DOI: https://doi.org/10.3126/forestry.v18i01.41762

Forestry: Journal of Institute of Forestry, Nepal

journal homepage: www.nepjol.info/index.php/forestry

Avian diversity and abundance in the Machhaplan complex, Hetauda, Nepal

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KEYWORDS

Avifauna
Point count
Terrestrial birds
Wetland birds
Hhreatened species
Hetauda

ABSTRACT

Avifaunal survey was carried out in Machhaplan Complex, Hetauda from December 2020 to April 2021. The objective of the study was to assess the avian species diversity, richness and abundance. A total of 164 bird species belonging to 19 orders and 59 families were recorded by using Point Count Method. Out of these, 117 species were terrestrial and 47 species were wetland dependent. Passeriformes and Muscicapidae were the most dominant orders and families, respectively with 73 and 12 species. The most abundant species was House Sparrow *(Passer domesticus)* (n=156). There were 109 resident species, 43 winter visitors, and 12 summer visitors among the recorded species. Common birds accounted for 41% of the total followed by uncommon birds, Rare birds, and Very Common birds with 33%, 17%, and 9%, respectively. Of the total recorded species, two species were Globally Threatened and nine species were Nationally Threatened. Terrestrial birds had the highest Shannon's Diversity Index (H=3.97) and Margalef's Richness Index (R=15.53) whereas wetland birds had the highest Pielou's Evenness Index (E=0.86). The assessment of avian diversity suggests that s Machhaplan Complex offers a suitable habitat for avifauna.

Introduction

Nepal's diverse ecosystems are home to a variety of resident and migratory bird species, including the endemic Spiny Babbler (Inskipp et al. 2017). According to Inskipp et al. (2016), approximately 550 species are residents, 62 species are summer visitors and 150 species are winter visitors to Nepal. Many resident species breed at higher altitudes in the mountain region and winter at lower altitudes. Every winter, migratory birds from Russia, Kyrgyzstan, Azerbaijan, Turkistan, Uzbekistan, China, Mongolia, Korea, Eastern Europe, Siberia and Tibet flock to Nepal in pursuit of warmer and more pleasant weather (Jha 2016). Moreover, thousands of birds fly to Nepal every year during the rainy season for breeding. Summer visitors include species of cuckoos, flycatchers, bee-eaters, swifts and drongos whereas winter

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Received 12 July 2021 Accepted 29 November 2021

visitors include ducks, geese, waders, birds of prey, pipits, bush warblers, wagtails, finches, buntings and thrushes (Inskipp et al. 2016).

Wetlands in Nepal cover about 5% of total freshwater area including rivers, lakes, reservoirs, marshy lands, ponds and irrigated paddy fields (MoFE 2018). Wetlands provide important ecological habitats for feeding and breeding of a large number of threatened birds, mammals, fishes, amphibians and reptiles. The wetlands of Nepal also serve as the rest places for migratory birds that transit through the country on their long-range migrations (Bhandari 2009). In addition, wetland habitats support nearly 200 species of birds in Nepal (Baral 2009).

Machhaplan Complex is a reservoir in Hetauda which consists of 42 ponds. Although the Complex focuses on fish farming, it could be a potential habitat for birds. Previous studies suggested that the ed Institute of Forestry Complex and Karra Khola as the suitable habitats for birds in Hetauda (Bajgain et al. 2020; Parajuli 2016). The beds of Rapti River also serve as an ideal habitat for Ibisbill and other riverine birds (Shrestha and Lakhey 2000). Despite being a well known bird watching destination in Hetauda, Machhaplan Complex is lacking information about its avifaunal diversity. Thus, this study was carried out to assess the avian species diversity, richness and abundance in the Machhaplan Complex.

Materials and Methods

Study Area

Machhaplan Complex is located in Hetauda Sub-Metropolitan City, Ward No. 5 in Makwanpur District of Bagmati Province in central Nepal. Hetauda, the capital of Bagmati Province, is one of the cleanest and greenest cities of Nepal, situated in a unique geographical structure called Doon in between Terai and Mid-hills. It is surrounded by hills, the Mahabharat range in the north and the Siwalik in the south (Neupane and Neupane 2013). The wet season in Hetauda is hot, humid, and partly cloudy, whereas the dry season is warm and mostly clear. Machhaplan Complex was established in 1967 AD for fisheries breeding as well as for the enhancement of aquaculture sector. It consists of 42 ponds and occupies an area of 47.9 hectares. It lies close to the bufferzone of Parsa National Park. There are 7 species of fishes including *Labeo rohita and Hypophthalmichthys molitrix* in the ponds. Predators of the fishes include jackal and birds of prey like Osprey, Peregrine Falcon, etc. The depth of ponds ranges from 1 to 2.5 m. Some ponds are built with concrete whereas some are naturally built with mud. The area is surrounded by human settlements on the north, south and west and on the east there lies tropical forest which is dominated by *Shorea robusta* along with other vegetation like *Terminalia tomentosa, Cassia fistula and Pinus roxburghii*. Paddy, wheat, mustard and other vegetables are cultivated around the Complex according to the season. The Kanti Rajpath passes through the Complex and the Karra Khola flows east to west along the southern boundary. Electric power transmission lines pass in and around the Complex and the Hetauda Industrial District is also located nearby. The spread of invasive species like *Eichhornia crassipes* and *Pistia stratiotes* degrades the pond. The Complex is located at 27°24'42.84" N and 85°03'0.72" E with an elevation of 437 m above the sea level. This mixed habitat of wetland, farmland and forest supports both water birds and terrestrial birds.

Methods

The survey was conducted from December 2020 (Winter Season) to April 2021 (Spring Season) twice in a month (Annex 2). The site's Species Richness and Abundance were determined using the Point Count Method (Buckland et al. 2004). Sixteen points were placed in the Machhaplan Complex considering probable bird habitats and experiences from

past observations. At each point fifteen minutes time was allotted for the observation of birds. The survey was conducted by two observers in the morning (7:00-10:30 AM) since peak activities of most of the birds last 1 to 2 hours after the sunrise (Singh et al. 2014). The birds were photographed with a Canon Power Shot 45× camera and observed via Nikon 8×42

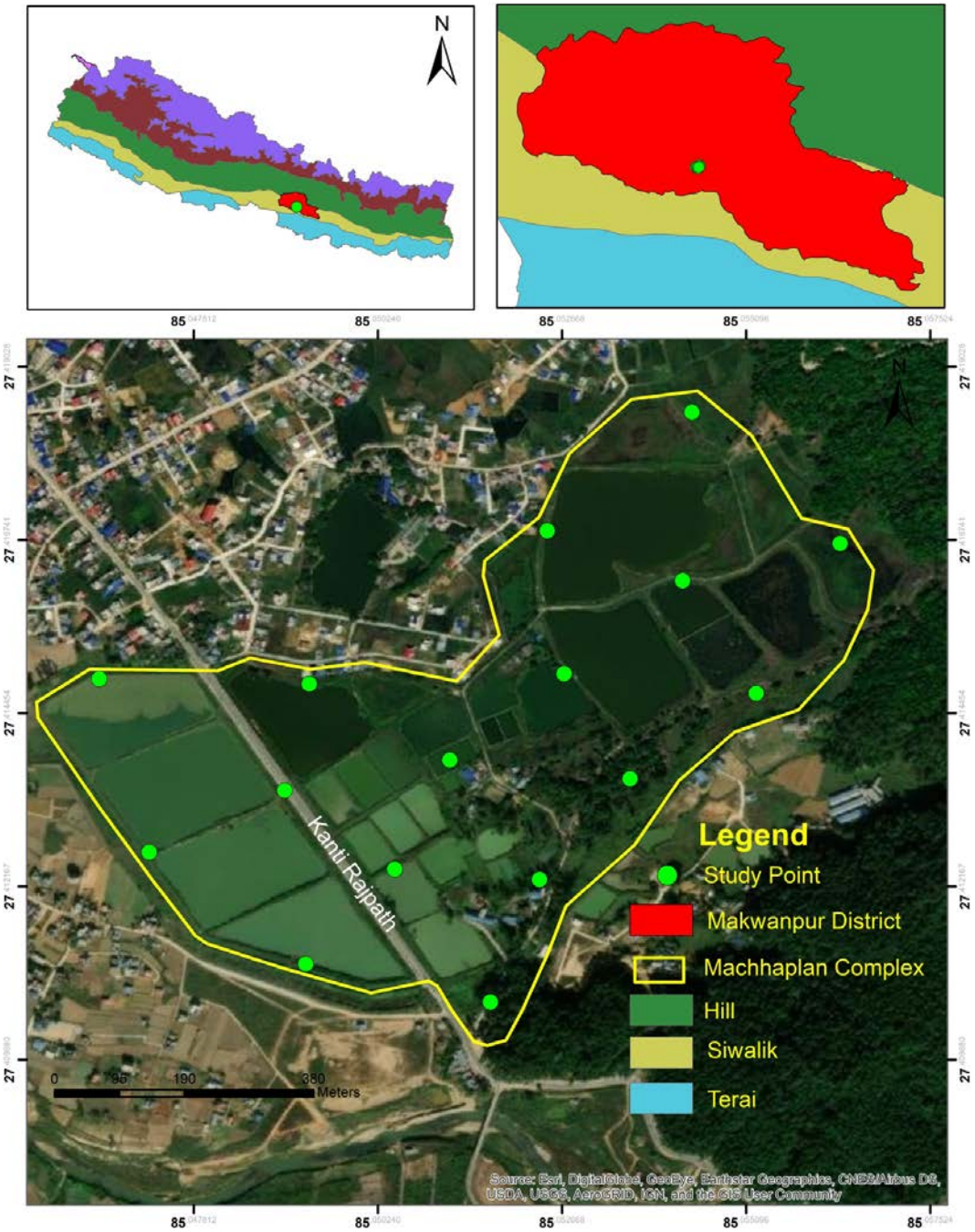

Figure 1: Location Map of Machhaplan Complex

binoculars. The birds were identified using Birds of Nepal (Grimmett et al. 2016) and the species seen and heard were recorded with confirmed identity. The richness and relative abundance of birds were estimated by frequency of sighting and numbers of birds seen (Jha 2019) whereas seasonal status of birds was evaluated by the presence or absence of birds in the site (Thakur et al. 2010).

Data Analysis

The species diversity was calculated using Shannon's Diversity Index, H (Shannon 1948).
Shannon's Diversity Index (H) = H' = $-\sum$ pi ln pi
Where 'pi' is the proportion of (n/N) of individuals of one particular species found (n) divided by total number of individuals found (N), 'ln' is natural log, $\sum$ is the sum of calculation and 's' is the number of species

Species Richness (R) and Evenness (E) were calculated using the formula:

1. Margalef's Richness Index (Margalef 1958): R=S-1/lnN
2. Pielou's Evenness Index (Pielou 1966): E=H/lnS

Where, N=total abundance, S=total no. of species, ln= logarithm of base e
The relative abundance of the avian species was assessed as 'very common', 'common', 'uncommon' and 'rare' based on their visit rates 75–100%, 50–74%, 25–49% and <25% respectively (Khan 2005).

We also used Microsoft Excel (2013) to present the results in the form of charts and tables.

Results

During the study period, a total of 2335 individuals of 164 species of birds belonging to 19 orders and 59 families were recorded in the Machhaplan Complex (Annex 1). Passeriformes was the most dominant order with 73 species of 30 families followed by Charadriiformes (12 species) and Accipitriformes (10 species) (Figure 2). Similarly, Muscicapidae was the most commonly represented family with 12 species followed by Accipitridae and Anatidae with 9 species (Figure 3). The most abundant

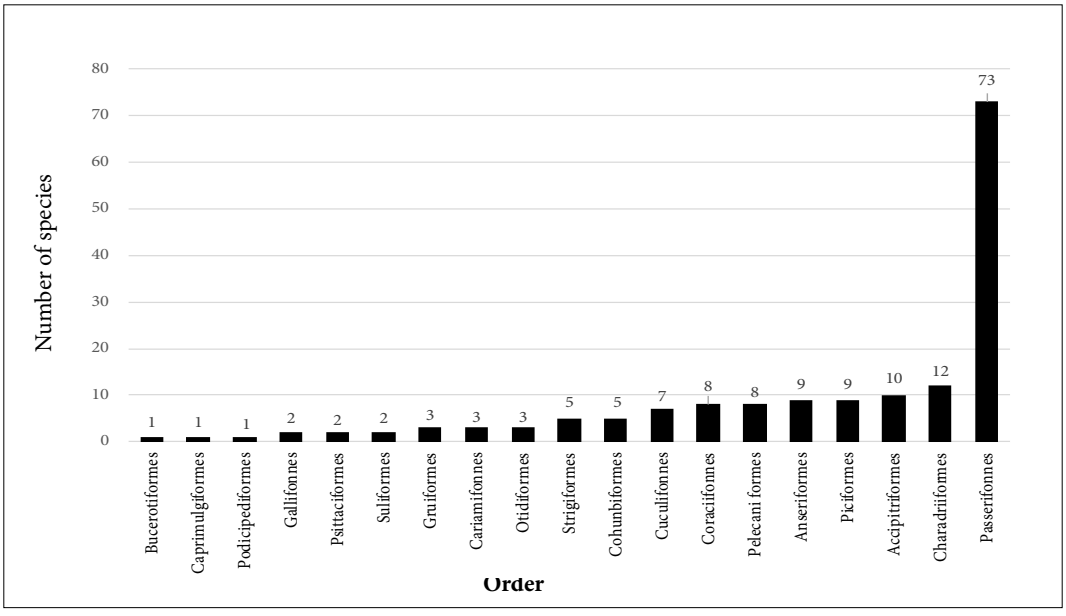

Figure 2: Avian Species Composition based on Order

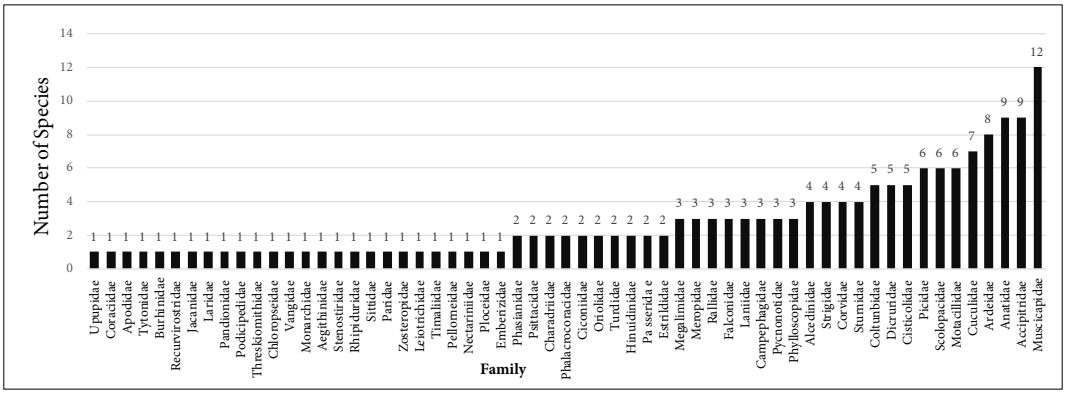

Figure 3: Avian Species Composition based on Family

species among the birds was the House Sparrow (*Passer domesticus*) (n=156) followed by Scaly-breasted Munia (*Lonchura punctulata*) (n=144) and Red-vented Bulbul (*Pycnonotus cafer*) (n=142) (Annex 1). The avian checklist (Annex 1) is not the first checklist from this area. Many bird watchers have their own checklists. This checklist is drawn from our research work within specific time period.

Status of Birds based on Habitat

Out of the 164 bird species, 117 species were terrestrial whereas 47 species were wetland dependent in the Machhaplan Complex (Annex 1). The terrestrial birds species were recorded higher than the wetland dependent birds (Figure 4).

Abundance and Migratory Status of Birds

The abundance category showed that Common birds accounted for 41% of the total followed by Uncommon birds, Rare birds, and Very Common birds with 33%, 17%, and 9%, respectively (Figure 5a). In addition, the

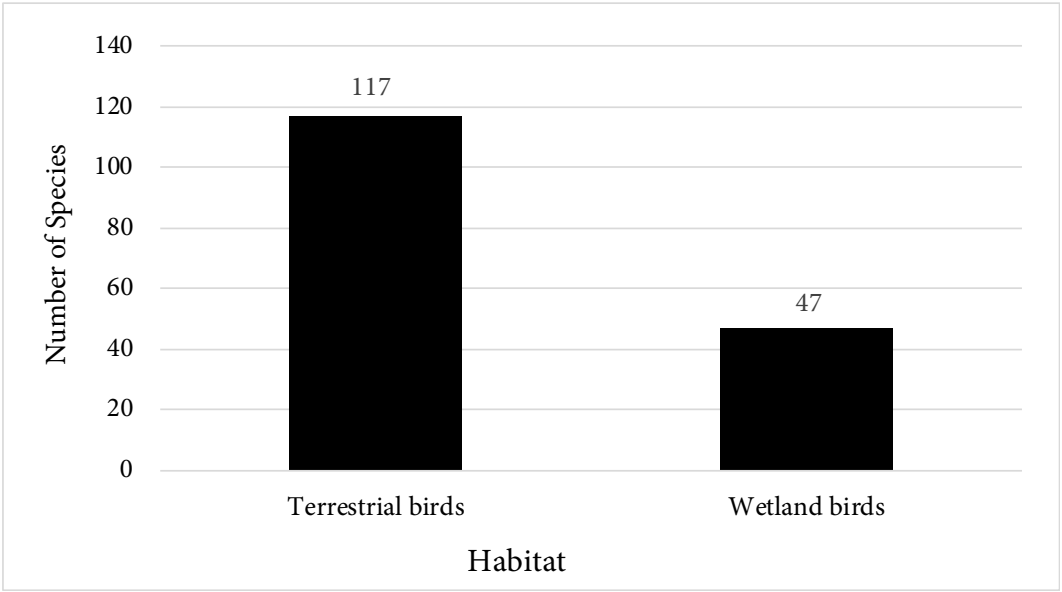

Figure 4: Status of Birds based on Habitat

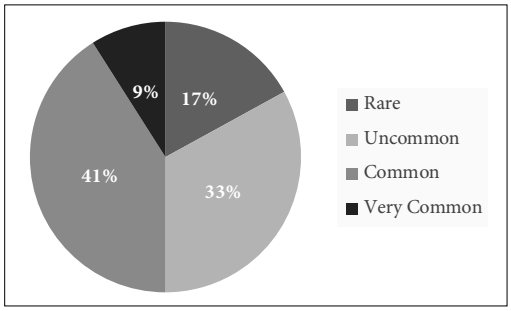

Figure 5(a): Abundance Status of Birds

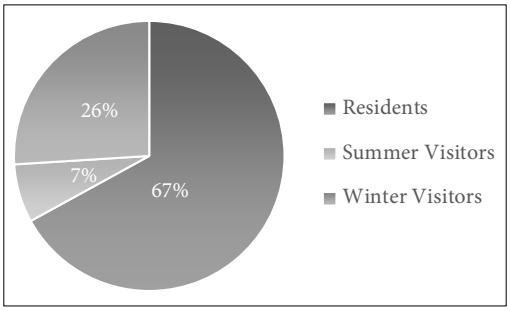

Figure 5(b): Migratory status of Birds

migratory status revealed that resident species dominated summer and winter visitors. There were 109 (67%) resident species, 43 (26%) winter visitors, and 12 (7%) summer visitors among the total recorded species (Figure 5b).

Conservation Status of Recorded Species

Of the total recorded species, 2 species were Globally Threatened species viz. Common Pochard (*Aythya ferina*), Steppe Eagle (*Aquila nepalensis*) and 9 species were Nationally Threatened species viz. Northern Pintail (*Anas acuta*), Himalayan Griffon (*Gyps himalayensis*), Steppe Eagle, Black-headed Gull (*Larus ridibundus*), Asian Openbill (*Anastomus oscitans*), Barn Owl (*Tyto alba*), Brown Fish Owl (*Ketupa zeylonensis*), Greater Necklaced Laughingthrush (*Garrulax pectoralis*) and Chestnut Munia (*Lonchura atricapilla*). Out of 9 Nationally Threatened species, 2 species were endangered and 7 species were vulnerable (Table 1).

Species Diversity

We followed the different diversity indices viz. Shannon's Diversity Index (H), Margalef's Richness Index (R) and Pielou's Evenness Index (E). We also performed analyses on two different habitats: terrestrial and wetland. The Shannon Diversity Index (H), Margalef's Richness Index (R) and Pielou's Evenness Index (E) of Machhaplan Complex were 4.38, 21.01 and 0.86, respectively. Similarly, terrestrial birds had the highest Shannon's Diversity Index (H=3.97) and Margalef's Richness Index (R=15.53) and this means they have higher species diversity and richness than wetland birds (Table 2). Wetland birds had the highest Pielou's Evenness Index (E=0.86) which means they are evenly distributed than terrestrial birds (Table 2).

Table 1: Threatened Species recorded in Machhaplan Complex

S. N.	English Name	National Status	Global Status	Number
1	Northern Pintail	EN	LC	2
2	Common Pochard	NT	VU	2
3	Himalayan Griffon	VU	NT	2
4	Steppe Eagle	VU	EN	6
5	Black-headed Gull	VU	LC	2
6	Asian Open-bill	VU	LC	24
7	Barn Owl	VU	LC	1
8	Brown Fish Owl	VU	LC	2
9	Greater Necklaced Laughingthrush	VU	LC	12
10	Chestnut Munia	EN	LC	4

Note: LC= Least Concern, EN=Endangered, NT= Near-Threatened, VU= Vulnerable (DNPWC and BCN 2018)

Table 2: Comparative Diversity Indices: Terrestrial Birds and Wetland Birds

Diversity Indices	Terrestrial Birds	Wetland Birds	Overall
Shannon's Diversity Index(H)	3.97	3.33	4.38
Margalef's Richness Index (R)	15.53	7.37	21.01
Pielou's Evenness Index (E)	0.83	0.86	0.86

Discussion

Species Composition

The study revealed the presence of 164 species of birds belonging to 19 orders and 59 families in the Machhaplan Complex. Among them, 117 species were terrestrial and 47 species were wetland dependent. The documentation of 164 bird species suggests s the Machhaplan Complex has high bird diversity which is 18.51% of the total bird species recorded in Nepal (DNPWC and BCN 2018). Bajagain et al. (2020) had recorded 132 avian species belonging to 15 orders and 44 families in the Institute of Forestry Complex, Hetauda. Similarly, 116 species of birds belonging to 41 families were recorded during the study carried out in Majal Water Reservior of India (Lawate 2021). Dhakal et al. (2020) recorded 33 species of waterbirds in Khaste Lake Complex, Nepal. Jha and Sharma (2019) also reported 16 species of water birds from their study carried out in Taudaha Lake, Kathmandu, Nepal. Moreover, 56 species of wetland birds were recorded in Jagdishpur Reservior, Kapilvastu, Nepal (Bhusal et al. 2020). The Machhaplan Complex supported more avian species than Institute of Forestry Complex and Majal Water Reservior. Comparatively, high bird diversity in Machhaplan Complex might be due to the presence of many ponds, forested land and abundant food sources within a small area. However, Khaste Lake Complex, Taudaha Lake, Jagdishpur Reservoir and Machhaplan Complex had a variation in the number of wetland dependent birds. Such variation might have occurred due to huge difference in their relative size and water availability. The availability of food supplies such as fishes, aquatic plants, planktons, invertebrates, etc. and suitable habitats for breeding might have contributed to diversity in wetland dependent birds in Machhaplan Complex. The diversification in species composition in different places could be due to time duration, season and coverage area of the study site.

Species Diversity

Terrestrial birds had the highest Shannon's Diversity Index (H=3.97) and Margalef's Richness Index (R=15.53) whereas wetland birds had the highest Pielou's Evenness Index (E=0.86) (Table 2). Similar results had been recorded by Khatri et al. (2019) in Phewa Wetland, Nepal. Wetland dependent birds were dominated by the terrestrial birds and this seems normal according to Khatri et al. (2019) as the terrestrial birds can have access to all of the suitable habitats within the reservoir. Bajagain et al. (2020) reported higher avian species diversity (H=4.08) in a wetland associated with grassland habitat than in a forested habitat (H=4.06) in the Institute of Forestry Complex, Hetauda. The variation in species diversity in different habitats might be due to food and water availability, vegetation cover and influence of anthropogenic activities.

Conservation Status and Threats to Avifauna

Of the 42 globally threatened and 167 nationally threatened species of birds in Nepal (DNPWC and BCN 2018), 2 globally threatened and 9 nationally threatened species were recorded (Table 1). None of the threatened species recorded in this area falls under the protected bird species list of Nepal (BCN and DNPWC 2011). Khatri et al. (2019) also recorded

7 globally threatened and 12 nationally threatened species in Phewa Wetland, Nepal. Increasing human settlement, industrialization and pollution were observed as the major threats to avifauna in Machhaplan Complex. Some local people were also found killing birds for meat by using catapult. One nationally vulnerable species, Barn Owl (*Tyto alba*) was found dead due to electrocution in the study site. Poisoning of river water and extraction of stones, sand and gravel in Karra Khola and Rapti River were major threats to riverine birds (Shrestha and Lakhey 2000; Parajuli 2016). Anthropogenic activities should be minimized along with proper management of electric power transmission lines in order to protect the natural habitat of birds and preserve the diversity.

Conclusion

This study shows that Machhaplan Complex supports diverse avifauna which is yet to be thoroughly explored. The study recorded 2335 individuals of 164 avian species belonging to 59 families under 19 orders, including 117 terrestrial and 47 wetland dependent species. Of the total recorded species, 2 species were globally threatened and 9 species were nationally threatened. However, focused scientific researches and systematic regular monitoring of avifauna are required to acquire more information about the species diversity and threats. Since the area possesses huge potential for bird ecotourism, biodiversity conservation and tourism activities can be carried out together by implementing appropriate plans and policies. The present study recommends raising awareness about the importance and conservation of birds and their habitats to both residents and visitors within the Machhaplan Complex.

Acknowledgements

We would like to acknowledge Natural Reservoir Fisheries Promotion and Conservation Center, Machhaplan Complex, Hetauda; Bird Conservation Nepal, Hetauda; Institute of Forestry, Hetauda Campus; and Agriculture and Forestry University, Faculty of Forestry, Hetauda. We are indebted to anonymous reviewer from the FORESTRY: Journal of Institute of Forestry, Nepal. We are very thankful to Mr. Krishna Prasad Bhusal, Mr. Amrit Poudel and Mr. Aavas Pradhan for their constant encouragement and guidance. We extend our sincere gratitude to everyone who supported us directly and indirectly throughout the research period.

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Annex 1

Avian Checklist of Machhaplan Complex					
Order/ Family	**Common Name**	***Scientific Name***	**Habitat Status**	**Migratory Status**	**Maximum Number Observed**
		GALLIFORMES			
		Phasianidae			
1	Red Junglefowl	*Gallus gallus*	TB	R	4
2	Indian Peafowl	*Pavo cristatus*	TB	R	2
		ANSERIFORMES			
		Anatidae			
3	Bar-headed Goose	*Anser indicus*	WB	W	5
4	Lesser Whistling Duck	*Dendrocygna javanica*	WB	R	56
5	Ruddy Shelduck	*Tadorna ferruginea*	WB	W	42
6	Gadwall	*Anas strepera*	WB	W	2
7	Eurasian Wigeon	*Anas penelope*	WB	W	1
8	Mallard	*Anas platyrhynchos*	WB	W	24
9	Common Teal	*Anas crecca*	WB	W	28
10	Northern Pintail	*Anas acuta*	WB	W	2
11	Common Pochard	*Aythya ferina*	WB	W	2
		PICIFORMES			
		Picidae			
12	Eurasian Wryneck	*Jynx torquilla*	TB	W	6
13	Rufous Woodpecker	*Celeus brachyurus*	TB	R	3
14	Grey-capped Pygmy Woodpecker	*Dendrocopos canicapillus*	TB	R	5
15	Fulvous-breasted Woodpecker	*Dendrocopos macei*	TB	R	12
16	Greater Yellownape	*Picus flavinucha*	TB	R	2
17	Greater Flameback	*Chryusocolaptes lucidus*	TB	R	3
		Megalimidae			
18	Lineated Barbet	*Megalamia lineata*	TB	R	5
19	Blue throated Barbet	*Megalamia asiatica*	TB	R	4
20	Coppersmith Barbet	*Megalamia haemacephala*	TB	R	4
		BUCEROTIFORMES			
		Upupidae			
21	Common Hoopoe	*Upupa epops*	TB	R	2
		CORACIIFORMES			
		Coraciidae			
22	Indian Roller	*Coracias benghalensis*	TB	R	4
		Meropidae			
23	Green Bee-eater	*Merops orientalis*	TB	R	16
24	Blue-tailed Bee-eater	*Merops philippinus*	TB	S	18

25	Chestnut-headed Bee-eater	*Merops leschenaulti*	TB	S	22
		Alcedinidae			
26	Common Kingfisher	*Alcedo atthis*	WB	R	12
27	Stork-billed Kingfisher	*Pelargopsis capensis*	WB	R	1
28	White-throated Kingfisher	*Halcyon smyrnensis*	WB	R	16
29	Pied Kingfisher	*Ceryle rudis*	WB	R	6
		CUCULIFORMES			
		Cuculidae			
30	Common Hawk Cuckoo	*Hierococcyx varius*	TB	R	3
31	Indian Cuckoo	*Cuculus micropterus*	TB	S	1
32	Eurasian Cuckoo	*Cuculus canorus*	TB	S	2
33	Asian Koel	*Eudynamys scolopaceus*	TB	S	12
34	Green-billed Malkoha	*Phaenicophaeus tristis*	TB	R	1
35	Greater Coucal	*Centropus sinensis*	TB	R	10
36	Lesser Coucal	*Centropus bengalensis*	TB	R	2
		PSITTACIFORMES			
		Psittacidae			
37	Alexandrine Parakeet	*Psittacula eupatria*	TB	R	15
38	Plum headed Parakeet	*Psittacula cyanocephala*	TB	R	28
		CAPRIMULGIFORMES			
		Apodidae			
39	House Swift	*Apus nipalensis*	TB	R	10
		STRIGIFORMES			
		Tytonidae			
40	Barn Owl		TB	R	1
		Strigidae			
41	Brown Fish Owl	*Ketupa zeylonensis*	TB	R	2
42	Jungle Owlet	*Glaucidium radiatum*	TB	R	3
43	Asian Barred Owlet	*Glaucidium cuculoides*	TB	R	1
44	Spotted Owlet	*Athene brama*	TB	R	6
		COLUMBIFORMES			
		Columbidae			
45	Oriental Turtle Dove	*Streptopelia orientalis*	TB	W	2
46	Spotted Dove	*Stigmatopelia chinensis*	TB	R	7
47	Red-collared Dove	*Streptopelia tranquebarica*	TB	R	6
48	Eurasian Collared Dove	*Streptopelia decaocto*	TB	R	2
49	Yellow-footed Green Pigeon	*Treron phoenicopterus*	TB	R	1
		GRUIFORMES			
		Rallidae			
50	Watercock	*Gallicrex cinerea*	WB	S	6
51	Common Moorhen	*Gallinula chloropus*	WB	R	16

52	Common Coot	*Fulica atra*	WB	W	8
		CHARADRIIFORMES			
		Scolopacidae			
53	Common Snipe	*Gallinago gallinago*	WB	W	16
54	Pintail Snipe	*Gallinago stenura*	WB	W	2
55	Common Greenshank	*Tringa nebularia*	WB	W	8
56	Green Sandpiper	*Tringa ochropus*	WB	W	14
57	Common Sandpiper	*Actitis hypoleucos*	WB	W	18
58	Temminck's Stint	*Calidris temminckii*	WB	W	7
		Burhinidae			
59	Eurasian thick-knee	*Burhinus oedicnemus*	TB	R	2
		Recurvirostridae			
60	Black-winged Stilt	*Himantopus himantopus*	WB	W	14
		Jacanidae			
61	Bronze-winged Jacana	*Metopidius indicus*	WB	R	1
		Charadriidae			
62	Little Ringed Plover	*Charadrius dubius*	WB	W	15
63	Red-wattled Lapwing	*Vanellus indicus*	WB	R	6
		Laridae			
64	Black-headed Gull	*Larus ridibundus*	WB	W	2
		ACCIPITRIFORMES			
		Pandionidae			
65	Osprey	*Pandion haliaetus*	WB	W	1
		Accipitridae			
66	Black Baza	*Aviceda leuphotes*	TB	S	2
67	Black-winged Kite	*Elanus axillaris*	TB	R	3
68	Black Kite	*Milvus migrans*	TB	R	6
69	Himalayan Griffon	*Gyps himalayensis*	TB	W	2
70	Crested Serpent Eagle	*Spilornis cheela*	TB	R	3
71	Shikra	*Accipiter badius*	TB	R	1
72	Oriental Honey Buzzard	*Pernis ptilorhynchus*	TB	R	2
73	Long-legged Buzzard	*Buteo rufinus*	TB	W	1
74	Steppe Eagle	*Aquila nepalensis*	TB	W	6
		CARIAMIFORMES			
		Falconidae			
75	Collared Falconet	*Microhierax caerulescens*	TB	R	3
76	Common Kestrel	*Falco tinnunculus*	TB	R	5
77	Peregrine Falcon	*Falco peregrinus*	TB	W	2
		PODICIPEDIFORMES			
		Podicipedidae			
78	Great Crested Grebe	*Podiceps cristatus*	WB	W	1
		SULIFORMES			

		Phalacrocoracidae			
79	Little Cormorant	*Phalacrocorax niger*	WB	R	28
80	Great Cormorant	*Phalacrocorax carbo*	WB	W	45
		PELECANIFORMES			
		Ardeidae			
81	Little Egret	*Egretta garzetta*	WB	R	35
82	Great Egret	*Casmerodius albus*	WB	R	2
83	Intermediate Egret	*Mesophoyx intermedia*	WB	R	3
84	Cattle Egret	*Bubulcus ibis*	WB	R	26
85	Grey Heron	*Ardea cinerea*	WB	W	2
86	Striated Heron	*Butorides striata*	WB	R	1
87	Black-crowned Night Heron	*Nycticorax nycticorax*	WB	R	2
88	Cinnamon Bittern	*Lxobrychus cinnamomeus*	WB	S	6
		OTIDIFORMES			
		Threskiornithidae			
89	Black Ibis	*Pseudibis papillosa*	TB	R	12
		Ciconiidae			
90	Asian Openbill	*Anastomus oscitans*	WB	R	24
91	Asian Woollyneck	*Ciconia episcopus*	WB	R	1
		PASSERIFORMES			
		Chloropseidae			
92	Orange-bellied Leafbird	*Chloropsis hardwickii*	TB	R	2
		Laniidae			
93	Brown Shrike	*Lanius cristatus*	TB	W	2
94	Long-tailed Shrike	*Lanius schach*	TB	R	14
95	Grey-backed Shrike	*Lanius tephronotus*	TB	W	6
		Corvidae			
96	Red-billed Blue Magpie	*Urocissa erythroryncha*	TB	R	10
97	Rufous Treepie	*Dendrocitta vagabunda*	TB	R	8
98	House Crow	*Corvus splendens*	TB	R	27
99	Large-billed Crow	*Corvus macrorhynchos*	TB	R	14
		Oriolidae			
100	Eurasian Golden Oriole	*Oriolus oriolus*	TB	S	4
101	Black-hooded Oriole	*Oriolus xanthornus*	TB	R	14
		Campephagidae			
102	Large Cuckooshrike	*Coracina macei*	TB	R	16
103	Black-winged Cuckooshrike	*Coracina melaschistos*	TB	R	2
104	Scarlet Minivet	*Pericrocotus flammeus*	TB	R	12
		Vangidae			
105	Bar-winged Flycatcher Shrike	*Hemipus picatus*	TB	R	6
		Dicruridae			
106	Black Drongo	*Dicrurus macrocerus*	TB	R	44

107	Ashy Drongo	*Dicrurus leucophaeus*	TB	R	6
108	White-bellied Drongo	*Dicrurus caerulescens*	TB	R	2
109	Spangled Drongo	*Dicrurus hottentottus*	TB	R	8
110	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	TB	R	12
		Monarchidae			
111	Asian Paradise Flycatcher	*Terpsiphone paradisi*	TB	S	2
		Aegithinidae			
112	Common Iora	*Aegithina tiphia*	TB	R	4
		Muscicapidae			
113	Blue Rock Thrush	*Monticola solitarius*	TB	R	2
114	Red-throated Flycatcher	*Ficedula albicilla*	TB	W	18
115	Verditer Flycatcher	*Eumyias thalassinus*	TB	S	6
116	Siberian Rubythroat	*Luscinia calliope*	TB	W	2
117	Bluethroat	*Luscinia svecica*	TB	W	6
118	Oriental Magpie Robin	*Copsychus saularis*	TB	R	24
119	White-rumped Shama	*Copsychus malabarica*	TB	R	4
120	Hogdson's Redstart	*Phoenicurus hodgsoni*	TB	W	5
121	Black-backed Forktail	*Enicurus immaculatus*	TB	R	4
122	Common Stonechat	*Saxicola torquatus*	TB	R	34
123	Pied Bushchat	*Saxicola caprata*	TB	R	21
124	Grey Bushchat	*Saxicola ferreus*	TB	R	10
		Turdidae			
125	Orange-headed Thrush	*Zoothera citrina*	TB	S	3
126	Scaly Thrush	*Zoothera dauma*	TB	R	6
		Stenostiridae			
127	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	TB	W	16
		Rhipiduridae			
128	White-throated Fantail	*Rhipidura albicollis*	TB	R	2
		Sturnidae			
129	Chestnut-tailed Starling	*Sturnus malabarica*	TB	R	26
130	Common Myna	*Acridotheres tristis*	TB	R	122
131	Asian Pied Starling	*Sturnus contra*	TB	R	42
132	Jungle Myna	*Acridotheres fuscus*	TB	R	26
		Sittidae			
133	Chestnut-bellied Nuthatch	*Sitta castanea*	TB	R	16
		Paridae			
134	Great Tit	*Parus major*	TB	R	12
		Hirundinidae			
135	Plain Martin	*Riparia paludicola*	TB	R	32
136	Barn Swallow	*Hirundo rustica*	TB	R	34
		Pycnonotidae			
137	Black-crested Bulbul	*Pycnonotus meanicterus*	TB	R	2

138	Red-vented Bulbul	*Pycnonotus cafer*	TB	R	142
139	Himalayan Bulbul	*Pycnonotus leucogenys*	TB	R	14
		Cisticolidae			
140	Grey-breasted Prinia	*Prinia hodgsonii*	TB	R	24
141	Plain Prinia	*Prinia inornata*	TB	R	38
142	Ashy Prinia	*Prinia socialis*	TB	R	23
143	Zitting Cisticola	*Cisticola juncidis*	TB	R	11
144	Common Tailorbird	*Orthotomus sultorius*	TB	R	24
		Zosteropidae			
145	Oriental White-eye	*Zosterops palpebrosus*	TB	R	12
		Phylloscopidae			
146	Common Chiffchaff	*Phylloscopus collybita*	TB	W	6
147	Dusky Warbler	*Phylloscopus fuscatus*	TB	W	4
148	Smoky Warbler	*Phylloscopus fuligiventer*	WB	W	6
		Leiotrichidae			
149	Greater Necklaced Laughing Thrush	*Garrulax pectoralis*	TB	R	12
		Timaliidae			
150	Black-chinned Babbler	*Stachyris pyrrhops*	TB	R	14
		Pellorneidae			
151	Jungle Babbler	*Turdoides striata*	TB	R	65
		Nectariniidae			
152	Purple Sunbird	*Nectarinia asiaticus*	TB	R	8
		Passeridae			
153	House Sparrow	*Passer domesticus*	TB	R	156
154	Eurasian Tree Sparrow	*Passer montanus*	TB	R	26
		Motacillidae			
155	White Wagtail	*Motacilla alba*	TB	W	24
156	White-browed Wagtail	*Motacilla maderaspatensis*	WB	R	42
157	Grey Wagtail	*Motacilla cinerea*	WB	W	8
158	Paddyfield Pipit	*Anthus rufulus*	TB	R	14
159	Olive-backed Pipit	*Anthus hodgsoni*	TB	W	10
160	Rosy Pipit	*Anthus roseatus*	WB	W	6
		Ploceidae			
161	Baya Weaver	*Ploceus philippinus*	TB	R	18
		Estrildidae			
162	Scaly-breasted Munia	*Lonchura punctulata*	TB	R	144
163	Chestnut Munia	*Lonchura atricapilla*	TB	R	4
		Emberizidae			
164	Crested Bunting	*Melophus lathami*	TB	W	6

Note: TB=Terrestrial Bird, WB=Wetland Bird, R=Resident, S=Summer Visitor and W=Winter Visitor

Annex 2: Detail of the Avifaunal Survey

S.N.	Date	Time	Team Members
1.	December 5, 2020	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
2.	December 19, 2020	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
3.	January 2, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
4.	January 23, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
5.	February 6, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
6.	February 20, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
7.	March 6, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
8.	March 20, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
9.	April 3, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel
10.	April 17, 2021	7:00-10:30 AM	Nahakul Bhusal, Sneha Paudel