Assessment of Avifaunal Diversity and Threats to them in Phewa Wetland, Nepal

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Abstract: We assessed species diversity and relative abundance during February - March by employing transect method in four line transects and 30 point count stations, and associated threats by direct observations and consultation with people (n= 1) living in vicinity of Phewa wetland. We counted 2651 bird individuals of 148 species belonging to 104 Genera of 44 Families under 11 Orders. Anatidae and Passeriformes with 11% and 39%, respectively were the dominant family and order among the recorded species. Out of these, seven bird species were globally threatened and 12 were nationally threatened. Terrestrial birds had higher species diversity (H’= 3.27), species richness (R= 11.98) and species evenness (e= 0.74) as compared to wetland birds (H’ = 3.07, R= 8.44 and e = 0.73). Common pigeon (7.50%) was the most abundant bird followed by lesser whistling duck (6.98%). People in the vicinity of Phewa wetland reported that water pollution caused by domestic sewages and waste water disposal was the major threat to birds and their habitat. Phewa wetland is providing crucial habitat to adequate residential and migratory bird species for which it should be protected for further enhancement of number of avian species.

Key words: Relative abundance, species diversity, terrestrial bird, wetland bird, globally and nationally threatened species

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Introduction

Wetlands, being the transition phase between terrestrial and aquatic habitats, are rich source of biological diversity. They have diverse utilitarian value for different living organisms; however, birds use wetlands basically for breeding, nesting and feeding purposes (Mutagwaba 2010; Parchizadeh, Williams 2018). These wetland birds play vital role in aquatic ecosystem by acting as predators, pollinators and bio-indicators of ecological condition of water bodies (Green, Elmberg 2014).

Among 886 bird species recorded from Nepal (DNPWC, BCN 2018); 40 are globally threatened, 19 are near threatened (IUCN 2018) and 200 are wetland dependent (Baral 2009). The wetlands of Nepal support a total of 40 (27%) of nationally threatened bird species. At present, 10 globally significant wetlands with the total area of 60,561 ha have been declared as Ramsar Sites of international significance as they support large number of residential and migratory birds. Lake cluster of Pokhara Valley, the largest Ramsar site with nine lakes and area of 262 km² within the Chitwan-Annapurna Landscape, harbors 128 species of vertebrates that include 32 species of mammals (18 Families), 140 birds (37 Families), 24 reptiles, 27 fishes and 11 amphibians (Tamrakar 2008). Phewa, the largest in this cluster and second largest in the country provides home for 104 bird species (43 water birds and 14 migratory species) (MOFE 2018). Gautam and Kafle (2007) in an annual survey from August 2003 to July 2004 recorded a total of 43 species of water birds of 14 families. Furthermore, Giri and Chalise (2008) studied seasonal diversity and population status of water birds from 2007 to 2008, and recorded a total of 39 species belonging to 17 families.

Nepal’s wetlands are facing tremendous anthropogenic pressure (IUCN 2004), which includes industrial pollution, intensification of agriculture, land encroachment, deforestation, over-fishing, eutrophication, sedimentation, siltation, soil erosion, pollution and diminution because of which they are degrading rapidly and hazardously (Baral, Inskipp 2005; Giri, Chalise 2008; Acharya, Rajbhandari 2012). All of these disturbances threaten wetland ecosystems, and can greatly influence the population structure and diversity of the bird community supported by that ecosystem (Birdlife International, Corsby 2003). The loss of wetland communities leads to loss of plant diversity, reduction in primary production and consequently loss of faunal diversity of wetland ecosystem due to loss of habitat, food, decreased aeration of sediments and increased nutrient levels (Epaphras et al. 2007; Armstrong et al. 2008). A comparative analysis of the four National Red Data Lists from 1996 to 2010 of the critically endangered (CR) birds and their dependency in the habitat reveals that 28 species listed under this category are wetland dependent species which
implies 35% of total wetland bird species in Nepal are considered threatened, far more than other habitat types (Baral et al. 2012).

Phewa wetland is also facing extreme anthropogenic pressure especially siltation and sedimentation. Consequently, the feeding and nesting sites of bird species are gradually modified affecting their survival in this wetland. Therefore, a thorough study is essential to analyze the status of avifaunal diversity in current habitat condition and to update the existing checklist provided by Gautam and Kafle (2007). Hence, we conducted this study with the aim to document species composition and relative abundance of bird fauna, and to identify threats faced by them in Phewa wetland. Additionally, this baseline information on bird diversity will provide starting point to bird scientists to track changes in population of particular bird species.

**Materials and Methods**

**Study Area**

Phewa, the largest lake of lake-cluster of Pokhara valley and the second largest lake of Nepal, is a semi-natural freshwater lake. It is located at an altitude of 784 m in Pokhara metropolitan city, Gandaki province of Nepal, and its water surface occupies an area of 4.33 km² (Figure 1). As per the feasibility study, a total of 5.9 km² of Phewa wetland area was taken. The lake area provides home to several important species including globally threatened migratory birds, such as critically endangered Baer's pochard (*Aythya baeri*) and Indian griffon (*Gyps indicus*) and threatened mammals such as clouded leopard (*Neofelis nebulosa*), common leopard (*Panthera pardus fusca*) and Indian pangolin (*Manis crassicaudata*) (MOFE 2018). The vegetation in the area is a mosaic of sub-tropical and temperate broad-leaved forests, including *Sal* (*Shorea robusta*) in the south, riparian forests (*Acacia catechu* and *Dalbergia sisoo*) along the banks of Seti river and its tributaries, and *Schima-Castanopsis* forests in the north and west. Sedimentation due to heavy loads of sediments during and after road construction and debris flow from Harpan and Andheri khola (streams) have resulted in decrease in core water area of Phewa lake at 4% over the past 20 years (MOFE 2018) whereas forest, grassland, shrub land and urbanization have been increasing (Dixit et al. 2015). The main drivers of degradation include conversion of watershed and lake reservation lands into private land including agricultural land, haphazard building and road construction, reclamation of lake area and encroachment, sedimentation and siltation, pollution and eutrophication, spread of alien invasive species such as water hyacinth (*Eichhornia crassipes*), overharvesting of fish and illegal poaching (MOFE 2018).
Methods

Data Collection

Bird Survey

By dividing the study area into two strata as water surface and sedimentation area, absolute count of birds was made following Gregory et al. (2004) and Ralph et al. (1995) along four line transects and 30 point count stations in respective strata. Species were recorded along with their numbers during two months between 07.00 and 10.00 AM since peak activities of birds lasts 1-2 hours after sunrise. The birds were then identified at species level with a popular guide, Helm Field Guide "Birds of Nepal" (Nepali version) (Grimmett et al. 2003) and whenever possible, photographs were taken and calls also recorded to aid in identification process. Field observations were not carried out during adverse environment condition.

Household survey

Considering households within 1 km from the edge of lake to be well knowledgeable about status of the lake and birds, altogether 91 respondents comprising farmers, boaters, hoteliers and elites were interviewed with semi-structured questionnaire in order to collect information regarding status of bird fauna and their habitat as well as natural and anthropogenic threats to wetland and their habitat.
Data analysis

BirdLife International, Crosby (2017) was followed for nomenclature and classification of recorded bird species. IUCN Red List Series (2018) and Inskipp et al. (2016) were followed to assess the global and national conservation status of species. The relative abundance of each observed species was determined in percentage by dividing numbers of individuals of particular recorded species by total number of individuals of recorded species. Following Khan (2005), abundance status of the species was assessed as very common, common, uncommon and rare based on their respective observation rates of 75–100%, 50–74%, 25–49% and <25%. The species diversity was determined using diversity indices:

Shannon – Wiener Diversity Index (1949): \( H' = - \sum \frac{n_i}{N} \ln \frac{n_i}{n} \)

i. Margalef’s Richness Index (Margalef 1958): \( R = \frac{S-1}{\ln N} \)

ii. Pielou’s Evenness Index (Pielou 1966): \( E = \frac{H'}{\ln S} \)

Where, \( n_i = \) species abundance, \( N = \) total abundance, \( s = \) total number of species and \( \ln = \) logarithm to base e.

Threats identified through direct observation and household survey, were ranked statistically and most promising threat was identified using the weighted mean.

Results and Discussion

Species Composition

This study revealed 2651 bird individuals of 148 species belonging to 103 genera and spread over 44 families of 11 orders (Annex 1). Out of the total recorded bird species, 63 (57%) were wetland-dependent birds and 85 (43%) terrestrial birds, which depict that the wetland is highly important habitat supporting diverse bird species to perform multiple activities, such as foraging, breeding, loafing and roosting. Some species, such as river lapwing (Vanellus duvaucelii), short eared owl (Asio flammeu) and greater scaup (Greater Scaup) were sighted for the first time in this wetland (Ghimire 2018 pers.comm.). Gautam and Kafle (2007) had recorded a total of 43 species of waterbirds of 14 families from August 2003 to July 2004 and Giri and Chalise (2008) recorded 39 species of water birds of 17 families from 2007 to 2008. This variation in total number of recorded bird species may be due to the season of study as our study was carried out during transition period between winter and summer and with focus on overall composition of avifaunal species.
Among families, Anatidae emerged as the dominant family (11%) followed by Accipitridae (8%), Ardeidae (5%) and so on (Figure 2). Similarly, Passeriformes was the most dominant order with 57 (39%) species of 21 families followed by Falconiformes (Figure 3). In contrast, Giri and Chalise (2008) had recorded Ciconiiformes as the dominant order with 18 species in their one-year survey of water birds while our study recorded only 12 species of order Ciconiiformes. This discrepancy may be the result of habitat modification as recent studies suggest that siltation and sedimentation are gradually reducing effective depth and surface area of Phewa Lake (Heyojoo, Takhachhe 2014; MOFE 2018). Water level is a major factor that directly or indirectly influences waterbird species composition and relative abundance in the wetland (Rajpar and Zakaria 2011).

Of the total recorded species, 78 were resident followed by winter migrant with 70 species (Figure 4). In addition, the abundance category showed that of 148 bird species, 63 species were Rare, 46 species Uncommon, 18 species Common and 21 species Very common (Figure 5).
Conservation Status of Recorded Bird Fauna

Of the recorded species, seven were globally threatened, viz. common pochard (*Aythya ferina*) Asian wollyneck stork (*Ciconia episcopus*), Egyptian vulture (*Neophron percnopterus*), steppe eagle (*Aquila nipalensis*), white-rumped vulture (*Gyps bengalensis*), slender-billed vulture (*Gyps tenuirostris*) and yellow breasted bunting (*Emberiza aureola*), and 12 were nationally threatened, viz. ferruginous duck (*Aythya nyroca*), black stork (*Ciconia nigra*), Egyptian vulture (*Neophron percnopterus*), Himalayan vulture (*Gyps himalayensis*), short-eared owl (*Asio flammeus*), steppe eagle (*Aquila nipalensis*), great bittern (*Botaurus sterllis*), northern pintail (*Anas acuta*), cinereous vulture (*Aegypius monachus*), white-rumped vulture (*Gyps bengalensis*), slender-billed vulture (*Gyps tenuirostris*) and yellow breasted bunting (*Gyps bengalensis*). In addition, black stork (*Ciconia nigra*), the protected species by NPWC Act (1973) of Nepal, listed in Schedule I was also recorded.

Species Diversity

The overall Shannon Wiener Diversity Index (H'), Margalef's Richness Index (R) and Pielou's Evenness Index (e) were 3.83, 18.64 and 0.77, respectively. Terrestrial birds had the highest Shannon Wiener Diversity Index (H'= 3.27), Margalef's Richness Index (R= 11.98) and Pielou's Evenness Index (e= 0.74) compared to wetland birds (Table 1). This means that terrestrial birds have higher species richness, and are also, evenly distributed than water birds. Similar results have been recorded by Rajpar and Zakaria (2010) at Paya Indah Wetland Reserve, Malaysia and Zakaria, Rajpur (2013) in Man-made marsh, Malaysia. Such dominancy of terrestrial birds over wetland birds seems normal as terrestrial birds being generalists can use all available habitats within the wetland. In addition, the lake is providing diverse habitat such as swamp, dry land, open water body, patches of shrubs and forest edge and abundant food resources, such as insects, grains and safe roosting and breeding sites.

Table 1 : Comparison of Bird Diversity Indices between Terrestrial Birds and Wetland Birds

| Indices                                | Terrestrial bird | Wetland bird | Overall |
|----------------------------------------|------------------|--------------|---------|
| Diversity Indices: Shannon's Index (H')| 3.27             | 3.077        | 3.83    |
| Richness Indices: Margalef's Index (S) | 11.98            | 8.44         | 18.64   |
| Evenness Indices: Pielou's Index (e)   | 0.74             | 0.73         | 0.77    |

Relative Abundance

The maximum relative abundance was recorded for common pigeon (7.50%) followed by lesser whistling duck (6.98%). Common pigeon was abundant among terrestrial birds, and they were found in wetland areas and human
settlements exhibiting foraging, loafing and breeding activities. Besides, lesser whistling duck was the most abundant among the recorded water birds. It is because ducks prefer deep open water bodies rich in submerged vegetation for foraging and loafing (Rajpar and Zakaria 2011), and similar habitat condition is prevalent in sedimentation part of Phewa wetland. Comparison of relative abundance of abundant terrestrial birds and wetland birds is presented in Table 2.

### Table 2: Comparison of Relative Abundance of Top Five Abundant Terrestrial Birds and Wetland Birds

| Species              | Wetland Bird RA | Species | Terrestrial Bird RA | Species          | Overall RA |
|----------------------|-----------------|---------|---------------------|------------------|------------|
| Lesser- whistling duck| 12.03           | Common pigeon | 17.86               | Common pigeon   | 7.50       |
| Great cormorant      | 11.82           | Black kite  | 13.57               | Lesser-whistling duck | 6.98     |
| Common teal          | 10.76           | House crow  | 9.19                | Great cormorant | 6.86       |
| Purple swamp hen     | 10.71           | Barn swallow | 6.83                | Common teal     | 6.24       |
| Cattle egret         | 7.53            | House sparrow | 5.03                | Purple swamp hen | 6.21       |

### Threats to Bird Fauna and their Habitat

Pollution due to domestic sewages and waste water disposal, habitat destruction due to road construction, disturbances to the birds due to recreational activities including boating, fishing, and paragliding as well as anthropogenic activities, namely, cattle grazing, removal of vegetation, logging, and colonization of lake by water hyacinth were the threats directly observed during the field visits. These threats were also highlighted by Gautam, Kafle (2007) in Phewa wetland, and similar threats are present in other lakes of lake-cluster of Pokhara valley (MOFE 2018). Majority of respondents reported water pollution as the major threats for avifauna and their habitat (Table 3).

### Table 3: Rating of Threats to Bird Fauna and their Habitat

| Threats                       | Rate / % Respondents | Weighted mean |
|-------------------------------|----------------------|---------------|
|                               | 1       | 2     | 3     | 4       | 5     |               |
| Water pollution               | Very high | High | Medium | Low     | Very low | 2.7             |
| Infrastructural development   | 24.8     | 22    | 20.8   | 23.2    | 9.2     | 2.7             |
| Invasive species              | 21.2     | 24    | 20     | 15.6    | 19.2    | 2.87            |
| Habitat destructive activities| 16       | 20.8  | 29.6   | 20      | 13.6    | 2.94            |
| Recreational activities       | 18.4     | 23.2  | 16     | 19.2    | 23.2    | 2.99            |
Conclusion

This study recorded 2651 bird individuals of 148 species belonging to 104 Genera, 44 Families and 11 Orders. The dominant family was Anatidae and dominant order was Passeriformes. Resident birds emerged as the most predominant with 78 species followed by the winter migrant with 70 species. Of 148 species, seven species were globally threatened and 12 species nationally threatened. Common pigeon was the most abundant bird followed by lesser-whistling duck. As per the abundance status, 63 species were rare, 46 species uncommon, 18 species common and 21 species very common. People reported pollution as a major threat followed by infrastructural development, colonization of invasive species, anthropogenic activities and recreational activities. It is concluded that the area has good potential for bird watching tourism that can integrate economic gain with biodiversity conservation. In this regard, concerned authority need to educate wetland land owners on importance and ecological role of birds in the wetland habitat. Species specific conservation plans and policies of highly threatened species should be prepared and implemented by the local government. In addition, regular monitoring of bird species should be done in and around the wetland areas to assess their status in the corresponding habitat.

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# ANNEX 1

## List of Birds Found in the Study Area

| S.N | Species                  | Scientific name     | Family      | Order    | BT | MS | NCS | IS  | RA  |
|-----|--------------------------|---------------------|-------------|----------|----|----|-----|-----|-----|
| 1   | Lesser whistling-duck    | *Dendrocygna javanica* | Anatidae    | Anseriformes | WB | R  | LC  | LC  | 7   |
| 2   | Greater white-            | *Anser albifrons*   | Anatidae    | Anseriformes | WB | V  | V   | LC  | 0.15|
|     | fonted goose             |                     |             |           |    |    |     |     |     |
| 3   | Ruddy shelduck           | *Tadorna ferruginea* | Anatidae    | Anseriformes | WB | W  | NT  | LC  | 1.34|
| 4   | Gadwall                  | *Anas strepera*     | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 0.7 |
| 5   | Eurasian pigeon          | *Anas penelope*     | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 0.23|
| 6   | Mallard                  | *Anas platyrhynchos* | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 4.07|
| 7   | Northern shoveler        | *Anas clypeata*     | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 0.06|
| 8   | Northern pintail         | *Anas acuta*        | Anatidae    | Anseriformes | WB | W  | EN  | LC  | 0.18|
| 9   | Common teal              | *Anas crecca*       | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 6.28|
| 10  | Red-crested pochard      | *Netta rufina*      | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 0.03|
| 11  | Common pochard           | *Aythya ferina*     | Anatidae    | Anseriformes | WB | W  | NT  | VU  | 0.15|
| 12  | Ferruginous duck         | *Aythya nyroca*     | Anatidae    | Anseriformes | WB | W  | VU  | NT  | 0.09|
| 13  | Tufted duck              | *Aythya fuligula*   | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 1.43|
| 14  | Goosander                | *Mergus merganser*  | Anatidae    | Anseriformes | WB | W  | LC  | LC  | 0.04|
| 15  | Greater scaup            | *Aythya marila*     | Anatidae    | Anseriformes | WB | V  | V   | LC  | 0.22|
| 16  | Bean goose               | *Anser fabalis*     | Anatidae    | Anseriformes | WB | V  | V   | LC  | 0.03|
| 17  | Bar-headed goose         | *Anser indicus*     | Anatidae    | Anseriformes | WB | V  | NT  | LC  | 0.34|
| 18  | Little grebe             | *Tachybaptus ruficollis* | Podicipedidae | Anseriformes | WB | W  | LC  | LC  | 0.37|
| 19  | Great crested grebe      | *Podiceps cristatus* | Podicipedidae | Anseriformes | WB | W  | LC  | LC  | 0.14|
| 20  | Black-necked grebe       | *Podiceps nigricollis* | Podicipedidae | Anseriformes | WB | W  | LC  | LC  | 0.04|
| 21  | Asian wollyneck stork    | *Ciconia episcopus* | Ciconiidae  | Ciconiiformes | WB | W  | NT  | VU  | 0.31|
| 22  | Black stork              | *Ciconia nigra*     | Ciconiidae  | Ciconiiformes | WB | W  | VU  | LC  | 0.34|
| 23  | Black-crowned night heron| *Nycticorax nycticorax* | Ardeidae | Ciconiiformes | WB | R  | LC  | LC  | 1.37|
| 24  | Indian pond heron        | *Ardea grayii*      | Ardeidae    | Ciconiiformes | WB | R  | LC  | LC  | 0.71|
| 25  | Grey heron               | *Ardea cinerea*     | Ardeidae    | Ciconiiformes | WB | W  | LC  | LC  | 0.5 |
| 26  | Cattle egret             | *Bubulcus ibis*     | Ardeidae    | Ciconiiformes | WB | R  | LC  | LC  | 4.4 |
| 27  | Great egret              | *Casmerodius albus* | Ardeidae    | Ciconiiformes | WB | W  | LC  | LC  | 0.18|
| 28  | Intermediate egret       | *Mesophoyx intermedia* | Ardeidae | Ciconiiformes | WB | R  | LC  | LC  | 2.07|
| 29  | Little egret             | *Egretta garzetta*  | Ardeidae    | Ciconiiformes | WB | R  | LC  | LC  | 3.2 |
| No. | Species                          | Family     | Order      | IUCN Status | Population |
|-----|---------------------------------|------------|------------|-------------|------------|
| 30  | Great bittern                   | Ardeidae   | Ciconiiformes | WB P      | EN LC 0.04 |
| 31  | Great cormorant                 | Phalacrocoracidae | Ciconiiformes | WB W      | NT LC 6.9  |
| 32  | Little cormorant                | Phalacrocoracidae | Ciconiiformes | WB W      | NT LC 0.29 |
| 33  | Common kestrel                  | Falcondae  | Falconiformes | TB R      | LC LC 0.06 |
| 34  | Black kite                      | Accipitridae | Falconiformes | TB R      | LC LC 5.7  |
| 35  | Osprey                          | Accipitridae | Falconiformes | TB W      | LC LC 0.28 |
| 36  | Egyptian vulture                | Accipitridae | Falconiformes | TB R      | VU EN 0.25 |
| 37  | White-rumped vulture            | Accipitridae | Falconiformes | TB R      | CR CR 0.12 |
| 38  | Slender-billed vulture          | Accipitridae | Falconiformes | TB R      | CR CR 0.04 |
| 39  | Himalayan vulture               | Accipitridae | Falconiformes | TB W      | VU NT 0.3  |
| 40  | Griffon vulture                 | Accipitridae | Falconiformes | TB P      | DD LC 0.03 |
| 41  | Cinereous vulture               | Accipitridae | Falconiformes | TB W      | EN NT 0.05 |
| 42  | Himalayan buzzard               | Accipitridae | Falconiformes | TB W      | DD LC 0.04 |
| 43  | Steppe eagle                    | Aquila nipalensis | Falconiformes | TB W      | VU EN 0.09 |
| 44  | Shikra                          | Accipitridae | Falconiformes | TB P      | LC LC 0.07 |
| 45  | Booted eagle                    | Accipitridae | Falconiformes | TB P      | LC LC 0.04 |
| 46  | White-breasted waterhen         | Rallidae   | Falconiformes | TB R      | LC LC 0.35 |
| 47  | Purple swamp hen                | Rallidae   | Falconiformes | WB R      | LC LC 6.23 |
| 48  | Common moorhen                  | Gallicrex chloropus | Rallidae | Falconiformes | WB R      | LC LC 0.41 |
| 49  | Eurasian coot                   | Fulicidae  | Falconiformes | WB R      | LC LC 1.55 |
| 50  | Common crane                    | Gruidae    | Falconiformes | WB W      | NT LC 0.04 |
| 51  | Jack snipe                      | Lymnocryptes minimus | Scolopacidae | Falconiformes | WB W      | LC LC 0.14 |
| 52  | Pin-tailed snipe                | Gallinago stenura | Scolopacidae | Falconiformes | WB W      | LC LC 0.09 |
| 53  | Common snipe                    | Gallinago gallinago | Scolopacidae | Falconiformes | WB W      | LC LC 0.21 |
| 54  | Green sandpiper                 | Tringa ochropus | Scolopacidae | Falconiformes | WB W      | LC LC 0.08 |
| 55  | Common sandpiper                | Actitis hypoleucus | Scolopacidae | Falconiformes | WB W      | LC LC 0.08 |
| 56  | Common greenshank               | Tringa nebularia | Scolopacidae | Falconiformes | WB W      | LC LC 0.04 |
| 57  | Bronzed-winged jacana           | Metopidius indicus | Jacanidae | Charadriiformes | WB R      | LC LC 0.32 |
| 58  | River lapwing                   | Vanellus duvaucellii | Charadriidae | Charadriiformes | WB W      | NT NT 0.04 |
| 59  | Grey-headed lapwing             | Vanellus cinereus | Charadriidae | Charadriiformes | WB W      | LC LC 0.2  |
| 60  | Red-wattled lapwing             | Vanellus indicus | Charadriidae | Charadriiformes | WB R      | LC LC 0.3  |
| 61  | Little-ringed plover            | Charadrius dubius | Charadriidae | Charadriiformes | WB W      | LC LC 0.14 |
| No. | Species Name                          | Scientific Name                          | Family                      | Order               | Status   | IUCN    | IUCN    | IUCN    | IUCN    | IUCN    |
|-----|---------------------------------------|------------------------------------------|-----------------------------|---------------------|----------|---------|---------|---------|---------|---------|
| 62  | Greater painted-snipe                 | *Rostratula benghalensis*                | Rostratulidae               | Charadriiformes     | WB       | R       | LC      | LC      | 0.04    |
| 63  | Pallas's gull                         | *Ichthyaeus ichthyaeus*                  | Laridae                    | Charadriiformes     | WB       | P       | LC      | NA      | 0.04    |
| 64  | Steppe gull                           | *Larus barabensis*                       | Laridae                    | Charadriiformes     | WB       | P       | LC      | NA      | 0.04    |
| 65  | Whiskered tern                        | *Chlidonias hybridus*                    | Laridae                    | Charadriiformes     | WB       | P       | LC      | LC      | 0.07    |
| 66  | Common pigeon                         | *Columba livia*                          | Columbidae                 | Columbiformes       | WB       | R       | LC      | LC      | 7.56    |
| 67  | Oriental turtle dove                  | *Streptopelia orientalis*                | Columbidae                 | Columbiformes       | TB       | W       | LC      | LC      | 0.21    |
| 68  | Spotted dove                          | *Stigmatopelia chinensis*                | Columbidae                 | Columbiformes       | TB       | R       | LC      | NA      | 0.21    |
| 69  | Rose-ringed parakeet                  | *Psittacula krameri*                     | Psittacidae                | Psittaciformes      | TB       | R       | LC      | LC      | 0.63    |
| 70  | Slaty-headed parakeet                 | *Psitacula himalayana*                   | Psittacidae                | Psittaciformes      | TB       | W       | LC      | LC      | 0.27    |
| 71  | Alexandrine parakeet                  | *Psittacula eupatria*                    | Psittacidae                | Psittaciformes      | TB       | R       | NT      | NT      | 0.04    |
| 72  | Asian Koel                            | *Eudynas scolopaceus*                    | Cuculidae                  | Cuculiformes        | TB       | R       | LC      | NA      | 0.02    |
| 73  | Green-billed malkoha                  | *Phaenicophaeus tritis*                  | Cuculidae                  | Cuculiformes        | TB       | R       | LC      | LC      | 0.09    |
| 74  | Common hawk cuckoo                    | *Hierococcyx varius*                     | Cuculidae                  | Cuculiformes        | TB       | R       | LC      | LC      | 0.04    |
| 75  | Greater coucal                        | *Centropus sinensis*                     | Centropodidae              | Cuculiformes        | TB       | R       | LC      | LC      | 0.09    |
| 76  | Short-eared owl                       | *Asio flammeus*                          | Strigidae                  | Cuculiformes        | TB       | P       | VU      | LC      | 0.04    |
| 77  | Spotted owlet                         | *Athene brama*                           | Strigidae                  | Cuculiformes        | TB       | R       | LC      | LC      | 0.18    |
| 78  | Asian barred owlet                    | *Glaucidium cuculoides*                  | Strigidae                  | Strigiformes        | TB       | R       | LC      | LC      | 0.05    |
| 79  | Himalayan swiftlet                    | *Collocalia brevirostris*                | Apodidae                   | Apodiformes         | TB       | R       | LC      | LC      | 0.05    |
| 80  | Alpine swift                          | *Tachymarptis melba*                     | Apodidae                   | Apodiformes         | TB       | R       | LC      | LC      | 0.15    |
| 81  | House swift                           | *Apus affinis*                           | Apodidae                   | Apodiformes         | TB       | R       | LC      | LC      | 0.33    |
| 82  | White-throated kingfish               | *Halcyon smyrnensis*                     | Alcedinidae                | Apodiformes         | WB       | R       | LC      | LC      | 0.55    |
| 83  | Common kingfish                       | *Alcedo atthis*                          | Alcedinidae                | Apodiformes         | WB       | R       | LC      | LC      | 0.08    |
| 84  | Blue-throated barbet                  | *Megalaima asiatica*                     | Megalaimidae               | Piciformes          | TB       | R       | LC      | LC      | 0.28    |
| 85  | Great barbet                          | *Megalaima virens*                       | Megalaimidae               | Piciformes          | TB       | R       | LC      | LC      | 0.28    |
| 86  | Coppersmith barbet                    | *Megalaima haemacephala*                 | Megalaimidae               | Piciformes          | TB       | R       | LC      | LC      | 0.19    |
| 87  | Fulvous-breasted woodpecker           | *Dendrocopos macei*                      | Picidae                    | Piciformes          | TB       | R       | LC      | LC      | 0.03    |
| 88  | Lesser yellownape                     | *Picus chlorolophus*                     | Picidae                    | Piciformes          | TB       | R       | LC      | LC      | 0.04    |
| 89  | Greater yellownape                    | *Picus flavinucha*                       | Picidae                    | Piciformes          | TB       | R       | LC      | LC      | 0.03    |
| 90  | Grey-headed woodpecker                | *Picus canus*                            | Picidae                    | Piciformes          | TB       | R       | LC      | LC      | 0.02    |
| 91  | Greater flameback                     | *Chrysocolaptes guttacristatus*          | Picidae                    | Piciformes          | TB       | R       | LC      | LC      | 0.02    |
### Assessment of Avifaunal Diversity and...  

| No. | Species Name          | Scientific Name                  | Order | Class   | TB  | RC    | LC    | KR   | Status   | 0.06 |
|-----|-----------------------|----------------------------------|-------|---------|-----|-------|-------|------|----------|------|
| 92  | Long-tailed Minivet   | Pericrocotus ethologus            | Campephagidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.06 |
| 93  | Large cuckoo shrike   | Coracina macei                   | Campephagidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.07 |
| 94  | Long-tailed shrike    | Lanius schach                    | Laniidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.21 |
| 95  | Grey-backed shrike    | Lanius tephronotus               | Laniidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.02 |
| 96  | Bronzed drongo        | Dicrurus aeneus                  | Dicuridae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.03 |
| 97  | Black drongo          | Dicrurus macrocercus             | Dicuridae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.37 |
| 98  | Spangled drongo       | Dicrurus hottentottus            | Dicuridae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.31 |
| 99  | Yellow-bellied fantail| Rhipidura hypoxantha             | Corvidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.04 |
| 100 | Maroon oriole         | Oriolus traillii                 | Oriolidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.04 |
| 101 | Red-billed blue magpie| Urocissa erythroryncha          | Corvidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.28 |
| 102 | Grey treepie          | Dendrocitta formosae             | Corvidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.28 |
| 103 | House crow            | Corvus splendens                 | Corvidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 3.88 |
| 104 | Large-billed crow     | Corvus macrorrhynchos            | Corvidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 1.41 |
| 105 | Rufous treepie        | Dendrocitta vagabunda            | Corvidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.11 |
| 106 | Black-vented tit      | Machlolophus xanthogenys         | Paridae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.12 |
| 107 | Great tit             | Parus major                      | Paridae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.26 |
| 108 | Plain martin          | Riparia chinensis                | Hirundinidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.79 |
| 109 | Barn swallow          | Hirundo rustica                  | Hirundinidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 2.89 |
| 110 | Red-rumped swallow    | Cecropis daurica                 | Hirundinidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.24 |
| 111 | Nepal house martin    | Delichon nipalense               | Hirundinidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.46 |
| 112 | Himalayan bulbul      | Pycnonotus leucogenys            | Pycnonotidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.23 |
| 113 | Red-vented Bulbul     | Pycnonotus cafer +C24            | Pycnonotidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 1.07 |
| 114 | Chestnut-headed tesi  | Cettia castaneocoronata          | Sylviidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.03 |
| 115 | Common tailorbird     | Orthotomus sutorius              | Sylviidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.34 |
| 116 | Dusky warbler         | Phylloscopus fascatus            | Sylviidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.23 |
| 117 | Smoky warbler         | Phylloscopus fulgiventer         | Sylviidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.05 |
| 118 | Buff-barred warbler   | Phylloscopus pulcher             | Sylviidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.05 |
| 119 | Hume's leaf warbler   | Phylloscopus humei               | Sylviidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.1  |
| 120 | Greenish warbler      | Phylloscopus trochiloides        | Sylviidae | Passeriformes | TB  | W     | LC    | LC   | LC       | 0.38 |
| 121 | Grey-hooded warbler   | Phylloscopus xanthoschistos      | Sylviidae | Passeriformes | TB  | R     | LC    | LC   | LC       | 0.08 |
| No. | Species Name                      | Scientific Name           | Family       | Order     | Status | Abundance |
|-----|----------------------------------|---------------------------|--------------|-----------|--------|-----------|
| 122 | Blue whistling thrush            | Myophonus caeruleus       | Turdidae     | Passeriformes | TB | R | LC | LC | 0.22 |
| 123 | White-crested laughingthrush     | Garrulax leucolophus       | Timaliidae   | Passeriformes | TB | R | LC | NA | 1.09 |
| 124 | Jungle myna                      | Acridoitheres fuscus       | Sturnidae    | Passeriformes | TB | R | LC | LC | 0.77 |
| 125 | Common myna                      | Acridoitheres tristis      | Sturnidae    | Passeriformes | TB | R | LC | LC | 1.64 |
| 126 | Oriental magpie robin            | Copsycus saularis         | Muscicapidae | Passeriformes | TB | R | LC | LC | 0.37 |
| 127 | Plumbeous water redstart         | Rhyacornis fuliginosa      | Muscicapidae | Passeriformes | TB | W | LC | LC | 0.20 |
| 128 | Common stonechat                 | Saxicola torquatus         | Muscicapidae | Passeriformes | TB | R | LC | LC | 1.06 |
| 129 | Pied bushchat                    | Saxicola caprata           | Muscicapidae | Passeriformes | TB | R | LC | LC | 0.10 |
| 130 | Taiga flycatcher                 | Ficedula albicilla         | Muscicapidae | Passeriformes | TB | W | LC | LC | 0.15 |
| 131 | Grey-headed canary flycatcher    | Calicicapa ceylonensis     | Muscicapidae | Passeriformes | TB | W | LC | LC | 0.18 |
| 132 | Slaty-blue flycatcher            | Ficedula tricolor          | Muscicapidae | Passeriformes | TB | W | LC | LC | 0.04 |
| 133 | Bluethroat                       | Luscinia svecica           | Muscicapidae | Passeriformes | TB | W | LC | LC | 0.02 |
| 134 | Oriental white-eye                | Zosterops palpebrosus      | Zosteropidae | Passeriformes | TB | R | LC | LC | 0.58 |
| 135 | Grey wagtail                     | Motacilla cinerea          | Motacillidae | Passeriformes | WB | W | LC | LC | 0.19 |
| 136 | Citrine wagtail                  | Motacilla citreola         | Motacillidae | Passeriformes | WB | W | LC | LC | 0.05 |
| 137 | White wagtail                    | Motacilla alba             | Motacillidae | Passeriformes | WB | W | LC | LC | 0.75 |
| 138 | White-browed wagtail             | Motacilla maderaspatensis  | Motacillidae | Passeriformes | WB | W | LC | LC | 0.53 |
| 139 | Paddyfield pipit                 | Anthus rufulus             | Motacillidae | Passeriformes | WB | R | LC | LC | 1.26 |
| 140 | Olive-backed pipit               | Anthus hodgsoni            | Motacillidae | Passeriformes | WB | W | LC | LC | 0.35 |
| 141 | Rosy pipit                       | Anthus roseatus            | Motacillidae | Passeriformes | WB | W | LC | LC | 0.15 |
| 142 | Velvet-fronted nuthatch          | Sitta frontalis            | Sittidae     | Passeriformes | TB | R | LC | LC | 0.02 |
| 143 | Crimson sunbird                  | Aethopyga sipraja          | Nectariniidae| Passeriformes | TB | R | LC | LC | 0.11 |
| 144 | House sparrow                    | Passer domesticus          | Passeridae   | Passeriformes | TB | R | LC | LC | 2.14 |
| 145 | Eurasian tree sparrow            | Passer montanus            | Passeridae   | Passeriformes | TB | R | LC | LC | 1.17 |
| 146 | White-rumped Munia               | Lonchura striata           | Estrildidae  | Passeriformes | TB | R | LC | LC | 0.06 |
| 147 | Orange-bellied leafbird          | Chloropsis hardwickii     | Irenidae     | Passeriformes | TB | R | LC | LC | 0.04 |
| 148 | Yellow breasted bunting          | Emberiza aureola           | Emberizidae  | Passeriformes | WB | W | CR | CR | 0.48 |