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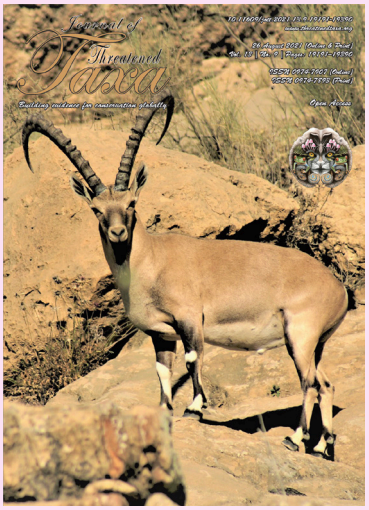

COMMUNICATION

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COMMUNICATION

On the high bird diversity in the non-protected regions of Trashiyangtse District in Bhutan

Lam Norbu [1], Phuntsho Thinley [2], Tandin Wangchuck [3], Ugyen Dechen [4], Lekey Dorji [5], Tshering Choephel [6] & Pasang Dorji [7]

[1,3,4,5,7] Tashigang Forest Division, Department of Forest and Park Services, Trashigang 42001, Bhutan.
[2] Ugyen Wangchuck Institute for Conservation and Environmental Research, Department of Forest and Park Services, Lamai Goenpa, Bumthang 32001, Bhutan.
[2] Ecosystem Management, University of New England, Armidale, New South Wales 2351, Australia.
[6] Bumdeling Wildlife Sanctuary, Department of Forest and Park Services, Trashiyangtse 46001, Bhutan.
[1] lam.norbu@ymail.com (corresponding author), [2] chetsho78@gmail.com, [3] twangchoks@gmail.com, [4] udechen@moaf.gov.bt, [5] lekid1308@gmail.com, [6] tsherichobhel@gmail.com, [7] pasangdorjiks@gmail.com

Abstract: Birds are ecological indicators of ecosystem health. Baseline information on bird diversity are, therefore, important for ecological monitoring. Such information is, however, sorely lacking for many areas outside the protected areas. Here, we explore the avian diversity and present a comprehensive checklist for the non-protected regions of Trashiyangtse District in northeastern Bhutan. We also categorise the bird species by their residency pattern, feeding guilds, abundance, and IUCN Red List status. We conducted an avifauna exploration for a period of four years from 2017 to 2020, mostly through opportunistic encounters coinciding with regular field visits. We recorded a total of 273 bird species belonging to 173 genera, 69 families and 19 orders. Passeriformes was the most dominant order with 41 families and 174 species and Muscicapidae was the most dominant family with 12 genera and 32 species. Most birds were altitudinal migrants (39%), insectivorous (45%), and occasional (44%) in terms of residency pattern, feeding guild, and abundance, respectively. Only one species (*Ardea insignis*) was listed as Critically Endangered and one (*Haliaeetus leucoryphus*) as Endangered. Our study identified the non-protected regions of Trashiyangtse District as an important bird diversity area in Bhutan.

Keywords: Avifauna, bird diversity, nonprotected area, northeastern Bhutan, threatened birds.

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Author details: Lam Norbu works as the Range Officer of Yangtse Range under Tashigang Territorial Forest Division of the Department of Forests and Park Services within the Royal Government of Bhutan. He takes ardent interest in studying lesser-known taxa to improve understanding of their ecology and distribution. Phuntsho Thinley is a wildlife biologist currently working as a postdoctoral research fellow at the University of New England in Australia. He focusses on understanding the distribution, ecology, and human dimensions of threatened wildlife. Tandin Wangchuck is a Forest Ranger at Doksum Range under Tashigang Territorial Forest Division. He specialises in plant taxonomy and wildlife photography. Ugyen Dechen oversees the Nature Conservation Section at the head office of Trashigang Territorial Forest Division. He deals with biodiversity conservation. Lekey Dorji is a Senior Forester at Khamdang Forest Beat under Yangtse Range. He is passionate about exploring butterflies, birds, and orchids. Tshering Choephel is a Senior Forester at Dungzam Range under Bumdeling Wildlife Sanctuary. He is an avid birder and a wildlife photographer. Pasang Dorji is a Forest Ranger at Yangtse Range. Recently, he developed interests in knowing about butterflies, moths, herpetofauna, and orchids.

Author contributions: LN and PT: Conceptualisation, study design, data collection, analysis, drafting and revision of the manuscript. TW and TC: data collection and species identification. UD, LD and PD: data collection.

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INTRODUCTION

Birds are the best known group of animal taxa at the global level, with the most extended time series data available (James et al. 2017). Their distribution is ubiquitous across all continents (Nyffeler et al. 2018), enabled by their preference to live in heterogeneous environments. Assessment of avifaunal communities is essential because they can serve as effective indicators of ecosystem status and health, in both qualitative and quantitative terms. This is because birds perform diverse ecological roles, ranging from disease regulation and, biomass recycling to environmental sanitation, seed dispersal, and pollination (James et al. 2017; Mukhopadhyay & Mazumdar 2017; Kiros et al. 2018). Birds are also sources of food and, spiritual inspiration, in addition to being important components of tourism industries (Kiros et al. 2018). Therefore, baseline information on birds of a particular locality, such as a species checklist, is vital for ecological monitoring, environmental assessments, conservation planning (Kandel et al. 2018; Sharma et al. 2018), and exploring eco-tourism potentials.

The first exploration of avifauna in Bhutan was conducted in 1837 by a British team (Gyeltshen et al. 2020). Later, several avifaunal expeditions and studies have been done in the country by Bhutanese nationals and foreign researchers, resulting in numerous online literature in the form of published articles, notes, and guidebooks. The number of publications on birds is expected to surge in the next few years with the current improvements in the institutional and personnel capacity and the concurrent emergence of citizen science that helps in building databases and species inventories.

Despite its small geographical size ~38,394km^2 (Thinley et al. 2021), Bhutan is a hotspot for bird diversity in the Himalaya with 23 important bird areas (IBA) (Banerjee & Bandopadhyay 2016) and is also part of the eastern Himalaya endemic bird area (Stattersfield et al. 1998; Bishop 1999). The latest record of confirmed bird species in the country stands at 748 species (Dendup et al. 2020; Gyeltshen et al. 2020) of which 31 are globally threatened and 18 are part of the 37 endemic bird species in eastern Himalaya (DoFPS 2020). This makes Bhutan a stronghold for bird diversity (Kandel et al. 2018). Currently, bird databases exist for most of the protected areas (PAs) in Bhutan. For instance, Avibase, the world bird database (Lepage 2020) has a checklist of 469 bird species for Trashiyangtse District which is inclusive of the areas falling inside the Bumdeling Wildlife Sanctuary (BWS). However, PAs occupy half of the country (Thinley et al. 2020; 2021) and databases are yet to be developed for the remaining half, which consists of the state reserved forests (SRF) administered by Territorial Forest Divisions. The areas outside the PAs are equally important for biodiversity conservation due to presence of vast tracts of relatively undisturbed forests that provide ideal habitats for a wide range of bird species. Thus, high bird diversity can be expected in some areas situated outside the PAs.

Here in this study, we explore the avian diversity and present a comprehensive bird checklist for the non-protected region of Trashiyangtse District, located in northeastern Bhutan. We also categorise the bird species by their residency pattern, feeding guilds, abundance, and conservation status.

MATERIALS AND METHODS

Study area description

The non-protected region of Trashiyangtse District (Figure 1; between 27.6116^{0}N and 91.498^{0}E) is bordered by the Tibetan Autonomous Region of China in the north and the Indian state of Arunachal Pradesh in the east. The district experiences a temperate climate, featured by warm & wet summers and cold & relatively dry winters, with an average annual temperature of 20.2 °C and precipitation of 1,065 mm (Norbu et al. 2019). Two major rivers, Kholongchu and Drangmechu, flow through the district and make it an important water catchment. Covering an area of approximately 1,449 km^2, the elevation ranges 800–6,000 m (FRMD 2017), and approximately 59% lies inside the BWS while the remaining 41% (600 km^2) is unprotected but managed as SRF land. The land cover in the non-protected region of Trashiyangtse is dominated by forest cover (70%) which is composed of major forest types of fir forest, mixed conifer forest (MCF), pine forest, mixed pine-cool broadleaved forest, chirpine forest, cool broadleaved forest (CBF), alpine shrubs, alpine meadows, and a few plantations (Koirala et al. 2021; FRMD 2017). Cool broadleaved forest is the most dominant forest type (44%) in this region, followed by MCF (15%). Although, several studies have been conducted on various taxonomic groups inside the protected region of the district, little is known about the biodiversity in the non-protected region which has potential for biodiversity conservation and ecotourism development.

Data collection and organization

We conducted an avifauna exploration for a period of

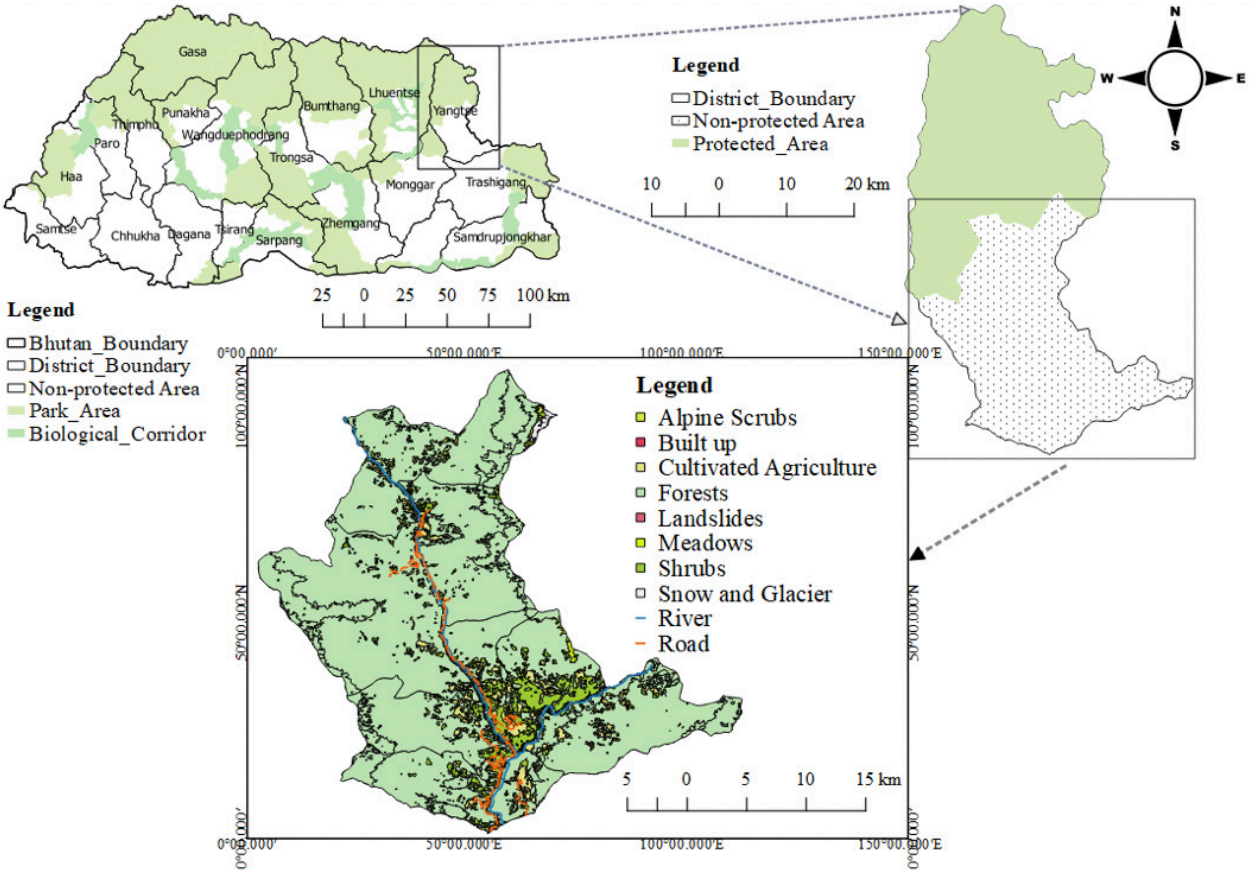

Figure 1. The location of the study area in the non-protected region of Trashiyangtse District situated in northeastern region of Bhutan.

four years (2017–2020) to maintain baseline data in the non-protected region of Trashiyangtse District. The data was collected mostly through opportunistic encounters coinciding with regular field visits to various locations in different seasons, including incidental rapid biodiversity surveys, site inspections, anti-poaching patrols, timber allotments, environmental impact assessments, anti-fishing patrols along the rivers, and forest inventories (for local forest management planning, heritage forests and community forests). The survey site covers all forest types and bird habitats, ranging from river sides, roadsides, and human settlements (rural and urban) to agriculture fields, plantations, meadows, rocky outcrops, and mountain tops, all within an elevation range of 800 m (at Jamkhardrang) to 4,050 m (at Dribla). In this way, terrestrial and water birds from lowland to high altitude uplands have been covered in the study. The birds were observed using binoculars (Nikon 10 x 40 mm) and were photographed using a digital camera (Cannon DC 18–135 mm lens). Bird photographs were compared with those on the latest guidebooks by Grimmett et al. 2011, 2019; Praveen et al. 2016, 2020) for species identification and species nomenclature. Additionally, bird calls were recorded (using an android phone) wherever possible and compared with the pre-recorded bird songs (e.g., Avibase bird call 2020) to further authenticate species identity. Online data bases (e.g., www.inaturalist.org/projects/birds-of-Bhutan) were also referred for species identification. For those in doubt, consultations were made with avian experts via email and social media.

We followed the IUCN Red List of Threatened Species for global conservation status of the recorded bird species. They were further categorized according to their residency pattern as residents, altitudinal migrants, summer visitors, winter visitors, and passage migrants, following Ali et al. (1996), Feijen & Feijen (2008), and Grimmett et al. (2019). Moreover, feeding guilds were assigned according to field observations (Kumar & Sharma 2018; Sharma et al. 2018; Singh et al. 2020), such that birds feeding on grains were categorized as granivorous, fruits as frugivorous, nectars as nectivorous, insects as insectivorous, vertebrates (amphibians, snakes, lizards, small mammals, small birds, and fishes) and invertebrates (crustaceans and

micro invertebrates) as carnivorous, and both plants and animals as omnivorous. Furthermore, birds were categorized as common, frequent, occasional and rare based on abundance and frequency of sightings during field investigation following Ali et al. (1996), Feijen & Feijen (2008), and Grimmett et al. (2019). Subsequently, the relative diversity (RDi) of families was calculated using the formula used by Singh et al. (2020): RDi= (Number of species in a family/Total number of species) x 100.

RESULTS AND DISCUSSION

We recorded a total of 273 bird species belonging to 173 genera, 69 families, and 19 orders in the outside protected region of Trashiyangtse District (Table 1). The occurrence of diverse bird species in the non-protected region of Trashiyangtse District is because of the rich forest cover with diverse mosaic habitats (marshy areas, artificial ponds, and irrigated crop fields along the bank of Kholongchu and Drangmechu rivers) supporting high diversity of food resources for birds in different seasons. However, our species richness was comparatively lower than in the remaining areas of the district encompassed by BWS where a total of 355 species have been recorded (BWS 2018). Further studies are needed to understand the factors driving the difference in bird diversity within and outside the protected regions.

Among the total of 19 orders (Figure 2; Table 1), Passeriformes was the most dominant, comprising 63.7% (174 species in 41 families) of the total species count, followed by Piciformes (14 species in three families) which constituted only 5.1% of the total species count. Buceriformes, Caprimulgiformes, Falconiformes, Podicipediformes, and Suliformes were the least represented orders each having a single species. Overall, passerines dominated (64%, n= 174) the avian diversity as compared to non-passerines (36%, n= 99) which was also the trend observed in the adjoining BWS (BWS 2018) because of the similar forest types prevalent in both the cases. Dominance of Passeriformes was also reported elsewhere in Bhutan, particularly the SRF Land of Trongsa district (Gyeltshen et al. 2020), along the Bindu River in Samtse district (Pasang 2018), Sakteng Wildlife Sanctuary (Wangyel et al. 2018), and Phrumshingla National Park (Inskipp et al. 2000). A similar pattern of Passerine dominance was reported from some areas in the eastern Himalayan region, such as in the Kanchenjunga Conservation Landscape, which is a transboundary complex shared by Bhutan, India, and Nepal (Kandel et al. 2018). This makes sense because Passerines are globally the largest and most diverse order of birds (Koli 2014).

Comparing by families, Muscicapidae with RDi of 11.7% (32 species in 12 genera) was the most dominant of the total of 69 families (Figure 3; Table 1) documented in our study area, followed by Leiothrichidae (6.2%; 17/8), Accipitridae (4.0%; 11/9), Fringillidae (4.0%; 11/7), Picidae (3.6%; 10/7), Phylloscopidae (3.3%; 9/1), Anatidae (3.3%; 9/7), and Cuculidae (2.9%; 8/6). Similarly, many other investigators such as Pasang (2018), Wangyel et al. (2018), Tobgay (2016), and Inskipp et al. (2000) have also found Muscicapidae to be the dominant family in their respective study areas. Similar observations were made from the Kangchengjunga Conservation Landscape (Kandel et al. 2018) and India (Koli 2014). Muscicapidae, indeed, is the largest family of birds restricted to the Old World (Europe, Africa, and Asia) with 322 species (Daniels 2020). In contrast, Gyeltshen et al. (2020) found Timaliidae to be the dominant family in the SRF Land of Trongsa District in central Bhutan. This variation could be attributed to the differences in habitat conditions occurring in different longitudes and elevation gradients.

Classifying by residency pattern, our data revealed the majority 39% (n= 106) were altitudinal migrants (Figure 4; Table 1) which was closely followed by residents (36%; n= 98). Constituting minor proportions were summer visitors (11%; n= 31), and winter visitors and passage migrants (7%; n= 19 each). Similarly, Gyeltshen et al. (2020) also reported that 36.7% (n= 121) of bird species recorded in the SRF region of Trongsa District were residents, followed by 34.5% (n= 114) altitudinal migrants, 15.2% (n= 50) summer visitors, 8.2% (n= 27) winter visitors, 4.8% (n= 16) passage migrants, and only two vagrants. Overall, in the entire Trashiyangtse District, a number of winter visitors and passage migratory species are observed annually across Kholongchu and Drangmechu river basins. This is because Bhutan lies on the Oriental Zoogeographic Realm and the Central Asian Flyways (CAF) which supports approximately 279 migratory water birds for wintering, stopover and even breeding (CMS 2019). Moreover, the major river basins of the country also provide shortest transit corridor or migratory routes connecting the significant bird habitat of Indo-Malayan Zoogeographic realms and Palearctic realms (DoFPS 2020).

When bird species were grouped by six major feeding guilds (Figure 5; Table 1), a maximum number of species (45%; n= 124) was insectivorous, followed by omnivorous (27%; n= 74), carnivorous (13%; n= 36), granivorous (9%;

Table 1. The avifauna checklist for the non-protected region of Trashiyangtse District in north-eastern Bhutan | categorized into feeding guild (Gra—Granivorous | Fru—Frugivorous | Nec—Nectivorous | Ins—Insectivorous | Car—Carnivorous | and Omn—Omnivorous) | residency pattern (R—Residents | AM—Altitudinal Migrants | SV—Summer Visitors | WV—Winter Visitors | and PM—Passage Migrants) | IUCN Red List status (CE—Critically Endangered | E—Endangered | VU—Vulnerable | NT—Near Threatened | and L—Least Concern) | and abundance (C—Common | F—Frequent | O—Occasional | R—Rare).

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Accipitriformes					
Accipitridae (11)					
Shikra	*Accipiter badius* (Gmelin, JF, 1788)	Car	R	LC	O
Eurasian Sparrowhawk	*Accipiter nisus* (Linnaeus, 1758)	Car	AM	LC	R
Himalyan Buzzard	*Buteo burmanicus* (Hume, 1875)	Car	WV	LC	R
Common Buzzard	*Buteo buteo* (Linnaeus, 1758)	Car	AM	LC	O
Hen Harrier	*Circus cyaneus* (Linnaeus, 1766)	Car	AM	LC	R
Himalayan Griffon Vulture	*Gyps himalayensis* (Hume, 1869)	Car	R	NT	O
Pallas's Fish Eagle	*Haliaeetus leucoryphus,* (Pallas, 1771)	Car	R	EN	R
Black Eagle	*Ictinaetus malaiensis* (Temminck, 1822)	Car	R	LC	O
Black-eared Kite	*Milvus migrans* (Boddaert, 1783)	Car	PM	LC	R
Mountain Hawk Eagle	*Nisaetus nipalensis* (Hodgson, 1836)	Car	R	LC	R
Crested Serpent Eagle	*Spilornis cheela* (Latham, 1790)	Car	SV	LC	O
Pandionidae (1)					
Osprey	*Pandion haliaetus* (Linnaeus, 1758)	Car	WV	LC	R
Anseriformes					
Anatidae (9)					
Mandarin Duck	*Aix galericulata* (Linnaeus, 1758)	Omn	PM	LC	R
Northern Pintail	*Anas acuta* (Linnaeus, 1758)	Omn	PM	LC	R
Common Teal	*Anas crecca* (Linneaus, 1758)	Omn	PM	LC	R
Mallard Duck	*Anas platyrhynchos* (Linnaeus, 1758)	Gra	PM	LC	R
Bar-headed Goose	*Anser indicus* (Latham, 1790)	Gra	PM	LC	R
Eurasian Wigeon	*Mareca penelope* (Linnaeus, 1758)	Gra	PM	LC	R
Goosander	*Mergus merganser* (Linnaeus, 1758)	Omn	PM	LC	R
Red-crested Pochard	*Netta rufina* (Pallas, 1773)	Omn	PM	LC	R
Northern Shoveler	*Spatula clypeata* (Linnaeus, 1758)	Gra	PM	LC	R
Apodiformes					
Apodidae (5)					
House swift	*Apus nipalensis* (Hodgson, 1837)	Ins	R	LC	O
Fork-tailed Swift	*Apus pacificus* (Latham, 1801)	Ins	SV	LC	O
Himalayan Swiftlet	*Collocalia brevirostris* (Horsfield, 1840)	Ins	R	LC	O
Asian Palm Swift	*Cypsiurus balasiensis* (Gray, JE, 1829)	Ins	R	LC	O
White-throated Needletail	*Hirundapus caudacutus* (Latham, 1801)	Ins	SV	LC	O
Buceriformes					
Upupidae (1)					
Eurasian Hoopoe	*Upupa epops* (Linnaeus, 1758)	Omn	AM	LC	C
Caprimulgiformes					
Caprimulgidae (1)					
Grey Nightjar	*Caprimulgus indicus* (Latham, 1790)	Ins	R	LC	O

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Charadriiformes					
Charadriidae (4)					
Little Ringed Plover	*Charadrius dubius* (Scopoli, 1786)	Omn	WV	LC	R
Long-billed Plover	*Charadrius placidus* (Gray, JE & Gray, GR, 1863)	Omn	WV	LC	R
River Lapwing	*Vanellus duvaucelii* (Lesson, 1826)	Ins	R	NT	R
Red-wattled Lapwing	*Vanellus indicus* (Roddaert, 1783)	Ins	SV	LC	R
Ibidorhynchidae (1)					
Ibisbill	*Ibidorhyncha struthersii* (Vigors, 1832)	Ins	WV	LC	R
Laridae (1)					
Brown-headed Gull	*Chroicocephalus brunnicephalus* (Jerdon, 1840)	Omn	PM	LC	R
Scolopacidae (3)					
Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	Car	PM	LC	R
Solitary Snipe	*Gallinago solitaria* (Hodgson, 1831)	Car	WV	LC	R
Green Sandpiper	*Tringa ochropus* (Linneaus, 1758)	Car	PM	LC	R
Tunicidae (1)					
Barred Buttonquail	*Turnix suscitator* (Gmelin, JF, 1789)	Gra	R	LC	R
Columbiformes					
Columbidae (6)					
Barred Cuckoo Dove	*Macropygia unchall* (Wagler, 1827)	Gra	SV	LC	O
Speckled Wood Pigeon	*Columba hodgsonii* (Vigors, 1832)	Gra	AM	LC	O
Snow Pigeon	*Columba leuconota* (Vigors, 1831)	Gra	AM	LC	R
Spotted Dove	*Spilopelia chinensis* (Scopoli, 1786)	Gra	SV	LC	C
Oriental Turtle Dove	*Streptopelia orientalis* (Latham, 1790)	Gra	R	LC	C
Wedge-tailed Green Pigeon	*Treron sphenurus* (Vigors, 1832)	Gra	AM	LC	O
Coraciiformes					
Alcedinidae (3)					
Common Kingfisher	*Alcedo atthis* (Linnaeus, 1758)	Car	AM	LC	O
White-throated Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	Car	AM	LC	R
Crested Kingfisher	*Megaceryle lugubris* (Temminck, 1834)	Car	AM	LC	O
Coraciidae (1)					
Indian Roller	*Coracias benghalensis* (Linnaeus, 1758)	Ins	AM	LC	R
Cuculiformes					
Cuculidae (8)					
Common Hawk Cuckoo	*Hierococcyx varius* (Vahl, 1797)	Ins	SV	LC	O
Lesser Coucal	*Centropus bengalensis* (Gmelin, JF, 1788)	Ins	R	LC	O
Eurasian Cuckoo	*Cuculus canorus* (Linnaeus, 1758)	Ins	SV	LC	O
Indian Cuckoo	*Cuculus micropterus* (Gould, 1838)	Ins	SV	LC	C
Himalayan Cuckoo	*Cuculus saturatus* (Blyth, 1843)	Ins	SV	LC	C
Large Hawk Cuckoo	*Hierococcyx sparverioides* (Vigors, 1832)	Ins	SV	LC	O
Green-billed Malkoha	*Phaenicophaeus tristis* (Lesson, 1830)	Ins	R	LC	R
Square-tailed Drongo-cuckoo	*Surniculus lugubris* (Horsfield, 1821)	Ins	SV	LC	O
Falconiformes					
Falconidae (1)					
Common Kestrel	*Falco tinnunculus* (Linnaeus, 1758)	Car	R	LC	O

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Galliformes					
Phasianidae (7)					
Blood Pheasant	*Ithaginis cruentus* (Hardwicke, 1821)	Omn	R	LC	R
Rufous-throated Partridge	*Arborophila rufogularis* (Blyth, 1849)	Omn	R	LC	R
Hill Partridge	*Arborophila torqueola* (Valenciennes, 1825)	Omn	R	LC	C
Common Quail	*Coturnix coturnix* (Linnaeus, 1758)	Omn	R	LC	R
Himalayan Monal	*Lophophorus impejanus* (Latham, 1790)	Omn	R	LC	R
Kalij Pheasant	*Lophura leucomelanos* (Latham, 1790)	Omn	R	LC	C
Satyr Tragopan	*Tragopan satyra* (Linnaeus, 1758)	Omn	R	NT	O
Gruiformes					
Gruidae (1)					
Black-necked Crane	*Grus nigricollis* (Przhevalsky, 1876)	Omn	WV	VU	R
Rallidae (4)					
White-breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	Omn	R	LC	R
Eurasian Coot	*Fulica atra* (Linnaeus, 1758)	Omn	PM	LC	R
Slaty-breasted Rail	*Lewinia striata* (Linnaeus, 1766)	Omn	WV	LC	R
Black-tailed Crake	*Zapornia bicolor* (Walden, 1872)	Omn	R	LC	R
Passeriformes					
Aegithalidae (2)					
Black-throated Bush tit	*Aegithalos concinnus* (Gould, 1855)	Ins	R	LC	C
Rufous-fronted Bush tit	*Aegithalos iouschistos* (Blyth,1845)	Ins	AM	LC	C
Alaudidae (2)					
Oriental Skylark	*Alauda gulgula* (Franklin, 1831)	Omn	WV	LC	R
Horned Lark	*Eremophila alpestris* (Linnaeus, 1758)	Omn	WV	LC	R
Alcippeidae (1)					
Nepal Fulvetta	*Alcippe nipalensis* (Hodgson, 1837)	Ins	R	LC	O
Calcariidae (1)					
Lapland Longspur	*Calcarius lapponicus* (Linnaeus, 1758)	Omn	AM	LC	R
Campephagidae (2)					
Long-tailed Minivet	*Pericrocotus ethologus* (Bangs & Phillips, 1914)	Ins	R	LC	O
Scarlet Minivet	*Pericrocotus fammeus* (Forster, JR, 1781)	Ins	AM	LC	O
Certhiidae (3)					
Brown-throated Treecreeper	*Certhia discolor* (Blyth, 1845)	Ins	AM	LC	O
Hodgson's Treecreeper	*Certhia hodgsoni* (Brooks, WE, 1871)	Ins	AM	LC	O
Rusty-flanked Treecreeper	*Certhia nipalensis* (Blyth, 1845)	Ins	AM	LC	F
Cettiidae (5)					
Yellow-bellied Warbler	*Abroscopus superciliaris* (Blyth, 1859)	Ins	AM	LC	C
Chestnut-headed Tesia	*Cettia castaneocoronata* (Burton, E, 1836)	Ins	AM	LC	O
Aberrant Bush Warbler	*Horornis flavolivaceus* (Blyth, 1845)	Ins	AM	LC	C
Brown-flanked Bush Warbler	*Horornis fortipes* (Hodgson, 1845)	Ins	AM	LC	C
Grey-bellied Tesia	*Tesia cyaniventer* (Hodgson, 1837)	Ins	AM	LC	O
Chloropseidae (1)					
Orange-bellied Leaf bird	*Chloropsis hardwickii* (Jardine & Selby, 1830)	Fru	R	LC	O
Cinclidae (2)					
White-throated Dipper	*Cinclus cinclus* (Linneaus, 1758)	Ins	AM	LC	O

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Brown Dipper	*Cinclus pallasii* (Temminck, 1820)	Ins	AM	LC	C
Cisticolidae (4)					
Common Tailorbird	*Orthotomus sutorius* (Pennant, 1769)	Ins	R	LC	C
Black-throated Prina	*Prinia atrogularis* (Moore, F, 1854)	Ins	R	LC	C
Striated Prina	*Prinia crinigera* (Hodgson, 1836)	Ins	R	LC	C
Rufescent Prinia	*Prinia rufescens* (Blyth, 1847)	Ins	R	LC	C
Corvidae (6)					
Grey Treepie	*Dendrocitta formosae* (Swinhoe, 1863)	Omn	R	LC	C
Large-billed Crow	*Corvus macrorhynchos* (Wagler, 1827)	Omn	R	LC	C
Eurasian Jay	*Garrulus glandarius* (Linnaeus, 1758)	Omn	AM	LC	O
Red-billed Chough	*Pyrrhocorax pyrrhocorax* (Linnaeus, 1758)	Ins	AM	LC	R
Spotted Nutcracker	*Nucifraga caryocatactes* (Linnaeus, 1758)	Omn	R	LC	O
Yellow-billed Blue Magpie	*Urocissa flavirostris* (Blyth, 1846)	Omn	R	LC	C
Dicaeidae (1)					
Fire-breasted Flowerpecker	*Dicaeum ignipectus* (Blyth,1843)	Fru	AM	LC	O
Dicruridae (3)					
Ashy Drongo	*Dicrurus leucophaeus* (Vieillot, 1817)	Ins	AM	LC	C
Black Drongo	*Dicrurus macrocercus* (Vieillot, 1817)	Ins	AM	LC	O
Hair-crested Drongo	*Dicrurus hottentottus* (Linnaeus, 1766)	Ins	SV	LC	O
Elachuridae (1)					
Spotted Wren Babbler	*Elachura formosa* (Walden, 1874)	Ins	LC	LC	R
Emberizidae (2)					
Crested Bunting	*Emberiza lathami* (Gray, JE, 1831)	Omn	SV	LC	O
Little Bunting	*Emberiza pusilla* (Pallas, 1776)	Omn	PM	LC	O
Estrildidae (1)					
Scaly-breasted Munia	*Lonchura punctulata* (Linnaeus, 1758)	Gra	AM	LC	R
Fringillidae (11)					
Common Rosefinch	*Carpodacus erythrinus* (Pallas, 1770)	Gra	AM	LC	O
Pink-browed Rosefinch	*Carpodacus rodochroa* (Vigors, 1831)	Gra	SV	LC	O
White-browed Rosefinch	*Carpodacus thura* (Bonaparte & Schlegel, 1850)	Gra	AM	LC	C
Yellow-breasted Greenfinch	*Chloris spinoides* (Vigors, 1831)	Gra	AM	LC	F
Scarlet Finch	*Carpodacus sipahi* (Hodgson, 1836)	Gra	AM	LC	O
Red Crossbill	*Loxia curvirostra* (Linnaeus, 1758)	Gra	SV	LC	O
White-winged Grosbeak	*Mycerobas carnipes* (Hodgson, 1836)	Fru	AM	LC	O
Spot-winged Grosbeak	*Mycerobes melanozanthos* (Hodgson, 1836)	Fru	AM	LC	O
Dark-breasted Rosefinch	*Procarduelis nipalensis* (Hodgson, 1836)	Gra	AM	LC	F
Red-headed Bullfinch	*Pyrrhula erythrocephala* (Vigors, 1832)	Gra	AM	LC	O
Brown Bullfinch	*Pyrrhula nipalensis* (Hodgson, 1836)	Gra	SV	LC	O
Hirundinidae (2)					
Red-rumped Swallow	*Cecropis daurica* (Laxmann, 1769)	Ins	SV	LC	O
Barn Swallow	*Hirundo rustica* (Linnaeus, 1758)	Ins	SV	LC	O
Laniidae (3)					
Brown Shrike	*Lanius cristatus* (Linnaeus, 1758)	Car	WV	LC	C
Long-tailed Shrike	*Lanius schach* (Linnaeus, 1758)	Car	AM	LC	C
Grey-backed Shrike	*Lanius tephronotus* (Vigors, 1831)	Car	R	LC	C

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Leiothrichidae (17)					
Rusty-fronted Barwing	*Actinodura egertoni* (Gould, 1836)	Omn	R	LC	C
Hoary-throated Barwing	*Actinodura nipalensis* (Hodgson, 1836)	Omn	R	LC	O
Himalayan Cutia	*Cutia nipalensis* (Hodgson, 1837)	Fru	R	LC	O
White-throated Laughingthrush	*Garrulax albogularis* (Gould, 1836)	Omn	R	LC	C
White-crested Laughingthrush	*Garrulax leucolophus* (Hardwicke, 1815)	Omn	R	LC	C
Striated Laughingthrush	*Grammatoptila striatus* (Vigors, 1831)	Omn	R	LC	C
Rufous Sibia	*Heterophasia capistrata* (Vigors, 1831)	Ins	R	LC	C
Long-tailed Sibia	*Heterophasia picaoides* (Hodgson, 1839)	Ins	R	LC	C
Spotted Laughingthrush	*Ianthocincla ocellata* (Vigors, 1831)	Omn	R	LC	C
Rufous-chinned Laughingthrush	*Ianthocincla rufogularis* (Gould, 1835)	Omn	R	LC	C
Red-bellied Leiothrix	*Leiothrix lutea* (Scopooli, 1786)	Ins	AM	LC	C
Blue-winged Siva	*Minla cyanouroptera* (Hodgson, 1837)	Ins	R	LC	C
Red-tailed Minla	*Minla ignotincta* (Hodgson, 1837)	Ins	AM	LC	C
Bar-throated Siva	*Minla strigula* (Hodgson, 1837)	Fru	R	LC	C
Black-faced Laughingthrush	*Trochalopteron affine* (Blyth, 1843)	Omn	R	LC	C
Chesnut-crowned Laughingthrush	*Trochalopteron erythrocephalum* (Vigors, 1832)	Omn	AM	LC	C
Bhutan Laughingthrush	*Trochalopteron imbricatum* (Blyth, 1843)	Omn	R	LC	C
Monarchidae (1)					
Indian Paradise-flycatcher	*Terpsihone paradisi* (Linnaeus, 1758)	Ins	SV	LC	R
Motacillidae (7)					
White Wagtail	*Motacilla alba* (Linnaeus, 1758)	Ins	R	LC	O
Grey Wagtail	*Motacilla cinerea* (Tunstall, 1771)	Ins	WV	LC	O
Citrine Wagtail	*Motacilla citreola* (Pallas, 1776)	Ins	AM	LC	O
Yellow Wagtail	*Motacilla flava* (Linnaeus, 1758)	Ins	WV	LC	O
White-browed Wagtail	*Motacilla maderaspatensis* (Gmelin, JF, 1789)	Ins	R	LC	O
Olive-backed Pipit	*Anthus hodgsoni* (Richmond, 1907)	Ins	AM	LC	O
Tree Pipit	*Anthus trivialis* (Linnaeus, 1758)	Ins	AM	LC	O
Muscicapidae (32)					
Oriental Magpie Robin	*Copsychus saularis* (Linnaeus, 1758)	Ins	R	LC	C
Blue-throated Blue Flycatcher	*Cyornis rubeculoides* (Vigors, 1831)	Ins	SV	LC	O
Pale-blue Flycatcher	*Cyornis unicolor* (Blyth, 1843)	Ins	AM	LC	O
Black-backed Forktail	*Enicurus immaculatus* (Hodgson, 1836)	Ins	AM	LC	O
Spotted Forktail	*Enicurus maculatus* (Vigors, 1831)	Ins	AM	LC	R
Slaty-backed Forktail	*Enicurus schistaceus* (Hodgson, 1836)	Ins	R	LC	C
Little Forktail	*Enicurus scouleri* (Vigors, 1832)	Ins	AM	LC	R
Verditer Flycatcher	*Eumyias thalassinus* (Swainson, 1838)	Ins	AM	LC	C
Snowy-browed Flycatcher	*Ficedula hyperythra* (Blyth, 1843)	Ins	AM	LC	O
Rufous-gorgeted Flycatcher	*Ficedula strophiata* (Hodgson, 1837)	Ins	AM	LC	C
Ultramarine Flycatcher	*Ficedula superciliaris* (Jerdon, 1840)	Ins	SV	LC	O
Slaty-blue Flycatcher	*Ficedula tricolor* (Hodgson, 1845)	Ins	AM	LC	C
Blue-capped Rock Thrush	*Monticola cinclorhyncha* (Vigors, 1832)	Omn	R	LC	C
Chestnut-bellied Rock Thrush	*Monticola rufiventris* (Jardine & Selby, 1833)	Omn	R	LC	C
Blue Rock Thrush	*Monticola solitarius* (Linnaeus, 1758)	Omn	R	LC	C
Ferruginous Flycatcher	*Muscicapa ferruginea* (Hodgson, 1845)	Ins	SV	LC	C

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Blue Whistling Thrush	*Myophonus caeruleus* (Scopoli, 1786)	Omn	R	LC	C
Large Niltava	*Niltava grandis (*Blyth, 1842)	Ins	AM	LC	O
Small Niltava	*Niltava macgrigoriae* (Burton, E, 1836	Ins	AM	LC	O
Rufous-bellied Niltava	*Niltava sundara* (Hodgson, 1837)	Ins	AM	LC	C
Blue-fronted Redstart	*Phoenicurus frontalis* (Vigors, 1831)	Omn	AM	LC	C
Plumbeous Water Redstart	*Phoenicurus fuliginosus* (Vigors, 1831)	Ins	AM	LC	C
Hodgson's Redstart	*Phoenicurus hodgsoni* (Moore, F, 1854)	Ins	WV	LC	C
White-capped water Redstart	*Phoenicurus leucocephalus* (Vigors, 1831)	Ins	AM	LC	C
Black Redstart	*Phoenicurus ochruros* (Gmelin, SG, 1774)	Ins	WV	LC	O
White-throated Redstart	*Phoenicurus schisticeps* (Gray, JE & Gray, GR, 1847)	Ins	WV	LC	F
Pied Bushchat	*Saxicola caprata* (Linnaeus, 1766)	Ins	AM	LC	R
Grey Bushchat	*Saxicola ferreus* (Gray, JE & Gray, GR, 1847)	Ins	AM	LC	C
Common Stonechat	*Saxicola torquatus* (Linnaeus, 1766)	Omn	WV	LC	O
Golden Bush Robin	*Tarsiger chrysaeus* (Hodgson, 1845)	Ins	SV	LC	O
White-browed Bush Robin	*Tarsiger indicus* (Vieillot, 1817)	Ina	AM	LC	O
Himalayan Bluetail	*Tarsiger rufilatus* (Hodgson, 1845)	Omn	AM	LC	O
Nectariniidae (5)					
Mrs Gould's Sunbird	*Aethopyga gouldiae* (Vigors, 1831)	Nec	AM	LC	C
Fire-tailed Sunbird	*Aethopyga ignicauda* (Hodgson, 1836)	Nec	AM	LC	C
Green-tailed Sunbird	*Aethopyga nipalensis* (Hodgson, 1836)	Nec	AM	LC	C
Black-throated Sunbird	*Aethopyga saturata* (Hodgson, 1836)	Nec	AM	LC	C
Crimson Sunbird	*Aethopyga siparaja* (Raffles, 1822)	Nec	R	LC	C
Oriolidae (2)					
Indian Golden Oriole	*Oriolus kundoo* (Skyes, 1832)	Fru	SV	LC	R
Maroon Oriole	*Oriolus traillii* (Vigors, 1832)	Fru	AM	LC	R
Paradoxornithidae (2)					
White-browed Fulvetta	*Fulvetta vinipectus* (Hodgson, 1837)	Ins	AM	LC	O
Fire-tailed Myzornis	*Myzornis pyrrhoura* (Blyth, 1843)	Omn	AM	LC	O
Paridae (4)					
Cinereous Tit	*Parus cinereus* (Vieillot, 1818)	Ins	AM	LC	O
Green-backed Tit	*Parus monticolus* (Vigors, 1831)	Ins	AM	LC	C
Rufous-vented Tit	*Periparus rubidiventris* (Blyth, 1847)	Ins	AM	LC	O
Coal Tit	*Periparus ater* (Linnaeus, 1758)	Ins	AM	LC	O
Passeridae (3)					
Russet Sparrow	*Passer cinnamomeus* (Gould, 1836)	Gra	AM	LC	C
House Sparrow	*Passer domesticus* (Linnaeus, 1758)	Gra	R	LC	C
Eurasian Tree Sparrow	*Passer montanus* (Linnaeus, 1758)	Gra	R	LC	C
Pellorneidae (2)					
Puff-throated Babbler	*Pellorneum ruficeps* (Swainson, 1832)	Ins	R	LC	O
Rufous-winged Fulvetta	*Schoeniparus castaneceps* (Hodgson, 1837)	Ins	AM	LC	O
Phylloscopidae (9)					
Tickell's Leaf Warbler	*Phylloscopus affinis* (Tickell, 1833)	Ins	SV	LC	C
Yellow-vented Warbler	*Phylloscopus cantator* (Tickell, 1833)	Ins	AM	LC	O
Chestnut-crowned Warbler	*Phylloscopus castaniceps* (Hodgson, 1845)	Ins	AM	LC	O

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Lemon-rumped Warbler	*Phylloscopus chloronotus* (Gray, JE & Gray, GR, 1847)	Ins	PM	LC	C
Ashy-throated Warbler	*Phylloscopus maculipennis* (Blyth, 1867)	Ins	AM	LC	C
Large-billed Leaf Warbler	*Phylloscopus magnirostris* (Blyth, 1843)	Ins	SV	LC	C
Blyth's Leaf Warbler	*Phylloscopus reguloides* (Blyth, 1842)	Ins	PM	LC	O
Whistler's Warbler	*Phylloscopus whistleri* (Ticehurst, 1925)	Ins	AM	LC	C
Grey-hooded Warbler	*Phylloscopus xanthoschistos* (Gray, JE & Gray, GR, 1847)	Ins	PM	LC	C
Pnoepygidae (1)					
Scaly-breasted Wren Babbler	*Pnoepyga albiventer* (Hodgson, 1837)	Ins	AM	LC	O
Prunellidae (3)					
Alpine Accentor	*Prunella collaris (*Scopoli, 1769)	Ins	AM	LC	O
Maroon-backed Accentor	*Prunella immaculata* (Hodgson, 1845)	Ins	R	LC	O
Rufous-breasted Accentor	*Prunella strophiata (*Blyth, 1843)	Ins	AM	LC	O
Pycnonotidae (5)					
Black Bulbul	*Hypsipetes leucocephalus* (Gmelin, JF, 1789)	Omn	AM	LC	C
Mountain Bulbul	*Ixos mcclellandii* (Horsfield, 1840)	Omn	AM	LC	C
Red-vented Bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	Omn	AM	LC	C
Himalayan Bulbul	*Pycnonotus leucogenys* (Gray, JE, 1835)	Omn	AM	LC	C
Striated Bulbul	*Pycnonotus striatus* (Blyth, 1842)	Omn	AM	LC	O
Rhipiduridae (1)					
White-throated Fantail	*Rhipidura albicollis* (Vieillot, 1818)	Omn	AM	LC	O
Sittidae (2)					
Chestnut-bellied Nuthatch	*Sitta cinnamoventris* (Blyth, 1842)	Omn	R	LC	O
White-tailed Nuthatch	*Sitta himalayensis* (Jardine & Selby, 1835)	Omn	R	LC	O
Stenostiridae (2)					
Yellow-bellied Fantail	*Chelidorhynx hypoxanthus* (Blyth, 1843)	Ins	AM	LC	C
Grey-headed Canary Flycatcher	*Culicicapa ceylonensis* (Swainson, 1820)	Ins	AM	LC	C
Timaliidae (6)					
Rusty-cheeked Scimitar Babbler	*Erythrogenys erythrogenys* (Vigors, 1831)	Omn	R	LC	C
Spot-breasted Scimitar Babbler	*Erythrogenys mcclellandi* (Godwin-Austen, 1870)	Omn	R	LC	O
Streak-breasted Scimitar Babbler	*Pomatorhinus ruficollis* (Hodgson, 1836)	Omn	R	LC	O
Golden Babbler	*Cyanoderma chrysaeum* (Blyth, 1844)	Omn	R	LC	O
Rufous-capped Babbler	*Cyanoderma ruficeps* (Blyth, 1847)	Omn	R	LC	O
Grey-throated Babbler	*Stachyris nigriceps* (Blyth, 1844)	Omn	R	LC	O
Trichodromidae (1)					
Wall Creeper	*Tichodroma muraria* (Linnaeus, 1766)	Ins	WV	LC	F
Troglodytidae (1)					
Eurasian Wren	*Troglodytes troglodytes* (Linnaeus, 1758)	Ins	AM	LC	R
Turdidae (6)					
Orange-headed Thrush	*Geokichla citrina* (Latham, 1790)	Omn	SV	LC	R
Black-throated Thrush	*Turdus atrogularis* (Jarocki, 1819)	Ins	AM	LC	O
Grey-winged Blackbird	*Turdus boulboul* (Latham, 1790)	Omn	AM	LC	O
White-collared Blackbird	*Turdus albocinctus* (Royle, 1840)	Omn	R	LC	O
Scaly Thrush	*Zoothera dauma* (Latham, 1790)	Omn	AM	LC	O
Alpine Thrush	*Zoothera mollissima* (Blyth, 1842)	Ins	AM	LC	O

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Vangidae (2)					
Bar-winged Flycatcher-shrike	*Hemipus picatus* (Sykes, 1832)	Ins	R	LC	O
Large Woodshrike	*Tephrodornis virgatus* (Temminck, 1824)	Ins	R	LC	O
Vireonidae (2)					
Blyth's Shrike-babbler	*Pteruthius aeralatus* (Blyth, 1855)	Ins	R	LC	O
Black-eared Shrike-babbler	*Pteruthius melanotis* (Hodgson, 1847)	Ins	AM	LC	O
Zosteropidae (5)					
Whiskered Yuhina	*Yuhina flavicollis* (Hodgson, 1836)	Omn	AM	LC	C
Stripe-throated Yuhina	*Yuhina gularis* (Hodgson, 1836)	Omn	AM	LC	O
Black-chinned Yuhina	*Yuhina nigrimenta* (Blyth, 1845)	Omn	AM	LC	O
Rufous-vented Yuhina	*Yuhina occipitalis* (Hodgson, 1836)	Omn	AM	LC	O
Oriental White-eye	*Zosterops palpebrosus* (Temminck, 1824)	Ins	R	LC	C
Pelecaniforms					
Ardeidae (4)					
White-bellied heron	*Ardea insignis* (Hume, 1878)	Car	R	CR	R
Indian Pond heron	*Ardeola grayii* (Sykes, 1832)	Car	AM	LC	R
Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)	Car	SV	LC	R
Black-crowned Night Heron	*Nycticorax nycticorax* (Linnaeus, 1758)	Car	AM	LC	R
Piciformes					
Indicatoridae (1)					
Yellow-rumped Honeyguide	*Indicator xanthonotus* (Blyth, 1842)	Ins	R	NT	R
Megalaimidae (3)					
Golden-throated Barbet	*Psilopogon franklinii* (Blyth, 1842)	Fru	AM	LC	O
Blue-throated Barbet	*Psilopogon asiaticus* (Latham, 1790)	Fru	AM	LC	O
Great Barbet	*Psilopogon virens* (Boddaert, 1783)	Omn	R	LC	C
Picidae (10)					
Bay Woodpecker	*Blythipicus pyrrhotis* (Hodgson, 1837)	Ins	R	LC	O
Greater Yellownape	*Chrysophlegma flavinucha* (Gould, 1834)	Ins	R	LC	O
Darjeeling Woodpecker	*Dendrocopos darjellensis* (Blyth, 1845)	Ins	R	LC	O
Rufous-bellied Woodpecker	*Dendrocopos hyperythrus* (Vigors, 1831)	Ins	R	LC	O
Fulvous-breasted Woodpecker	*Dendrocopos macei* (Vieillot, 1818)	Ins	R	LC	O
Crimson-breasted Woodpecker	*Dryobates cathpharius* (Bylth, 1843)	Ins	R	LC	O
Speckled Piculet	*Picumnus innominatus* (Burton, E, 1836)	Ins	R	LC	O
Grey-headed Wookpecker	*Dendropicos spodocephalus* (Bonaparte, 1850)	Ins	R	LC	O
Lesser Yellownape	*Picus chlorolophus* (Vieillot, 1818)	Ins	R	LC	O
Grey-capped Pygmy Woodpecker	*Yungipicus canicapillus* (Blyth, 1845)	Ins	R	LC	O
Podicipediformes					
Podicipedidae (1)					
Great Crested Grebe	*Podiceps cristatus* (Linnaeus, 1758)	Car	PM	LC	R
Strigiformes					
Strigidae (7)					
Spotted Owlet	*Athene brama* (Temminck, 1821)	Car	R	LC	R
Spot-bellied Eagle Owl	*Bubo nepalensis* (Hodgson, 1836)	Car	R	LC	R
Collard Owlet	*Glaucidium brodiei* (Burton, E, 1836)	Car	R	LC	O

Order/ Family (no. of species)/ Common name	Scientific name	Feeding guild	Residency pattern	IUCN Red List status	Abundance
Asian Barred Owlet	*Glaucidium cuculoides* (Vigors, 1831)	Car	R	LC	O
Jungle Owlet	*Glaucidium radiatum* (Tickell, 1833)	Car	R	LC	O
Mountain Scops Owl	*Otus spilocephalus* (Blyth, 1846)	Car	R	LC	R
Brown Wood Owl	*Strix leptogrammica* (Temminck, 1832)	Car	R	LC	R
Tytonidae (1)					
Barn Owl	*Tyto alba* (Scopoli, 1769)	Car	R	LC	R
Suliformes					
Phalacrocoracidae (1)					
Great Cormorant	*Phalacrocorax carbo* (Linnaeus, 1758)	Car	WV	LC	O
Trogoniformes					
Trogonidae (2)					
Red-headed Trogon	*Harpactes erythrocephalus* (Gould, 1834)	Omn	SV	LC	R
Ward's Trogon	*Harpactes wardi* (Kinnear, 1927)	Omn	SV	NT	R

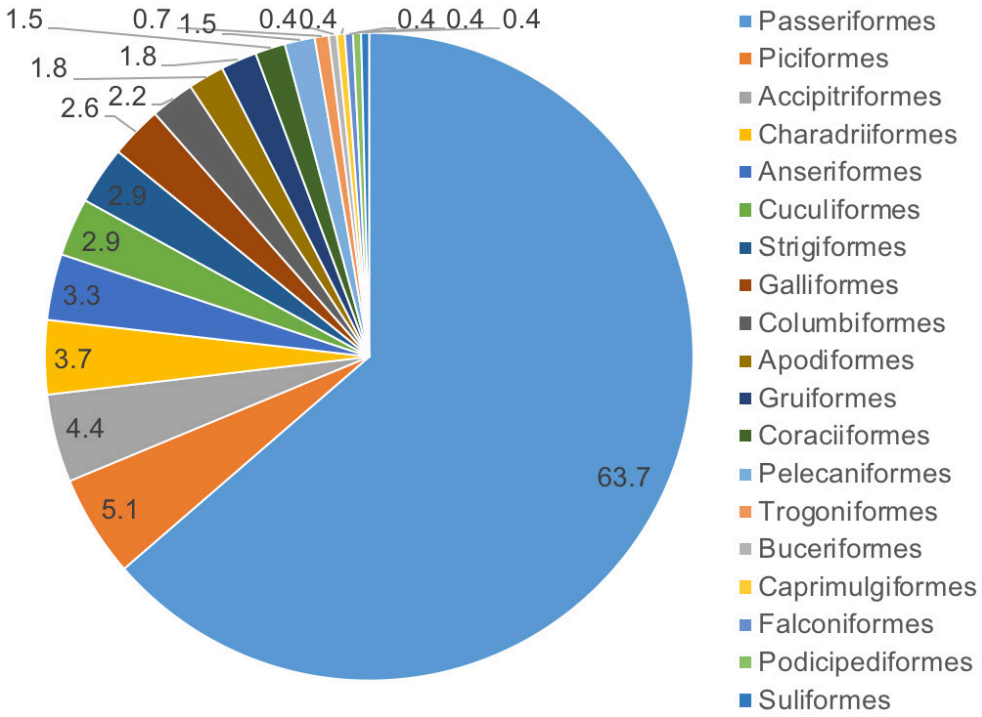

Figure 2. Classification of the bird species by Order in the non-protected region of Trashiyangtse District in northeastern Bhutan.

n= 24), frugivorous (4%; n= 10), and nectivorous (2%; n= 5). This representation of major trophic guilds indicates that the area holds a wide spectrum of food resources for birds due to the presence of a wide range of food niches, which reduces food competition among different species (Kumar & Sharma 2018). Most bird species are insectivorous, and the predominance of insectivore as a feeding style among birds is provisioned by diversity of insects prevalent in the agroecosystem mosaic comprised by croplands, settlements, grazing pastures, wetlands, and developed areas which represent a highly predictable food resources and diverse niches to birds (Nyffeler et al. 2018).

Upon classifying by abundance, the majority (44%; n= 121) of birds belonged to the occasional, exhibiting seasonal or altitudinal migration in the district while

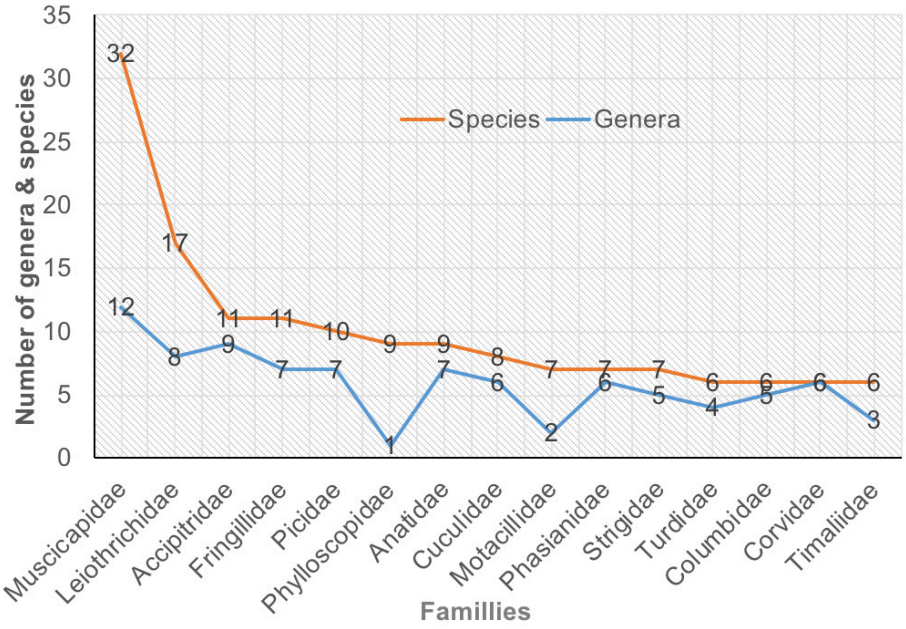

Figure 3. The dominant families of birds (with more than five species) shown along with their corresponding number of genera and species recorded in the non-protected region of Trashiyangtse District in northeastern Bhutan.

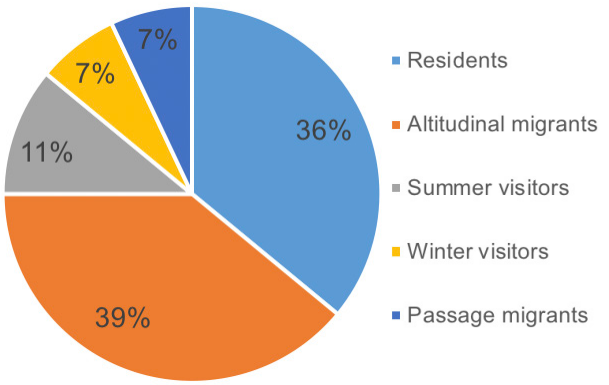

Figure 4. Bird classification by residency pattern in the non-protected region of Trashiyangtse District in northeastern Bhutan.

30% (n= 82) were common, whereas 24% (n= 65) and 2% (n= 5) were rare and frequent respectively (Table 1). Among the rare bird species encountered, the White-bellied Heron *Ardea insignis* and Indian Paradise Flycatcher *Terpsihone paradisi* sighted were only once in the study area. The former was sighted in 2019 behind the Dongtidzong and along the Dongdichu stream that feeds in to the Kholongchu River and later in 2018 near Yangtse town.

Finally, when bird species were categorized as per their IUCN Red List, only one species (White-bellied Heron) was listed as 'Critically Endangered', one (Palla's Fish Eagle *Haliaeetus leucoryphus*) as 'Endangered', one (Black-necked Crane *Grus nigricollis*) as 'Vulnerable', and five (Himalayan Griffon Vulture *Gyps himalayensis*, River Lapwing *Vanellus duvaucelii*, Satyr Tragopan *Tragopan satyra*, Yellow-rumped Honeyguide *Indicator xanthonotus*, and Ward's Trogon *Harpactes wardi*) as 'Near Threatened' (Table 1). Additionally, Himalayan Griffon Vulture, Black-necked Crane, and Palla's Fish Eagle are included in Appendix I and II of CITES (2019). Seven species (Palla's Fish Eagle, River Lapwing, White-bellied Heron, Yellow-rumped Honeyguide, Ward's Trogon, Black-necked Crane, and Himalayan Monal) are nationally protected and listed under Schedule I of the Forest and Nature Conservation Act 1995 (RGoB 1995) and Schedule II of the Forest and Nature Conservation Rules and Regulation of Bhutan 2017 (RGoB 2017).

Our study represents one of the few documented cases of complete bird inventory in areas adjoining a protected area in the eastern Himalayan region. Our data can be used as a baseline for future monitoring and survey. Aside from providing a comprehensive bird checklist along with their conservation status, our findings suggest the areas lying outside the protected areas with heterogeneous and mosaic landscapes of varying topography, elevation, weather, climate, and vegetation pattern offer ideal habitats and alternative conservation areas for birds. This bodes well with the current drive to identify and support conservation outside the protected areas (Kullberg et al. 2019; Kshettry et al. 2020). However, the current massive clearing of

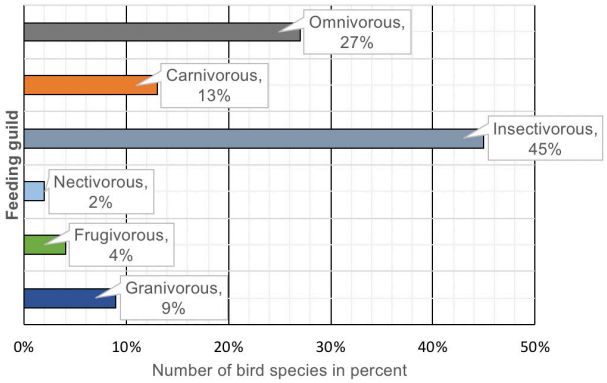

Figure 5. Distribution of avian species according to their feeding guild in the non-protected region of Trashiyangtse District in northeastern Bhutan.

forests along the Kholongchu River for a 600 megawatts hydro power construction, new power transmission lines, highway widening and also the increasing number of new farm road and trail constructions and increased resource collections, mainly due to less restrictions as opposed to a protected area, pose significant threats to the bird community in Trashiyangtse District.

We recommend conservation donors and wildlife managers to include non-protected areas such as ours as conservation priorities and accordingly provide funds to initiate bird conservation work for overall biodiversity conservation and eco-tourism. We also suggest similar studies to be conducted in other areas adjacent to protected areas in Bhutan as well as in the region.

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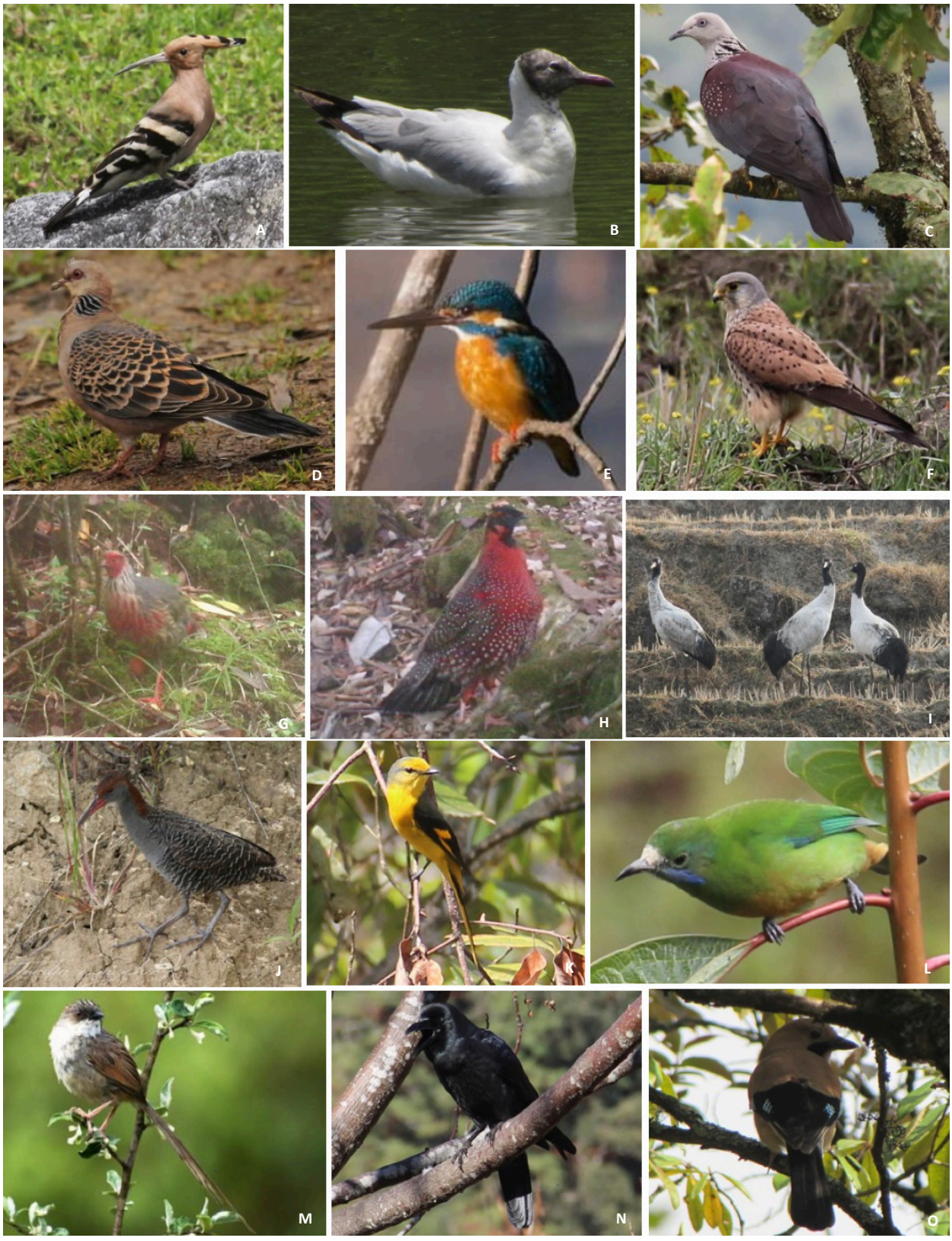

Image 1A–O Birds in study area: A—*Upupa epops* | B—*Chroicocephalus brunnicephalus* | C—*Columba hodgsonii* | D—*Streptopelia orientalis* | E—*Alcedo atthis* | F—*Falco tinnunculus* | G—*Ithaginis cruentus* | H—*Tragopan satyra* | I—*Grus nigricollis* | J—*Gallirallus striatus* | K—*Pericrocotus ethologus* | L—*Chloropsis hardwickii* | M—*Prinia rufescens* | N—*Dendrocitta formosae* | O—*Garrulus glandarius*. Photo credits for image 'C, D, E & M' © T. Wangdi; Image 'J' © T. Wangchuck; Image 'A, B, F, G, H, I, K, L, N, O' © L. Norbu.

Image 1P—Ad. Birds in study area: P—*Nucifraga caryocatactes* | Q—*Dicaeum erythrorhynchosl* | R—*Emberiza pusilla* | S—*Loxia curvirostra* | T—*Lanius schach* | U—*Garrulax striatus* | V—*Heterophasia capistrata* | W—*Terpsihone paradisi* | X—*Motacilla maderaspatensis* | Y—*Anthus hodgsoni* | Z—*Cosychus saularis* | Aa—*Enicurus schistaceus* | Ab—*Enicurus scouleri* | Ac—*Eumyias thalassinus* | Ad—*Ficedula superciliaris*. Photo credits for image 'P, Q, R, T, U, V, W, X, Y, Z, Aa, Ab, Ac & Ad' © L. Norbu; Image 'S' © T. Wangdi

Image 1Ae–As. Birds in study area: Ae—*Monticola cinclorhyncha* | Af—*Monticola solitarius* | Ag—*Niltava grandis* | Ah—*Niltava sundara* | Ai—*Saxicola ferreus* | Aj—*Saxicola torquatus* | Ak—Tarsiger rufilatus | Al—*Aethopyga nipalensis* | Am—*Prunella collaris* | An—*Pycnonotus leucogenys* | Ao—*Urdus albocinctus* | Ap—*Bubulcus ibis* | Aq—*Indicator xanthonotus* | Ar—*Dendrocopos hyperythrus* | As—*Parus monticolus*. Photo credits for image 'Ae, Af, Ag, Ah, Ai, Ak, Al, Am, An, Ao, Ar & As' © L. Norbu; Image 'Aj, Ap & Aq' © T. Wangdi

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