A survey of Avifauna in aquatic habitat and their adjoining areas of Ramnagar, Uttarakhand, India

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INTRODUCTION

Birds are one of the important groups of indicators of environmental health (Collar and Andrew, 1988). The Himalayan region supports the rich avifaunal diversity due to rich floral diversity at different altitudinal ranges (Mohan and Sondhi, 2017). Many previous studies have shown that 80% of birds of the Indian Sub-continent found in the Himalayan region including some endemic species (Price et al., 2003). The Himalayan region is also known as a biological hotspot (Grimmett et al., 1998). Birds are good indicator species because they are ecologically versatile and thrive in all kinds of habitats as herbivores, carnivores, and omnivores. Their presence is an indication of a healthy ecosystem or habitat (Järvinen, O. and Väisänen, 1979; Jarvinen, 1983). The wetlands areas (Natural and manmade both) of Himalayan foothills provided a good habitat for long and short-distance migrants of the avian community (Saini et al., 2017). The Corbett Tiger Reserve and its adjoining area have different types of avian species (Bhattacharjee and Bargali, 2013). Due to the support of good food and habitat availability, approximately 40% of avian species found in India were recorded in the study area (Dhakate et al., 2008). The study area is listed as an important bird area (Islam and Rahmani, 2004). Many avian species migrate from a short to a very long distance every year while other species are non-migratory and spend their life cycle in a particular area (Arya et al., 2019). Our study area hosts many types of resident and migratory species. Most of the migratory birds perform the migration activity to migrate in the Indian sub-continent through Central Asian flyways such as Bar-Headed goose (Bhatt et al., 2015).

Considering the importance of avifauna in Uttarakhand, India, previously, no study has been done for assessing the avifauna survey in aquatic habitat and their adjoining areas of Ramnagar. Therefore, keeping the presence of important species in view in the study area efforts towards conservation of these species are needed. The present study was an observation attempt on avian species in and around the Ramnagar and their adjoining areas to make a new record of avian species.
MATERIALS AND METHODS

Study area
The present study was conducted from January 2020 to February 2020. The study was carried out in and around aquatic habitat i.e. Tumria Dam (29°19'33.2"N 78°55'57.2"E) and Haripura Jalashaya (29°07'48.0"N 79°18'52.2"E) of Ramnagar and their adjoining forest areas i.e. Corbett Tiger Reserve forest, Pawalgarh forest and Syat forest (Figure 1). The Tumria dam and Haripura Jalashaya mainly serves for irrigation purpose and fish farming. These aquatic areas are attached with many agricultural patches that attract many migratory aquatic and terrestrial birds. The forest area of Ramnagar i.e. Kyari Village forest (29°22'N; 79°11'E), Pawalgarh forest (29°21'48.3"N; 79°11'08.5"E) and Syat forest (29°23'31.7"N; 79°20'21.0"E) are characterized by dance forest diversity and Sal (Shorea robusta) is a dominant forest species in all these forest areas. These forest areas are not only rich in wild animals but also the richest habitat for avian fauna.

Field survey and data collection
The field survey was conducted in and around the aquatic habitat and their adjoining forest areas from January 2020 to February 2020. The field survey was carried out by using a field binocular and Nikon point shoot camera. Identification of birds in the field was based on Grimmett et al. (1998). Birds are classified based on their preferred habitat by direct observation and with help of field guide books (Ali et al., 1987; Grimmett et al., 1998; Grimmett et al., 2016). During the field, survey birds were counted by two standards methods i.e. line transect method and point count method. The survey was made from 6:00 am to 10:00 am and evening from 5:00 pm to 7:00 pm excluding rains.
RESULTS AND DISCUSSION

In the present study, we recorded a total of 145 avian species belonging to the 54 families during the study period (Table 1). Among these 113 residents and 32 winter visitor species were identified (Figure 2). The percentage of resident and winter visitor avian species was found to be 78.08% and 21.91%, respectively. The maximum number of species recorded from the family Muscicapidiae (15) followed by Anatidae (10), Picidae (6). Out of these four families were recorded with 5 species each, seven families with 4 species each, Eight families with 3 species each, and thirteen families with 2 species each. The remaining twenty families were recorded with 1 species from each family (Figure 3). These 146 species were recorded in a session. Variations in the vegetation structure have also impacted species distribution (MacArthur et al., 1962). Habitat quality and food availability are important factors to support the avian diversity in this particular area. Out of these 146 species, 68 insectivorous, 25 omnivorous, 24 Carnivorous, 17 Frugivorous, 10 Granivorous, and 2 Nectarivorous species were recorded according to their feeding habit (Figure 4). We recorded the maximum number of insectivorous species indicating that a particular area has a large diversity of insect species. This study showed that among the avian species, four species viz., River Lapwing, River tern, Great Hornbill, and Alexandrine Parakeet are under the Near Threatened (NT) category and one species namely Red-headed vulture is critically endangered according to IUCN Red data book. Vultures as scavengers have an important ecological role by maintaining equilibrium in the ecosystem. They remove animal waste like carcasses of livestock and wild animals and carrion from the environment (Singh and Bisht, 2019). The presence of globally threatened Red-headed vulture in the particular area indicates the significant habitat for this species. Some previous studies (Tanveer et al., 2019, Ahmed et al., 2019, Ghosh, et al., 2018, Bhattacharjee and Bargali, 2013) also indicated that aquatic habitats are best for residential as well as visiting avifauna species.

Table 1. Avian species as recorded during the study period in the different habitats of Ramnagar, Uttarakhand.

| Family        | Common Name          | Scientific Name      | Status | Status (IUCN) | Preferred Habitat | Food Guild    |
|---------------|----------------------|----------------------|--------|---------------|-------------------|--------------|
| Accipitridae  | Black Kite           | Milvus migrans       | R      | LC            | Forest            | Carnivorous  |
|               | Red-headed Vulture   | Sarcogyps calvus     | R      | CR            | Forest            | Carnivorous  |
|               | Crested Serpent Eagle| Spilornis cheela     | R      | LC            | Forest            | Carnivorous  |
|               | Changeable Hawk Eagle| Spizaetus cirrhatus  | R      | LC            | Forest            | Carnivorous  |
| Alcedinidae   | Common kingfisher    | Alcedo atthis        | R      | LC            | Forest            | Carnivorous  |
|               | Crested Kingfisher   | Megaceryle lugubris  | R      | LC            | Forest            | Carnivorous  |
|               | Pied Kingfisher      | Ceryle rudis         | R      | LC            | Forest            | Carnivorous  |
| Anatidae      | Common Merganser     | Mergus merganser     | WV     | LC            | Wetland           | Omnivorous   |
|               | Eurasian Teal        | Anas crecca          | WV     | LC            | Wetland           | Omnivorous   |
|               | Gadwall              | Anas Strepera        | WV     | LC            | Wetland           | Omnivorous   |
|               | Mallard              | Anas platyrhynchos   | WV     | LC            | Wetland           | Omnivorous   |
|               | Northern Pintail     | Anas acuta           | WV     | LC            | Wetland           | Omnivorous   |
|               | Red-crested Pochard  | Netta rufina         | WV     | LC            | Wetland           | Omnivorous   |
|               | Ruddy Shelduck       | Tadorna ferruginea   | WV     | LC            | Wetland           | Omnivorous   |
|               | Tufted Duck          | Aythya fuligula      | WV     | LC            | Wetland           | Omnivorous   |
|               | Indian Spot-billed Duck| Anas poecilorhyncha | WV     | LC            | Wetland           | Omnivorous   |
|               | Bar-headed Goose     | Anser indicus        | WV     | LC            | Wetland           | Omnivorous   |
| Anhingidae    | Darter               | Anhinga melanogaster | R      | LC            | Wetland           | Carnivorous  |
| Ardeidae      | Great Egret          | Casmerodius albus    | R      | LC            | Wetland           | Carnivorous  |
|               | Indian Pond Heron    | Ardeola grayii       | R      | LC            | Wetland           | Carnivorous  |
|               | Little Egret         | Egretta garterta     | R      | LC            | Wetland           | Carnivorous  |
|               | Black-crowned Night Heron | Nycticorax nycticorax | WV     | LC            | Wetland           | Omnivorous   |
|               | Cattle egret         | Bubulcus ibis        | R      | LC            | Agriculture       | Insectivorous|
| Bucerotidae   | Indian Grey Hornbill | Ocyceros birostris   | R      | LC            | Forest            | Frugivorous  |
|               | Oriental Pied Hornbill| Anthracoceros albirostris | R | LC | Forest | Frugivorous |
|               | Great Hornbill       | Buceros bicornis     | R      | NT            | Forest            | Frugivorous  |
| Order          | Genus                  | Species            | Habitat | Diet           |
|---------------|------------------------|--------------------|---------|----------------|
| Campephagidae | Scarlet Minivet        | *Pericrocotus      | R       | LC             |
|               | Small Minivet          | *Pericrocotus      | R       | LC             |
|               | Common Woodshrike       | *Tephrodornis      | R       | LC             |
|               | Large Cuckoo shrike     | *Coricina macei    | R       | LC             |
| Certhiidae    | Bar-tailed Tree-creeper | *Certha himalayana | WV      | LC             |
| Cettiidae     | Chestnut-headed Tesla   | *Tesa castaneocoronata | R       | LC             |
| Charadriidae  | Red-wattled Lapwing     | *Vanellus indicus  | R       | LC             |
|               | River Lapwing           | *Vanellus duvaucelli | R       | NT             |
| Cisticolidae  | Ashy Prinia             | *Prinia socialis   | R       | LC             |
|               | Zitting Cisticola       | *Cisticola juncidis| R       | LC             |
|               | Striated Prinia         | *Prinia cinriner   | R       | LC             |
|               | Common Tailorbird       | *Orthotomus sutorius| R       | LC             |
| Columbidae    | Rock Pigeon             | *Columba livia     | R       | LC             |
|               | Spotted Dove            | *Streptopelia      | R       | LC             |
|               | Emerald Dove            | *Chalcophaps indica| R       | LC             |
|               | Eurasian collared dove  | *Streptopelia      | R       | LC             |
|               | Oriental turtle dove    | *Streptopelia      | R       | LC             |
| Coraciidae    | Indian Roller           | *Coracias          | R       | LC             |
| Corvidaes     | Rufous Treepie          | *Dendrocitta       | R       | LC             |
|               | Common Green Magpie     | *Cissa chinesis    | R       | LC             |
|               | Red-billed Blue Magpie  | *Urocissa           | R       | LC             |
|               | Large-billed Crow       | *Corvus macrorhynchos| R       | LC             |
|               | Grey Treepie            | *Dendrocitta       | R       | LC             |
| Cuculidae     | Greater Coucal          | *Centropus sinensis| R       | LC             |
| Dicuridae     | Black Drongo            | *Dicurus macrocercus| R       | LC             |
|               | Bronzed Drongo          | *Dicurus aeneus    | R       | LC             |
|               | Spangled Drongo         | *Dicurus hotentottus| R       | LC             |
|               | Ashy Drongo             | *Dicurus leucophaeus| WV      | LC             |
| Emberizidae   | Crested Bunting         | *Melophus lathami  | W/S     | LC             |
| Estrididae    | Scaly-breasted Munia    | *Lonchura punctulata| R       | LC             |
| Falconidae    | Collared Falconet       | *Microhierax       | WV      | LC             |
| Halcyonidae   | White-throated Kingfish | *Halcyon smyrnensis| R       | LC             |
| Hirundinidae  | Barn Swallow            | *Hirundo rustica   | WV      | LC             |
| Ibidorhynchida| Ibis Bill               | *Lbidorhyncha struthersil | R       | LC             |
| Lanniidae     | Long-tailed Shrike      | *Lanius Schach     | R       | LC             |
| Leiothrichida | White-crested Laughing Thrush | *Garrulax leucolpus| R       | LC             |
| Laridae       | Pallas’s Gull           | *Ichthyaeus         | WV      | LC             |
|               | Black-headed gull       | *Chroicocephalus    | WV      | LC             |
|               | Brown headed gull       | *Chroicocephalus    | WV      | LC             |
|               | River tern              | *Sturna aurantia   | WV      | NT             |

Table 1. Contd...
| Family         | Species Name                          | Status | Diet     | Habitat    |
|----------------|---------------------------------------|--------|----------|------------|
| Megalaimidae   | *Megalaima haemacephala*              | R      | LC       | Forest     | Frugivorous |
|                | *Megalaima zeylanica*                 | R      | LC       | Forest     | Frugivorous |
|                | *Megalaima asiatica*                  | R      | LC       | Forest     | Frugivorous |
|梅洛皮亚科     | *Merops orientalis*                   | R      | LC       | Forest     | Frugivorous |
|                | *Nyctyornis athertoni*                | R      | LC       | Forest     | Frugivorous |
|                | *Motacilla maderaspatensis*           | R      | LC       | Riverine   | Insectivorous |
|                | *Motacilla flavida*                   | WV     | LC       | Riverine   | Insectivorous |
|                | *Motacilla cinerea*                   | WV     | LC       | Riverine   | Insectivorous |
|                | *Motacilla alba*                      | WV     | LC       | Riverine   | Insectivorous |
|                | *Myophonus caeruleus*                 | R      | LC       | Scrub      | Insectivorous |
|                | *Copsychus malabaricus*               | R      | LC       | Scrub      | Insectivorous |
|                | *Saxicola fulicata*                   | R      | LC       | Scrub      | Insectivorous |
|                | *Chaimarrornis leucocephalus*         | R      | LC       | Riverine   | Insectivorous |
|                | *Rhyacornis fuliginosus*              | R      | LC       | Riverine   | Insectivorous |
|                | *Phoenicurus frontalis*               | WW     | LC       | Riverine   | Insectivorous |
|                | *Copsychus saularis*                  | R      | LC       | Forest     | Insectivorous |
|                | *Saxicol ferrer*                      | R      | LC       | Scrub      | Insectivorous |
|                | *Saxicola caprata*                    | R      | LC       | Scrub      | Insectivorous |
|                | *Luscinia pectoralis*                 | WW     | LC       | Forest     | Insectivorous |
|                | *Niltava sundara*                     | R      | LC       | Forest     | Insectivorous |
|                | *Ficedula strophiata*                 | R      | LC       | Forest     | Insectivorous |
|                | *Monticola Solitarius*                | WW     | LC       | Forest     | Insectivorous |
|                | *Niltava macgrigiorgiae*              | WW     | LC       | Forest     | Insectivorous |
|                | *Ficedula tricolor*                   | W/S    | LC       | Forest     | Insectivorous |
|                | *Nectarinia asiatica*                 | R      | LC       | Scrub      | Nectarivorous |
|                | *Aethopyga sipara*                    | R      | LC       | Scrub      | Nectarivorous |
|                | *Oriolus trilii*                      | R      | LC       | Forest     | Omnivorous   |
|                | *Oriolus xanthornus*                  | R      | LC       | Forest     | Omnivorous   |
|                | *Parus major*                         | R      | LC       | Forest     | Insectivorous |
|                | *Passer domesticus*                   | R      | LC       | Human habitation | Granivorous |
|                | *Pellorneum Ruficeps*                 | R      | LC       | Forest     | Insectivorous |
|                | *Phalacrocorax niger*                 | R      | LC       | Wetland    | Carnivorous  |
|                | *Phalacrocorax carbo*                 | R      | LC       | Wetland    | Carnivorous  |
|                | *Franolinus pondicerianus*            | R      | LC       | Forest     | Omnivorous   |
|                | *Gallus gallus*                       | R      | LC       | Forest     | Omnivorous   |
|                | *Lophura leucomeleas*                 | R      | LC       | Forest     | Omnivorous   |
|                | *Pavo cristatus*                      | R      | LC       | Forest     | Omnivorous   |
|                | *Seicercus xanthochistos*             | R      | LC       | Forest     | Omnivorous   |
|                | *Phylloscopus humei*                  | WW     | LC       | Forest     | Insectivorous |
|                | *Seicercus burkii*                    | R      | LC       | Forest     | Insectivorous |
|                | *Picus canus*                         | R      | LC       | Forest     | Insectivorous |
|                | *Chrysocolaptes lucidus*              | R      | LC       | Forest     | Insectivorous |
|                | *Picus flavinucha*                    | R      | LC       | Forest     | Insectivorous |
|                | *Dinopium benghalense*                | R      | LC       | Forest     | Insectivorous |
|                | *Dendrocopos canicapillus*            | R      | LC       | Forest     | Insectivorous |
|                | *Picus xanthopygaeus*                 | R      | LC       | Forest     | Insectivorous |
| Order               | Family          | Genus              | Species              | Code | Status | Habitat | Diet          |
|---------------------|----------------|--------------------|----------------------|------|--------|----------|---------------|
| Psittaculidae       | Rose-ringed Parakeet | Psittacula krameri | R                   | LC   | Forest | Frugivorous |               |
|                     | Plum-headed Parakeet | Psittacula cyanoecephala | R             | LC   | Forest | Frugivorous |               |
|                     | Alexandrine Parakeet | Psittacula eupatria | R                   | NT   | Forest | Frugivorous |               |
|                     | Slaty headed Parakeet | Psittacula himalayana | R              | LC   | Forest | Frugivorous |               |
| Pycnonotidae        | Ashy Bulbul       | Hemixos flavula    | R                   | LC   | Forest | Frugivorous |               |
|                     | Himalayan Bulbul  | Pycnonotus leucogenys | R               | LC   | Forest | Frugivorous |               |
|                     | Red-vented Bulbul | Pycnonotus cafer    | R                   | LC   | Forest | Frugivorous |               |
|                     | Black-crested Bulbul | Pycnonotus melaniicterus | R      | LC   | Forest | Frugivorous |               |
|                     | Red-whiskered Bulbul | Pycnonotus jocosus  | R                   | LC   | Scrub  | Frugivorous |               |
| Rallidae            | White-breasted Waterhen | Amaurornis phoenicurus | R          | LC   | Forest | Omnivorous |               |
| Rhipiduridae        | White-browed Fantail | Rhipidura aureola  | R                   | LC   | Forest | Insectivorous |               |
|                     | White-throated Fantail | Rhipidura albicollis | R              | LC   | Forest | Insectivorous |               |
| Saxicolinae         | Brown rockchat    | Cercomela fusca    | R                   | LC   | Forest | Insectivorous |               |
| Scolopacidae        | Common Sandpiper  | Actitis hypoleucus | WV                 | LC   | Riverine | Insectivorous |               |
| Sittidae            | Chestnut-bellied Nuthatch | Sitta castanea     | R                   | LC   | Forest | Insectivorous |               |
|                     | Velvet-fronted Nuthatch | Sitta frontalis   | R                   | LC   | Forest | Insectivorous |               |
|                     | White-tailed Nuthatch | Sitta leucalis    | R                   | LC   | Forest | Insectivorous |               |
| Stenostiridae       | Grey-headed Canary Flycatcher | Culicicapa ceylonensis | WV          | LC   | Forest | Insectivorous |               |
|                     | Yellow-bellied Fantail | Rhipidura hypoxantha | WV          | LC   | Forest | Insectivorous |               |
| Strigidae           | Brown Fish Owl    | Ketupa zeylonensis | R                   | LC   | Forest | Carnivorous |               |
|                     | Spotted Owlet     | Athene brama       | R                   | LC   | Forest | Carnivorous |               |
|                     | Jungle Owlet      | Glaucidium radiatum | R              | LC   | Forest | Carnivorous |               |
| Sturnidae           | Common Myna       | Acridotheres tristis | R             | LC   | Human habitation | Granivorous |               |
|                     | Bank myna         | Acridotheres ginniganus | R        | LC   | Human habitation | Granivorous |               |
|                     | Asian Pied Starling | Sturnus ginniganus  | R                   | LC   | Human habitation | Granivorous |               |
| Tephrodornithidae   | Bar-winged Flycatcher-shrike | Hemipus picatus | R              | LC   | Forest | Insectivorous |               |
| Threskiornithidae   | Red-naped ibis    | Pseudibis papillosa | R                   | LC   | Agriculture | Insectivorous |               |
| Tichodromadidae     | Wall Creeper      | Tichodroma muraria | WV                 | LC   | Forest | Insectivorous |               |
| Timaliidae          | Black-chinned Babbler | Stachyris pyrrhops | R                   | LC   | Forest | Insectivorous |               |
| Upupidae            | Common Hoopoe     | Upupa epops        | R                   | LC   | Forest | Insectivorous |               |
| Zosteropidae        | Oriental White-eye | Zosterops palpebrosus | R            | LC   | Forest | Insectivorous |               |
Avian community structure as per habitat

The aquatic habitat adjoined with forest, shrub, and agricultural patches attracts more numbers of avian species due to good sources of food and nesting shelters (Singh et al., 2019). During this study period, we were able to make observations in different habitats (Figure 2-4). We tried to understand the habitat structure of avifauna in this particular area. Out of 146 species, 95 species were recorded in forest habitat, 22 species were recorded in wetland areas, and 12 species were recorded in riverine areas, 10 species were recorded in scrub type’s habitat. We also observed 3 species in and around the agricultural land. Some avian species prefer to stay around the human habitation. We also recorded the four species around human habitation (Figure 5). Maximum numbers of forest birds were recorded to indicate the rich diversity of the forest in this area. Some of the photographs of bird species observed at study sites are given in Figure 6. Thus, we found that the biodiversity of birds was significantly affected by the type of habitat as revealed from our findings. Also, Tanveer et al. (2019) found that aquatic habitats having high nourishment resources may support the higher bird diversity in particular areas.

Figure 2. Migratory and Resident avian species recorded during the study period.

Figure 3. Family-wise diversity of birds recorded during the study period.

Figure 4. Avian community structure as per different feeding Habitat of the study area.

Figure 5. Avifauna diversity classified based on different habitats of the study area.
Conclusion

From the findings of this study, we concluded that nearly 146 avian species were recorded in only two months, indicating high avian diversity in the study area. We recorded the maximum number of insectivorous avian species as a sign of the rich insect diversity in particular areas. We found the maximum number of forest birds to indicate the wide variety of forests found in particular areas. The presence of four near threatened (NT) and one critically endangered species makes it a vital area for biological diversity conservation. Thus, the findings of this study suggest implementing effective measures for conserving the residing bird species in the affected areas.

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