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

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KEYWORDS
Avifauna
Point count
Terrestrial birds
Wetland birds
Threatened 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 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
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.
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 \( H = H' = -\sum p_i \ln p_i \) Where ‘\( p_i \)’ 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, \( \Sigma \) 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):
   \[ R = S - \frac{1}{\ln N} \]

2. Pielou’s Evenness Index (Pielou 1966):
   \[ E = \frac{H}{\ln S} \]

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 Machhapalan 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](image-url)
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...
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)
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 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 Reservoir 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 Reservoir, Kapilvastu, Nepal (Bhusal et al. 2020). The Machhaplan Complex supported more avian species than Institute of Forestry Complex and Majal Water Reservoir. 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

| 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    |

Table 2: Comparative Diversity Indices: Terrestrial Birds and Wetland Birds
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           | W                | 5                       |
| 4             | Lesser Whistling Duck| *Dendrocygna javanica* | WB R        | W                | 56                      |
| 5             | Ruddy Shelduck       | *Tadorna ferruginea* | WB W           | R                | 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           | R                | 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    | *Chrysocholaptes 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                       |
| **CORACIIIFORMES** |                |                      |                |                  |                         |
| 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                      |
| No. | Species Name                        | Common Name                        | Family          | Order           | Sex | Annual | Reference |
|-----|------------------------------------|------------------------------------|-----------------|----------------|-----|--------|-----------|
| 25  | Chestnut-headed Bee-eater          | *Merops leschenaulti*              | TB S 22         |                |     |        |           |
| 26  | Common Kingfisher                  | *Alcedo atthis*                    | WB R 12         |                |     |        |           |
| 27  | Stork-billed Kingfisher            | *Pelargopsis capensis*             | WB R 1          |                |     |        |           |
| 28  | White-throated Kingfisher          | *Halycon smyrnensis*               | WB R 16         |                |     |        |           |
| 29  | Pied Kingfisher                    | *Ceryle rudis*                     | WB R 6          |                |     |        |           |
| 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          |                |     |        |           |
| 37  | Alexandrine Parakeet               | *Psittacula eupatria*              | TB R 15         |                |     |        |           |
| 38  | Plum headed Parakeet               | *Psittacula cyanocephala*          | TB R 28         |                |     |        |           |
| 39  | House Swift                        | *Apus nipalensis*                  | TB R 10         |                |     |        |           |
| 40  | Barn Owl                           |                                    | TB R 1          |                |     |        |           |
| 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          |                |     |        |           |
| 45  | Oriental Turtle Dove               | *Streptopelia orientalis*          | TB W 2          |                |     |        |           |
| 46  | Spotted Dove                       | *Stigmopeelia 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          |                |     |        |           |
| 50  | Watercock                          | *Gallicrex cinerea*                | WB S 6          |                |     |        |           |
| 51  | Common Moorhen                     | *Gallinula chloropus*              | WB R 16         |                |     |        |           |
|   | Common Coot | Fulica atra | WB | W | 8 |
|---|-------------|-------------|----|---|---|
|   | Common Snipe | Gallinago gallinago | WB | W | 16 |
|   | Pintail Snipe | Gallinago stenura | WB | W | 2 |
|   | Common Greenshank | Tringa nebularia | WB | W | 8 |
|   | Green Sandpiper | Tringa ochropus | WB | W | 14 |
|   | Common Sandpiper | Actitis hypoleucos | WB | W | 18 |
|   | Temminck's Stint | Calidris temminckii | WB | W | 7 |
|   | Eurasian thick-knee | Burhinus oedicnemus | TB | R | 2 |
|   | Black-winged Stilt | Himantopus himantopus | WB | W | 14 |
|   | Bronze-winged Jacana | Metopidius indicus | WB | R | 1 |
|   | Little Ringed Plover | Charadrius dubius | WB | W | 15 |
|   | Red-wattled Lapwing | Vanellus indicus | WB | R | 6 |
|   | Black-headed Gull | Larus ridibundus | WB | W | 2 |
|   | Osprey | Pandion haliaetus | WB | W | 1 |
|   | Black Baza | Aviceda leuphotes | TB | S | 2 |
|   | Black-winged Kite | Elanus axillaris | TB | R | 3 |
|   | Black Kite | Milvus migrans | TB | R | 6 |
|   | Himalayan Griffon | Gyps himalayensis | TB | W | 2 |
|   | Crested Serpent Eagle | Spilornis cheela | TB | R | 3 |
|   | Shikra | Accipiter badius | TB | R | 1 |
|   | Oriental Honey Buzzard | Pernis ptilorhynchus | TB | R | 2 |
|   | Long-legged Buzzard | Buteo rufinus | TB | W | 1 |
|   | Steppe Eagle | Aquila nepalensis | TB | W | 6 |
|   | Collared Falconet | Microhierax caerulescens | TB | R | 3 |
|   | Common Kestrel | Falco tinnunculus | TB | R | 5 |
|   | Peregrine Falcon | Falco peregrinus | TB | W | 2 |
|   | Great Crested Grebe | Podiceps cristatus | WB | W | 1 |
| No. | Species Name                           | Genus                      | WB | R  | Count |
|-----|---------------------------------------|----------------------------|----|----|-------|
| 79  | Little Cormorant                      | Phalacrocorax niger        | WB | R  | 28    |
| 80  | Great Cormorant                       | Phalacrocorax carbo        | WB | W  | 45    |
| 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     |
| 89  | Black Ibis                            | Pseudibis papillosa       | TB | R  | 12    |
| 90  | Asian Openbill                        | Anastomus oscitans        | WB | R  | 24    |
| 91  | Asian Woollyneck                      | Ciconia episcopus         | WB | R  | 1     |
| 92  | Orange-bellied Leafbird               | Chloropsis hardwickii     | TB | R  | 2     |
| 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     |
| 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    |
| 100 | Eurasian Golden Oriole                | Oriolus oriolus           | TB | S  | 4     |
| 101 | Black-hooded Oriole                   | Oriolus xanthonurus       | TB | R  | 14    |
| 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    |
| 105 | Bar-winged Flycatcher Shrike          | Hemipus picatus           | TB | R  | 6     |
| 106 | Black Drongo                          | Dicrurus macrocerus       | TB | R  | 44    |
| No.  | Species Name                  | Scientific Name           | Subfamily | Region | No. |
|------|-------------------------------|---------------------------|-----------|--------|-----|
| 107  | Ashy Drongo                   | *Dicrurus leucophaeus*    | Monarchidae | TB     | R   | 6   |
| 108  | White-bellied Drongo          | *Dicrurus caerulescens*   | Monarchidae | TB     | R   | 2   |
| 109  | Spangled Drongo               | *Dicrurus hottentottus*    | Monarchidae | TB     | R   | 8   |
| 110  | Greater Racket-tailed Drongo  | *Dicrurus paradiseus*     | Monarchidae | TB     | R   | 12  |
| 111  | Asian Paradise Flycatcher     | *Terpsiphone paradisi*    | Monarchidae | TB     | S   | 2   |
| 112  | Common Iora                   | *Aegithina tipha*         | Aegithinidae | TB     | R   | 4   |
| 113  | Blue Rock Thrush              | *Monticola solitarius*    | Muscicapidae | TB     | R   | 2   |
| 114  | Red-throated Flycatcher       | *Ficedula albicilla*      | Muscicapidae | TB     | W   | 18  |
| 115  | Verditer Flycatcher           | *Eumyias thalassinus*     | Muscicapidae | TB     | S   | 6   |
| 116  | Siberian Rubythroat           | *Luscinia calliope*       | Muscicapidae | TB     | W   | 2   |
| 117  | Bluethroat                    | *Luscinia svecica*        | Muscicapidae | TB     | W   | 6   |
| 118  | Oriental Magpie Robin         | *Copsychus saularis*      | Aegithinidae | TB     | R   | 24  |
| 119  | White-rumped Shama            | *Copsychus malabarica*    | Aegithinidae | TB     | R   | 4   |
| 120  | Hodgson’s Redstart           | *Phoenicurus hodgsoni*    | Aegithinidae | TB     | W   | 5   |
| 121  | Black-backed Forktail         | *Enicurus immaculatus*     | Aegithinidae | TB     | R   | 4   |
| 122  | Common Stonechat              | *Saxicola torquatus*      | Turdidae   | TB     | R   | 34  |
| 123  | Pied Bushchat                 | *Saxicola caprata*        | Turdidae   | TB     | R   | 21  |
| 124  | Grey Bushchat                 | *Saxicola ferreus*        | Turdidae   | TB     | R   | 10  |
| 125  | Orange-headed Thrush          | *Zoothera citrina*        | Stenostiridae | TB     | S   | 3   |
| 126  | Scaly Thrush                  | *Zoothera dauma*          | Stenostiridae | TB     | R   | 6   |
| 127  | Grey-headed Canary Flycatcher | *Culicicapa ceylonensis*  | Rhipiduridae | TB     | W   | 16  |
| 128  | White-throated Fantail        | *Rhipidura albicollis*    | Sturnidae   | TB     | R   | 2   |
| 129  | Chestnut-tailed Starling      | *Sturnus malabarica*      | Sturnidae   | TB     | R   | 26  |
| 130  | Common Myna                   | *Acridotheres tristis*    | Sittidae    | TB     | R   | 122 |
| 131  | Asian Pied Starling           | *Sturnus contra*          | Sittidae    | TB     | R   | 42  |
| 132  | Jungle Myna                   | *Acridotheres fuscus*     | Sittidae    | TB     | R   | 26  |
| 133  | Chestnut-bellied Nuthatch     | *Sitta castanea*          | Paridae     | TB     | R   | 16  |
| 134  | Great Tit                     | *Parus major*             | Paridae     | TB     | R   | 12  |
| 135  | Plain Martin                  | *Riparia paludicola*      | Hirundinidae | TB     | R   | 32  |
| 136  | Barn Swallow                  | *Hirundo rustica*         | Hirundinidae | TB     | R   | 34  |
| 137  | Black-crested Bulbul          | *Pycnonotus meanicterus*  | Pycnonotidae | TB     | R   | 2   |
| No. | Species                                      | Scientific Name      | Category | Status | Notes          |
|-----|---------------------------------------------|----------------------|----------|--------|----------------|
| 138 | Red-vented Bulbul                           | *Pycnonotus cafer*   | TB       | R      | 142            |
| 139 | Himalayan Bulbul                            | *Pycnonotus leucogenys* | TB      | R      | 14            |
| 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            |
| 145 | Oriental White-eye                          | *Zosterops palpebrosus* | TB  | R      | 12            |
| 146 | Common Chiffchaff                           | *Phylloscopus collybita* | TB  | W      | 6             |
| 147 | Dusky Warbler                               | *Phylloscopus fuscatus* | TB  | W      | 4             |
| 148 | Smoky Warbler                               | *Phylloscopus fuligiventer* | WB  | W      | 6             |
| 149 | Greater Necklaced Laughing Thrush           | *Garrulax pectoralis* | TB       | R      | 12            |
| 150 | Black-chinned Babbler                       | *Stachyris pyrrhops* | TB       | R      | 14            |
| 151 | Jungle Babbler                              | *Turdoides striata*  | TB       | R      | 65            |
| 152 | Purple Sunbird                              | *Nectarinia asiatica* | TB       | R      | 8             |
| 153 | House Sparrow                               | *Passer domesticus*  | TB       | R      | 156           |
| 154 | Eurasian Tree Sparrow                       | *Passer montanus*    | TB       | R      | 26            |
| 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             |
| 161 | Baya Weaver                                 | *Ploceus philippinus* | TB       | R      | 18            |
| 162 | Scaly-breasted Munia                        | *Lonchura punctulata* | TB | R      | 144           |
| 163 | Chestnut Munia                              | *Lonchura atricapilla* | TB | R      | 4             |
| 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 |