STUDIES OF THE AVIFAUNA IN URBAN LIMITS OF AJMER, RAJASTHAN, INDIA

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Abstract

The urban sprawls are common in the present age. The urban biodiversity conservation is a challenge for the urban planners. The habitats formed within the green and blue spaces are home for the wide variety of floral and faunal diversity. In the series of the conservation actions, the present investigation was undertaken in the urban areas of the central Rajasthan, i.e., Ajmer. It aimed to review and prepare comprehensive database through assessment of the avifaunal species of the municipal area of Ajmer. The seasonal surveys and periodic sampling observations were recorded for twenty-four months from February 2017 to January 2019. The urban area was classified into three regions namely, the Urban Green Patches (UGP), Urban Aquatic Area (UAA) and Human Settlement Area (HSA). The UGA & HSA harbored 104 species and 41 species respectively whereas the UAA harbored 95 species. The Relative Diversity Index of the various species was calculated. The present investigation recorded 167 species from 58 families. With the earlier studies with a reporting of 235 species from 62 families, there was addition of 13 new species and two families. Thus, the cumulative list of Ajmer District presented an account of 243 bird species from 64 families.

Keywords: Urban, Birds, Conservation, Aravalli, Ajmer, Rajasthan.

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1. Introduction

The urbanization process has given rise to the human dominated landscapes with complex ecological systems as the urban ecosystems which need to be explored and converted to the opportunity [1-7]. Such man-made ecosystems have certain areas of high biological diversity. These sites are the point of interest for the conservationists for the study of the urban biodiversity especially avifauna. The patterns of biodiversity determine the features of the urban ecosystems.
Rajasthan (India) owes diversity of the habitats which area also evident in the human settlements. The western low rainfall desert region, central hilly terrains, eastern high rainfall terrains of plains and plateau provide habitats for diverse avifauna. Over 500 avifaunal species are being recorded from the state of Rajasthan. The Aravalli Hills harbor over 300 avifaunal species, near about eighty percent of which are recorded from the central parts [3,5,6,8].

The study of the birds gives the better understanding of the past and present status of the biodiversity of the area. The environmental challenges could be better understood by the birds [9-11]. Further, monitoring the species abundance, habitat preference, and correlation between species abundance and habitat provides basic information for determining factors causing population fluctuation of bird species. Richness, abundance and community composition are often used by ecologists to understand the diversity of species in their natural occurrence [12]. The change in vegetation composition could impact the quality and quantity of habitat for birds in terms of food, water and cover which can further affect the diversity, abundance and distribution of birds [13]. In order to prioritize the future conservation of species, understanding the effect of habitat on bird community structure is important [14]. In the long run, the relative value of different habitats and conservation importance of sites can be assessed by investigating the diversity of birds present at those sites [15].

2. Material and Methods

Profile of Study Area
Rajasthan is situated in north – western part of India between the latitude 23° 03’ to 30° 12’ N and longitude 69° 30’ to 78° 17’ E. It is the largest state of the Republic of India by area. Geographical features include the Thar Desert, Aravalli Mountain Ranges, Southern Malwa Plateau and Eastern plains. The Ajmer District is located nearly in the center of the Rajasthan and bordered with one of the world oldest mountain ranges i.e. Aravalli Hills (Fig. 1). The Ajmer Municipal area lies in the foothills of the Central Aravalli Hills with the highest peak Taragarh (870 feet) (Fig. 2). It experiences a mean annual rainfall of 573mm but scanty and often uncertain. Temperature ranges from 2°C to 46°C. The summers are extremely hot in this part. However, there are many climate changes the Aravalli has witnessed in the recent past, particularly the rainfall, temperature fluctuation and shift of weathers.
For the ease of study, the habitats of the municipal area of Ajmer city in the present study was categorized under two broad groups (see 2, 3).

1) **Urban Aquatic Areas (UAA):** All perennial and seasonal water bodies within the municipal limits of Ajmer city were categorized under Urban Aquatic Areas (Anasagar Lake, Foy Sagar Lake, Chaurasiywas Talab, Paal Bichla Talab and Khanpura Talab).

2) **Urban Terrestrial Areas:** The terrestrial area within the municipal limits of Ajmer city which was further classified as:
   - **Human Settlement Areas (HSA):** Areas with direct human involvement and high anthropogenic pressure were included in this category (Constructed areas, buildings, roads etc.).
   - **Urban Green Patches (UGP):** This includes areas with less human intervention and lesser anthropogenic pressure (Institutional and Urban gardens, Agricultural fields, green patches of hillock of Aravalli).
Field Studies and Surveys

The field surveys and observations were taken for the period of two years February 2017 to January 2019. Recording of the bird species were also made from the calls. Regular surveys carried out by systematically walking on the fixed routes through the study area. Systematic observations of the species in different habitats of the municipal limits (Fig. 2) were recorded from 6:00 to 9:00 hrs and from 16:00 to 18:00 hrs. General observations were also made during other timings too. The nomenclature is after Manakadan & Pittie [16], and taxonomic arrangement is following Gill & Donsker [17]. The status of the species like resident, winter migrant, summer migrant and passage migrant were assigned as per the observations in each survey based on the presence/absence method along with analysis of the other parameters.

Data Collection and Analysis

Relative Diversity (RDi): The relative diversity (RDi) of families was calculated using the following formula [18]

\[
RDi = \frac{\text{Number of bird species in a family}}{\text{Total number of species}} \times 100
\]

Similarity Indices: Similarity indices between the intensive study sites were calculated using Jaccard Index and Sorenson Index [12].

Jaccard Index:

\[
C_j = j / (a + b - j)
\]

Where
- j = the number of species common to both sites
- a = the number of species in site A and
- b = the number of species in site b

Sorenson Index:

\[
C_s = 2j / (a + b)
\]

Where
- j = the number of species common to both sites
- a = the number of species in site A and
- b = the number of species in site b
Observation and Results

Table 1: The Avi-Faunal Composition of Municipal Area of Ajmer District, Rajasthan (Family wise species occurrence at classified microhabitats)

| S.No. | Common Name               | Scientific Name                          | UAA | HSA | UGP |
|-------|---------------------------|------------------------------------------|-----|-----|-----|
|       | Grebes                    | Podicipedidae                            |     |     |     |
| 1     | Little Grebe              | Tachybaptus ruficollis (Pallas, 1764)     | +   | -   | -   |
| 2     | Great White Pelican       | Pelecanus onocrotalus (Linnaeus, 1758)   | +   | -   | -   |
| 3     | Dalmatian Pelican         | Pelecanus crispus (Bruch, 1832)          | +   | -   | -   |
|       | Pelicans                  | Pelecanidae                              |     |     |     |
| 4     | Little Cormorant          | Phalacrocorax niger (Vieillot, 1817)     | +   | -   | -   |
| 5     | Indian Shag               | Phalacrocorax fuscicollicis (Stephens, 1826) | +   | -   | -   |
| 6     | Great Cormorant           | Phalacrocorax carbo (Linnaeus, 1758)     | +   | -   | -   |
|       | Cormorants/Shags          | Phalacrocoracidae                        |     |     |     |
| 7     | Darter                    | Anhinga melanogaster (Pennant, 1769)     | +   | -   | -   |
|       | Darter                    | Anhingida                                |     |     |     |
|       | Herons, Egrets & Bitterns| Ardeida                                  |     |     |     |
| 8     | Little Egret              | Egretta garzetta (Linnaeus, 1766)        | +   | -   | -   |
| 9     | Grey Heron                | Ardea cinerea (Linnaeus, 1758)           | +   | -   | -   |
| 10    | Purple Heron              | Ardea purpurea (Linnaeus, 1766)          | +   | -   | -   |
| 11    | Large Egret               | Casmerodius albus (Linnaeus, 1758)       | +   | -   | -   |
| 12    | Median Egret              | Mesophoyx intermedia (Wagler, 1829)      | +   | +   | -   |
| 13    | Cattle Egret              | Bubulcus ibis (Linnaeus, 1758)           | +   | +   | +   |
| 14    | Indian Pond-Heron         | Ardeola grayii (Sykes, 1832)             | +   | +   | +   |
| 15    | Little Green Heron        | Butorides striatus (Linnaeus, 1758)      | +   | -   | -   |
| 16    | Black-crowned Night-Heron | Nycticorax nyticorax (Linnaeus, 1758)   | +   | -   | -   |
|       | Storks                    | Ciconiidae                               |     |     |     |
| 17    | Painted Stork             | Mycteria leucocephala (Pennant, 1769)    | +   | -   | +   |
| 18    | Asian Openbill-Stork      | Anastomus oscitans (Boddaert, 1783)     | +   | -   | -   |
|       | Ibisises & Spoonbills     | Threskiornithidae                        |     |     |     |
| 19    | Glossy Ibis               | Plegadis falcinellus (Linnaeus, 1766)    | +   | -   | -   |
| 20    | Oriental White Ibis       | Threskiornis melanocephalus (Latham, 1790) | +   | -   | -   |
| 21    | Black Ibis                | Pseudibis papillosa (Temminck, 1824)     | +   | -   | +   |
| 22    | Eurasian Spoonbill        | Platalea leucorodia (Linnaeus, 1758)     | +   | -   | -   |
|       | Flamingos                 | Phoenicopteridae                         |     |     |     |
| 23    | Greater Flamingo          | Phoenicopterus ruber (Linnaeus, 1758)    | +   | -   | -   |
| Swans, Geese & Ducks       | Anatidae                                      |
|---------------------------|----------------------------------------------|
| 24 Greylag Goose          | Anser anser (Linnaeus, 1758)                 |
| 25 Bar-headed Goose       | Anser indicus (Latham, 1790)                 |
| 26 Brahminy Shelduck      | Tadorna ferruginea (Pallas, 1764)            |
| 27 Comb Duck              | Sarkidiornis melanotos (Pennant, 1769)       |
| 28 Gadwall                | Anas strepera (Linnaeus, 1758)               |
| 29 Eurasian Wigeon        | Anas penelope (Linnaeus, 1758)              |
| 30 Mallard                | Anas platyrhynchos (Linnaeus, 1758)         |
| 31 Spot-billed Duck       | Anas poecilorhyncha (J.R. Forester, 1781)   |
| 32 Northern Shoveller     | Anas clypeata (Linnaeus, 1758)              |
| 33 Northern Pintail       | Anas acuta (Linnaeus, 1758)                 |
| 34 Garganey               | Anas querquedula (Linnaeus, 1758)           |
| 35 Common Teal            | Anas crecca (Linnaeus, 1758)                |
| 36 Red-crested Pochard    | Rhodonessa rufina (Pallas, 1773)            |
| 37 Common Pochard         | Aythya ferina (Linnaeus, 1758)              |
| 38 Ferruginous Pochard    | Aythya nyroca (Guldenden, 1770)             |
| Hawks, Eagles, Buzzards, Old World Vultures, Kites, Harriers | Accipitridae                              |
| 39 Oriental Honey-Buzzard | Pernis ptilorhynchus (Temminck, 1821)       |
| 40 Black-shouldered Kite  | Elanus caeruleus (Desfontaines, 1789)       |
| 41 Black Kite             | Milvus migrans (Boddart, 1783)              |
| 42 Egyptian Vulture       | Neophron percnopterus (Linnaeus, 1758)      |
| 43 Short-toed Snake-Eagle | Circaetus gallicus (Gmelin, 1788)           |
| 44 Western Marsh-Harrier  | Circus aeruginosus (Linnaeus, 1758)         |
| 45 Shikra                 | Accipiter badius (Gmelin, 1788)             |
| 46 Tawny Eagle            | Aquila rapax (Temminck, 1828)               |
| 47 Steppe Eagle           | Aquila nipalensis Hodgson, 1833             |
| Osprey                    | Pandionidae                                  |
| 48 Osprey                 | Pandion haliaetus (Linnaeus, 1758)          |
| Falcons                  | Falconidae                                   |
| 49 Common Kestrel         | Falco tinnunculus (Linnaeus, 1758)          |
| Pheasants, Partridges, Quails | Phasianidae                               |
| 50 Grey Francolin         | Francolinus pondicerianus (Gmelin, 1789)   |
|   |   |   |   |
|---|---|---|---|
| 51 | Rain Quail | Coturnix coromandelica (Gmelin, 1789) | - | - | + |
| 52 | Jungle Bush-Quail | Perdicula asiatica (Latham, 1790) | - | - | + |
| 53 | Indian Peafowl | Pavo cristatus (Linnaeus, 1758) | - | + | + |
| **Rails, Crakes, Moorhens, Coots** | **Rallidae** |   |   |   |
| 54 | White-breasted Waterhen | Amaurornis phoenicurus (Pennant, 1769) | + | - | + |
| 55 | Purple Moorhen | Porphyrio porphyrio (Linnaeus, 1758) | + | - | - |
| 56 | Common Moorhen | Gallinula chloropus (Linnaeus, 1758) | + | - | - |
| 57 | Common Coot | Fulica atra (Linnaeus, 1758) | + | - | - |
| **Jacanas** | **Jacanidae** |   |   |   |
| 58 | Pheasant-tailed Jacana | Hydrophasianus chirurgus (Scopoli, 1786) | + | - | - |
| 59 | Bronze-winged Jacana | Metopidius indicus (Latham, 1790) | + | - | - |
| **Painted-Snipes** | **Rostratulidae** |   |   |   |
| 60 | Greater Painted-Snipe | Rostratula benghalensis (Linnaeus, 1758) | + | - | - |
| **Plovers, Dotterels, Lapwings** | **Charadriidae** |   |   |   |
| 61 | Little Ringed Plover | Charadrius dubius (Scopoli, 1786) | + | - | - |
| 62 | Kentish Plover | Charadrius alexandrinus (Linnaeus, 1758) | + | - | - |
| 63 | Yellow-wattled Lapwing | Vanellus malabaricus (Boddaert, 1783) | + | - | + |
| 64 | Red-wattled Lapwing | Vanellus indicus (Boddaert, 1783) | + | + | + |
| **Sandpipers, Stints, Snipes, Godwits & Curlews** | **Scolopacidae** |   |   |   |
| 65 | Common Snipe | Gallinago gallinago (Linnaeus, 1758) | + | - | - |
| 66 | Black-tailed Godwit | Limosa limosa (Linnaeus, 1758) | + | - | - |
| 67 | Spotted Redshank | Tringa erythropus (Pallas, 1764) | + | - | - |
| 68 | Common Redshank | Tringa totanus (Linnaeus, 1758) | + | - | - |
| 69 | Wood Sandpiper | Tringa glareola (Linnaeus, 1758) | + | - | - |
| 70 | Common Sandpiper | Actitis hypoleucos (Linnaeus, 1758) | + | - | + |
| 71 | Little Stint | Calidris minuta (Leisler, 1812) | + | - | + |
| 72 | Temminck’s Stint | Calidris temminckii (Leisler, 1812) | + | - | - |
| 73 | Ruff | Philomachus pugnax (Linnaeus, 1758) | + | - | + |
| **Ibisbill, Avocets & Stilts** | **Recurvirostridae** |   |   |   |
| 74 | Black-winged Stilt | Himantopus himantopus (Linnaeus, 1758) | + | + | + |
| 75 | Pied Avocet | Recurvirostra avosetta (Linnaeus, 1758) | + | - | - |
| Gulls, Terns & Noddies | Laridae |
|------------------------|--------|
| 76 Pallas’s Gull        | Larus ichthyaetus (Pallas, 1773) | +   |
| 77 Brown-headed Gull    | Larus brunnicephalus (Jerdon, 1840) | +   |
| 78 Black-headed Gull    | Larus ridibundus (Linnaeus, 1766) | +   |
| 79 Gull-billed Tern     | Gelochelidon nilotica (Gmelin, 1789) | +   |
| 80 River Tern           | Sterna aurantia (J.E. Gray, 1831) | +   |
| 81 Whiskered Tern       | Chlidonias hybridus (Pallas, 1811) | +   |

| Sandgrouse              | Pteroclidae |
|-------------------------|-------------|
| 82 Chestnut-bellied Sandgrouse | Pterocles exustus (Temminck, 1825) | -   |
| 83 Painted Sandgrouse   | Pterocles indicus (Gmelin, 1789) | -   |

| Pigeons & Doves         | Columbidae |
|-------------------------|------------|
| 84 Blue Rock Pigeon     | Columba livia (Gmelin, 1789) | +   |
| 85 Little Brown Dove    | Streptopelia senegalensis (Linnaeus, 1766) | +   |
| 86 Red Collared-Dove    | Streptopelia tranquebarica (Hermann, 1804) | -   |
| 87 Eurasian Collared-Do | Streptopelia decaocto (Frivaldszky, 1838) | +   |
| 88 Yellow-legged Green-P | Treron phoenicoptera (Latham, 1790) | -   |

| Parakeets & Hanging-Parrots | Psittacidae |
|-----------------------------|------------|
| 89 Alexandrine Parakeet     | Psittacula eupatria (Linnaeus, 1766) | -   |
| 90 Rose-ringed Parakeet     | Psittacula krameri (Scopoli, 1769) | +   |
| 91 Plum-headed Parakeet     | Psittacula cyanopechala (Linnaeus, 1766) | -   |

| Cuckoos, Malkohas & Coucals | Cuculidae |
|-----------------------------|----------|
| 92 Asian Koel               | Eudynamys scolopacea (Linnaeus, 1758) | -   |
| 93 Greater Coucal           | Centropus sinensis (Stephens, 1815) | -   |

| Owls                        | Strigidae |
|-----------------------------|----------|
| 94 Spotted Owlet             | Athene brama (Temminck, 1821) | -   |

| Nightjars                   | Caprimulgidae |
|-----------------------------|---------------|
| 95 Common Indian Nightjar   | Caprimulgus asiaticus (Latham, 1790) | -   |

| Swifts                      | Apodidae     |
|-----------------------------|--------------|
| 96 House Swift              | Apus affinis (J.E. Gray, 1830) | -   |

| Kingfishers                 | Alcedinidae  |
|-----------------------------|--------------|
| 97 Small Blue Kingfisher    | Alcedo atthis (Linnaeus, 1758) | +   |

| 98 White-breasted Kingfisher | Halcyon smyrnensis (Linnaeus, 1758) | +   |

[288]
| No. | Common Name                               | Scientific Name                                           | Genus/Order         |
|-----|-------------------------------------------|-----------------------------------------------------------|--------------------|
| 99  | Lesser Pied Kingfisher                    | Ceryle rudis (Linnaeus, 1758)                             | Bee-eaters Meropidae |
| 100 | Small Bee-eater                           | Merops orientalis (Latham, 1801)                          | Bee-eaters Meropidae |
| 101 | Blue-cheeked Bee-eater                    | Merops persicus (Pallas, 1773)                            | Bee-eaters Meropidae |
| 102 | Blue-tailed Bee-eater                     | Merops philippinus (Linnaeus, 1766)                       | Bee-eaters Meropidae |
| 103 | European Roller                           | Coracias garrulus (Linnaeus, 1758)                        | Rollers Coraciidae |
| 104 | Indian Roller                             | Coracias benghalensis (Linnaeus, 1758)                    | Rollers Coraciidae |
| 105 | Common Hoopoe                             | Upupa epops (Linnaeus, 1758)                              | Hoopoes Upupidae    |
| 106 | Indian Grey Hornbill                      | Ocycteros birostris (Scopoli, 1786)                       | Hornbills Buceroctidae |
| 107 | Coppersmith Barbet                        | Megalaima haemacephala (P.L.S. Muller, 1776)              | Barbets Capitoridae |
| 108 | Eurasian Wryneck                          | Jynx torquilla (Linnaeus, 1758)                           | Woodpeckers Picidae |
| 109 | Lesser Golden-backed Woodpecker           | Dinopium benghalense (Linnaeus, 1758)                     | Woodpeckers Picidae |
| 110 | Singing Bush-Lark                         | Mirafra cantillans (Blyth, 1845)                          | Larks Alaudidae     |
| 111 | Common Crested Lark                       | Galerida cristata (Linnaeus, 1758)                        | Swallows & Martins Hirundinidae |
| 112 | Dusky Crag-Martin                         | Hirundo concolor (Sykes, 1833)                            | Swallows & Martins Hirundinidae |
| 113 | Wire-tailed Swallow                       | Hirundo smithii (Leach, 1818)                             | Swallows & Martins Hirundinidae |
| 114 | Red-rumped Swallow                        | Hirundo daurica (Linnaeus, 1771)                          | Swallows & Martins Hirundinidae |
| 115 | Streak-throated Swallow                   | Hirundo fluvicola (Blyth, 1855)                           | Swallows & Martins Hirundinidae |
| 116 | Large Pied Wagtail                        | Motacilla maderaspatensis (Gmelin, 1789)                  | Wagtails & Pipits Motacillidae |
| 117 | Citrine Wagtail                           | Motacilla citreola (Pallas, 1776)                         | Wagtails & Pipits Motacillidae |
| 118 | Yellow Wagtail                            | Motacilla flava (Linnaeus, 1758)                          | Wagtails & Pipits Motacillidae |
| 119 | Paddyfield Pipit                          | Anthus rufulus (Vieillot, 1818)                           | Wagtails & Pipits Motacillidae |
| 120 | Small Minivet                             | Pericrocotus cinnamomeus (Linnaeus, 1766)                 | Cuckoo-Shrikes, Flycatcher-Shrikes, Trillers, Minivets, Woodshrikes Campephagidae |
| 121 | Common Woodshrike                         | Tephrodornis pectorialis (Gmelin, 1789)                   | Cuckoo-Shrikes, Flycatcher-Shrikes, Trillers, Minivets, Woodshrikes Campephagidae |
| Bulbuls & Finchbills | Pycnonotidae | Shrikes | Laniidae |
|----------------------|-------------|---------|----------|
| 122 White-eared Bulbul | Pycnonotus leucotis (Gould, 1836) | - | - | + |
| 123 Red-vented Bulbul | Pycnonotus cafer (Linnaeus, 1766) | + | + | + |
| Bay-backed Shrike | Lanius vittatus (Valenciennes, 1826) | - | - | + |
| 125 Rufous-backed Shrike | Lanius schach (Linnaeus, 1758) | - | - | + |
| 126 Southern Grey Shrike | Lanius meridionalis (Temminck, 1820) | - | + | + |

| Thrushes, Shortwings, Robins, Forktails, Wheaters | Turdinae |
|---------------------|---------|
| 127 Bluethroat | Luscinia svecica (Linnaeus, 1758) | + | - | - |
| 128 Oriental Magpie-Robin | Copsychus saularis (Linnaeus, 1758) | - | - | + |
| 129 Indian Robin | Saxicoloides fulicata (Linnaeus, 1776) | - | + | + |
| 130 Black Redstart | Phoenicurus ochruros (Gmelin, 1774) | - | - | + |
| 131 Common Stonechat | Saxicola torquata (Linnaeus, 1766) | - | - | + |
| 132 Pied Bushchat | Saxicola caprata (Linnaeus, 1766) | - | - | + |
| 133 Desert Wheatear | Oenanthe deserti (Temminck, 1825) | - | - | + |
| 134 Isabelline Wheatear | Oenanthe isabellina (Temminck, 1829) | - | - | + |
| 135 Indian Chat | Cercomela fusca (Blyth, 1851) | - | + | + |

| Babblers, Laughingthrushes, Babaxes, Barwings, Yuhinas | Timaliinae |
|-------------------------|-----------|
| 136 Yellow-eyed Babbler | Chrysomma sinense (Gmelin, 1789) | + | - | - |
| 137 Common Babbler | Turdoides caudatus (Dumont, 1823) | - | - | + |
| 138 Large Grey Babbler | Turdoides malcolmi (Sykes, 1832) | - | + | + |
| 139 Jungle Babbler | Turdoides striatus (Dumont, 1823) | - | - | + |

| Goldcrest, Prinias, Tesias, Warblers | Sylviinae |
|----------------------------------|----------|
| 140 Ashy Prinia | Prinia socialis (Sykes, 1832) | - | + | + |
| 141 Rufous-fronted Prinia | Prinia buchanani (Blyth, 1844) | - | - | + |
| 142 Plain Prinia | Prinia inornata (Sykes, 1832) | - | - | + |
| 143 Common Chiffchaff | Phylloscopus collybita (Vieillot, 1817) | - | + | + |
| 144 Common Lesser Whitethroat | Sylvia curruca (Linnaeus, 1758) | - | + | + |

| Flycatchers | Muscicapinae |
|----------------|-------------|
| 145 Red-throated Flycatcher | Ficedula parva (Bechstein, 1792) | - | - | + |
| 146 Grey-headed Flycatcher | Culicicapa ceylonensis (Swainson, 1820) | - | - | + |

| Monarch-Flycatchers & Paradise-Flycatchers | Monarchinae |
|   | Common Name                          | Scientific Name                                      | Status |
|---|-------------------------------------|------------------------------------------------------|--------|
|  147 | Asian Paradise-Flycatcher           | Terpsiphone paradisi (Linnaeus, 1758)               | -      |
|  148 | White-browed Fantail-Flycatcher     | Rhipidura aureola (Lesson, 1830)                   | -      |
|  149 | Great Tit                           | Parus major (Linnaeus, 1758)                        | -      |
|  150 | Purple Sunbird                      | Nectarinia asiatica (Latham, 1790)                 | -      |
|  151 | Oriental White-eye                  | Zosterops palpebrosus (Temminck, 1824)             | -      |
|  152 | Crested Bunting                     | Melophus lathami (Gray, 1831)                      | -      |
|  153 | Common Rosefinch                    | Carpodacus erythrinus (Pallas, 1770)               | +      |
|  154 | White-throated Munia                | Lonchura malabarica (Linnaeus, 1758)              | -      |
|  155 | Spotted Munia                       | Lonchura punctulata (Linnaeus, 1758)              | -      |
|  156 | House Sparrow                       | Passer domesticus (Linnaeus, 1758)                 | +      |
|  157 | Yellow-throated Sparrow             | Petronia xanthocollis (Burton, 1838)              | -      |
|  158 | Baya Weaver                         | Ploceus philippinus (Linnaeus, 1766)               | +      |
|  159 | Brahminy Starling                   | Sturnus pagodarum (Gmelin, 1789)                   | -      |
|  160 | Rosy Starling                       | Sturnus roseus (Linnaeus, 1758)                    | +      |
|  161 | Asian Pied Starling                 | Sturnus contra (Linnaeus, 1758)                    | +      |
|  162 | Common Myna                         | Acridotheres tristis (Linnaeus, 1766)              | +      |
|  163 | Bank Myna                           | Acridotheres ginniganianus (Latham, 1790)          | +      |
|  164 | Eurasian Golden Oriole              | Oriolus oriolus (Linnaeus, 1758)                   | -      |
|  165 | Black Drongo                        | Dicrurus macrocercus (Vieillot, 1817)              | +      |
|  166 | Indian Treepie                      | Dendrocitta vagabunda (Latham, 1790)               | -      |
|  167 | House Crow                          | Corvus splendens (Vieillot, 1817)                  | +      |

**Fantail-Flycatchers**  
Rhipidurinae

**Tits**  
Paridae

**Sunbirds & Spiderhunters**  
Nectarinidae

**White-eyes**  
Zosteropidae

**Buntings**  
Emberizinae

**Finches**  
Fringillidae

**Munias (Estrildid Finches)**  
Estrildidae

**Sparrows & Snowfinches**  
Passerinae

**Weavers**  
Ploceinae

**Starlings & Mynas**  
Sturnidae

**Orioles**  
Oriolidae

**Drongos**  
Dicruridae

**Crows, Jays, Treepies, Magpies**  
Corvidae
Table legends
UAA: Urban Aquatic Areas; HSA: Human Settlement Areas; UGP: Urban Green Patches
(+) represents presence of species and (-) represents absence of species

![Image of Figure 3: Observed Species at different Microhabitats of Municipal Area of Ajmer District, Rajasthan]

Table 2: Relative diversity (RDi) of avian families at Municipal area of Ajmer District, Rajasthan and number of species at various sites

| S. No. | Family Commonly Known as | Family Name | Overall Rdi | No of Species in UAA | No of Species in HSA | No of Species in UGP |
|--------|--------------------------|-------------|-------------|----------------------|---------------------|---------------------|
| 1      | Grebes                   | Podicipedidae | 0.6         | 1                    | 0                   | 0                   |
| 2      | Pelicans                 | Pelecanidae  | 1.19        | 2                    | 0                   | 0                   |
| 3      | Cormorants/Shags         | Phalacrocoracidae | 1.79   | 3                    | 0                   | 0                   |
| 4      | Darters                  | Anhingidae   | 0.6         | 1                    | 0                   | 0                   |
| 5      | Herons, Egrets & Bitterns | Ardeidae   | 5.36        | 9                    | 3                   | 2                   |
| 6      | Storks                   | Ciconiidae   | 1.19        | 2                    | 0                   | 1                   |
| 7      | Ibises & Spoonbills      | Threskiornithidae | 2.38   | 4                    | 0                   | 0                   |
| 8      | Flamingos                | Phoenicopteridae | 0.6     | 1                    | 0                   | 0                   |
| 9      | Swans, Geese & Ducks    | Anatidae     | 8.93        | 15                   | 0                   | 0                   |
| 10     | Hawks, Eagles, Buzzards, Old World Vultures, Kites, Harriers | Accipitrinae | 5.36        | 2                    | 2                   | 9                   |
| 11     | Osprey                   | Pandionidae  | 0.6         | 1                    | 0                   | 0                   |
| 12     | Falcons                  | Falconidae   | 0.6         | 0                    | 0                   | 1                   |
| 13     | Pheasants, Partridges, Quails | Phasianidae | 2.38        | 0                    | 2                   | 4                   |
| 14     | Rails, Crakes, Moorhens, Coots | Rallidae | 2.38        | 4                    | 0                   | 1                   |
| 15     | Jacanas                  | Jacanidae    | 1.19        | 2                    | 0                   | 0                   |
| 16     | Painted-Snipes           | Rostratulidae | 0.6      | 1                    | 0                   | 0                   |
| 17     | Sandpipers, Stints, Snipes, Godwits & Curlews | Scolopacidae | 5.36        | 4                    | 1                   | 2                   |
| 18     | Plovers, Dotterels, Lapwings | Charadriidae | 2.38        | 9                    | 0                   | 3                   |
| 19     | Ibisbill, Avocets & Stilts | Recurvirostridae | 1.19   | 2                    | 1                   | 1                   |
| 20     | Gulls, Terns & Noddies   | Laridae      | 3.57        | 6                    | 0                   | 0                   |
|   | Common Name | Family     | Genus | Total | #1 | #2 | #3 | #4 |
|---|-------------|------------|-------|-------|----|----|----|----|
| 21 | Sandgrouse  | Pteroclidae|       |       | 1.19| 0  | 0  | 2  |
| 22 | Pigeons & Doves | Columbidae |       |       | 2.98| 3  | 3  | 5  |
| 23 | Parakeets & Hanging-Parrots | Psittacidae |       |       | 1.79| 1  | 1  | 3  |
| 24 | Cuckoos, Malkohas & Coucals | Cuculidae |       |       | 1.19| 0  | 1  | 2  |
| 25 | Owls | Strigidae |       |       | 0.6 | 0  | 1  | 1  |
| 26 | Nightjars | Caprimulgidae |       |       | 0.6 | 0  | 0  | 1  |
| 27 | Swifts | Apodidae |       |       | 0.6 | 0  | 0  | 1  |
| 28 | Kingfishers | Alcedinidae |       |       | 1.79| 3  | 1  | 1  |
| 29 | Bee-eaters | Meropidae |       |       | 1.79| 1  | 1  | 3  |
| 30 | Rollers | Coraciidae |       |       | 1.19| 1  | 0  | 2  |
| 31 | Hoopoes | Upupidae |       |       | 0.6 | 0  | 1  | 1  |
| 32 | Hornbills | Bucerotidae |       |       | 0.6 | 0  | 1  | 1  |
| 33 | Barbets | Capitonidae |       |       | 0.6 | 0  | 1  | 1  |
| 34 | Woodpeckers | Picidae |       |       | 1.19| 0  | 1  | 2  |
| 35 | Larks | Alaudidae |       |       | 1.19| 0  | 0  | 2  |
| 36 | Swallows & Martins | Hirundinidae |       |       | 2.38| 1  | 2  | 4  |
| 37 | Wagtails & Pipits | Motacillidae |       |       | 2.38| 4  | 0  | 1  |
| 38 | Cuckoo-Shrikes, Flycatcher-Shrikes, Trillers, Minivets, Woodshrikes | Campephagidae |       |       | 1.19| 0  | 1  | 2  |
| 39 | Bulbuls & Finchbills | Pycnonotidae |       |       | 1.19| 1  | 1  | 2  |
| 40 | Shrikes | Laniidae |       |       | 1.79| 0  | 1  | 3  |
| 41 | Thrushes, Shortwings, Robins, Forktails, Wheaters | Turdinae |       |       | 5.36| 1  | 2  | 8  |
| 42 | Babblers, Laughingthrushes, Babaxes, Barwings, Yuhinas | Timaliinae |       |       | 2.38| 1  | 1  | 3  |
| 43 | Goldcrest, Prinias, Tesias, Warblers | Sylviinae |       |       | 2.98| 0  | 3  | 5  |
| 44 | Flycatchers | Muscicapinae |       |       | 1.19| 0  | 0  | 2  |
| 45 | Monarch-Flycatchers & Paradise-Flycatchers | Monarchinae |       |       | 0.6 | 0  | 0  | 1  |
| 46 | Fantail-Flycatchers | Rhipidurinae |       |       | 0.6 | 0  | 0  | 1  |
| 47 | Tits | Paridae |       |       | 0.6 | 0  | 0  | 1  |
| 48 | Sunbirds & Spiderhunters | Nectariniidae |       |       | 0.6 | 0  | 1  | 1  |
| 49 | White-eyes | Zosteropidae |       |       | 0.6 | 0  | 0  | 1  |
| 50 | Buntings | Emberizinae |       |       | 0.6 | 0  | 0  | 1  |
| 51 | Finches | Fringillidae |       |       | 0.6 | 1  | 0  | 1  |
| 52 | Munias (Estrildid Finches) | Estrildidae |       |       | 1.19| 0  | 0  | 2  |
| 53 | Sparrows & Snowfinches | Passerinae |       |       | 1.19| 1  | 1  | 2  |
| 54 | Weavers | Ploceinae |       |       | 0.6 | 1  | 0  | 1  |
| 55 | Starlings & Mynas | Sturnidae |       |       | 3.57| 4  | 4  | 5  |
| 56 | Orioles | Oriolidae |       |       | 0.6 | 0  | 0  | 1  |
| 57 | Drongos | Dicruridae |       |       | 0.6 | 1  | 1  | 1  |
| 58 | Crows, Jays, Treepies, Magpies | Corvidae |       |       | 1.19| 1  | 2  | 2  |

Total: 100  95  41  104
Table 3: Similarity indices (Jaccard Index and Sorenson Index) between the various study sites

| Sorenson Index | Jaccard Index |
|----------------|---------------|
|               | UAA | HAS | UGP |
| UAA           | 0.1709 |      |     |
| HSA           |      | 0.2919 |     |
| UGP           |      |      | 0.3300 |
|               |      |      | 0.5517 |

3. Results and Discussions

In the investigation period of twenty-four months, a total of 167 species of birds belonging to 58 families were recorded in the study area (Table 1). The three different study sites i.e. Urban Aquatic Area (UAA) had 39% of the total species observed; Human Settlement Area (HSA) had 18% and Urban Green Patches (UGP) had 43% of the total species observed (Fig. 3). The Relative Diversity of different families was calculated to determine the dominance of species occurrence at a particular study site (Table 2). The highest relative diversity was recorded as of Anatidae family with 15 species and 8.93 RDi followed by Ardeidae, Accipitridae, Scolopacidae and Turdinae families with 9 species each and 5.36 RDi respectively representing the dominance of species occurrence belonging to these families at study area (Table 2). The calculation for the similarity indices among different study sites revealed that Urban Green Patches and Human Settlement Areas had more similar habitat structure as the Jaccard index and Sorenson Index values are higher i.e. 0.3809 and 0.5517 respectively. While on the other hand Urban Aquatic Areas and Human Settlement Areas had very less similarity in habitat characteristics hence the values of Jaccard index and Sorenson Index are lower as 0.1709 and 0.2919 respectively (Table 3).

Overall, 95 species belonging to 34 families were present in the Urban Aquatic Area (UAA). The Anatidae family with 15 species dominated the Urban Aquatic Area followed by the Scolopacidae with 9 species. The urban terrestrial area which was further classified for simplification into Human Settlement Area (HAS) and Urban Green Patches (UGP). The Human Settlement Area was represented by 41 species belonging to 27 families. This Area had a lesser number of species and was dominated by Sturnidae family (4 species) followed by Ardeidae, Columbidae, and Sylviinae (3 species each). The Urban Green Patches had 47 families (104 species) and Accipitrinae family dominated the area (9 species) followed by Turdinae family (8 species).

4. Conclusion

The present study concluded that the Municipal area of Ajmer district represents near about 68% of the avifaunal diversity observed in different habitats of the Ajmer District as a whole [2,3,5-8]. The study area includes the foothills of the oldest mountain range the Aravalli that provides an excellent habitat for various floral and faunal components hence the diversity is rich at the study area. The Urban Aquatic Areas (Anasagar Lake, Foy Sagar Lake, Chaurasiywas Talab, Paal Bichla Talab and Khanpura Talab) represented by the 96 species belonging to the 34 families. The Anasagar Lake, which is located in the central part of Ajmer Municipal area supports the 40 species [19], whereas another study conducted after two years by same authors documented 42 species from the same locality [20]. In the continuation another worker documented 48 species of birds from the Anasagar Lake and 42 species from the Foy Sagar Lake [21].
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