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Smriti Van: An Urban Abode for Avifaunal Diversity in Jaipur, Rajasthan, India

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Abstract: The species of birds are less affected by contaminated constituents flowing through cities and are better able to acclimate to artificial light, to communicate over the noise of traffic and mechanization, to breed successfully on human-built constructions. As most of natural habitat of earth is destroyed, only the urban habitat is providing the typical abode for survival and life. The present study was therefore taken up with a view to assess the avifaunal diversity of Smriti Van and its different habitat type. An attempt has also been made to identify the local status of birds along with the population trends of migratory species. No comprehensive work has been done before in this area. A total of 35 species spread across 25 families are observed during this study period. Out of 35 species, most are residential and local breeder, only black redstart was the migratory species which was observed during the study. Family-wise distribution of species count maximum from Columbidae (4) and minimum from Strigidae (1) and Upupidae (1). The Study revealed that among the four zone of Smriti Van, family Leiothrichidae have the highest mean number of birds in all the zones while family Megalaimidae and Upupidae have minimum number of bird's population during whole study period. Family wise Percentage distribution showed that family Leiothrichidae contribute highest number as compared to other families. The outcome of present work would help in understanding the status of avifauna in the district and devising better plan for its conservation and management in future.

Keywords: Diversity, Smriti Van, Conservation, Avifauna, Columbidae, Leiothrichidae, Strigidae, Megalaimidae

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Introduction

The biodiversity of the planet is quickly dwindling (Balmford *et al.*, 2003; Jenkins *et al.*, 2003). Around the globe, widespread degradation of the natural environment is thought to be the main factor contributing to the extinction of several

species. Because of habitat destruction, fragmentation, and degradation, many species are reaching critical population levels. In addition to this, anthropogenic actions carried out in the name of development, pollution, invasive species,

climate change, and other factors all contribute to the instability of natural ecosystems. One of the most significant components of global biodiversity is avian variety. Birds may be found in practically every type of environment on the planet and are essential components of many food chains.

One of the best pollinators for different plants is the bird. This ensures the survival and growth of numerous plant species. Many birds also play a significant role in the dissemination of plant seeds. Experts at this task include parakeets and nutcracker birds. Since the majority of bird species are insectivores, they effectively manage insects problem in horticulture and agriculture. Birds eat a variety of invertebrate species as well as several species of lower vertebrates, in addition to insects. This contributes to population management and, eventually, ecological balancing. In food chains and food webs, birds play a crucial role, from primary consumers like seed-eating pigeons to top consumers like birds of prey. Birds play a crucial role in biogeochemical cycles, such as the phosphorus cycle. Guano deposits play a crucial role in the phosphorus cycle. All that is present in these deposits are the dried droppings of birds that consume fish. For farmers, this guano is extremely useful because it makes excellent fertilizer. Some bird species are excellent scavengers. Crows, kites, and the master scavenger "Vulture" are all excellent and effective environmental cleaners. Since the world's population is growing, a large portion of the avifauna has already disappeared.

The species of birds are less affected by contaminated constituents flowing through cities, and are better able to acclimate to artificial light, to communicate over the noise of traffic and mechanization and to breed successfully on human built constructions. As most of natural habitat of earth is destroyed, only the urban habitat is providing the typical abode for survival and life (Paul *et al.*, 2008). The artificial ecosystems of cities such as well-maintained parks and seasonal ponds can support an astoundingly large number of birds. The birds are often most

visible where people have congregated to buy, sell, eat and discard food. The commensal relationship between birds and humans for food, habitat and protection shows near benches in city parks, in playgrounds, sports stadiums, at deserted refuse disposal areas, and at window ledge feeders.

By virtue of its geographical features and extreme climatic conditions, Rajasthan is home to a wide variety of birds and tourists equally. Birds provide many direct and indirect ecosystem services. As birds are high up in the food chain, they are also good indicators of environmental health. In Addition to this, bird watching and related eco-tourism is a major economic force in many parts of the nation. Rajasthan is a state in northwest India. Despite having few water resources, this state has a diverse avian population. A little over 40% of the 1224 species that make up the Indian avifauna are found in the state, which makes up just 10% of the nation's total land area. The existence of diverse habitats and the state's geographic placement inside the migratory bird flyway are the causes of the remarkable variety. A total of 496 bird species have been reported from Rajasthan by Devarshi (2004), which represents around 40% of India's avifauna. According to Grimmett and Inskipp (2003), the state of Rajasthan is home to about 510 species of birds. 24 IBAs and two Ramsar sites have been identified for conservation purposes. In India, there are 61 endemic bird species, and 17 of them are found in Rajasthan (Ripley, 1961; Ali and Ripley, 1987). The earliest observations on the birds of Sambhar Lake and its surroundings were published by Adam in 1873, and Barnes published his study on bird nesting in Rajputana in 1886. Ornithological surveys have a long history in Rajasthan. In 1929, Baker described ducks from India, including Rajasthan, for the first time. Whistler then published his account of the ornithological study of the Jodhpur region in 1938. Tehsin and Sharma (1994) provided an updated list of the birds found in southern Rajasthan. Since then, valuable contributions have been made by Rahmani (1986, 1997), Sangha and Kulshreshtha (1998) and Sharma (2002).

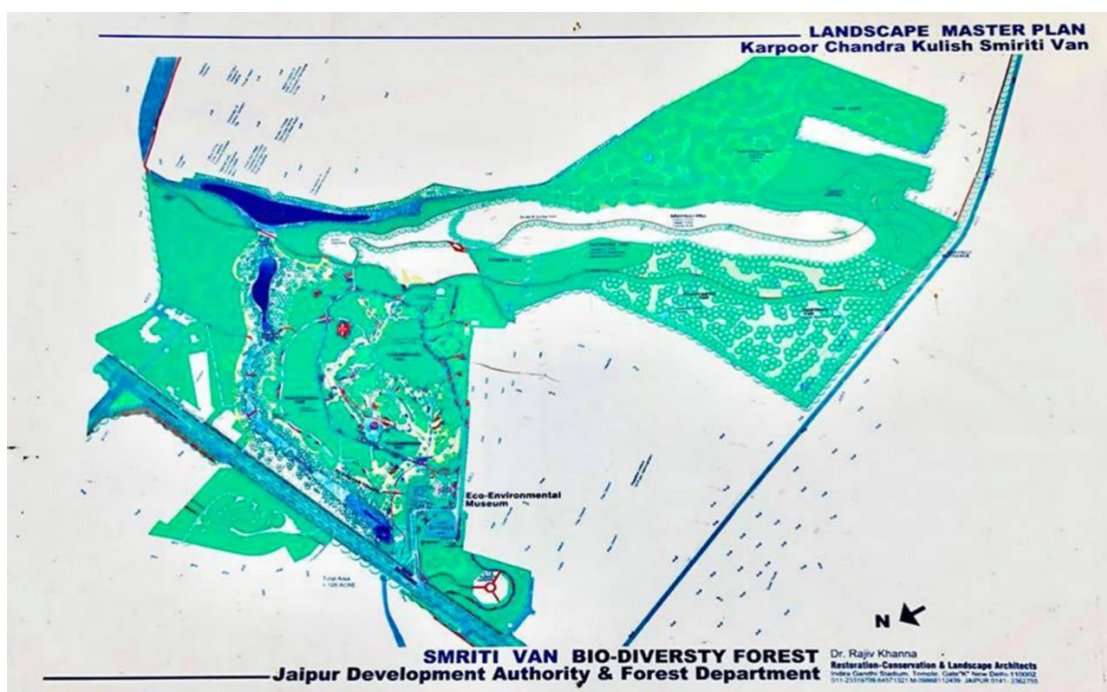


Fig. 1: Map of Study Area.

Smriti Van in Jaipur is an extended region of Jhalana Wildlife park, situated in the heart of Jaipur, India. Smriti Van is spread over 108 acres of land and so far no work has been done on the bird fauna of this area. The present study was therefore taken up with a view to assess the avifaunal diversity of Smriti Van and its different habitat type. An attempt has also been made to identify the local status of birds along with the population trends of migratory species. No comprehensive work has been done before in this area. The outcome of present work would help in understanding the status of avifauna in the district and devising better plan for its conservation and management in future.

Materials and Methods

Total forests area of Rajasthan is 32639 km² forest, which is 9.54 % of the total state's geographical area. Reserve Forests constitute 38.16%, Protected Forests 53.36% and Unclassified Forests 8.48% of the forest area. Rajasthan is famous for the heaven of migratory birds and the only region for resident birds of desert area. Many species of eagles, harries,

falcons can be observed. The state is also noted for National Parks and Wildlife Sanctuaries and there are four national parks and wildlife sanctuaries.

The area selected for the study of the bird diversity was Smriti Van (Fig. 1) in Jaipur which is the capital and largest city of the Indian state of Rajasthan. Jaipur has a monsoon-influenced hot semi-arid climate (Köppen climate classification BSh) with long, extremely hot summers and short, mild to warm winters. Annual precipitation is over 63 cm, falling mostly in July and August due to monsoon, causing the average temperatures in these two months to be lower compared to drier May and June. Jaipur is known for its diverse wildlife that is found here which includes tigers, leopards, cheetahs, elephants and many other exotic species of animals and birds. Smriti Van of Jaipur is a biodiversity forest making it the best place to get close to the nature's souvenir. This Biodiversity Forest was formed during 1981 flood that caused deep ravines. The area was flourished to sow trees in the memory of dear ones. Later, the Rajasthan Government took possession and developed this segment under Green Rajasthan Campaign, naming it Smriti Van.

The study was carried out in Jaipur district to develop the baseline data of the bird's fauna of Smriti Van.

1. The study area was visited four times in a month due to limitation of resources and time; during which a bird census was carried out. All together 26 visits were made at study sites over a period of 6 months. The study was conducted between January 2023 to June 2023. Study was divided into four zones according to its habitat i.e. A-Zone (North), B-Zone (South), C-Zone (East) and D-Zone (West).
2. Status and distribution was done with the help of the secondary and primary data sheets. The surveys were carried out during suitable time of the day (morning and evening hours). The status of birds was determined by observation as well as literature review. Standard scientific sampling techniques was used.
3. Point count method for Aves count stations was made within the study plot either in a systematic manner or in a random manner. The distance between the two points was at least 50 meters. Counting was done for a fixed time period in all the 11 different segments of Smriti Van.
4. Birds roosting on the trees and dust bathing activity was directly observed following the open ended line transect method early in the morning (7: 00 to 9:00 am) and evening (3:00 to 5:00 pm) in each visit. The activities of the birds were recorded and photographed. The species was identified following the field guide books (Inskipp and Inskipp, 1985; Ali *et al.*, 1995; Grewal *et al.*, 2002; Grimmett *et al.*, 2014; Arlott, 2015).
5. The path transects used for this purpose is shown in the image with an orange line. The path covered a total distance of about 500 m. This path transact was chosen as this path had shown maximum bird activity based on a coarse observation earlier. This is expected as this path forms the edge of open undeveloped

land. No observations were made inside the land itself as it was not possible to move inside due to thick bushes and shrubs.

6. The birds were recorded according to their status, seasonal visits, site and habitat types. Records were supported with photography using Cannon 70 D camera and 7D Canon SLR Camera. Birds sighted during the study period were categorized according to their presence (month-wise) status as IUCN. All the observations were visual without capturing any bird so no Sub-specific identification was carried out.
7. The data collected were pooled for six months according to the Indian climate at four distinct zones and analyzed the mean and standard error of mean (SEM) using SPSS and Excel Software.

Results and Discussion

Status and Diversity of Birds in Smriti Van:

A total of 35 species spread across 25 families are reported during the study for the observation period. Family wise distribution of species count is Alcedinidae (1), Accipitridae (2), Ardeidae (1), Columbidae (4), Charadriidae (1), Corvidae (2), Cisticolidae (2), Cuculiformes (1), Dicruridae (1), Leiothrichidae (1), Muscicapidae (1), Megalaimidae (1), Meropidae (1), Muscicapidae (2), Nectariniidae (1), Phasianidae (2), Psittacidae (1), Pycnonotidae (1), Picidae (2), Passeridae (1), Pycnonotidae (2), Rallidae (2), Sturnidae (2), Strigidae (1) and Upupidae (1) (Table 1). Out of 35 species most are residential and local breeder, only black redstart was the migratory species which was observed during the study.

Family-wise distribution of species count maximum from Columbidae (4) and minimum from Strigidae (1) and Upupidae (i). The study revealed that among the four zone of Smriti Van family Leiothrichidae have the highest mean number of birds in all the zones while family Megalaimidae and Upupidae have minimum number of bird's population during whole study period. Family wise percentage distribution

Table 1: Birds Diversity in Smriti Van, Jaipur (India)

S. No.	Family	Common Name	Scientific Name	IUCN Status	Residential status	Activity
1	Alcedinidae	White throated kingfisher	<i>Halcyon smyrnensis</i>	Least concern	Resident	Roosting on tree.
2	Accipitridae	Black kite	<i>Milvus migrans</i>	Least concern	Resident	Flying
3		Shikra	<i>Accipiter badius</i>	Least concern	Resident	Roosting
4	Ardeidae	Cattle Egret	<i>Bubulcus ibis</i>	Least concern	Resident	Eating
5	Columbidae	Feral pigeon	<i>Columba livia</i>	Least concern	Small population	Foraging
6		Eurasian Collared dove	<i>Streptopelia decaocto</i>	Least concern	Strongly dispersive	Foraging
7		Laughing Dove	<i>Spilopelia senegalensis</i>	Least Concern	Resident	Roosting on tree.
8		Spotted Dove	<i>Spilopelia chinensis</i>	Least concern	Resident	Roosting
9	Charadriidae	Red wattled lapwing	<i>Vanellus indicus</i>	Least concern	Resident	Foraging
10	Corvidae	Magpie robin	<i>Copsychus saularis</i>	Least concern	Resident, breeder	Flying
11		House Crow	<i>Corvus splendens</i>	Least Concern	Resident	Roosting on tree.
12	Cisticolidae	Plain prinia	<i>Prinia inornata</i>	Least concern	Resident breeder	Roosting on tree.
13		Ashy prinia	<i>Prinia socialis</i>	Least concern	Resident breeder	Roosting
14	Dicruridae	Black Drongo	<i>Dicrurus macrocercus</i>	Least concern	Common resident breeder	Roosting on tree.
15	Leiothrichidae	Large grey babbalar	<i>Turdoides malcolmi</i>	Least concern	Resident	Foraging, flying
16	Muscicapidae	Indian robin	<i>Saxicoloides fulicatus</i>	Least concern	Resident and non-migratory	Flying
17	Megalaimidae	Coppersmith barbet	<i>Megalaima haemacephalus</i>	Least concern	Resident	Foraging
18	Meropidae	Asian Green Bee Eater	<i>Merops orientalis</i>	Least Concern	Resident	Roosting on tree.
19	Muscicapidae	Black rock-chat	<i>Cercomela fusca</i>	Least concern	Resident breeder	Flying
20		Purple sunbird	<i>Cinnyris asiaticus</i>	Least concern	Resident	Eating
21	Phasianidae	India peafowl	<i>Pavo cristatus</i>	Least concern	Resident breeder	Foraging, dancing
22		Grey Francolin	<i>Francolinus pondicerianus</i>	Least Concern	Resident	Eating
23	Psittacidae	Rose ringed parakeet	<i>Psittacines</i>	Least Concern	Resident	Foraging
24	Pycnontidae	Red Vented bulbul	<i>Pycnonotus cafer</i>	Least concern	Resident breeder	Roosting on tree.
25	Picidae	Greater flameback	<i>Chrysocolaptes guttacristates</i>	Least Concern	Resident	Digging the nest.
26		Cinereous Tit	<i>Parus Cinereus</i>	Least concern	Resident	Flying
27		Great tit	<i>Parus major</i>	Least Concern	Resident	Roosting on tree.
28	Passeridae	Yellow Throated Sparrow	<i>Petronia xanthocollis</i>	Least Concern	Resident	Roosting
29	Pycnonotidae	Red whiskered Bulbul	<i>Pycnonotus jocosus</i>	Least concern	Resident	Flying
30	Rallidae	Common Moorhen	<i>Gallinula chloropus</i>	Least concern	Resident	Drinking water
31		White Breasted Waterhen	<i>Amauornis phoenicurus</i>	Least Concern	Resident	Eating
32	Sturnidae	Common myna	<i>Acridotheres tristis</i>	Least concern	Resident	Foraging.
33		Brahminy Starling	<i>Sturnia pagodarum</i>	Least Concern	Resident	Flying
34	Strigidae	Jungle owelet	<i>Glaucidium radiatum</i>	Least concern	Resident	Roosting
35	Upupidae	Hoopoe	<i>Upupa epops</i>	Least concern	Resident	Eating

showed that family Leiothrichidae contribute highest number as compared to other families.

Nadim and Chaudhary (2020) studied the bird's diversity, their abundance, and their

protection in the Udaipur district. In their study 66 distinct avifaunal species were recorded across various environments throughout the study period. The 66 bird species identified included 62

Table 2: Overall population status of bird's population in January

Family	Mean	SEM
Alcedinidae	2.75	2.11
Accipitridae	3.06	5.54
Ardeidae	1.25	1.66
Columbidae	7.98	4.39
Charadriidae	3.50	1.95
Corvidae	9.00	5.85
Cisticolidae	2.28	1.90
Cuculiformes	1.06	1.07
Dicruridae	6.94	4.72
Leiothrichidae	15.06	8.76
Muscicapidae	3.81	2.09
Megalaimidae	0.00	0.00
Meropidae	2.94	2.37
Muscicapidae	3.00	1.37
Nectariniidae	0.81	0.63
Phasianidae	8.00	5.05
Psittacidae	3.94	2.78
Pycnontidae	2.75	1.06
Picidae	1.79	0.61
Passeridae	2.69	0.90
Pycnonotidae	3.59	1.46
Rallidae	1.78	1.84
Strigidae	0.75	0.41
Upupidae	0.65	0.50

resident species and 4 migratory species. These birds' species have been classified in accordance with the IUCN Red List for 2018. Of the 66 species, 63 were the least endangered, one was vulnerable, and two were almost extinct. The greatest number of species were found next to wetlands (52), followed by agricultural land (46), while the smallest number of species were found in colonies (38). 35 of the 66 bird species were found in each of the three areas. The majority of bird species were insectivorous (39.39%), followed by carnivores (24.24%), omnivores (22.72%), graminivorous (7.57%), frugivorous (4.54%), and nectarivorous (1.51%) in terms of food priority or guild reaction (Nadim and Choudhary, 2020).

Overall mean population status in the month of January:

Overall mean population status in the month of January showed that family Leiothrichidae have the highest mean number of birds (15.06 ± 8.76) and families Strigidae, Upupidae revealed the lowest mean number of birds-- 0.75 ± 0.41 and 0.65 ± 0.50 , respectively (Table 2; Fig. 2). Family-wise percentage distribution of total population in January stated that family Leiothrichidae have the highest relative % of birds (17%) and families Strigidae, Upupidae show the lowest relative % of birds (1% each) (Fig. 3).

Overall mean population status in the month of February:

Overall mean population status in the month of February shows that family Leiothrichidae have the highest mean number of birds (12.66 ± 9.14) and families Megalaimidae, Strigidae, Upupidae

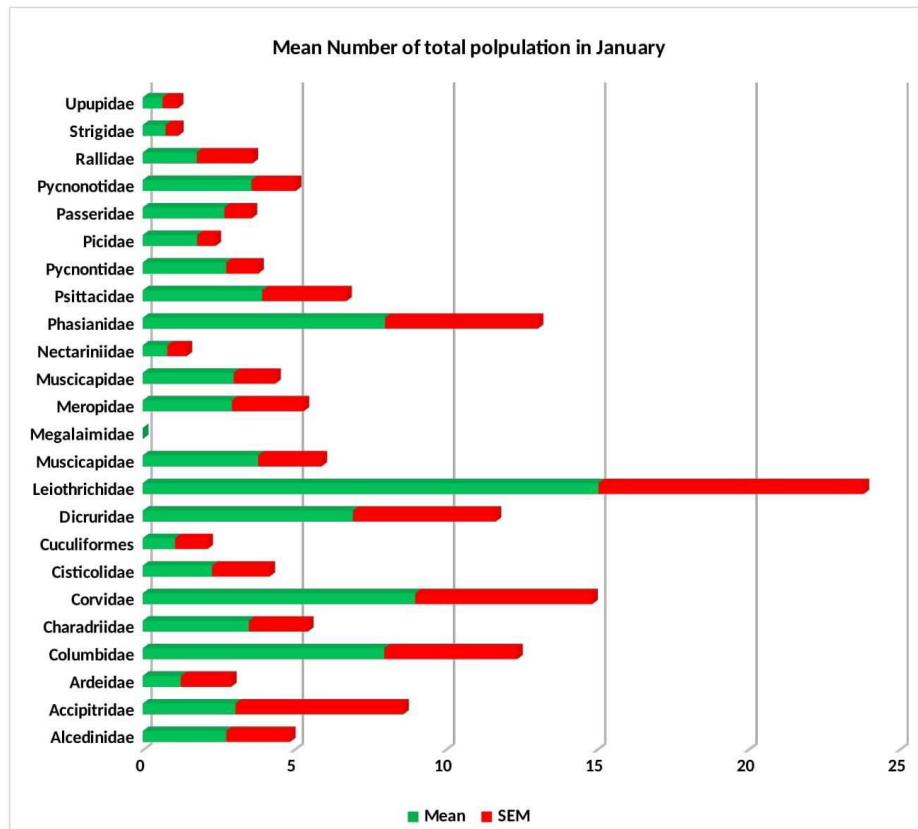


Fig. 2: Mean Number of total population in January.

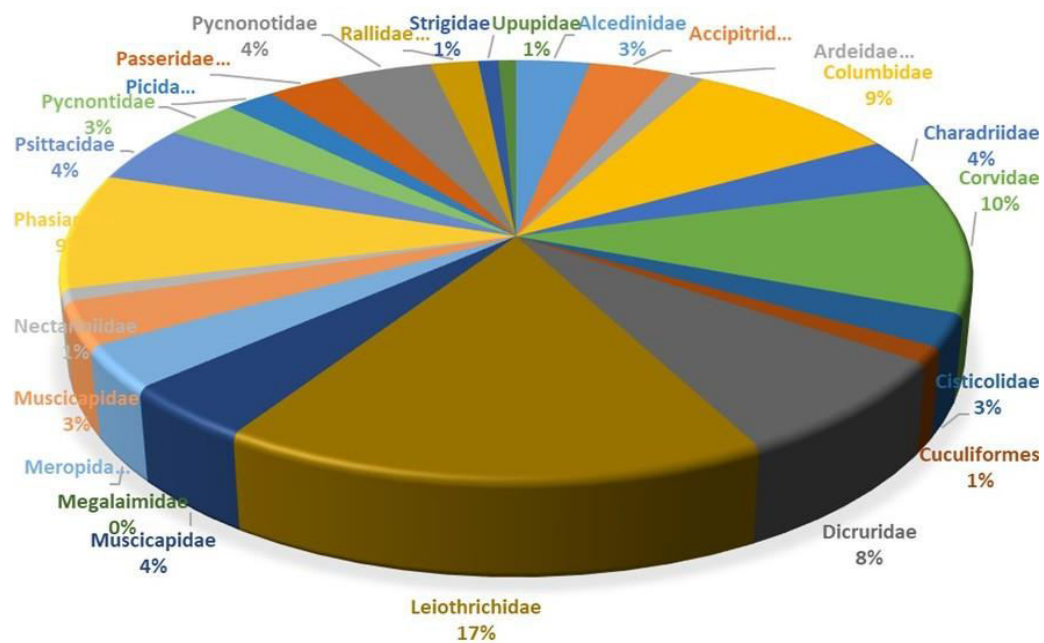


Fig. 3: Family-wise distribution of total population in January.

Table 3: Overall population status of bird's population in February

Family	Mean	SEM
Alcedinidae	2.32	1.46
Accipitridae	3.66	3.55
Ardeidae	1.44	1.23
Columbidae	4.37	3.61
Charadriidae	2.78	1.58
Corvidae	5.12	4.64
Cisticolidae	1.85	1.68
Cuculiformes	1.54	1.29
Dicruridae	4.74	2.82
Leiothrichidae	12.66	9.14
Muscicapidae	2.84	1.24
Megalaimidae	0.39	0.24
Meropidae	2.54	1.93
Muscicapidae	1.57	1.40
Nectariniidae	0.80	0.29
Phasianidae	5.59	4.10
Psittacidae	2.82	1.92
Pycnontidae	4.42	2.50
Picidae	1.39	1.21
Passeridae	6.92	7.88
Pycnonotidae	2.43	1.54
Rallidae	3.15	2.93
Sturnidae	1.75	1.39
Strigidae	0.42	0.38
Upupidae	0.42	0.38

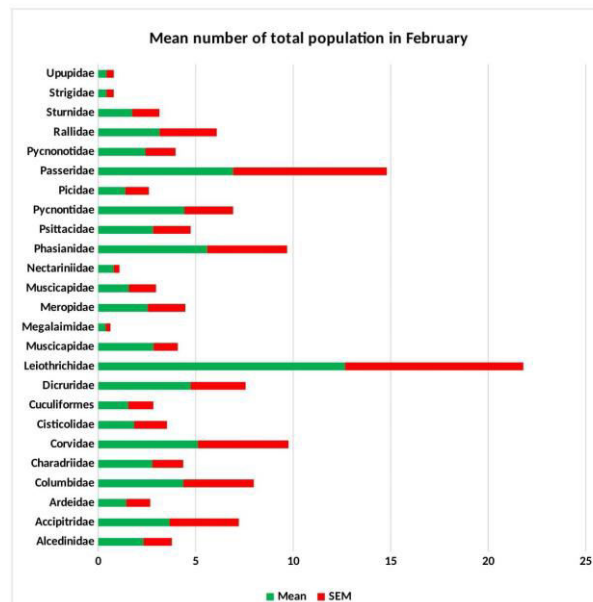


Fig. 4: Mean Number of total populations in February.

Table 4: Overall population status of bird's population in March

Family	Mean	SEM
Alcedinidae	3.00	1.81
Accipitridae	4.47	2.29
Ardeidae	3.44	1.01
Columbidae	1.18	0.92
Charadriidae	3.81	0.97
Corvidae	5.28	3.09
Cisticolidae	2.94	0.62
Cuculiformes	0.37	0.29
Dicruridae	5.25	1.74
Leiothrichidae	20.50	8.74
Muscicapidae	1.88	1.13
Megalaimidae	1.13	0.48
Meropidae	2.69	0.55
Muscicapidae	1.31	0.69
Nectariniidae	1.00	1.02
Phasianidae	7.22	2.87
Psittacidae	2.31	1.42
Pycnontidae	2.06	1.20
Picidae	1.44	0.54
Passeridae	5.44	6.06
Pycnonotidae	2.44	1.14
Rallidae	2.44	1.91
Sturnidae	2.53	1.53
Strigidae	0.39	0.33
Upupidae	0.48	0.38

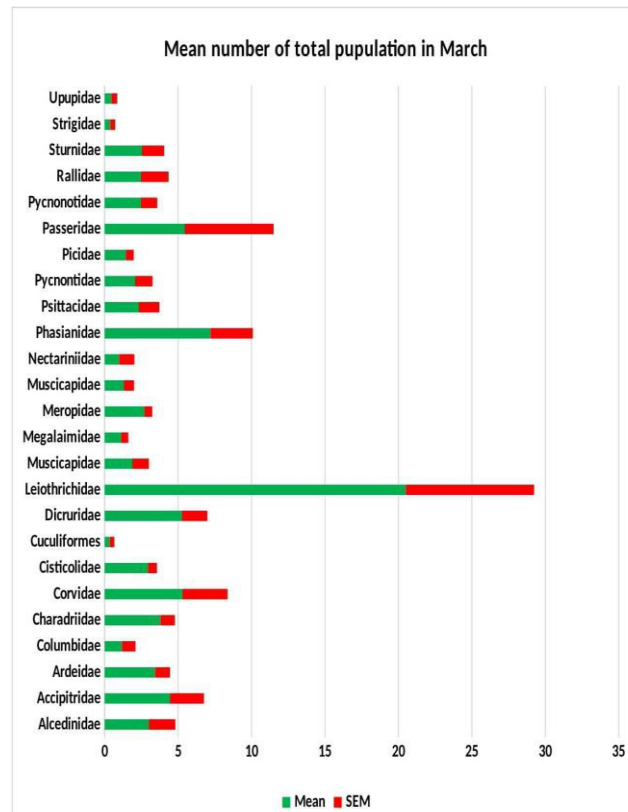


Fig. 6: Mean Number of total population in March.

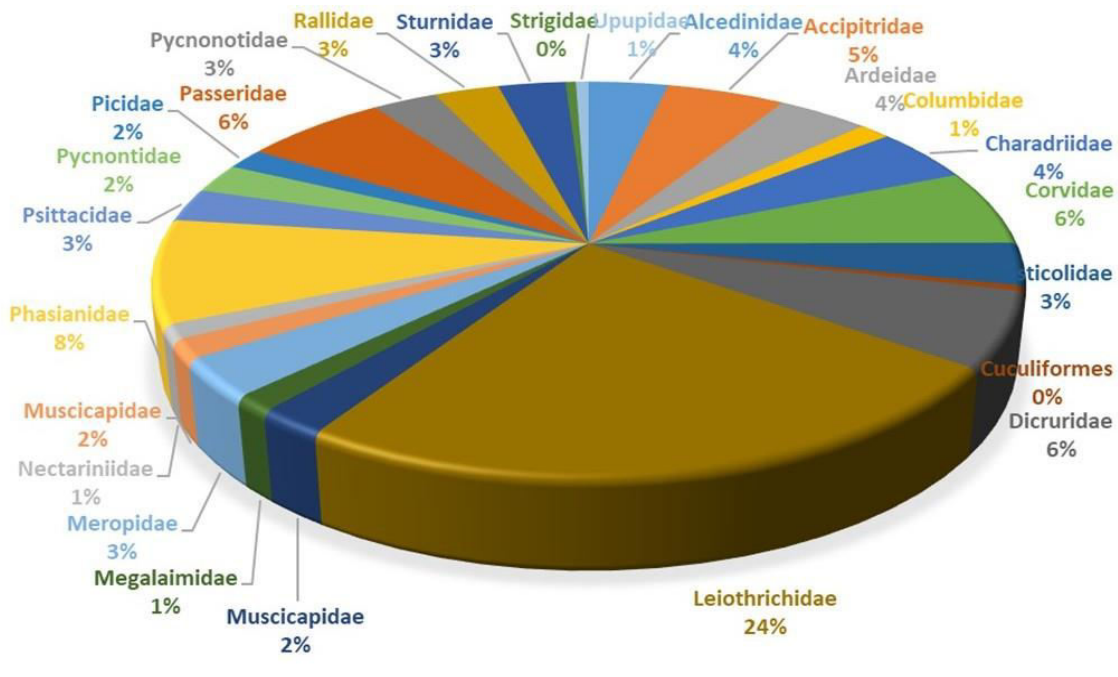


Fig. 7: Family-wise distribution of total population in March.

Table 5: Overall population status of bird's population in April

Family	Mean	SEM
Alcedinidae	2.63	1.24
Accipitridae	3.72	1.60
Ardeidae	3.06	0.82
Columbidae	5.27	2.57
Charadriidae	2.94	0.65
Cuculiformes	0.38	0.28
Dicruridae	4.50	1.85
Leiothrichidae	15.63	5.66
Muscicapidae	2.00	1.40
Megalaimidae	1.25	0.47
Meropidae	2.56	0.57
Nectariniidae	0.75	0.00
Psittacidae	2.13	0.91
Pycnontidae	2.00	0.77
Passeridae	2.13	0.67
Strigidae	0.29	0.22
Upupidae	0.65	0.52

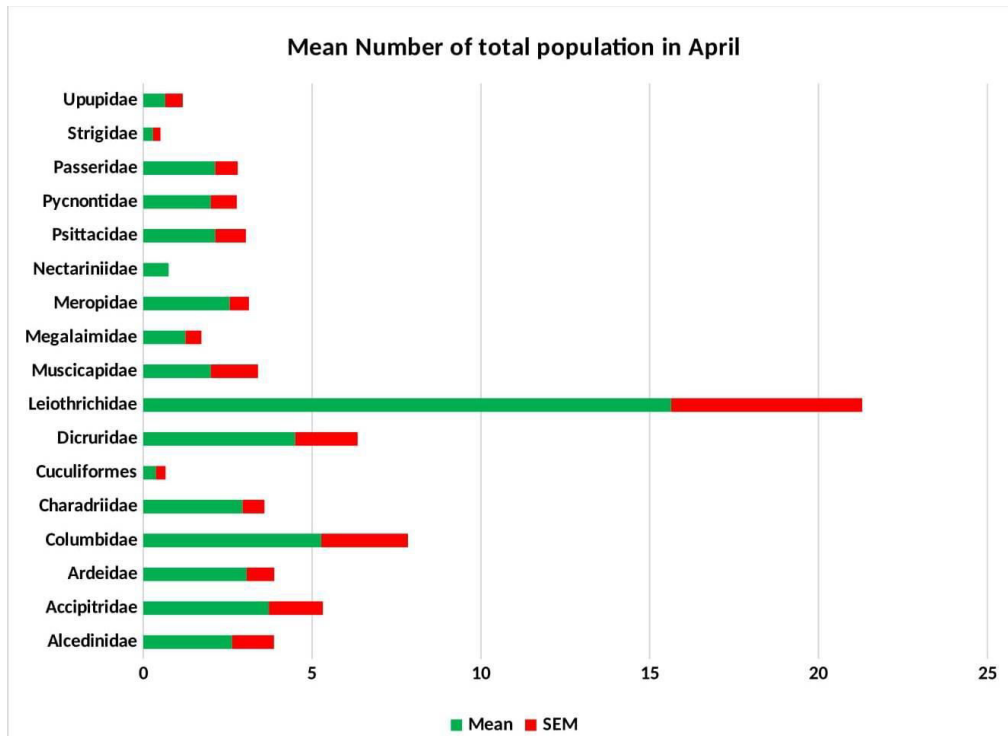


Fig. 8: Mean Number of total population in April.

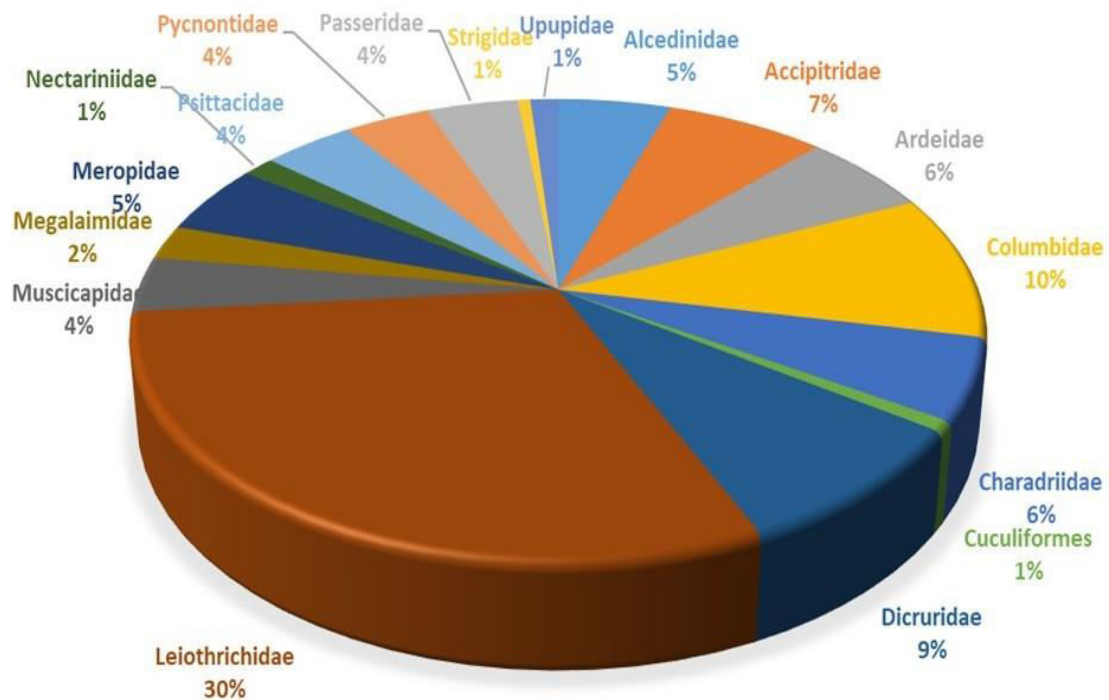


Fig. 9: Family-wise distribution of total population in April.

Table 6: Overall population status of bird's population in May

Family	Mean	SEM
Alcedinidae	2.31	1.25
Accipitridae	4.59	2.96
Ardeidae	1.19	1.07
Columbidae	3.47	1.66
Charadriidae	2.81	1.56
Corvidae	7.13	4.22
Cisticolidae	2.53	1.61
Cuculiformes	1.38	1.44
Dicruridae	6.63	2.62
Leiothrichidae	19.19	9.46
Muscicapidae	3.63	1.16
Megalaimidae	0.25	0.20
Meropidae	3.06	1.78
Muscicapidae	2.69	0.63
Nectariniidae	0.94	0.47
Phasianidae	8.56	3.88
Psittacidae	2.88	1.11
Pycnontidae	4.44	2.15
Picidae	2.28	1.17
Passeridae	3.56	0.66
Pycnonotidae	2.69	1.86
Rallidae	2.47	0.83
Sturnidae	2.78	1.42
Strigidae	0.35	0.32
Upupidae	0.35	0.32

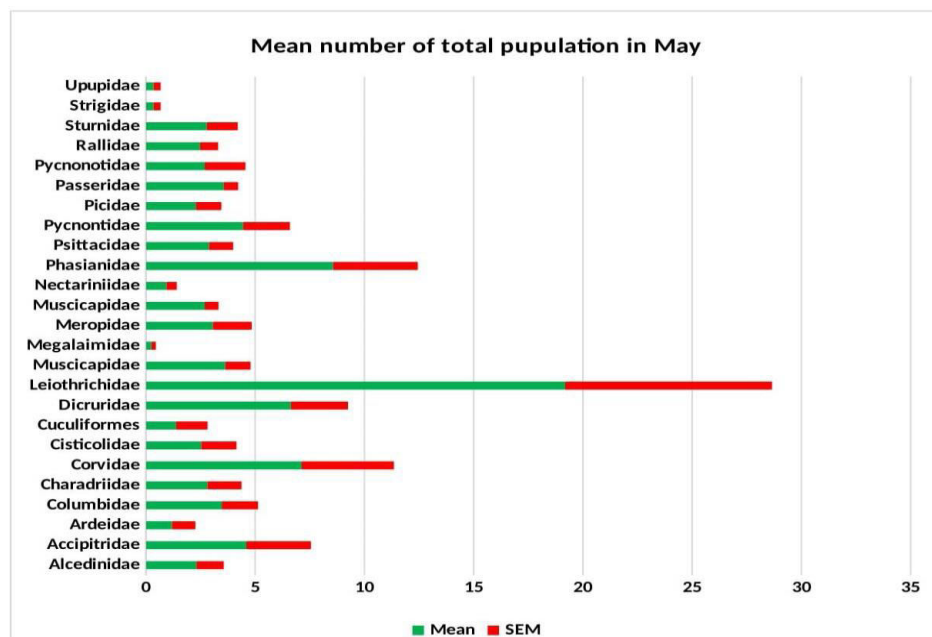


Fig. 10: Mean Number of total population in May.

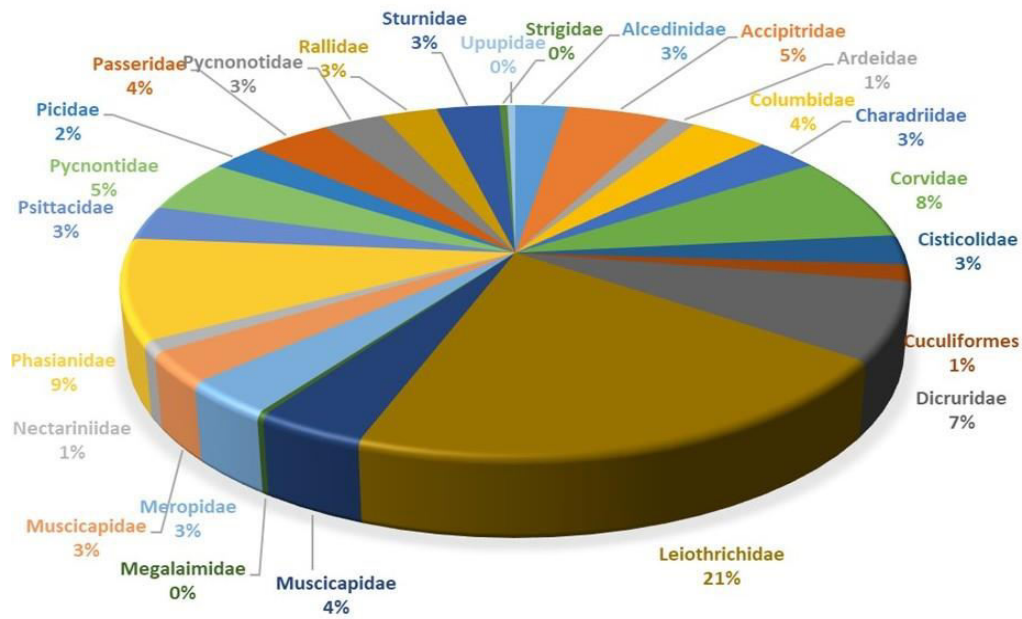


Fig. 11: Family-wise distribution of total population in May.

Table 7: Overall population status of bird's population in June

Family	Mean	SEM
Alcedinidae	4.31	2.44
Accipitridae	6.84	3.57
Ardeidae	1.25	1.32
Columbidae	4.66	3.01
Charadriidae	3.56	1.99
Corvidae	7.38	4.78
Cisticolidae	2.22	1.61
Cuculiformes	0.94	0.77
Dicruridae	5.15	3.11
Leiothrichidae	13.81	8.56
Muscicapidae	2.69	1.75
Megalaimidae	0.00	0.00
Meropidae	3.13	2.17
Muscicapidae	2.53	1.40
Nectariniidae	1.50	0.82
Phasianidae	8.03	5.02
Psittacidae	3.25	1.14
Pycnontidae	2.06	0.72
Picidae	1.75	0.62
Passeridae	1.56	0.47
Pycnonotidae	3.50	1.76
Rallidae	1.91	2.06
Sturnidae	3.75	1.20
Strigidae	0.63	0.32
Upupidae	0.42	0.35

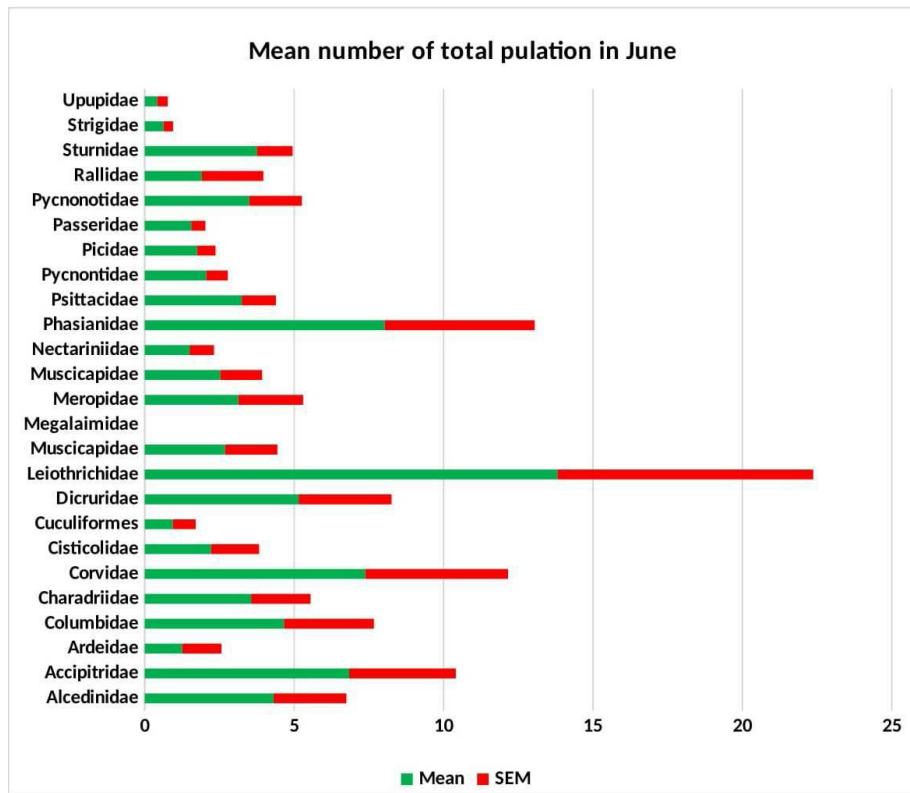


Fig. 12: Mean Number of total population in June.

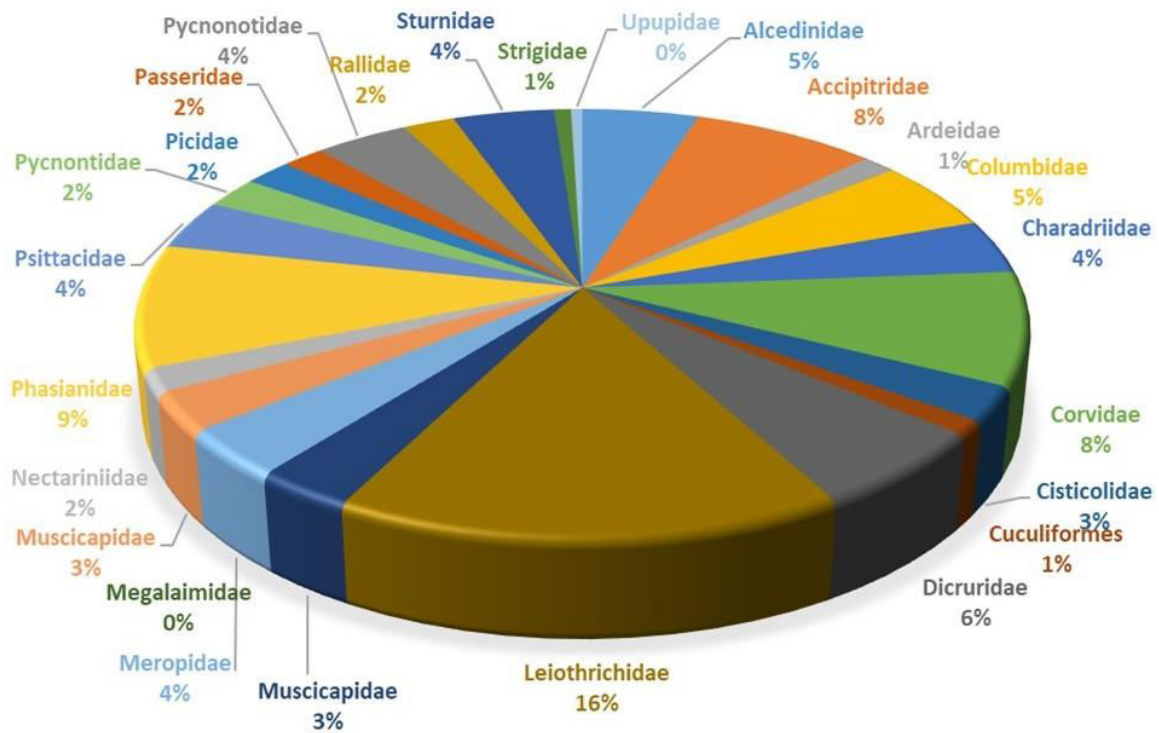


Fig. 13: Family-wise distribution of total population in June.

families Megalimidae, Strigidae, Upupidae revealed the lowest mean number of birds-- 0.00 ± 0.00 , 0.63 ± 0.32 , and 0.42 ± 0.35 , respectively (Table 7; Fig. 12). Family-wise percentage distribution of total population in June indicated that family Leiothrichidae have the highest relative % of birds (21%) and families Strigidae, Upupidae show the lowest relative % of birds (1%, 0%) (Fig. 13). Figure 14 illustrates the bird species encountered in the Smriti van.

The diverse floral and animal life is housed in the ecosystems that have created inside the green and blue areas. Similar study conducted by Upadhyay *et al.* (2020) in Ajmer, a city in central Rajasthan, as part of a series of conservation initiatives. The seasonal surveys and periodic sampling observations were recorded from February 2017 to January 2019. The UGA and HSA harbored 104 species and 41 species, respectively. They have observed 167 species from 58 families. Another study (Mehra *et al.*, 2020) revealed 243 bird species from 64 families in the Ajmer District's cumulative list.

Species wise mean number shows that Indian Peafowl and Large grey babbler was found maximum and Common hoopoe, White breasted kingfisher, Barbet have the minimum number of mean population during the study period, because when temperature increase some of migratory birds migrate to their destination.

Species diversity and numbers were decreased when temperature increases. Zone-A have maximum numbers of birds and Zone-D have minimum numbers. Reason of this changes are because zone A have maximum diversity of plants and food and nesting place on the other hand Zone -D have only babul and some xerophytic plants so number of birds were less in that area.

Khalora and Johari (2021) reported that birds are found all over the world and live in a variety of settings. Birds play a significant role in the management of insects and pests and are one of the markers of environmental changes. The goal of their study was to catalogue the variety of birds

that was found around the Khandiya Reservoir in Rajasthan's Jhalawar district and they identified of 53 species, 49 genera, 33 families, and 13 orders. Comparatively, it was found that bird variety was higher in the winter and lower in the summer.

Threats to the birds:

The survivality of terrestrial as well as aquatic birds is mostly affected by certain factors such as destruction of habitat, illegal hunting and capturing, cutting of host trees, loss of food etc. Various threats are observed that are responsible for destruction of avian diversity in the study area. The local tourists often gather in large numbers in Smiriti Van, particularly during the festive days. Some of them disturb the vultures purposely by hitting stones at them, just for fun. There are awareness boards in Hindi and English, but many of the local tourists are uneducated, they do not bother to realize the importance of the birds. The volunteers have rescued several birds that were injured by such notorious tourists. Breeding sites are taken into account, tourism is problematic due to the strife by sporting activities (for example climbing, and paragliding) and/or recreation/curiosity. Followings are major threats to birds:

- Deforestation practices in the name of infrastructural development, agricultural expansion and urban expansion.
- Land pollution due to greater use of chemicals in the form of pesticides, weedicides and fertilizers in the cultivated areas.
- Unmanaged dumping of domestic and commercial garbage and dead animals in open areas, especially in the areas nearby human habitation.
- Continuous and prolonged dry periods leading to scarcity of food and shelter.
- Road kills and accidental deaths of bird species. Traffic also affects nesting and breeding potential of the birds.
- Electrocution by network of high-tension wires



White throated kingfisher
(*Halcyon smyrnensis*)



Black kite (*Milvus migrans*)



Shikra (*Accipiter badius*)



Cattle Egret (*Bubulcus ibis*)



Feral pigeon (*Columba livia*)



Eurasian collared dove (*Streptopelia decaocto*)



Laughing Dove (*Spilopelia senegalensis*)



Spotted dove (*Spilopelia chinensis*)



Red wattled lapwing (*Vanellus indicus*)



Magpie robin (*Copsychus saularis*)



House crow (*Corvus splendens*)



Plain prinia (*Prinia inornata*)



Ashy prinia (*Prinia socialis*)



Black drongo (*Dicrurus macrocercus*)



Large grey babbalar (*Turdoides malcolmi*)



Indian robin (*Saxicoloides fulicatus*)



Coppersmith barbet (*Megalaema haemacephala*)



Asian green bee eater (*Merops orientalis*)



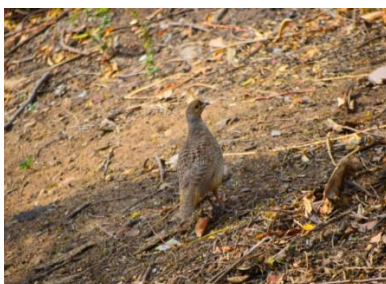
Black rock-chat/Indian Chat (*Cercomela fusca*)



Purple sunbird (*Cinnyris asiaticus*)



Indian peafowl (*Pavo cristatus*)



Grey francolin (*Francolinus pondicerianus*)



Rose ringed parakeet (*Psittacula krameri*)



Red Vented Bulbul (*Pycnonotus cafer*)



White-naped Woodpecker
(*Chrysocolaptes festivus*)



Cinereous tit (*Parus cinereus*)



Great tit (*Parus major*)



Yellow throated sparrow
(*Petronia xanthocollis*)



Red whiskered bulbul (*Pycnonotus jocosus*)



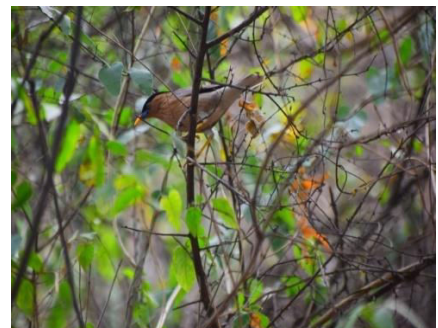
Common moorhen (*Gallinula chloropus*)



White breasted waterhen
(*Amaurornis phoenicurus*)



Common myna (*Acridotheres tristis*)



Brahminy starling (*Sturnia pagodarum*)



Jungle owlet (*Glaucidium radiatum*)



Hoopoe (*Upupa epops*)

Fig. 14: Glimpses of birds in Smriti Van.

- Certain festive occasions such as Makar Sankranti when kite flying is practiced in a large number as a ritual. Birds, being unable to see the thin but sharp threads are trapped by the threads and get injured or wounded in large numbers, most of them culminate into death.
- Lack of surface water bodies or shallow wetlands is one of the major factors for the less occurrence of water bird in the area.
- Illegal hunting and catching of birds for various purposes is another major threat to avifauna of the Jhunjhunu district.
- Agricultural practices are performed only in monsoon season in the district. The fields do not serve food and shelter to the birds for the remaining eight to nine months.
- Unavailability of proper nesting and roosting sites is one of the major threat to big birds like raptors.
- Presence of extreme climatic conditions. Due to the combined effect of all the above mentioned perils, the birds have become vulnerable and an easy target to succumb to these threats.

The survivability of terrestrial birds is mostly affected by certain factors such as destruction of habitat, illegal hunting and capturing, cutting of host trees, loss of food etc. Various threats are observed that are responsible for destruction of avian diversity in the study area. Some of the plausible major threats confronted by the birds are: tourism, pollution and urbanization. The heavy metal buildup is brought on by pollution from coal-fired power stations, and this varies depending on the species. Blackbirds acquire substantially more heavy metal residues than great tit or rock buntings (Llacuna *et al.*, 1995). In addition to the aforementioned issues, a variety of other issues can arise, such as decreased breeding success, as seen in the case of the great tit in southern Poland (Nyholm *et al.*, 1995). Air pollution can also damage a great tits song in

addition to having an impact on their physiology. This is demonstrated by the finding that great tit males sing less when they are close to emission sources (Gorissen *et al.*, 2005; Isaksson *et al.*, 2005). The thickness of egg shells, egg volume and content, clutch size, and hatching success of great tit and pied flycatchers (*Ficedula hypoleuca*) have also been reported to decrease in response to copper smelter emissions (Eeva and Lehtikoinen 1995). Next, the ruby-throated hummingbird (*Archilochus colubris*) is affected by ozone (along with several other atmospheric contaminants) when it comes to feeding. These birds are more vulnerable to the harmful effects of ozone because they breathe larger quantities of air relative to their body weight (Lewis, 2006). Physiological, morphological, and behavioural implications could result from long-term effects. Such effects on reproductive success and survival could be lasting and cross-generational. In fact, even brief exposure to stressors like noise during development may have a significant impact (Crino *et al.*, 2013). This has been seen in nestlings of white-crowned sparrows (*Zonotrichia leucophrys*) that exhibit phenotypic changes in response to louder traffic noise (Crino *et al.*, 2013).

Conservational requirements for the protection of birds:

During the study period, a stepwise process was taken for developing effective communications programs. The stages of these processes included: develop concept about community participation, the significance of community in bird's conservation, perception of community about the conservation measures and awareness through social media. During the research work, local communities specially tourist were inspired to conserve the birds within and outside the areas. The conservation strategies and attitude of locals towards bird's conservation began to understand and care about the relationships between communities and birds. Conservation workshops, training, awareness drive, field trips and nature trail were some of the approaches that used to communicate.

Awareness Activities:

Awareness Programmes provide an opportunity to open up a whole new world of curiosity and interest as well as sensitize local people regarding the value and need for conservation of avifauna, their diversity apart from environmental issues. Due to increasing population pressure, urbanization, industrial development and change in the climatic condition, the number of birds species decline rapidly. The aims of the awareness drive were:

- To aware the local community and students, local people about the birds, their threats, diversity and conservational requirements.
- To train the students as well as local people as Nature Messengers.

Conservation techniques:

A variety of strategies have been devised by scientists and conservationists to safeguard bird species. The effectiveness of these methods varies.

Conclusion

The study was conducted from January 2023 to June 2023. The present study revealed the taxonomy diversity, threats and conservational requirements of various group of birds of Smirti Van, their status and monthly variations are documented. Some of the birds are very crucial for the ecosystem as well as an excellent seed disperser. They all have diverse ecological location as well as they all have different type of effect due to different human activities. The study also pointed important findings of the present work can be enumerated as follow follows:

- A total of 35 species of birds observed from Smiriti Van spread across 25 families are reported during the study for the observation period. Family wise distribution of species count is Alcedinidae (1), Accipitridae (2), Ardeidae (1), Columbidae (4), Charadriidae (1), Corvidae (2), Cisticolidae (2), Cuculiformes (1), Dicruridae (1), Leiothrichidae (1), Muscicapidae (1), Megalaimidae (1), Meropidae (1),

Muscicapidae (2), Nectariniidae (1), Phasianidae (2), Psittacidae (1), Pycnontidae (1), Picidae (2), Passeridae (1), Pycnonotidae (2), Rallidae (2), Sturnidae (2), Strigidae (1) and Upupidae (1).

- The Study revealed that among the four zone of Smriti Van family Leiothrichidae have the highest mean number of birds in all the zones while family Megalaimidae and Upupidae have minimum number of bird's population during whole study period. Family wise Percentage distribution shows that family Leiothrichidae contribute highest number as compare to others families.
- Overall mean population status in the month of January shows that family Leiothrichidae have the highest mean number of birds and families Strigidae, Upupidae reveals the lowest mean number of birds. Familywise percentage distribution of total population during study period stated that family Leiothrichidae have the highest relative % of birds and families Strigidae, Upupidae show the lowest relative % of birds.
- Some of the major threats to the Smiriti Van identified during the study included; ecological, environmental and anthropogenic. Disturbance during tourist activities, pollution, dehydration and urbanization are the common threats which was observed.
- This study includes some concepts about community participation, capacity building and the role of local people in bird's conservation and management, reason for conservation of these sites, birds' conservation based on local participation, and approaches for ensuring participation in bird's conservation programs. These include public awareness campaign, using local media (newspapers, newsletters or word of mouth), information products (brochures, flyers, pocket calendars, fact sheets and posters), training, workshops and meetings (small or large gatherings with targeted stakeholders),

nature trails and bird's surveys. There is a serious need to aware and sensitize the local people, particularly teachers and students of educational institutes and the general public to know the importance of birds and upcoming problems. A major drawback to bird's conservation in Jaipur and its associated areas has been the lack of proper implementation of the policies guiding their utilization. It is therefore essential that the various stakeholders of the wetlands be identified and their needs assessed.

- Smiriti Van is a protected area and there is no anthropogenic threat as well, hence, it has the good species diversity. Small protected areas like Smiriti Van have very good density both seasonally and monthly. These kinds of small forest patches are called satellite green areas and needed more attention. They act as small pockets of habitat that harbour and nourish not only resident but also migratory bird species. Therefore, it is necessary to conserve such small areas, which will maintain the bird's diversity and will play an important role in the biodiversity conservation. These small and satellite areas have the potential to become Important Bird Areas (IBA) in themselves.

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