canopy cover, tree species richness, arthropod abundance, food availability, traffic, noise, footfall, pest control and management intensity, not proxies.
6. Conduct multi-year sampling to assess if the abundance and breeding success are maintained through the breeding seasons in 2026.
7. Try to establish a uniform interval for checking nests and provide details of days that nests are exposed, to allow daily nest-survival estimates to be replicated and compared between studies.

References

- Angelier, F., & Brischoux, F. (2019). Are house sparrow populations limited by the lack of cavities in urbanized landscapes? An experimental test. *Journal of Avian Biology*, 50, e02009. <https://doi.org/10.1111/jav.02009>
- Behera, U., & Mishra, G. (2019). Habitat preference and congregation sites of House sparrow (*Passer domesticus*) in the rural and suburban areas of Ganjam district, Odisha. *International Journal of Biosciences*, 14(1), 510–519. <https://doi.org/10.12692/ijb/14.1.510-519>
- Bernat-Ponce, E., Ferrer, D., Gil-Delgado, J. A., & López-Iborra, G. M. (2022). Effect of replacing surface with underground rubbish containers on urban House Sparrows *Passer domesticus*. *Urban Ecosystems*, 25, 121–132. <https://doi.org/10.1007/s11252-021-01138-y>
- Bernat-Ponce, E., Gil-Delgado, J. A., & Guijarro, D. (2018). Factors affecting the abundance of House Sparrows *Passer domesticus* in urban areas of southeast of Spain. *Bird Study*, 65(3), 404–416. <https://doi.org/10.1080/00063657.2018.1518403>
- Bernat-Ponce, E., Gil-Delgado, J. A., & López-Iborra, G. M. (2020). Replacement of semi-natural cover with artificial substrates in urban parks causes a decline of house sparrows *Passer domesticus* in Mediterranean towns. *Urban Ecosystems*, 23, 471–481. <https://doi.org/10.1007/s11252-020-00940-4>
- Bibi, S., Jadoon, A., & Rehman, A. (2019). Study of population and breeding biology of house sparrow (*Passer domesticus*) in district Haripur, Khyber Pakhtunkhwa, Pakistan. *Journal of Wildlife and Ecology*, 3(2), 16–21.
- Bosco, L., Lehtikoinen, A., Piha, M., Seimola, T., Tiainen, J., & Ekroos, J. (2024). Relative effects of arable land-use, farming system and agri-environment schemes on landscape-scale farmland bird assemblages. *Landscape Ecology*, 39, Article 113. <https://doi.org/10.1007/s10980-024-01906-z>
- Brüggeshemke, J., Drung, M., Löffler, F., & Fartmann, T. (2022). Effects of local climate and habitat heterogeneity on breeding-bird assemblages of semi-natural grasslands. *Journal of Ornithology*, 163, 695–707. <https://doi.org/10.1007/s10336-022-01972-7>
- Choudhary, S., Chauhan, N. S., & Kalsi, R. (2019). Seasonal habitat selection by house sparrows across the urbanization matrix in Delhi, India. *Journal of Wildlife and Biodiversity*, 3(4), 57–65. <https://doi.org/10.22120/jwb.2019.113270.1084>
- Ciebia, O., Gajda, K., Stamm, A., Szczepaniak, K., Cieniuch, P., Zajdel, M., & Czechowski, P. (2022). Breeding ecology of the Tree Sparrow in Western Poland. *International Studies on Sparrows*, 44, 14–27. <https://doi.org/10.2478/isspar-2023-0002>
- Frank, C., Hertzog, L., Klimek, S., Schwieder, M., Tetteh, G. O., Böhner, H. G. S., Röder, N., Levers, C., Katzenberger, J., Kreft, H., & Kamp, J. (2024). Woody semi-natural habitats modulate the effects of field size and functional crop diversity on farmland birds. *Journal of Applied Ecology*, 61(5), 987–999. <https://doi.org/10.1111/1365-2664.14604>
- Guerrero, I., Duque, D., Oñate, J. J., Pärt, T., Bengtsson, J., Tschardtke, T., Liira, J., Aavik, T., Emmerson, M., Berendse, F., Ceryngier, P., Weisser, W. W., & Morales, M. B. (2024). Agricultural intensification affects birds' trait diversity across Europe. *Basic and Applied Ecology*, 74, 40–48. <https://doi.org/10.1016/j.baae.2023.11.007>
- Hanson, H. E., Mathews, N. S., Hauber, M. E., & Martin, L. B. (2020). The natural history of model organisms: The house sparrow in the service of basic and applied biology. *eLife*, 9, e52803. <https://doi.org/10.7554/eLife.52803>

- Havlíček, J., Riegert, J., Bandhauerová, J., Fuchs, R., & Šálek, M. (2021). Species-specific breeding habitat association of declining farmland birds within urban environments: Conservation implications. *Urban Ecosystems*, 24, 1259–1271. <https://doi.org/10.1007/s11252-021-01111-9>
- Kasten, M. K., Hiller, T., Tassoni, S., Böhmer, R., Schurr, F. M., Röhl, M., Roth, M., & Grass, I. (2026). Farmland bird diversity requires heterogeneity between and within habitats. *Landscape Ecology*, 41, Article 117. <https://doi.org/10.1007/s10980-026-02406-y>
- Kukreti, M. (2024). House sparrow (*Passer domesticus*) nesting behaviours in a rural habitat of the western Himalayas. *Rivista Italiana di Ornitologia—Research in Ornithology*, 94(2), 3–9. <https://doi.org/10.4081/rio.2024.742>
- Lee, J.-H., Nam, W.-H., & Sung, H.-C. (2020). Breeding ecology of the Eurasian Tree Sparrow *Passer montanus* living in urban area in South Korea. *Korean Journal of Ornithology*, 27(2), 81–89. <https://doi.org/10.30980/kjo.2020.12.27.2.81>
- Li, D., Lee, M.-B., Xiao, W., Tang, J., & Zhang, Z. (2020). Noncrop features and heterogeneity mediate overwintering bird diversity in agricultural landscapes of southwest China. *Ecology and Evolution*, 10(12), 5815–5828. <https://doi.org/10.1002/ece3.6319>
- Khan A, Amber, Zubair F, Bilal B, Riaz J, Niala, Akhtar, Asif I. Infectious and Non-Infectious Diseases: An Overview of Global Health Challenges. *The Life*. 2026;1:306-314. Unique Scientific Publishers.
- Bilal A, Ali U. Molecular Basis of Cancer and use of Natural Chemotherapeutic Agents in Drug Discovery. *Emerging Infectious Diseases in the 21st Century: Zoonoses, Vectors and Global Health Challenges*. 2026;1:35-42.
- Rizwan M, Javed A, Islam MJ, Riaz K, Bilal A, Nasir M, Ali A. Isolation, Quantification, and Characterization of Microplastics in Atmospheric Fallout Across Different Areas of Lahore, Punjab, Pakistan. *Journal of Bioresource Management*. 2026;13(2):11.
- Liao, J., Zhang, T., He, X., Zhang, P., & Ran, J. (2024). Effects of agricultural intensity and landscape pattern on terrestrial birds in China's agroecosystem differ between temperature zones. *Biological Conservation*, 300, 110876. <https://doi.org/10.1016/j.biocon.2024.110876>
- MacGregor-Fors, I., Quesada, J., Lee, J. G.-H., & Yeh, P. J. (2019). On the lookout for danger: House Sparrow alert distance in three cities. *Urban Ecosystems*, 22(5), 955–960. <https://doi.org/10.1007/s11252-019-00874-6>
- Maxmellion, P. M. E., & Rajendran, P. (2021). A study on the nesting site preference and adaptability of House Sparrow to various locations in the rural, suburban and urban gradients. *Journal of Science & Technology*, 6(5), 89–98. <https://doi.org/10.46243/jst.2021.v6.i05.pp89-98>
- McHugh, N. M., Prior, M., Leather, S. R., & Holland, J. M. (2018). Relationships between tree sparrow *Passer montanus* fledging success and the quantity and quality of agricultural habitats—A model comparison study. *Ecological Informatics*, 47, 73–76. <https://doi.org/10.1016/j.ecoinf.2017.07.002>
- Sattar RZ, Bilal A, Bashir S, Iftikhar A, Yaqoob I. Embryotoxicity of fluconazole on developing chick embryos. *The Journal of Basic and Applied Zoology*. 2024 Apr 15;85(1):8.
- Noreen K. Uptake and determinants of HPV vaccination in South Asia: a systematic review and meta-analysis. *Front Public Health*. 2024.
- Afzal M, Ali U, Riaz A, Tanvir F, Bilal A, Ahmad S. In-silico analysis of deleterious single nucleotide polymorphisms (SNPs) of leukemia inhibitory factor (LIF), and their conformational predictions. *Journal of Population Therapeutics and Clinical Pharmacology*. 2024;31(1):2792-811.
- Mohring, B., Henry, P.-Y., Jiguet, F., Malher, F., & Angelier, F. (2021). Investigating temporal and spatial correlates of the sharp decline of an urban exploiter bird in a large European city. *Urban Ecosystems*, 24, 501–514. <https://doi.org/10.1007/s11252-020-01052-9>
- Murray, B. G., Jr. (2000). Measuring annual reproductive success in birds. *The Condor*, 102(2), 470–473. <https://doi.org/10.1093/condor/102.2.470>
- Pandian, M. (2023). Habitats of House Sparrow *Passer domesticus* (Linnaeus, 1758) in Rameswaram Island, Tamil Nadu, India. *Journal of Threatened Taxa*, 15(2), 22586–22596.

- Patel, F. P., Dodia, P. P., & Mehta, D. M. (2024). Factors influencing the occurrence of the House Sparrow *Passer domesticus* (Linnaeus, 1758) (Aves: Passeriformes: Passeridae) in Bhavnagar, Gujarat, India. *Journal of Threatened Taxa*, 16(6), 25360–25372. <https://doi.org/10.11609/jott.8632.16.6.25360-25372>
- Peach, W. J., Mallord, J. W., Ockendon, N., Orsman, C. J., & Haines, W. G. (2018). Depleted suburban House Sparrow *Passer domesticus* population not limited by food availability. *Urban Ecosystems*, 21, 1053–1065. <https://doi.org/10.1007/s11252-018-0784-4>
- Ali U, Bilal A, Fatima U, Anjum MI, Akbar I, Sajjad MK. Consumption of meat and the human health. *J Med Res Surg*. 2021;2(3):1-3.
- Shamsi U. Human papillomavirus vaccine awareness and acceptability among the adult population in Pakistan. 2024.
- Peralta-Sánchez, J. M., Colmenero, J., Redondo-Sánchez, S., Ontanilla, J., & Soler, M. (2020). Females are more determinant than males in reproductive performance in the House Sparrow *Passer domesticus*. *Journal of Avian Biology*, 51, e02240. <https://doi.org/10.1111/jav.02240>
- Rurangwa, M. L., Niyigaba, P., Tobias, J. A., & Whittaker, R. J. (2022). Functional and phylogenetic diversity of an agricultural matrix avifauna: The role of habitat heterogeneity in Afrotropical farmland. *Ecology and Evolution*, 12, e9024. <https://doi.org/10.1002/ece3.9024>
- Sial, M. A. (2026). Monitoring bird species biodiversity & environmental threats in the agricultural landscape of tehsil Sahiwal, Punjab, Pakistan. *Heliyon*, 12(2), e44497. <https://doi.org/10.1016/j.heliyon.2025.e44497>
- Bilal A, Bibi R, Umar M, Sajjad A, Kharal S, Noor E, Fatima K, Munir A. The relationship between obesity and breast cancer among women of Punjab, Pakistan. *The Research of Medical Science Review*. 2025;3(2):668-84.
- Basharat M, Bilal A, Rizwan M, Asif I, Shahin F, Hussain M. Identification of fish diversity, distribution, and fauna at Head Qadirabad, Marala and Khankis, Chenab River, Punjab. Pakistan. *Journal of Survey in Fisheries Sciences*. 2024;11(3):75-81.
- Noor A, Bilal A, Ali U. Towards personalized cancer care: A report of CRISPR-Cas9 applications in targeted therapies and precision medicine. *Journal of Health and Rehabilitation Research*. 2024 Jun 15;4(2):1375-80.
- Bilal A, Tanvir F, Ahmad S, Saba I, Mohammed OA, Al-Mijalli SH, Iqbal M, Aslam F, Zubair F. Leveraging Computational Biology to Validate the Anticancer Efficacy of Jujube Against Tumor Protein 53-Mutated Mammary Carcinoma. *INPHYTON-ANNALES REI BOTANICAE* 2026 Mar 15 (Vol. 66, No. 1, pp. 78-108).
- Tassin de Montaigu, C., & Goulson, D. (2023). Habitat quality, urbanisation & pesticides influence bird abundance and richness in gardens. *Science of the Total Environment*, 870, 161916. <https://doi.org/10.1016/j.scitotenv.2023.161916>
- Torres-Alba, V., Rodríguez-Flores, C. I., Bacigalupe, L. D., Vázquez, L.-B., & MacGregor-Fors, I. (2026). Coexisting and competing? Relationship of urban and anthropogenic variables and House Sparrow (*Passer domesticus*) abundance with the abundance of native Rufous-collared Sparrow (*Zonotrichia capensis*) in a small Mexican town. *Urban Ecosystems*, 29(3), Article 114. <https://doi.org/10.1007/s11252-026-01967-9>
- Vicente, M. O., França, F. G. R., & Araújo, H. F. P. (2024). Abundance, temporal variation, and microhabitat use of the house sparrow, *Passer domesticus* (Passeriformes: Passeridae), in urban and anthropogenic environments in Northeastern Brazil. *Zoologia*, 41, e23081. <https://doi.org/10.1590/S1984-4689.v41.e23081>
- Bilal A, Ahmad S, Tanvir F, Tariq M, Ramzan K, Saleem M, Saleem HG. Predictive modeling of N-acetyl transferase 2 single nucleotide polymorphisms and breast cancer risk using in-silico approaches. *The Journal of Microbiology and Molecular Genetics*. 2022 Aug 31;3(2):105-21.
- Sardar N, Raouf S, Bilal A, Iqbal MS, Tanvir F. Expression analysis of epithelial membrane protein 1 (EMP1) gene in kidney stone patients. *International urology and nephrology*. 2026 Jun 10:1-0.
- Bilal A. Impacts of depression on pregnancy: A review. *Occup Med Health Aff*. 2021 Jan;9(2).
- Yasin, M., Khan, H. A., Abdin, Z. U., & Mustafa, S. (2025). Behavioural responses of the passerine birds to the environmental variables in Central Punjab, Pakistan. *Pakistan Journal of Zoology*, 57(6), 2637–2644. <https://doi.org/10.17582/journal.pjz/2024031112128>



2026 by the authors; Journal of *Kashmir Journal of Academic Research and Development*. This is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).