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Species diversity, conservation status and feeding habitate of Avifauna in Waraseoni Tehsil of Madhya Pradesh, India

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Abstract

Avian biodiversity is not evenly distributed around the earth and their populations are declining due to anthropogenic (deforestation, water contamination, urbanisation, pollutions, pesticides etc.) as well as natural (climate change) causes. Furthermore, Birds are employed as a bioindicator because they are very sensitive to environmental changes. Therefore, there is a great need to know the number/diversity of birds in a given area. Hence, a study was done to obtain the data related to avian diversity in Waraseoni Tehsil of Madhya Pradesh (MP), India. A total of 174 species of avifauna (representing 60 families and 19 orders) were identified for the present research. The largest number of species (75), maximum species percentage (41.21%), and maximum family number (27) were noted in the Passeriformes order. In migratory status, 146 species were identified as resident, whereas 28 species (24 WM and 4 SM) were found as migratory out of the 174 species. Moreover, 167 species (or 96%) were classified as Least Concern (LC) by the IUCN status, five species (*Ciconia episcopus*, *Prinia familiaris*, *Threskiornis melanocephalus*, *Psittacula eupatria*, and *Anhinga melanogaster*) were judged to be near threatened (NT) and two species (*Grus Antigone* and *Sterna aurantia*) were found to be vulnerable (VU). The majority of species were found to be omnivorous (49), followed by insectivorous (47), carnivorous (46), granivorous (11), frugivorous (5), herbivorous (2) and nectivorous (2) in feeding pattern. In this study, the locality of different birds species in a specific geographical area shows that Waraseoni tehsil has full of avian biodiversity. This study recommends that the government should make special efforts to conserve birds and take efforts to stop their hunting by villagers/tribal people in this area.

Keywords: IUCN, avifauna, conservation, vulnerable, migratio

Introduction

Numerous species of organisms make up India's biodiversity. India has a large amount of biodiversity. Nearly everywhere on Earth, from the pole to the equator, birds may be found. They are incredibly diverse in terms of habitat and geographic location. Birds live in diverse types of environments. According to the variety of resources that animals utilize, their use of habitat is determined (King *et al.*, 2006) [11]. The use of animal habitats also has significant consequences for wildlife conservation because it may demonstrate factors affecting the pattern of population growth and the effect of human activity on the number and distribution of species (Larson *et al.*, 2004) [14]. For instance, migratory birds need to gather suitable supplies at several locations during their yearly process, such as stopover, nesting, and staying sites (Harrison *et al.*, 2011; Mancini *et al.*, 2018) [9, 15].

Because of their crucial functions as pollinators, drivers of seed dispersal, predators, birds are among the best monitors of environmental changes. Alters in their population, patterns of conduct, and fertility rates have most frequently been used to examine the long-term effects of habitat fragmentation (Harisha and Hosetti, 2009; Bibi and Ali, 2013; Koli *et al.*, 2014) [8, 4, 12]. Birds tend to be the most suitable biological indicators for assessing the health of the ecosystem since they are attractive and sensitive to environmental changes. A deeper ecological knowledge of function of patterns in bird diversity and avian community structure is required for the conservation of birds and the ecosystem (Khan and Pant 2017) [10].

India is one of the twelve nations with megabiodiversity. Approximately, 1313 bird species have been discovered from the Indian subcontinent out of 9702 bird species known globall.

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(Sibley and Monroe, 1990; Grimmett *et al.*, 2011) [20, 7]. Madhya Pradesh is a state in the Indian Republic is 119,016 square miles (308,250 Km²) in size. In the geographic center of India, it is situated between latitudes 21.6°N and 26.30°N and longitudes 74°9'E and 82°48'E. This state prevails in tropical weather. According to geology, the Central Indian Plateau is a segment of the Gondwana Plate. This region's rocks are among the oldest in the entire globe. Summertime is rather comfortable in the Malwa plateau and in the Satpura-Maikal highlands. The two coldest months are December and January. Generally speaking, the warm months of March through May have low humidity (from 20% to 30%) while the rainy season has a high proportion of humidity (85% to 95%). 30.9 percent of Madhya Pradesh entire geographical area is covered by forests. Madhya Pradesh is home to thorn forests, wet deciduous forests, tropical dry deciduous forests, and subtropical hill forests (Chandra and Singh, 2004) [6]. A huge number of avifauna which are 488 species was reported by Chandra and Singh (2004) [6] in Madhya Pradesh. Rawat and Rao (2021) [19] recorded a total of 104 bird species numbers (belonging to 16 orders and 48 families) from the urban area of north Madhya Pradesh (Gwalior and Chambal divisions).

Present study was done in Waraseoni Tehsil (21°45'53"N 80°2'58"E) of Balaghat district (located at 21.8°N 80.18°E) the Indian state of Madhya Pradesh. The Wainganga River runs next to the community. The aim of the study is to collect data about avian diversity and bird distribution in different parts of the Waraseoni Tehsil.

Materials and Methods

Study area

The study of avifauna diversity was conducted from April 2022 to March 2023 at Waraseoni Tehsil of Balaghat district, Madhya Pradesh, India (Figure 1). The size of the Waraseoni Tehsil is 465.02 square km. It is bordered on the north by Lalbarra Tehsil, to the east and southeast region by Kirnapur

Tehsil, the south by Khairlanji Tehsil, and the west region by Katangi Tehsil. This region is situated between 21°37'4.8"N, 80°06'12.96"E to 21°52'37.92"N, 79°55'50.88"E with average rainfall and temperature ranging from 137.85 mm (5.43 in) and 21.79 °C to 33.9 °C, respectively. The Waraseoni Tehsil represents four distinct seasons winter (November to February), summer (March to May), rainy season (June to August), and post-rainy season (September to October). The Chandan River, along with its tributaries the Chanai River and the Todya Nala, is the major river that flows through the Waraseoni Tehsil. The Wainganaga River covers the Waraseoni area from the east whereas Dhuti canals along these rivers irrigate the land of the region and provide favourable habitats for birds.

The study was conducted in different parts of Waraseoni Tehsil including Sarandi, Saongi, Ram Rama, Bodlaksha, Ansera, Rampayli, Lingmara, Batarmara area, etc. Special attention was given to exploring forest areas, water banks, grasslands, and agricultural lands (Fig. 1).

Study Method and Data collection

Both the direct count and total count methods were used to count the birds for this experiment (Urfi *et al.*, 2005) [22]. Many different types of bird species were counted using the direct count technique for all visible birds. The total count method was done by walking around the site and doing the entire count. Sutherland (2006) [21] asserted that the point count approach is the most effective method for determining the diversity of birds. Using this technique, observations are made at a single, predetermined location while covering a 50-100 m field distance and the observer's observations are recorded. In this method, the birds are counted by listening to their sounds and seeing them directly by remaining stationary in one place without any movement for about an hour. Information related to bird counts and known species was compiled using the above methods.

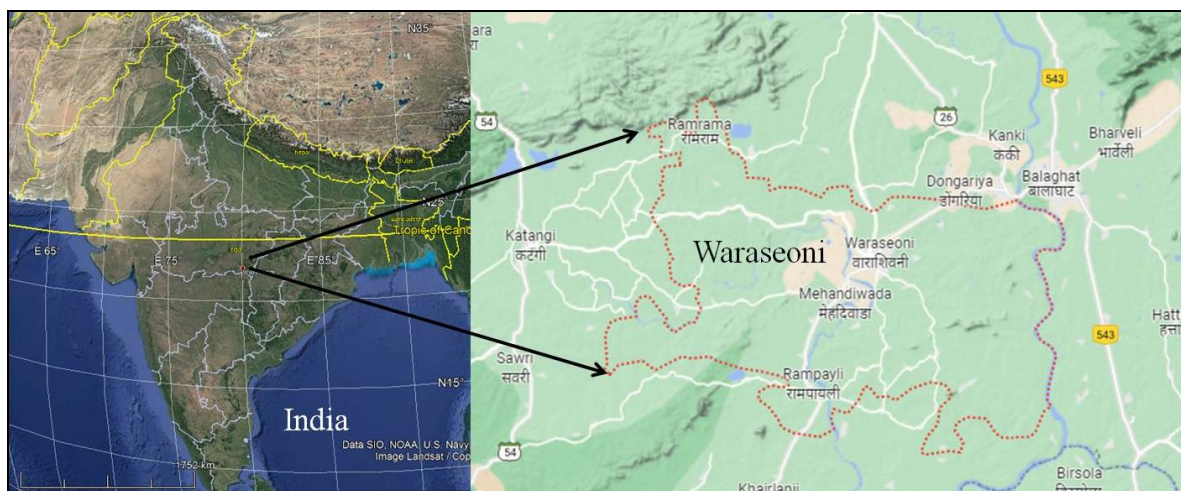


Fig 1: Geographical location of study area, Waraseoni Tehsil, Madhya Pradesh, India.

The study was conducted from June 2022 to May 2023. The most appropriate time for the survey was chosen and observations of Birds were made two times a day which is in the early morning and late evening but sometime in the afternoon and at night. On all days, the birds were counted from 6 am to 7 am in the morning, from 12.30 pm to 1 pm in the afternoon, and from 5 pm to 6 pm in the evening and 9 pm to 11 pm at night. Canon 1500d digital single lens reflex (DSLR) and 55-250 mm and 100 - 400 mm lenses were used

for the photography. Field guides and publications were used to identify birds (Ali, 2017) [3]. The samples were carefully examined, and they were compared with images given in birds-identifying applications. Mobile applications (Merlin and eBird), publications, and experts were used for identification websites.

Based on their migration patterns, the birds were divided into residents (R), winter migrants (WM) and summer migrants (SM). The birds were further divided into six groups based on

their eating patterns, including Herbivorous (HV), Omnivorous (OV), Insectivorous (IV), Frugivorous (FV), Carnivorous (CV) and Nectivorous (NV) (Ali and Ripley, 1987) [2]. Moreover, birds were divided into three groups according to their IUCN (International Union for Conservation of Nature) Conservation status: Least Concern (LC), Nearly Threatened (NT), and Vulnerable (VU) (Bird Life International, 2022) [5].

Results and Discussion

Diversity of Avifauna Species, family and order

In the present study, a total number of 174 species of birds

belonging to 19 orders and 60 families were found in the Waraseoni tehsil of Balaghat district, Madhya Pradesh, India (Figure 4-9). Maximum species number (a total of 75 species number) observed under Passeriformes order followed by Charadriiformes order observed with the second highest number of species (13) and families (7) numbers. Anseriformes and Pelecaniformes orders were recorded with 10 numbers of species. Whereas, a minimum number of species (1) was observed in Apodiformes, Caprimulgiformes and Podicipediformes orders (Figure 2; Table 1, 2).

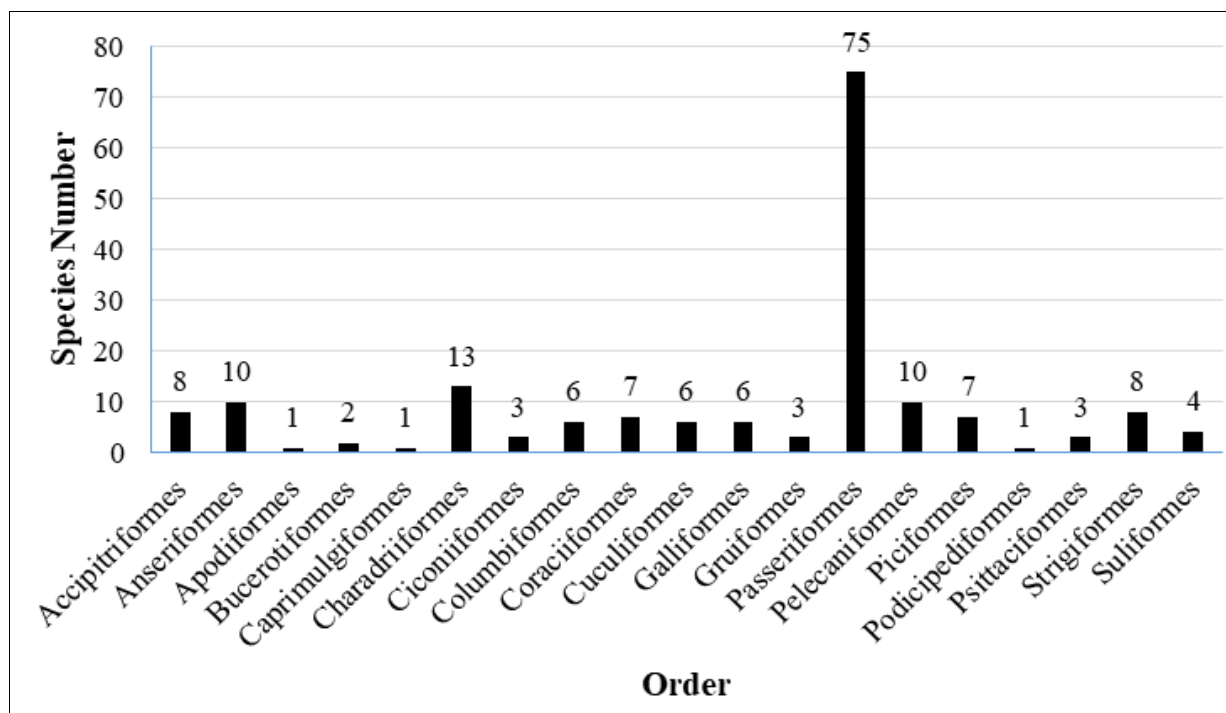


Fig 2: A graph showing the relationship between species order and species number.

Maximum percent (41.21%) of avifauna species were found in Passeriformes order followed by Charadriiformes (7.14%), Anseriformes (5.49%), Pelecaniformes (5.49%), Accipitriformes (4.4%) and Strigiformes (4.4%) whereas minimum percentage was recorded in Apodiformes (0.55%), Caprimulgiformes (0.55%) and Podicipediformes (0.55%) orders (Table 2). Maximum family numbers (27) were observed in Passeriformes order followed by Charadriiformes (7) and Coraciiformes order (3). Whereas, Accipitriformes,

Anseriformes, Apodiformes, Ciconiiformes, Cuculiformes, Galliformes and Podicipediformes orders were recorded with minimum family number (1) (Table 2).

A maximum number of species (10) were observed in Anatidae (Anseriformes order) and Muscicapidae family (Passeriformes order) followed by Accipitridae (Accipitriformes order) and Ardeidae family (Pelecaniformes order) with 8 number of species and Strigidae

Table 1: A list of avifauna with their IUCN status, Residential status and Eating pattern

Sr. No.	Order	Family	Common Name	Scientific Name	IUCN Status	Residential status	Eating patterns
1	Accipitriformes	Accipitridae	Long legged buzzard	<i>Buteo rufinus</i>	LC	R	Carnivorous
2			Black winged kite	<i>Elanus caeruleus</i>	LC	R	Omnivorous
3			Crested honey buzzard	<i>Pernis ptilorhynchus</i>	LC	R	Insectivorous
4			Black kite	<i>Milvus migrans</i>	LC	R	Carnivorous
5			Shikra	<i>Accipiter badius</i>	LC	R	Carnivorous
6			Crested hawk eagle	<i>Nisaetus cirrhatus</i>	LC	R	Carnivorous
7			Crested serpent eagle	<i>Spilornis chcela</i>	LC	R	Carnivorous
8			Besra	<i>Accipiter virgatus</i>	LC	R	Carnivorous
9	Anseriformes	Anatidae	Northern pintail duck	<i>Anas acuta</i>	LC	WM	Omnivorous
10			Mallard	<i>Anas platyrhynchos</i>	LC	WM	Omnivorous
11			Indian spot billed duck	<i>Anas poecilorhyncha</i>	LC	R	Omnivorous
12			Greylag goose	<i>Anser anser</i>	LC	WM	Herbivorous
13			Domestic goose	<i>Anser anser domesticus</i>	LC	R	Omnivorous
14			Common pochard	<i>Aythya ferina</i>	LC	WM	Omnivorous

15			Lesser whistling duck	<i>Dendrocygna javanica</i>	LC	R	Omnivorous
16			Red crested pochard	<i>Netta rufina</i>	LC	WM	Herbivorous
17			Cotton pygmy goose	<i>Nettapus coromandelianus</i>	LC	R	Omnivorous
18			Ruddy shelduck	<i>Tadorna ferruginea</i>	LC	WM	Omnivorous
19	Apodiformes	Apodidae	Little swift	<i>Apus affinis</i>	LC	R	Insectivorous
20	Bucerotiformes	Bucerotidae	Indian grey hornbill	<i>Tockus birostris</i>	LC	R	Omnivorous
21		Upupidae	Indian hoopoe	<i>Upupidae epops</i>	LC	R	Insectivorous
22	Caprimulgiformes	Caprimulgidae	Common Indian night jar	<i>Caprimulgus asiaticus</i>	LC	R	Insectivorous
23	Charadriiformes	Burhinidae	Indian thick knee	<i>Burhinus indicus</i>	LC	R	Carnivorous
24			Kentish plover	<i>Charadrius alexandrinus</i>	LC	R	Insectivorous
25		Charadriidae	Little ringed plover	<i>Charadrius dubius</i>	LC	R	Carnivorous
26			Red-wattled lapwing	<i>Vanellus indicus</i>	LC	R	Omnivorous
27			Yellow-wattled lapwing	<i>Vanellus malabaricus</i>	LC	R	Omnivorous
28		Glareolidae	Small pratincole	<i>Glareola lactea</i>	LC	R	Insectivorous
29		Jacanidae	Bronze-winged jacana	<i>Metopidius indicus</i>	LC	R	Omnivorous
30			Pheasant tailed jacana	<i>Hydrophasianus Chirurgus</i>	LC	R	Omnivorous
31		Laridae	River tern	<i>Sterna aurantia</i>	VU	R	Carnivorous
32		Recurvirostridae	Black-winged stilt	<i>Himantopus Himantopus</i>	LC	R	Omnivorous
33		Scolopacidae	Common sandpiper	<i>Actitis hypoleucos</i>	LC	WM	Omnivorous
34			Wood sandpiper	<i>Tringa glareola</i>	LC	WM	Carnivorous
35			Temminck's stint	<i>Calidris temminckii</i>	LC	WM	Insectivorous
36		Ciconiiformes	Ciconiidae	Asian Openbill stork	<i>Anastomus oscitans</i>	LC	R
37	Asian wolly necked stork			<i>Ciconia episcopus</i>	NT	R	Carnivorous
38	Black stork			<i>Ciconia nigra</i>	LC	WM	Carnivorous
39	Columbiformes	Columbidae	Rock pigeon	<i>Columba livia</i>	LC	R	Granivorous
40			Eurasian Collared dove	<i>Streptopelia decaocto</i>	LC	R	Granivorous
41			Spotted dove	<i>Streptopelia chinensis</i>	LC	R	Granivorous
42			Common emerald dove.	<i>Chalcophaps indica</i>	LC	R	Granivorous
43			Laughing dove	<i>Spilopelia senegalensis</i>	LC	R	Granivorous
44			Yellow footed green pigeon	<i>Treron phoenicoptera</i>	LC	R	Frugivorous
45	Coraciiformes	Alcedinidae	Common kingfisher	<i>Alcedo atthis</i>	LC	R	Carnivorous
46			Pied kingfisher	<i>Ceryle rudis</i>	LC	R	Carnivorous
47			White throated kingfisher	<i>Halcyon smyrnensis</i>	LC	R	Carnivorous
48			Stork billed kingfisher	<i>Pelargopsis capensis</i>	LC	R	Carnivorous
49		Coraciidae	Indaian roller	<i>Coracias benghalensis</i>	LC	R	Carnivorous
50		Meropidae	Green bee eater	<i>Merops orientalis</i>	LC	R	Insectivorous
51	Blue tailed bee eater		<i>Merops philippinus</i>	LC	SM	Insectivorous	
52	Cuculiformes	Cuculidae	Oriental cuckoo	<i>Cuculus optatus</i>	LC	SM	Insectivorous
53			Greater coucal	<i>Centropus sinensis</i>	LC	R	Omnivorous
54			Pied cuckoo	<i>Clamator jacobinus</i>	LC	SM	Omnivorous
55			Eurasian cuckoo	<i>Cuculus canorus</i>	LC	SM	Insectivorous
56			Common hawk cuckoo	<i>Cuculus varius</i>	LC	R	Omnivorous
57	Galliformes	Phasianidae	Asian koal	<i>Eudynamys scolopaceus</i>	LC	R	Omnivorous
58			Rain quail	<i>Coturnix coromandelica</i>	LC	R	Omnivorous
59			Painted francolin	<i>Francolinus pictus</i>	LC	R	Omnivorous
60			Grey francolin	<i>Francolinus pondicerianus</i>	LC	R	Omnivorous
61			Red jungle fowl	<i>Gallus gallus</i>	LC	R	Omnivorous
62			Indian pea fowl	<i>Pavo cristatus</i>	LC	R	Omnivorous
63	Gruiformes	Gruidae	Jungle bush quail	<i>Perdica asiatica</i>	LC	R	Omnivorous
64			Sarus crane	<i>Grus antigone</i>	VU	R	Omnivorous
65		Rallidae	Common moorhen	<i>Gallinula chloropus</i>	LC	R	Omnivorous
66			Grey-headed swamphen	<i>Porphyrio poliocephalus</i>	LC	R	Omnivorous
67	Passeriformes	Aegithinidae	Common iora	<i>Aegithina tiphia</i>	LC	R	Omnivorous
68		Alaudidae	Rufous tailed finch lark	<i>Ammomanes phoenicura</i>	LC	R	Omnivorous
69			Greater short-toed lark	<i>Calandrella brachydactyla</i>	LC	WM	Omnivorous
70			Sykes's lark	<i>Galerida deva</i>	LC	R	Omnivorous
71			Indian bushlark	<i>Mirafra erythroptera</i>	LC	R	Granivorous/ Insectivorous
72		Campephagidae	Cuckoo shrike	<i>Coracina macei</i>	LC	R	Carnivorous
73			White bellied minivet	<i>Pericrocotus erythropygus</i>	LC	R	Insectivorous
74			Small minivet	<i>Pericrocotus cinnamomeus</i>	LC	R	Insectivorous
75		Chloropseidae	Golden fronted leafbird	<i>Chloropsis aurifrons</i>	LC	R	Frugivorous/ Insectivorous
76			Jordan leafbird	<i>Chloropsis jerdoni</i>	LC	R	Frugivorous/ Nacterivorous/ insectivorous
77	Cisticolidae	Common tailorbird	<i>Orthotomus sutorius</i>	LC	R	Nactivorous/ Insectivorous	

78		Bar-winged prinia	<i>Prinia familiaris</i>	NT	R	Insectivorous
79		Plain prinia	<i>Prinia inornata</i>	LC	R	Nactivorous/ Insectivorous
80		Ashy prinia	<i>Prinia socialis</i>	LC	R	Nactivorous/ Insectivorous
81		Tawny flanked prinia	<i>Prinia subflava</i>	LC	R	Insectivorous
82	Corvidae	Jungal crow	<i>Corvas macrorhynchos</i>	LC	R	Carnivorous
83		House crow	<i>Corvus splendens</i>	LC	R	Carnivorous
84		Rufous tree pie	<i>Dendrocitta vagabunda</i>	LC	R	Frugivorous
85	Dicaeidae	Flowerpecker	<i>Dicaeidae</i>	LC	R	Nactivorous/ Insectivorous
86	Dicruridae	Common drongo	<i>Dicrurus adsimilis</i>	LC	R	Insectivorous
87		White bellied drongo	<i>Dicrurus caerulescens</i>	LC	R	Insectivorous
88		Ashy drongo	<i>Dicrurus leucophaeus</i>	LC	WM	Insectivorous
89		Large racket tailed drongo	<i>Dicrurus paradiseus</i>	LC	R	Insectivorous
90	Estrildidae	Red munia	<i>Amandava amandava</i>	LC	R	Granivorous/ Insectivorous
91		Indian silverbill	<i>Euodice malabarica</i>	LC	R	Omnivorous
92		Tricolored munia	<i>Lonchura malacca</i>	LC	R	Granivorous
93		Scaly Breasted Munia	<i>Lonchura punctulata</i>	LC	R	Granivorous
94	Hirundinidae	Indain clift swallow	<i>Hirundo fluvicola</i>	LC	R	Insectivorous
95		Barn swallow	<i>Hirundo rustica</i>	LC	WM	Insectivorous
96		Wire tailed swallow	<i>Hirundo smithii</i>	LC	R	Insectivorous
97	Laniidae	Shrike	<i>Lanius collurio</i>	LC	WM	Carnivorous
98		Brown shrike	<i>Lanius cristatus</i>	LC	R	Insectivorous
99		Rufous backed shrike	<i>Lanius schach</i>	LC	R	Carnivorous
100	Leiothrichidae	Common babbler	<i>Turdoides caudata</i>	LC	R	Omnivorous
101		Jungle babbler	<i>Turdoides striata</i>	LC	R	Omnivorous
102	Monarchidae	Black naped monarch	<i>Hypothymis azurea</i>	LC	R	Insectivorous
103		Indian paradise flycatcher	<i>Terpsiphone paradisi</i>	LC	R	Insectivorous
104	Motacillidae	Paddyfield pipit	<i>Anthus rufulus</i>	LC	R	Insectivorous
105		Long billed pipit	<i>Anthus similis</i>	LC	R	Omnivorous
106		Tree pipit	<i>Anthus trivialis</i>	LC	WM	Insectivorous
107		Grey wagtail	<i>Motacilla cinerea</i>	LC	R	Insectivorous
108		Yellow wagtail	<i>Motacilla flava</i>	LC	WM	Insectivorous
109		White browed wagtail	<i>Motacilla maderaspatensis</i>	LC	R	Insectivorous
110	Muscicapidae	White rumped shama	<i>Copsychus malabaricus</i>	LC	R	Omnivorous
111		Oriental magpie robin	<i>Copsychus saularis</i>	LC	R	Insectivorous
112		Tickells blue flycatcher	<i>Cyornis tickelliae</i>	LC	R	Insectivorous
113		Verditer flycatcher	<i>Eumyias thalassinus</i>	LC	R	Insectivorous
114		Taiga Flycatcher	<i>Ficedula albicilla</i>	LC	WM	Insectivorous
115		Bluethroat	<i>Luscinia svecica</i>	LC	WM	Insectivorous
116		Brown rock chat (indian chat)	<i>Oenanthe fusca</i>	LC	R	Insectivorous
117		Black redstart	<i>Phoenicurus ochruros</i>	LC	WM	Insectivorous
118		Indian robin	<i>Saxicoloides fulicatus</i>	LC	R	Insectivorous
119		Stonechat	<i>Saxicola rubicola</i>	LC	WM	Insectivorous
120	Nectariniidae	Purple sunbird	<i>Cinnyris asiaticus</i>	LC	R	Nactivorous/ Insectivorous
121		Olive-backed sunbird	<i>Cinnyris jugularis</i>	LC	R	Nectivorous
122		Purple rumped sunbird	<i>Leptocoma zeylonica</i>	LC	R	Nactivorous/ Insectivorous
123	Oriolidae	Indian Golden oriole	<i>Oriolus oriolus</i>	LC	R	Omnivorous
124		Black headed oriole	<i>Oriolus xanthornus</i>	LC	R	Omnivorous
125	Passeridae	Yellow throated sparrow	<i>Gymnoris xanthocollis</i>	LC	R	Nactivorous/ Insectivorous
126		House sparrow	<i>Passer domesticus</i>	LC	R	Granivorous
127	Pittidae	Indian pitta	<i>pitta brachyura</i>	LC	WM	Insectivorous
128	Ploceidae	Baya Weaver bird	<i>Ploceus philippinus</i>	LC	R	Omnivorous
129	Pycnonotidae	Red vented bulbul	<i>Pycnonotus cafer</i>	LC	R	Omnivorous
130		Yellow-vented bulbul	<i>Pycnonotus goiavier</i>	LC	R	Nactivorous/ Insectivorous
131		White browed bulbul	<i>Pycnonotus luteolus</i>	LC	R	Frugivorous/ Insectivoous
132	Rhipiduridae	White browed fantail flycatcher	<i>Rhipidura aureola</i>	LC	R	Insectivorous
133	Sittidae	Indian nuthatch	<i>Sitta castanea</i>	LC	R	Omnivorous
134	Sturnidae	Jungle myna	<i>Acridotheres fuscus</i>	LC	R	Omnivorous
135		Common myna	<i>Acridotheres tristis</i>	LC	R	Granivorous
136		Pied myna	<i>Sturnus contra</i>	LC	R	Granivorous

137	Turdidae	Black headed myna	<i>Sturnia pagodarum</i>	LC	R	Granivorous	
138		Orange headed thrush	<i>Geokichla citrina</i>	LC	R	Omnivorous	
139		Indian blackbird	<i>Turdus simillimus</i>	LC	R	Omnivorous	
140		Vangidae	Common wood shrike	<i>Tephrodornis pondicerianus</i>	LC	R	Insectivorous
141	Zosteropidae	Oriental white eye	<i>Zosterops palpebrosus</i>	LC	R	Omnivorous	
142	Ardeidae	Paddy bird/ Indian pond heron	<i>Ardeola grayii</i>	LC	R	Carnivorous	
143		Black crowned night heron	<i>Nycticorax nycticorax</i>	LC	R	Carnivorous	
144		Great egret	<i>Ardea alba</i>	LC	WM	Carnivorous	
145		Cattle egret	<i>Bubulcus ibis</i>	LC	R	Carnivorous	
146		Little egret	<i>Egretta garzetta</i>	LC	R	Carnivorous	
147		Common heron (grey heron)	<i>Ardea cinerea</i>	LC	R	Carnivorous	
148		Purple heron	<i>Ardea purpurea</i>	LC	WM	Carnivorous	
149		Cinnamon bittern	<i>Ixobrychus cinnamomeus</i>	LC	R	Carnivorous	
150		Red naped ibis	<i>Pseudibis papillosa</i>	LC	R	Carnivorous	
151	Threskiornithidae	Black-headed Ibis	<i>Threskiornis melanocephalus</i>	NT	R	Carnivorous	
152	Megalaimidae	Brown headed barbet	<i>Psilopogon zeylanicus</i>	LC	R	Omnivorous	
153		Coppersmith barbet	<i>Megalaima haemacephala</i>	LC	R	Omnivorous	
154	Picidae	Eurasian wryneck	<i>Jynx torquilla</i>	LC	WM	Insectivorous	
155		White-naped woodpecker	<i>Chrysocolaptes festivus</i>	LC	R	Insectivorous	
156		Black rumped flamback woodpecker	<i>Dinopium benghalense</i>	LC	R	Insectivorous	
157		Yellow-crowned woodpecker	<i>Leiopicus mahrattensis</i>	LC	R	Insectivorous	
158		Brown capped woodpecker	<i>Yungipicus nanus</i>	LC	R	Insectivorous	
159	Podicipediformes	Podicipedidae	Little grabe	<i>Tachybaptus ruficollis</i>	LC	R	Carnivorous
160	Psittaciformes	Phasianidae	Rose ringed parakeet	<i>Psittacula krameri</i>	LC	R	Frugivorous
161		Plum-headed parakeet	<i>Psittacula cyano-cephala</i>	LC	R	Frugivorous	
162	Psittaculidae	Alexandrine parakeet	<i>Psittacula eupatria</i>	NT	R	Frugivorous	
163	Strigiformes	Strigidae	Spotted owl	<i>Athene brama</i>	LC	R	Carnivorous
164			Indian eagle-owl	<i>Bubo bengalensis</i>	LC	R	Carnivorous
165			Jungle owl	<i>Glauclidium radiatum</i>	LC	R	Carnivorous
166			Spot-bellied eagle-owl	<i>Ketupa nipalensis</i>	LC	R	Carnivorous
167			Brown Fish owl	<i>Ketupa zeylonensis</i>	LC	R	Carnivorous
168			Indian scops owl	<i>Otus bakkamoena</i>	LC	R	Carnivorous
169	Mottled Wood owl	<i>Strix ocellata</i>	LC	R	Carnivorous		
170	Tytonidae	Barn Owl	<i>Tyto alba</i>	LC	R	Carnivorous	
171	Suliformes	Anhingidae	Oriental darter	<i>Anhinga melanogaster</i>	NT	R	Carnivorous
172		Phalacrocoracidae	Great cormorent	<i>Phalacrocorax carbo</i>	LC	R	Carnivorous
173			Indian cormorent	<i>Phalacrocorax fuscicollis</i>	LC	R	Carnivorous
174			Little commorant	<i>Phalacrocorax pygmeus</i>	LC	R	Carnivorous

LC = Least Concern; NT = Near Threatened; VU = Vulnerable; R = resident; WM= winter migrant; SM=summer Migrant

(Strigiformes order) family with 7 number of species. Whereas, 22 families were found with a minimum number (1) of species (Table 2).

Table 2: A list of order, species number and species percentage

S. No.	Order	Number of Species	Species number %	Family number
1	Accipitriformes	8	4.40	1
2	Anseriformes	10	5.49	1
3	Apodiformes	1	0.55	1
4	Bucerotiformes	2	1.10	2
5	Caprimulgiformes	1	0.55	1
6	Charadriiformes	13	7.14	7
7	Ciconiiformes	3	1.65	1
8	Columbiformes	6	3.30	1
9	Coraciiformes	7	3.85	3
10	Cuculiformes	6	3.30	1
11	Galliformes	6	3.30	1
12	Gruiformes	3	1.65	2
13	Passeriformes	75	41.21	27
14	Pelecaniformes	10	5.49	2
15	Piciformes	7	3.85	2
16	Podicipediformes	1	0.55	1
17	Psittaciformes	3	1.65	2
18	Strigiformes	8	4.40	2
19	Suliformes	4	2.20	2
		Total= 174		Total=60

Vishwakarma *et al.*, (2021) [23] found 133 avifauna species and 47 families under 18 orders during three consecutive winter seasons (2016-2018) in Kopra Reservoir (wetland), Bilaspur, CG, India. Agase *et al.*, (2021) [1] obtained 117 bird species and 53 families under 18 orders from December 2020 to July 2021 at Wainganga river basin at Balaghat district, MP, India. Passeriformes order was measured with the maximum number of species (57) whereas the minimum number in Anseriformes (1), Apodiformes (1), Bucerotiformes (1), and Caprimulgiformes (1) order. Kushwaha *et al.* (2015) [13] studied the Avifaunal diversity of Tikamgarh (District), MP, India and found 170 bird species belonging 46 families moreover, the maximum number of bird species (16) were found in the family Accipitridae. Puri and Virani (2016) found 86 species, (including water birds and land birds) belonged to 33 distinct families of birds from Khairbandha Lake in Gondia district, Maharashtra, India. In

Todgarh-Raoli Wildlife Sanctuary, Rajasthan, India, a total of 142 bird species from 45 families and 18 orders were identified from January 2013 to December 2013 by Koli (2014) [12]. With 23 species, Muscicapidae was the dominating family. Khan and Pant (2017) [10] observed 147 avian species (under 58 families and 20 orders) in Bhimbandh Wildlife Sanctuary, India. Mistry (2015) [17] obtained 64 bird species (under 34 families) in Berhampore, West Bengal, India and Passeriformes order was observed with the maximum number of species (22 species under 15 families) (34.37% species number). Mathialagan *et al.*, (2022) [16] found a total of 34 species of birds (under 26 families and 12 orders) from January 2021 to March 2021 in a sugarcane research station in Sirugamani, Tiruchirappalli, Tamil Nadu, India. The majority of number of species was recorded in Passeriformes order (13 species).

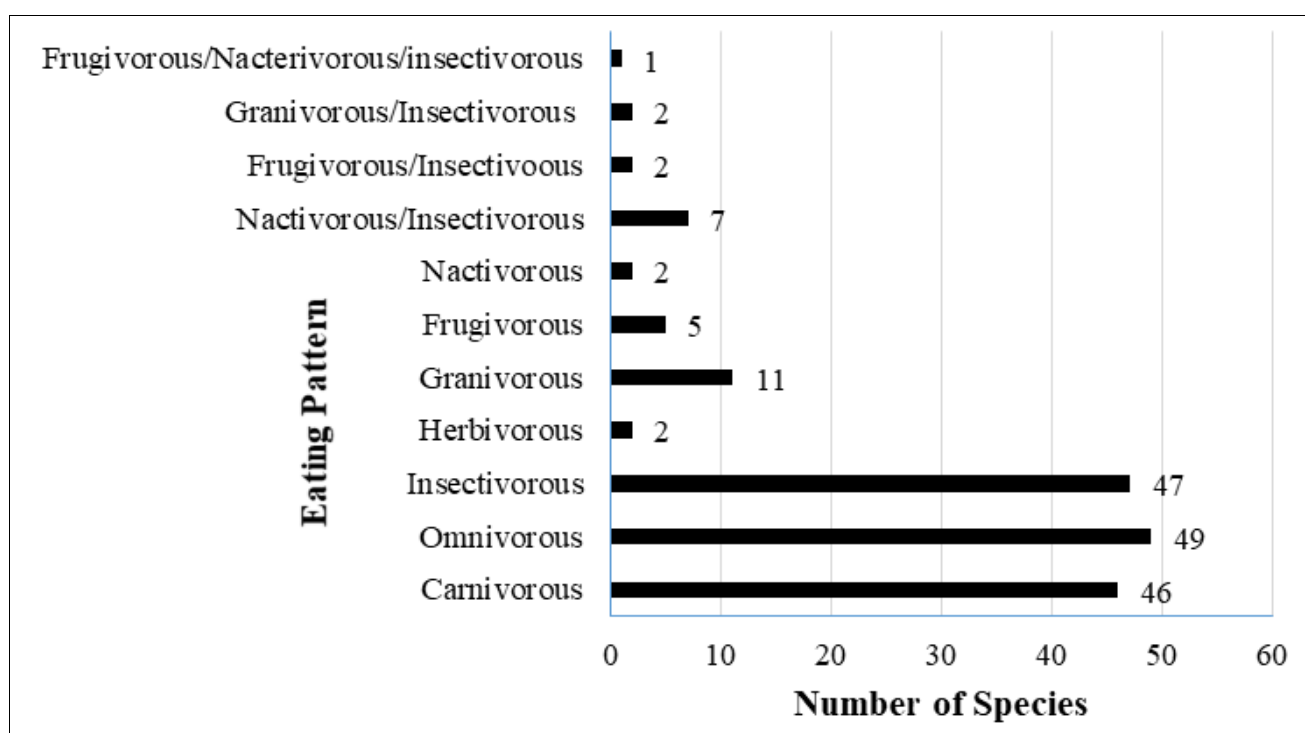


Fig 3: A graph showing the relation between eating pattern and number of species.

Rawat and Rao (2021) [19] obtained 100 species under Least Concern (LC), 3 species as near threatened (NT) and one as endangered category (EN).

IUCN status

According to IUCN status, a total of 167 species (96%) were found Least Concern (LC) out of 174 species in the present study. Whereas five species, *Ciconia episcopus* (Asian wolly-necked strok), *Prinia familiaris* (Bar-winged prinia), *Threskiornis melanocephalus* (Black-headed Ibis), *Psittacula eupatria* (Alexandrine parakeet) and *Anhinga melanogaster* (Oriental darter) were found near threatened (NT). Moreover, two species such as *Sterna aurantia* (River tern) and *Grus Antigone* (Sarus crane) were observed as vulnerable (VU) (Table 1). Vishwakarma *et al.*, (2021) [23] recorded 80 species as a resident and 53 species as migratory species among 133 species, whereas four species were found as Near Threatened species (*Mycteria leucocephala*, *Threskiornis*

melanocephalus, *Numenius arquata*, *Limosa limosa*), one Vulnerable (VU) (*Ciconia episcopus*) and one Endangered (EN) (*Neophron percnopterus*). Agase *et al.*, (2021) [1] recorded 113 species as Least Concern (LC), three species as near threatened (NT) and one species as vulnerable (VU). Kushwaha *et al.* (2015) [13] reported 13 species as Not Assessed (NA), 148 species were Least Concern, 4 species were Near Threatened, one species each that is Vulnerable and Endangered, and 3 species are Critically Endangered. Koli (2014) [12] found 128 species as least concern, one species as endangered, two species as being critically endangered, six species as being near threatened, and two species as being vulnerable. Khan and Pant (2017) [10] observed 142 species as Least Concern and 4 species (*Psittacula eupatria*, *Psittacula roseate*, *Anhinga melanogaster*, and *Falco jugger*) were found in Near Threatened category, whereas one species (*Aythya farina*) was in a vulnerable category in IUCN status.



Fig 4: A - Black kite, B - Crested Honey Buzzard, C - Shikra, D - Changeable Hawk Eagle, E -Crested Serpent Eagle, F - Black Winged Kite, G - Red-naped Ibis, H - Black Headed Ibis, I - Asian Open bill Stork, J - Coppersmith barbet, K- Tawny-flanked Prinia, L - Bay Backed Shrike.



Fig 5: A - Barn Owl, B - Indian Eagle Owl, C - Spot Bellied Eagle Owl, D - Jungle Owlet, E- Brown Fish Owl, F - Spotted Owlet, G - White Throated Kingfisher, H - Common Kingfisher, I - Pied Kingfisher, J - Plum Headed Parakeet K - Rose Ringed Parakeet, L - Common Cuckoo.



Fig 6: A- Indian Pond Heron, B - Cattle Egret, C - Great Egret, D - Little Egret, E- Black Crowned Night Heron, F- Common Sandpiper, G- Common Moorhen, H- Bronze-Winged Jacana, I - Ruddy Shelduck, J - Black Winged Stilt, K - Cotton Pygmy Goose, L - Domestic Goose.



Fig 7: A - Reed Cormorant, B - Little Grebe, C - Little Cormorant, D - Spotted Dove, E - Collared Dove, F - Common Emerald Dove, G - Black Headed Oriol, H - Indian Golden Oriol, I - Loughing Dove, J - Grey Wagtail, K - Pheasant Tailed Jacana, L - Grey Francolin

Migration patterns

In the present study, most of the species of birds were found residential and some were found as migrants. A total of 146 species (83.9%) were found as residential out of 174 species. Whereas, 28 species number (16.1%) were recorded as migrants, in which 24 were winter migrants (WM), 4 were

summer migrants (SM) (Blue tailed beef eater (*Merops philippinus*); Oriental cuckoo (*Cuculus optatus*); pied cuckoo (*Clamator jacobinus*) and Eurasian cuckoo (*Cuculus canorus*)). The maximum WM species were found in Passeriformes order (11) followed by Anseriformes (Anatidae family; 06), Charadriiformes (Scolopacidae family; 03)

Pelecaniformes (Ardeidae family; 02), Ciconiiformes (Ciconiidae family; 01) and Piciformes (Picidae family; 01) order. Moreover, Most of the summer migrant species (03) were obtained in Cuculiformes order (Table 1). Agase *et al.*, (2021) ^[1] measured 110 species as Resident (R), 5 winter migrants and 2 summer migrants out of 117 species. Kushwaha *et al.* (2015) ^[13] reported 137 species as residential and 33 were recorded as migratory. Mistry (2015) ^[17] recorded 71.87% of species as resident, 15.62% were found as

local migrant and 12.50% were observed as winter migrant species in Berhampore, West Bengal, India.

Rawat and Rao (2021) ^[19] recorded 60 bird species as Residential (R), 24 species as Local Migrant (LM), 12 species as Migratory (M), 7 Species as Winter Visitors (WV) and 1 species as Semi-Migratory (SM) among the 104 bird species from the urban area of north Madhya Pradesh (Gwalior and Chambal divisions).



Fig 8: A - Black Drongo, B - Rocket Tail Drongo, C - White Bellied Drongo, D - Jungle Babbler, E- Southern Pied Babbler, F - Little Ringed Plover, G - Brahminy Starling, H - Common Myna, I - Indian Pied Myna, J - Asian Koel, K - Large Cuckoo Shrike, L - Indian Grey Hornbil



Fig 9: A - Indian Paradise Flycatchers, B - Black-Naped Monarch, C - Black-Rumped Flameback Woodpecker, D - Orange Headed Thrush, E - Indian Clift Swallow, F - Indian Peafowl, G - Indian Silverbill, H - Indian Roller, I - Oriental Magpie Robin Female, J - Green Bee- Eater, K - Indian Chat, L - Eurasian Hoopoe.

Feeding habits

The feeding habits and eating pattern of the bird is different in different species which is shown in Figure 3. Most of the species number was observed as Omnivorous (49) followed

by insectivorous (47) Carnivorous (46) Granivorous (11) Frugivorous (5) whereas minimum species (2) were found as Herbivorous (*Anser anser* and *Netta rufina*) and Nactivorous (2). Some species (12) had mixed types of feeding habits such

as Nectivorous/Insectivorous (7), Frugivorous/Insectivorous (2), Granivorous/Insectivorous (2) and Frugivorous/Nectivorous /insectivorous (1) (Table 1). A high number of insectivorous bird species in the present study is showing a significant application in pest (insect) management in agriculture, forest and horticulture fields. All species of Dicruridae, Hirundinidae, Monarchidae family whereas most of the species of Motacillidae and Muscicapidae family of Passeriformes order were found as insectivorous. Most of the species of Columbiformes (Columbidae family) were Granivorous. All species of Psittaciformes order (Phasianidae and Psittaculidae family) were recorded as Frugivorous. Nectariniidae order was recorded with Nectivorous and Nectivorous/insectivorous species.

All species of Ciconiiformes (Ciconiidae family), Pelecaniformes (Ardeidae, Threskiornithidae family), Strigiformes (Tytonidae and Strigidae family) and Suliformes (Anhingidae and Phalacrocoracidae) orders were recorded as Carnivorous. Moreover, species of Alcedinidae and Coraciidae family of Coraciiformes order were found Carnivorous. All species of Galliformes (Phasianidae family), Gruiformes (Gruidae and Rallidae family) orders and most of the species of Anseriformes (Anatidae) order were recorded as Omnivorous.

Koli (2014) ^[12] found 44 species (maximum number) as omnivorous, 42 species as insectivorous, 35 species as carnivorous, 12 species as granivorous, 4 species as frugivorous, 4 species as insectivorous/nectivorous, and 1 species as nectivorous in feeding habit. Mathialagan *et al.*, (2022) ^[16] found maximum feeding habits of species as insectivorous (38.2%) followed by Omnivorous (20.6%), Carnivorous (20.6%), Granivorous (8.8%), Frugivorous (8.8%) and Nectarivorous (2.9%) in sugarcane research station, Sirugamani, Tiruchirappalli, Tamil Nadu, India.

Conclusion

In the current study, a total of 174 avifauna species (belonging to 60 families and 19 orders) were obtained. Maximum number of species (75), maximum species percentage (41.21%) and maximum family number (27) were observed in Passeriformes order. Among of 174 species, 146 species were resident whereas 28 species (24 WM and 4 SM) were recorded as migratory. Out of 174 species, 167 species (or 96%) are identified as Least Concern (LC) by the IUCN. Five species were determined to be near threatened (NT). Furthermore, two species (*Grus Antigone* and *Sterna aurantia*) were found as vulnerable (VU). Most of the species were observed as Omnivorous (49), followed by insectivorous (47) and Carnivorous (46) whereas some species were found as Granivorous (11) Frugivorous (5) Herbivorous (2) and Nectivorous (2) in eating pattern. This study shows that the ecological condition of Waraseoni Tehsil is very favourable for the habitat diversity of different bird species. Rather, in this study an attempt was made to identify as many birds as possible and success was also achieved. Still, efforts will have to be made to identify such birds which have not been found. Moreover, an extensive study is required to know their migration pattern and food habit.

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Declaration of competing interest

The authors declare that authors do not have any conflict of interest regarding this study and all photographs were clicked by first author.

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