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UNIVERSITY GREEN SPACES SUSTAIN BIRDS, BUT HABITAT DIVERSITY IS KEY

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ABSTRACT

University campuses with expansive green spaces and limited human presence for much of the day can offer excellent habitats for birds. However, environmental and anthropogenic factors can significantly impact bird populations. The present study aimed to investigate the effects of climatic, hydrological, and landscape variables, as well as anthropogenic disturbance, on the population dynamics of birds from June 2022 to June 2023 at the University of Veterinary and Animal Sciences, Ravi Campus, Pattoki, Pakistan. The point count method was utilized to record bird observations, generalized linear mixed models were applied to assess the effects of these variables on bird abundance and species richness, while generalized additive mixed models were applied to identify the threshold for each effect. Through the 12 months of the study, 64,657 individuals of 117 bird species belonging to 47 families were observed at the university campus. Bird abundance declines as distance from human settlements increases, suggesting that human-modified landscapes may support avian populations. Species richness decreases with rising minimum temperatures. Among the hydrological variables, increasing water depth negatively affected overall species richness, with a decline observed after 1.2 m. In conclusion, university campuses have the potential to serve as significant avian hotspots, and their ecological value can be further enhanced by providing a combination of natural areas and human-modified habitats, which may help mitigate the effects of environmental variables.

Keywords: Climate impact, Green campuses, Green spaces, Landscape planning, Mixed modelling, Population dynamics**.**

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INTRODUCTION

University campuses globally vary in landscape design, influenced by history, geography, and landscape planning (Jaeger, 2021). Asian universities, for instance, typically have more green spaces as compared to their European counterparts, which are often located in densely urbanized areas with limited natural habitats (Muñoz-Suárez *et al*., 2020). Consequently, campuses with expansive areas integrated with natural elements, such as native trees and green spaces, can support diverse wildlife (Chen, 2019). This wildlife flourishes during quieter hours due to limited human presence, particularly outside of the typical 8 AM to 4 PM timeframe on weekdays (Soulsbury and White, 2015; König *et al*., 2020). Moreover, trees contribute to cooler temperatures and cleaner air, creating a more hospitable environment for wildlife.

According to a review of over 300 universities and colleges worldwide since 1940, by Liu *et al*. (2021), campuses support a high avian species richness, providing crucial habitats. Their findings indicate that each campus typically hosts an average of 66 bird species, including some that are threatened, making these campuses significant refuges for birds in urban areas. The emerging concept of "green campus" promotes integrating wildlife conservation within university campuses, fostering environments that support diverse species and prioritizing ecological sustainability (Verhoef *et al*., 2020).

The Ravi Campus of the University of Veterinary and Animal Sciences (UVAS) is located in the suburbs of Pattoki, in Punjab, Pakistan. With over 400 hectares, it holds substantial potential for becoming a green campus. In 2009 and 2010, 102 bird species have been reported from this campus; however, species diversity has been steadily decreasing due to factors such as changes in land use and climate (Ali *et al*., 2015). As bird abundance and diversity has been correlated with several abiotic and biotic factors, understanding these factors is crucial for safeguarding avian populations and maintaining species richness.

Climatic and hydrological conditions play a central role in shaping bird communities. Precipitation affects food availability and breeding success (Fasola *et al*., 2010; Haq *et al*., 2018), temperature influences species distribution and metabolic rates (Sumasgutner *et al*., 2023), and relative humidity impacts habitat suitability and thermoregulation (Yasin *et al*., 2021). Similarly, hydrological variables, such as water temperature, water depth, and dissolved oxygen define their habitats (Tavares *et al*., 2015; Haq *et al*., 2018). Landscape variables, including vegetation type (Xu *et al*., 2022), distance from human settlements (Hayes *et al*., 2023), and proximity to nearby roads (Kroeger *et al*., 2022; Polak and Polak, 2024), influence bird populations by contributing to habitat fragmentation and disturbance. Similar to abundance, species richness is also affected by these variables in both positive and negative ways (Akhrorov *et al*., 2022). For example, where some species could benefit from an increase in precipitation due to improved habitat conditions and food availability (Liang *et al*., 2020), House Sparrows *(Passer domesticus*) were negatively affected due to decreased food availability, leading to higher mortality rates and reduced breeding success (Treen *et al*., 2015). Increasing temperature has decreased active foraging in Rosy Starling (*Pastor roseus*), Tree Swallow (*Tachycineta bicolor*), and Brown Shrike (*Lanius cristatus*) (Yasin *et al*., 2021). Climatic conditions also impact migratory birds, affecting their migration timing and patterns. For example, some warblers show delayed or altered migration due to climatic changes (Allcock *et al*., 2022), while Great Tit (*Parus major*) arrives earlier at the breeding grounds in spring as temperature increases (Tomotani *et al*., 2018). Among hydrological variables, increasing water depth can make it difficult for some bird species to forage effectively. For instance, deeper water can make it difficult for some waders such as whimbrels to obtain food (Navedo *et al*., 2012). Diving birds, vegetation gleaners, and dabbling ducks have specific depth preferences for foraging and habitat selection (Ramirez *et al*., 2018). Small waders, such as Red-wattled Lapwing (*Vanellus indicus*) and Black-winged Stilt (*Himantopus himantopus*) are inversely related to increasing water depth; while fish-eating birds were more abundant when dissolved oxygen levels in the water were around 5.5 mg/l, resulting in higher fish abundance (Haq *et al*., 2018).

Human activity influences bird abundance and species richness through both disturbance and habitat modification (Ibáñez-Álamo *et al*., 2020). In addition to direct disturbances by humans, birds also respond to broader landscape features, often selecting natural and farmland-related habitats based on proximity to natural elements such as water bodies (i.e. streams and rivers) and orchards, which influence foraging opportunities (Tu *et al*., 2020). For instance, some fishing birds are more abundant near human settlements due to increased food availability, whereas small wading birds tend to avoid human-dominated areas due to disturbance factors such as movement and altered habitat conditions (Tavares *et al*., 2015). Similarly, roads act as a major disturbance factor, benefiting generalist species such as the Eurasian Collared Dove (*Streptopelia decaocto*) and Canary Island Chiffchaff (*Phylloscopus canariensis*), while forest specialists and disturbance-sensitive birds avoid high-traffic areas due to increased predation risk, pollution, and human presence (Polak and Polak, 2024).

While studies on factors affecting avian populations are abundant, there is a notable gap in research specifically examining these factors within the context of university campuses. This lack of research presents a significant gap in understanding how these unique environments impact avian populations, highlighting the need for focused studies in this area. The current study describes the observed abundance and diversity of birds at UVAS, Ravi Campus, Pattoki and examines how they are affected by various climatic, hydrological, landscape, and disturbance variables.

MATERIALS AND METHODS

Study area: The study site was the Ravi Campus of the University of Veterinary and Animal Sciences, Lahore located in Pattoki, Punjab, Pakistan (31.5739°N, 74.2997°E). The UVAS, Ravi Campus spans about 4.05 km² across four blocks: (A: 1.83 km^2, B: 0.91 km^2, C: 1.06 km^2, and D: 0.02 km^2). This study focuses on Blocks A and C, excluding Blocks B and D as they are designated for livestock farming with limited human presence. The campus is located near the River Ravi and contains agricultural fields, fruit plantations, a botanical garden, constructed areas (departments and hostels), and the dense Changa Manga Forest nearby. On campus, wheat (*Triticum aestivum*), oats (*Avena sativa*), mustard (*Brassica nigra*), and sorghum (*Sorghum bicolor*) are widely cultivated crops. The Ravi Campus has fishponds that attract waterbirds. The climate in the area is moderate, with a mean annual temperature ranging of 10–40°C and an average annual precipitation of 22.1 mm.

Field surveys: From June 15, 2022, to June 15, 2023, point count surveys (Verner, 1985) were conducted biweekly at six designated points (Figure 1) for a total of 20 minutes at each point. The survey points were selected based on habitat diversity, accessibility, and prior observations of bird activity to ensure comprehensive coverage of different habitats. These points were evenly spaced, approximately 500 meters apart, and situated at a higher elevation relative to the surrounding landscape to maximize the visibility and detectability of birds. A single expert conducted surveys to ensure consistent data collection and minimize bias. Bird surveys started at 7:00 am under favorable weather conditions, avoiding periods of heavy rain, strong winds, or extreme temperatures that could affect bird detectability. The observer used 10x50 binoculars for bird watching. Birds were identified both visually and acoustically, with efforts made to minimize disturbance during counts.

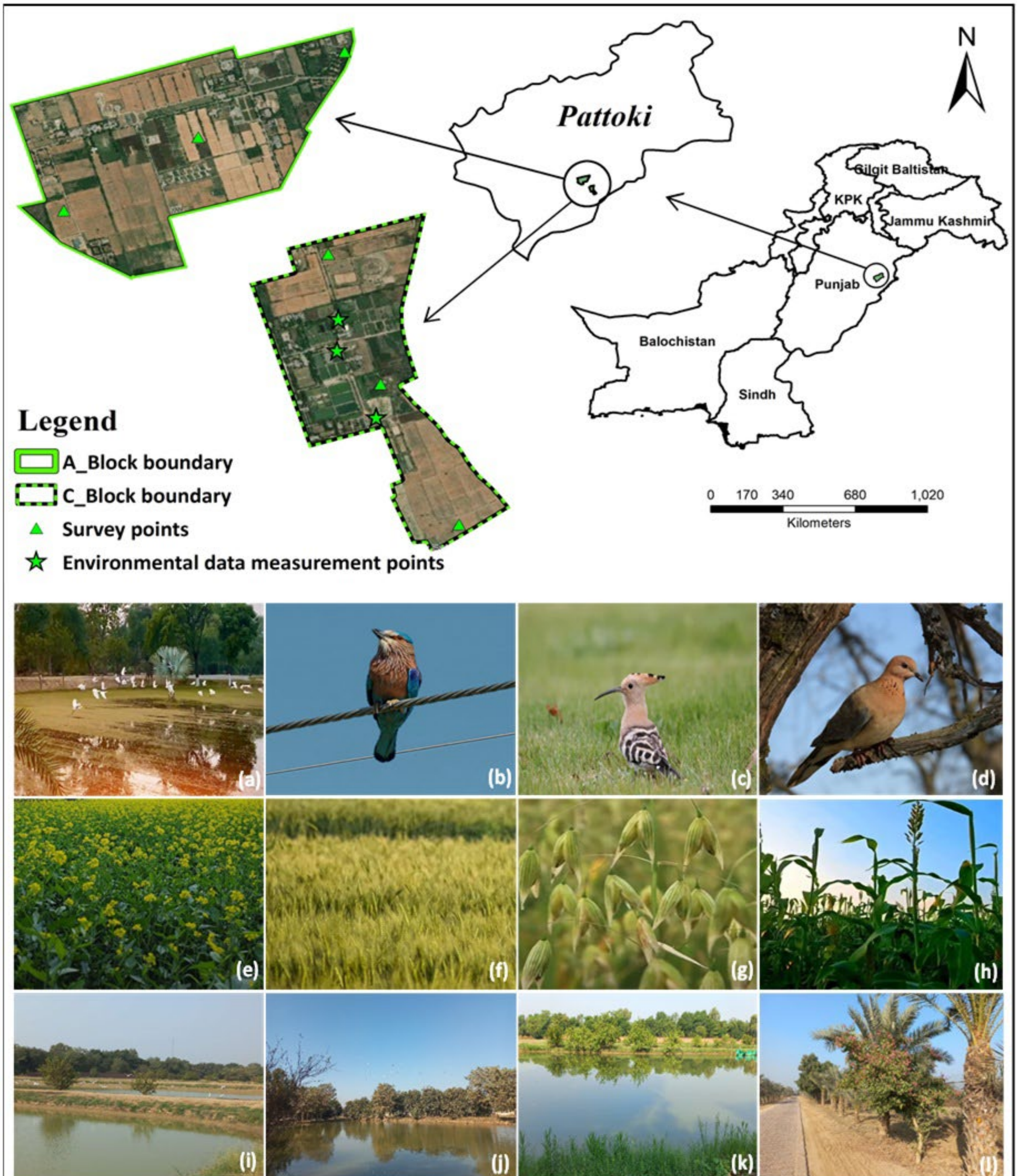

Figure 1. The survey locations and environmental data measurement points at the Ravi Campus of the University of Veterinary and Animal Sciences, Lahore in Pattoki, Punjab, Pakistan. A selection of bird species and habitats: (a) a flock of Cattle Egrets (*Bubulcus ibis*) and Little Egrets (*Egretta garzetta)*; (b) Indian Roller (*Coracias benghalensis*); (c) Common Hoopoe (*Upupa epops*); (d) Laughing Dove (*Spilopelia senegalensis*); (e–h) crops (mustard, wheat, oats, and sorghum, respectively); (i–j) fishponds; (k) and (l) fruit plantations (guava, pomegranate, date palm, Indian jujube, mulberries, and java plum) found on the university campus.

Explanatory variables: Four types of explanatory variables were considered for this study (Table 1). Climatic data were sourced from Weather.com, a standardized online meteorological database, and verified using a handheld temperature and humidity monitor. Hydrological parameters (water pH, temperature, and dissolved oxygen) were measured *in situ* using a multimeter at fixed measurement points, ensuring spatial consistency with bird survey locations. Water depth was measured using fixed-graded sticks placed in the water. All readings were taken during the surveys. Landscape and disturbance variables were measured once at the start of the study using Google Maps and verified through field measurements with a handheld GPS device.

Table 1. Summary of climatic, hydrological, landscape, and disturbance variables measured at UVAS, Ravi campus from 2022 to 2023, including units, descriptions, and observed ranges (mean, minimum, and maximum values).

Variable	Unit	Description	Mean	Min	Max
Climatic					
Air temperature	°C	Average air temperature.	24	2	43
Relative humidity	%	Atmospheric moisture content.	77	33	100
Precipitation	mm	Rainfall.	10.77	0	86.3
Hydrological					
Water depth	m	The average depth of the water bodies.	1.32	0.6	2
Water temperature	°C	Temperature of water bodies.	20.37	8	33
Water pH		Acidity or alkalinity of water.	7.9	7.7	8.7
Dissolved oxygen	mg/l	Oxygen concentration in water.	6.36	3.5	9
Landscape					
Distance from nearest crop field	m	Distance from the nearest cultivated crop field (e.g., wheat, oats, mustard, sorghum).	109.47	15	290
Distance from water	m	Distance from the nearest water body.	324.93	10	700
Disturbance					
Distance from roads	m	The distance from each survey point to the nearest road.	172.87	50	310
Distance from human settlement	m	Distance from the nearest human settlement (e.g., hostels, office buildings).	371.65	125	618

Statistical analysis: Generalized Linear Mixed Models (GLMMs) were utilized to determine the effects of climatic, hydrological, landscape, and disturbance variables on the population dynamics of birds using *lme4* package (Bates *et al*., 2015) in R statistical software Version 4.3.0 (R Core Team, 2023). A Likelihood Ratio (LR) test was performed to assess overdispersion in the count data and test the null hypothesis (Brown, 2021). The LR test confirmed significant overdispersion and indicated that the data fit the Negative Binomial family of GLMMs more effectively. As a result of the better fit, the Negative Binomial family of GLMMs was utilized for all models.

Bird abundance and richness were added as response variables for GLMMs. Predictor variables were added in two ways: individually for each variable and climatic, hydrological, landscape, and disturbance variables together. Survey points were added as a random effect (intercept) in all models. Pearson's correlation test was conducted for all predictor variables and those with a high correlation ($r > 0.5$) were removed from the same model to avoid multicollinearity (Zuur *et al*., 2009). Standardization was applied to the data for all predictor variables.

Model selection was based on Akaike's Information Criterion (AIC) with the *wiqid* package (Meredith, 2016), selecting the model with the lowest AIC score as the best fit. In cases where AIC scores did not significantly differ, alternative models with $\Delta AIC < 2$ were considered. Model averaging was used to estimate coefficients for uncertain models and unconditional standard errors through the *MuMIn* package (Barton, 2019). The variables that have significant effects on bird populations were selected using an 85% confidence interval. This interval simplifies model selection and aligns parameter assessment criteria more effectively than the smaller interval widths, such as 95% (Arnold, 2010). Generalized Additive Mixed Models (GAMMs) were utilized through the *mgcv* package (Wood, 2017) to determine the threshold level of each significant variable, as estimated from GLMMs. This was then assessed graphically, following the methodology outlined by Haq *et al*. (2018).

RESULTS

In the 12 months of the study, 117 species from 47 families representing 14 orders were observed at

UVAS, Ravi campus (Figure 2). Passeriformes was the most dominant order, represented by 24 families and 62 species followed by Charadriiformes (five families and seven species), Accipitriformes (two families and 12 species), and Coraciiformes (three families and five species). Among the observed species, 74 (63%) were residents, 34 (29%) were winter visitors, six (5%) were summer breeders, and three (2.5%) were passage migrants. Based on the IUCN Red List (IUCN, 2024), 111 species were Least Concern, three were Near Threatened (Pallid Harrier (*Circus macrourus*), Eurasian Curlew (*Numenius arquata*), and Alexandrine Parakeet (*Palaeornis eupatria*)), one species was Vulnerable (River Tern (*Sterna aurantia*)), and two were Endangered (Egyptian Vulture (*Neophron percnopterus*) and Steppe Eagle (*Aquila nipalensis*)) (Appendix Table 1).

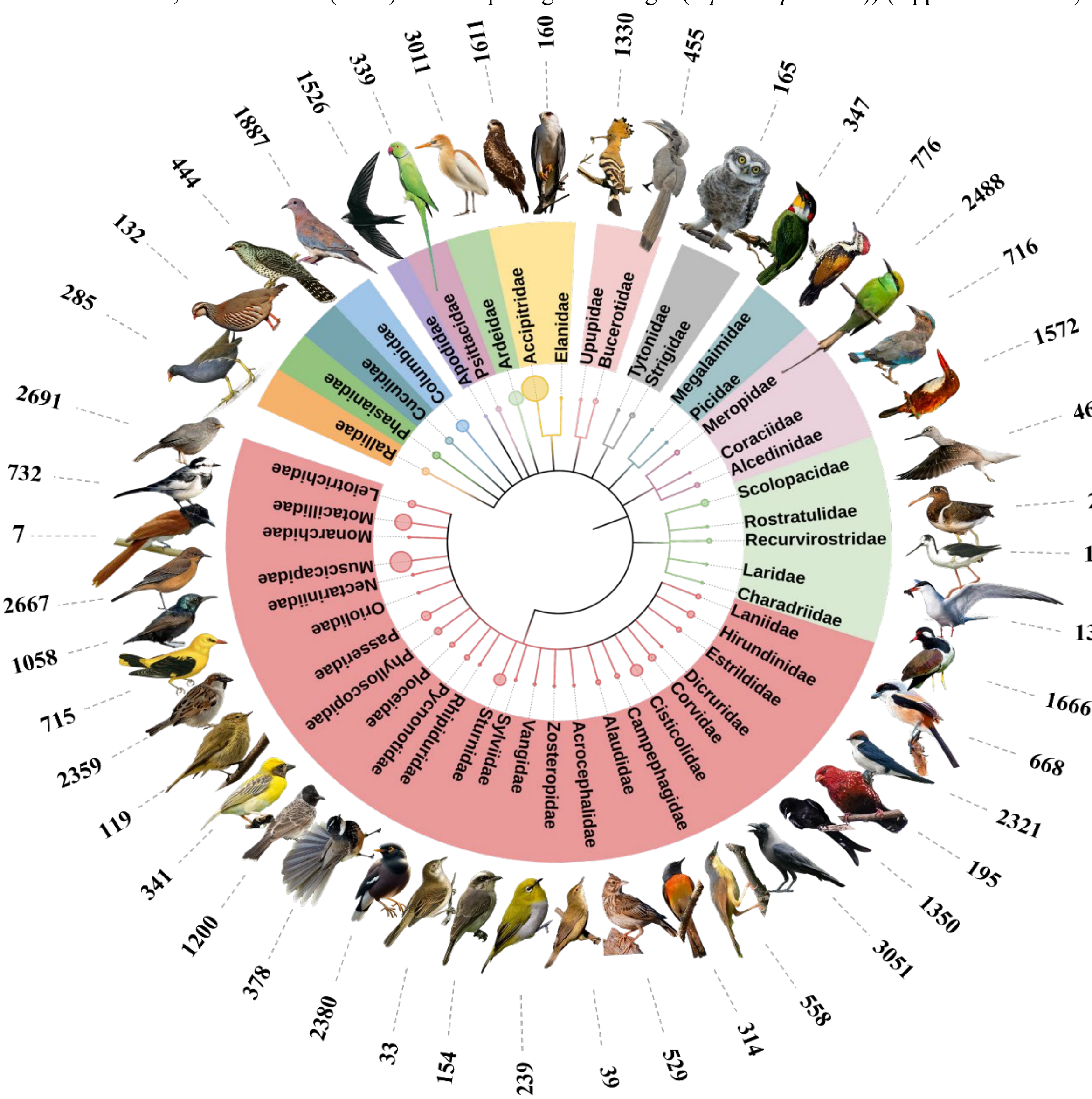

Figure 2. Species diversity and abundance of the 117 species of birds observed at UVAS, Ravi Campus, highlighting the most abundant species within each family and their respective abundance. The size of each circle correlates with the number of species present in the family. Photos of the species are sourced from pexels.com.

Factors affecting the abundance of birds: Based on the analysis of 23 different negative binomial models, the model with average minimum temperature, precipitation, and distance from human settlements had the lowest AIC score for bird abundance models (Table 2). The highest abundance occurred at the minimum temperature of 10°C, while abundance declined significantly when the minimum temperature exceeded 20°C (Estimate = -0.30, $p < 0.001$; Table 3, Figure 3). Similarly, bird abundance showed a slight decline when precipitation exceeded

15mm; however, this effect was not statistically significant (Estimate = -0.02, p = 0.116; Table 3, Figure 3). Additionally, bird abundance declined significantly when the distance from human settlements exceeded 375m (Estimate = -0.09, p < 0.001; Table 3, Figure 3).

Factors affecting bird species richness: Among the 21 models that were tested for species richness, the best included minimum temperature and water depth, and the second-best model included minimum temperature and distance from water (Table 2). In terms of climatic variables, an increase in average minimum temperature had a significant negative effect on the species richness (Estimate = -0.16, p < 0.001; Table 3, Figure 3). Among hydrological variables, water depth had a negative effect on species richness, but this relationship was not statistically significant (Estimate = -0.03, p = 0.203; Table 3, Figure 3). Among landscape variables, increasing distance from water was associated with a slight decrease in species richness; however, this relationship was also not statistically significant (Estimate = -0.03, p = 0.322; Table 3, Figure 3).

Table 2. The best Generalized Linear Mixed Models (GLMMs) explaining bird abundance and species richness at UVAS, Ravi Campus from 2022 to 2023.

	K	AIC	ΔAIC	W
Abundance (23 models tested)				
Minimum temperature + precipitation + distance from human settlements	6	3231.81	0.00	1.00
Null model	3	3612.66	380.85	0.00
Richness (21 models tested)				
Minimum temperature + water depth	5	2052.73	0.00	0.54
Minimum temperature + distance from water	5	2053.43	0.69	0.38
Null model	3	2336.92	284.18	0.00

Abbreviations: K: the total number of parameters estimates in the model. AIC: Akaike's Information Criterion. ΔAIC: difference in AIC scores between ranked models. W: model weight.

Table 3. Average estimates of the coefficients, unconditional standard errors, and confidence intervals of the variables present in the best Generalized Linear Mixed Models (GLMMs).

Population dynamics of birds	Estimate	**Uncond. S.E.**	Lower 85%	Upper 85%
Abundance				
Minimum temperature	-0.30	0.01	-0.32	0.28
Precipitation	-0.02	0.01	-0.04	0.00
Distance from human settlements	-0.09	0.02	-0.12	-0.06
Richness				
Minimum temperature	-0.16	0.00	-0.17	-0.14
Water depth	-0.03	0.02	-0.06	0.00
Distance from water	-0.03	0.02	-0.07	0.00

Uncond. S.E. = Unconditional standard error.

Highest species richness was detected at 8°C, which typically occurs during winter; however, similar temperatures may also be observed in early spring or late autumn at nighttime, depending on annual climatic variability. The richness of bird species declined when the minimum temperature exceeded 18°C, which typically corresponds to the summer months i.e., fewer species were present during warmer periods compared to winter. Abundance decreased as the distance from the nearest human settlement increased beyond 375 m, and richness decreased as the distance from the nearest water source increased beyond 325 m. The optimal water depth for bird richness seemed to be less than 1.2m bird richness decreased when water depths exceeded 1.2m (Figure 3).

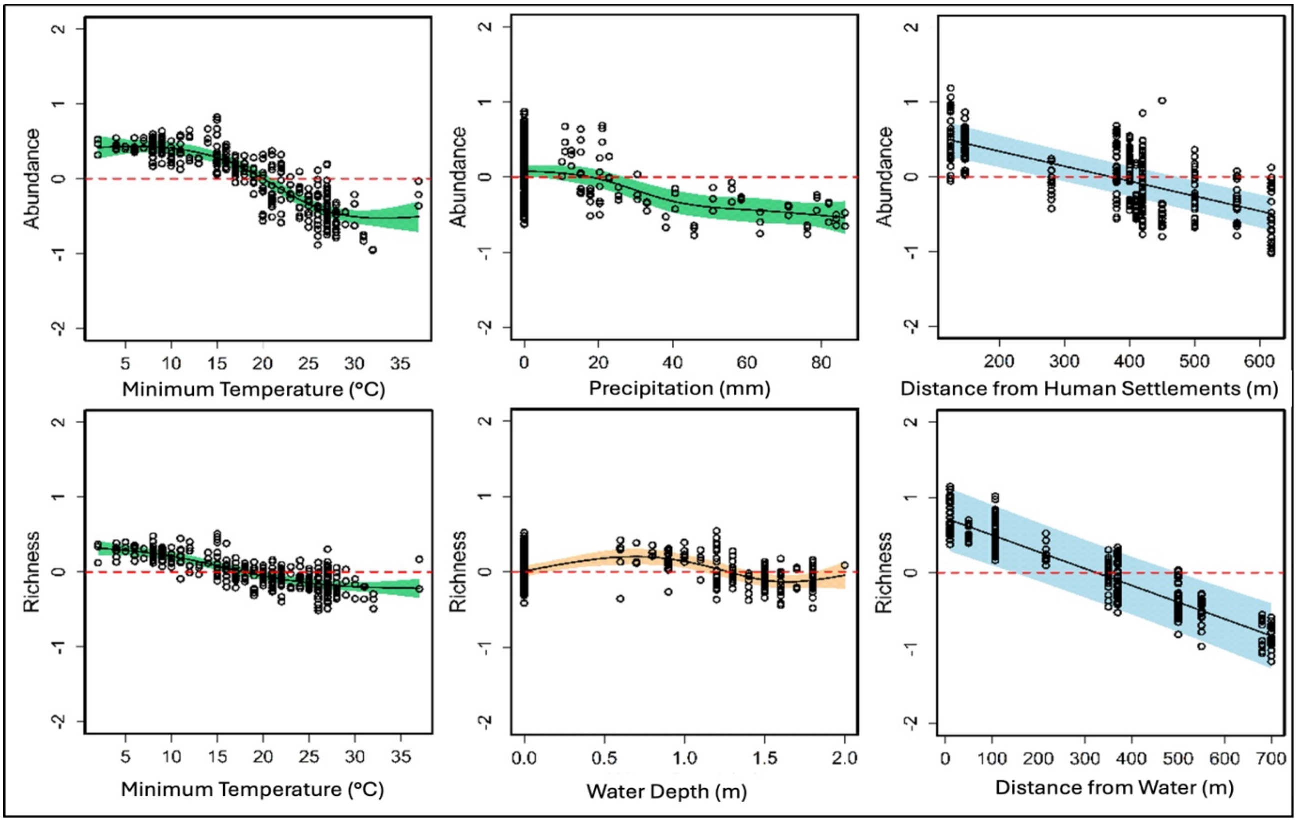

Figure 3. Response of avian abundance and richness recorded at UVAS, Ravi Campus from June 2022 to June 2023 to explanatory variables. Shaded areas show 95% Confidence Interval, while circles indicate partial residuals. Green-shaded graphs indicate climatic variables, blue-shaded graphs indicate landscape/disturbance variables, and orange-shaded graphs indicate hydrological variables.

DISCUSSION

In this study, 117 bird species were identified at the UVAS, Ravi Campus, compared to the 102 species documented in a previous study by Ali *et al*. (2015) which covered the period from September 2009 to December 2010. The increase in species richness can be attributed to habitat changes over time. Since 2010, a significant number of new trees were planted on these two blocks, which are now well-established. This vegetation growth may have created new ecological niches and green spaces, attracting more bird species. Additionally, shifts in climatic conditions, such as variations in temperature and precipitation, may have influenced bird distributions, allowing previously absent or less common species to establish themselves. These findings highlight the significance of university campuses as important refuges for birds.

Effect of environmental and landscape variables on avian abundance and species richness: The results revealed that minimum temperature significantly influenced the abundance and species richness of birds. As temperatures rise at the end of winter in Punjab, Pakistan, migratory species begin departing, contributing to changes in overall bird abundance and species richness (Ali *et al*., 2015). Our observation that rising minimum temperatures are associated with a decrease in bird abundance is consistent with findings from Koleček *et al*. (2020). In addition, studies suggest that warmer temperatures disrupt the migratory and breeding cycles of birds, potentially leading to a mismatch between the timing of food availability. According to Sam *et al*. (2019), temperature changes impact species richness by altering habitat structure and food resources. As temperatures rise, species may need to migrate to higher elevations or adjust their habitat preferences, leading to shifts in species distributions and a decrease in overall richness.

Additionally, precipitation (average daily rainfall: 10.77 mm; range: 0–86.3 mm from June 2022 to June 2023) showed a negative effect on bird abundance although the effect was not statistically significant. Rainfall patterns can influence the availability of food sources, brood reduction, and habitat quality, further affecting bird populations (Schöll and Hille, 2020). It can also impact the nesting success of some bird species, particularly those that rely on stable water levels for breeding, such as the Common Moorhen (*Gallinula chloropus*). Heavy rainfall can cause water level fluctuations, leading to nest flooding and reduced habitat suitability, ultimately affecting breeding success (Lai *et al*., 2018). According to Golawski and Mitrus (2018), rainfall affects birds by impacting food availability, which in turn influences egg size and its variability. They reported that increased rainfall can reduce insect activity, a primary food source for species such as the Red-backed Shrike (*Lanius collurio*). This reduction in food availability forces birds to expend more energy to obtain sufficient nourishment, highlighting the broader implications of rainfall for avian reproductive traits and overall health.

Relative humidity also showed no effect on the abundance and diversity of birds at Ravi campus. This might be because different species respond variably to climatic factors, and our study was not species specific. For example, relative humidity did affect the foraging behaviour of certain species, such as the House Sparrow, Brown Shrike, and Rosy Starling, by influencing the evening roosting timing. In contrast, Tree Swallows were less affected, possibly due to physiological or behavioural adaptations that make them less sensitive to humidity changes (Yasin *et al*., 2021).

Water depth appeared as a variable in our model; however, its effect was not statistically significant. This may be because shallow water supports a wide range of species, while deeper water tends to be preferred by specific taxa. Moreover, our study focused on a mixed assemblage of bird species, which may have masked individual habitat preferences. For instance, deeper waters positively affect open-water piscivorous and carnivorous bird species, and waders prefer to forage in shallow water bodies (Brandolin and Blendinger, 2016). Similarly, small waders typically prefer shallow waters because their small bills limit their ability to catch prey in deeper waters. Shallow waters also promote the growth of aquatic plants such as macrophytes (Zhang *et al*., 2016), which provide nesting and feeding environments for vegetation gleaners. As water depth increases, the abundance of small waders and vegetation gleaners declines due to reduced accessibility to prey and suitable vegetation cover. As reported by Haq *et al*. (2018), an optimal water depth of less than 1.8 meters is required to support wader species such as the Red-wattled Lapwing, the Black-winged Stilt, and vegetation gleaners such as the Common Moorhen. Therefore, maintaining appropriate water levels is essential for ensuring the availability of foraging and breeding habitats for small waders and vegetation gleaners in wetland ecosystems. On the Ravi campus of UVAS, both small waders such as the Red-wattled Lapwing and the Black-winged Stilt, and vegetation gleaners such as the Common Moorhen, were observed. Among these, the Black-winged Stilt is a winter visitor, while the Red-wattled Lapwing and the Common Moorhen are resident species that breed on the campus.

Water bodies in urban areas provide essential resources such as food, breeding sites, and microhabitats that support high bird diversity (Xie *et al*., 2022). In this study, distance from water body had a negative effect on bird richness but did not affect bird abundance. Similarly, in a study conducted in urban areas of Brazil by Barbosa *et al*. (2020), distance from nearest water body negatively impacted both resident and migratory bird richness. However, the tendency of birds to stay near water does not always imply that they primarily use it as a resource; rather, water may help them with manage their body temperature and locate food.

Effect of disturbance variables on avian abundance and species richness: The findings of this study suggest that proximity to human settlements is associated with higher bird abundance. Human-modified landscapes, such as villages and farmland, can support higher bird abundance and species richness than forests, as some functional groups such as insectivores, granivores and frugivores prefer human-dominated areas, likely due to the availability of food resources and altered land use practices (Wang *et al*., 2022). However, at Ravi campus these settlements included student hostels, faculty rest houses, and staff accommodations. Such institutional settings may pose less direct disturbance to birds. However, this pattern may not hold beyond the boundaries of a gated university campus, particularly in surrounding areas where wildlife poaching is more prevalent. According to Haq *et al*. (2023), Punjab recorded the highest number of wildlife crime incidents among Pakistan's administrative units, with particularly high activity in Kasur, the district where Ravi campus is located. The proximity of Changa Manga Forest further contributes to the vulnerability of the area, as poachers often target nearby forested habitats to capture birds and other wildlife (Mushtaq, 2023). The relatively supportive conditions within the campus make it particularly important as a potential refuge for bird populations.

While studies from other regions have indicated that variables considered for this study such as dissolved oxygen (Haq *et al*., 2018), pH (Tavares *et al*., 2015; Brandolin and Blendinger, 2016), distance from crops (Wilson *et al*., 2017), and distance from roads (Kroeger *et al*., 2022; Polak and Polak, 2024) had effects on bird population dynamics, these variables did not appear in any of the models in our study. Nevertheless, further studies are needed to confirm this finding.

Conclusion: The results highlight the importance of UVAS, Ravi Campus in maintaining avian biodiversity. Rising temperatures negatively impact bird populations and species richness, however, these impacts can be mitigated by establishing green spaces near human settlements, as bird abundance declines beyond 375 meters from these areas. Wetlands on campus should maintain a range of water depths not exceeding 1.2 meters to support species diversity. Conservation actions should also prioritize endangered species, such as the Egyptian Vulture and Steppe Eagle by protecting their habitats and reducing human disturbances. Incorporating these considerations into campus planning can not only support a diverse avian community but also contribute to the emerging concept of a "green campus"—a sustainable, multifunctional space for both people and wildlife. This study emphasizes the value of site-specific ecological assessments and encourages similar research to identify local variables and guide tailored strategies for transforming educational institutions into green campuses.

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Appendix

Table 1. The bird species recorded from the Ravi Campus of the University of Veterinary and Animal Sciences, Lahore from June 2022 to June 2023 with their distribution and conservation status in Pakistan according to Grimmett *et al*. (2008) and IUCN Red List (IUCN, 2024), respectively. In the Common Name/Distribution column, common names in back indicates Resident, blue indicates Winter Visitors, green indicates Summer Breeders, and red indicates Passage Migrants; whereas, in Scientific Name/IUCN Status column, scientific names in black indicates Least Concern (LC), red indicates Endangered (EN), orange indicates Near Threatened (NT), and green indicates Vulnerable (VU).

Order	Family	Common Name/Distribution	Scientific Name/IUCN Status
ACCIPITRIFORMES	Accipitridae	Black Kite	*Milvus migrans*
		Brahminy Kite	*Haliastur indus*
		Egyptian Vulture	*Neophron percnopterus*
		Eurasian Sparrowhawk	*Accipiter nisus*
		Griffon Vulture	*Gyps fulvus*
		Long-legged Buzzard	*Buteo rufinus*
		Pallid Harrier	*Circus macrourus*
		Shikra	*Accipiter badius*
		Steppe Eagle	*Aquila nipalensis*
		Western Marsh-harrier	*Circus aeruginosus*
		White-eyed Buzzard	*Butastur teesa*
	Elanidae	Black-winged Kite	*Elanus caeruleus*
BUCEROTIFORMES	Bucerotidae	Indian Grey Hornbill	*Ocyceros birostris*
		Oriental Pied Hornbill	*Anthracoceros albirostris*
	Upupidae	Common Hoopoe	*Upupa epops*
CAPRIMULGIFORMES	Apodidae	House Swift	*Apus nipalensis*
CHARADRIIFORMES	Charadriidae	Red-wattled Lapwing	*Vanellus indicus*
	Laridae	River Tern	*Sterna aurantia*
	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*
	Rostratulidae	Greater Painted-snipe	*Rostratula benghalensis*
	Scolopacida	Common Snipe	*Gallinago gallinago*
		Eurasian Curlew	*Numenius arquata*
		Green Sandpiper	*Tringa ochropus*
COLUMBIFORMES	Columbidae	Eurasian Collared-dove	*Streptopelia decaocto*
		Laughing Dove	*Spilopelia senegalensis*
		Red Collared-dove	*Streptopelia tranquebarica*
		Rock Dove	*Columba livia*
		Yellow-footed Green-pigeon	*Treron phoenicopterus*
CORACIIFORMES	Alcedinidae	Pied Kingfisher	*Ceryle rudis*
		White-throated Kingfisher	*Halcyon smyrnensis*
	Coraciidae	Indian Roller	*Coracias benghalensis*
	Meropidae	Asian Green Bee-eater	*Merops orientalis*
		Blue-cheeked Bee-eater	*Merops persicus*
CUCULIFORMES	Cuculidae	Greater Coucal	*Centropus sinensis*
		Jacobin Cuckoo	*Clamator jacobinus*
		Western Koel	*Eudynamys scolopaceus*
GALLIFORMES	Phasianidae	Black Francolin	*Francolinus francolinus*
		Common Quail	*Coturnix coturnix*
		Grey Francolin	*Ortygornis pondicerianus*
GRUIFORMES	Rallidae	Eurasian Coot	*Fulica atra*
		Common Moorhen	*Gallinula chloropus*
		White-breasted Waterhen	*Amaurornis phoenicurus*
PASSERIFORMES	Acrocephalidae	Clamorous Reed-warbler	*Acrocephalus stentoreus*
	Alaudidae	Crested Lark	*Galerida cristata*
		Oriental Skylark	*Alauda gulgula*

	Campephagidae	Long-tailed Minivet	*Pericrocotus ethologus*
		Small Minivet	*Pericrocotus cinnamomeus*
	Cisticolidae	Ashy Prinia	*Prinia socialis*
		Common Tailorbird	*Orthotomus sutorius*
		Graceful Prinia	*Prinia gracilis*
		Plain Prinia	*Prinia inornata*
		Rufous-fronted Prinia	*Prinia buchanani*
	Corvidae	Common Raven	*Corvus corax*
		House Crow	*Corvus splendens*
		Rufous Treepie	*Dendrocitta vagabunda*
	Dicruridae	Black Drongo	*Dicrurus macrocercus*
	Estrildidae	Indian Silverbill	*Euodice malabarica*
		Red Avadavat	*Amandava amandava*
	Hirundinidae	Asian Plain Martin	*Riparia chinensis*
		Barn Swallow	*Hirundo rustica*
		Wire-tailed Swallow	*Hirundo smithii*
	Laniidae	Bay-backed Shrike	*Lanius vittatus*
		Long-tailed Shrike	*Lanius schach*
	Leiotrichidae	Common Babbler	*Argya caudata*
		Jungle Babbler	*Argya striata*
		Striated Babbler	*Argya earlei*
	Monarchidae	Indian Paradise-flycatcher	*Terpsiphone paradisi*
	Motacillidae	Citrine Wagtail	*Motacilla citreola*
		Grey Wagtail	*Motacilla cinerea*
		Paddyfield Pipit	*Anthus rufulus*
		Tawny Pipit	*Anthus campestris*
		Western Yellow Wagtail	*Motacilla flava*
		White Wagtail	*Motacilla alba*
		White-browed Wagtail	*Motacilla maderaspatensis*
	Muscicapidae	Black Redstart	*Phoenicurus ochruros*
		Bluethroat	*Luscinia svecica*
		Brown Rockchat	*Oenanthe fusca*
		Common Stonechat	*Saxicola torquatus*
		Indian Robin	*Copsychus fulicatus*
		Oriental Magpie-robin	*Copsychus Saularis*
		Pied Bushchat	*Saxicola caprata*
		Red-breasted Flycatcher	*Ficedula parva*
		Variable Wheatear	*Oenanthe picata*
	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus*
	Oriolidae	Eurasian Golden Oriole	*Oriolus oriolus*
	Passeridae	House Sparrow	*Passer domesticus*
		Sind Sparrow	*Passer pyrrhonotus*
		Spanish Sparrow	*Passer hispaniolensis*
	Phylloscopidae	Common Chiffchaff	*Phylloscopus collybita*
		Greenish Warbler	*Phylloscopus trochiloides*
		Hume's Leaf-warbler	*Phylloscopus humei*
	Ploceidae	Baya Weaver	*Ploceus philippinus*
		Streaked Weaver	*Ploceus manyar*
	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*
		White-eared Bulbul	*Pycnonotus leucotis*
	Rhipiduridae	White-browed Fantail	*Rhipidura aureola*
	Sturnidae	Bank Myna	*Acridotheres ginginianus*
		Common Myna	*Acridotheres tristis*
		Common Starling	*Sturnus vulgaris*
		Indian Pied Starling	*Gracupica contra*
		Rosy Starling	*Pastor roseus*

	Sylviidae	Lesser Whitethroat	*Curruca curruca*
	Vangidae	Common Woodshrike	*Tephrodornis pondicerianus*
	Zosteropidae	Indian White-eye	*Zosterops palpebrosus*
PELECANIFORMES	Ardeidae	Cattle Egret	*Bubulcus ibis*
		Cinnamon Bittern	*Ixobrychus cinnamomeus*
		Great White Egret	*Ardea alba*
		Grey Heron	*Ardea cinerea*
		Indian Pond-heron	*Ardeola grayii*
		Little Egret	*Egretta garzetta*
PICIFORMES	Megalaimidae	Coppersmith Barbet	*Psilopogon haemacephalus*
	Picidae	Black-rumped Flameback	*Dinopium benghalense*
PSITTACIFORMES	Psittacidae	Alexandrine Parakeet	*Palaeornis eupatria*
		Rose-ringed Parakeet	*Alexandrinus krameri*
STRIGIFORMES	Strigidae	Short-eared Owl	*Asio flammeus*
		Spotted Owlet	*Athene brama*
	Tytonidae	Common Barn-owl	*Tyto alba*