Journal of Biodiversity Management & Forestry

Research Article A SCITECHNOL JOURNAL

Seasonal Variation of Bird Diversity in Dhaneshwor Baikiwa Community Forest, Kavrepalanchowk District, Nepal

Aarati Nepali[1], Srijana Khanal[1*], Suman Sapkota[1] and Nanda Bahadur Singh[1,2]

[1]*Central Department of Zoology, Tribhuvan University, Kirtipur, Nepal*

[2]*Mid-western University, Surkhet, Nepal*

[*]**Corresponding Author:** Srijana Khanal, Central Department of Zoology, Tribhuvan University, Kirtipur, Nepal, E-mail: srijana.khanalgautam@gmail.com

Received date: March 01, 2021; **Accepted date:** March 16, 2021; **Published date:** March 21, 2021

Abstract

Seasonal variation plays an important role in the survival of birds in an ecosystem which is less explored in Nepal. The study was carried out in Dhaneshwor Baikiwa Community Forest of Kavrepalanchowk District, Nepal between January to August 2019 with the objectives to explore the bird diversity and seasonal variation along with the factors affecting bird diversity in the study area. Mackinnon's Listing Method and Point Count Method were used for bird survey during winter and summer seasons. 108 bird species belonging to 15 orders and 43 families were recorded. Shannon winner diversity index showed the highest bird diversity and evenness during winter season (N=82, H=3.929, E=0.627) than during summer season (N=71, H =3.808, E=0.625). Among 108 species, 79 species were resident, 13 species were winter visitors, 12 species were summer visitors, and four species were passage migrants. Only one globally vulnerable and one nearly threatened species were recorded. Bird diversity was affected by habitat type, distance to nearest settlement, fodder collection, livestock and number of human trails as shown by Canonical Correspondence Analysis (CCA). Gaining knowledge on bird diversity in any specific habitat will further helps to understand the ecology of bird species.

Keywords: Community forest, Diversity, Factors, Seasonal variation

Introduction

Birds are one of the sensitive species which show the quick response towards different changes in parameters of the habitat. The presence of bird in various habitats types shows their tolerance to a wide range of ecological conditions [1]. Seasonality plays an important role in the characterization of bird diversity in an ecosystem. The distinct seasonality of rainfall and seasonal variation in the presence of food resources [2] in the environment can have effect on the existence of bird species in numerous ways.

As Nepal is in a region of overlap between the Palearctic realm to the north and the Oriental (Indomalayan) realm to the south, the country has varying habitats that contribute to excessively diverse avifauna. Out of 887 species recorded from Nepal, 35 species have been assessed as globally threatened species and 19 species are kept under near threatened category [3]. Migratory pattern plays a significant role that causes the variations in avian community structure and differences in bird richness, also social and foraging behavior in different seasons [4]. In Nepal, most of the Himalayan resident species are altitudinal migrants; some residents are sedentary throughout the year while some species tackle irregular movements, either locally or widely in the region, as per the weather condition and food supply. About 62 species are summer visitors and 150 species are winter visitors migrating mainly from northern and Central Asia, some of which are also passage migrants [5]. The differences in the number of captures of birds are also regulated by the arrival and departure of seasonal altitudinal migrants [6].

Various abiotic gradients such as type of soil, climatic conditions, elevation, slope, aspects and vegetation cover as well as biotic features such as predation, competition, and heterogeneity of plant cover or state of succession can affect the diversity of birds in the specified area [7]. Such circumstances lead to a replacement in species composition and can affect each species individually [8].

Research regarding bird diversity and seasonal variation is very rare in Nepal. Till date, there is no any research in this study area. So, it is crucial to fulfill this gap in evidence to start the bird conservation in the area. Therefore, the aim of this study is to explore the seasonal variation and the factors that affect the bird diversity in Dhansehwor Baikiwa Community Forest at Kavrepalanchowk district of Nepal.

Materials and Methods

Study Setting

The study was conducted in Dhaneshwor Baikiwa Community Forest (270 37'47" N: 850 31'17"E), Banepa and Panauti Municipality of Kavrepalanchowk district, Nepal. It covers an area of 74.64 hectare at an elevation of 1000-2000 m.a.s.l. This forest falls in mid temperate climatic region. During the year, the average temperatures vary by 12.6 °C. About 1745 mm of precipitation falls annually. The forest has temperate and sub-tropical types of vegetation. The main vegetation found in this region is Katush (*Castanopsis indica*), Chilaune (*Schima walichii*), Salla (*Pinus roxburghii*), Dudhilo (*Ficus nemoralis*), Peepal (*Ficus religiosa*), Lapsi (*Choerospondias axillaris*), Phalant (*Quercus species*) [9].

Methods

Surveys were carried out within the months of January, 2019 (winter) and August, 2019 (summer) to assess seasonal variation. Birds were observed through Mackinnon's Listing Method [10] and Point Count Method as described by [11]. Location of each point was determined using Garmin Etrex 10. Altogether, 13 points count stations was established within study site representing forest, shrub land and open habitat according to birding route, keeping each point at the difference of 200 meters. Different disturbance variables which include the distance to nearest settlement, number of trails, livestock and fodder collection were also measured at each station. Bird observation was done early in the morning from 07:00 hrs to 11:00 hrs. With the help of binoculars for about 20 minutes at each point (Olympus 8X40). Ten days was spent in the field during each season.

A bird was recorded by direct observation and calls aided by photographs (Canon 800 D, 75 mm-300 mm telelens) and Field guidebook "Birds of Nepal". However, study of flying raptors and nocturnal birds was not done in the current research.

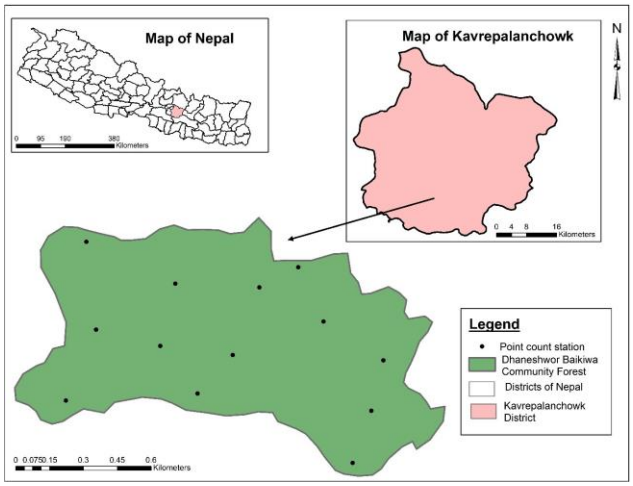

Figure 1: Map of the study area.

Data Analysis

After the collection of data, the avian diversity of each habitat was analyzed using Shannon-Wiener Diversity Index (H) [12] which was calculated from the software PAST version 3.25 [13]. Paired T-test was performed to compare bird diversity in different habitats and seasons.

For describing frequency of occurrence and comparative abundance, the terms described by [14] were used where 51-200: Very Common (VC), 21-50: Common (C), 5-20: Fairly Common (FC) and 1-4: Rare (R).

CCA was used to compare the association of species with different habitat type and disturbance variables. The response of different birds with habitat type and disturbance was performed by using Program CANOCO v4.5. The result was presented in the form of biplot. Monte-Carlo Permutation Test by using 499 permutations under reduced model was used to identify those variables which were significantly associated. For every ordination, down weighting of rare species was done.

Parameters	Variables	Description and CANACO levels
Habitat variables	Habitat types	Forest: This area was dominated by dense trees with mixed vegetation type such as Chilaune (*Schima walichii*), Katus (*Castonopsis indica*) and Utis (*Alnus nepalensis*).
		Shrub land: This area was dominated by bushes and shrubs. The shrubs included Banmaara (*Eupatorium glandulosum kunth*) and Narayanpaati (*Buddleja paniculata*).
		Open Areas: This area was dominated by grasses, herbs, barren lands, ditches and streams.
Disturbance Variables	Distance to nearest settlement	Euclidean distance measured from sampling point to the nearest settlements by the help of google earth.
	Number of human trails	Euclidean distance measured from sampling point to the nearest trails or roads used by people with the help of google earth.
	Livestock	Presence or absence of livestock in the sampling point.
	Fodder collection	Presence or absence of fodder collection by people through direct observation within sampling point.

Table 1: Details of variables used for CCA analysis.

Results

Species composition and seasonal variation

A total of 1,569 individuals of 108 bird species belonging to 15 orders and 43 families were recorded from the study area. Out of total birds, Passeriformes was the most dominant order including 26 families and 73 species followed by 7 species from Piciformes and 5 species from Cuculiformes. At the family level, the highest number of species was from Muscicapidae represented by 12 species followed by 5 species each from Cuculidae and Corvidae.

From the 108 species of birds identified during the study period, 81 species including 849 individuals belonging to 13 orders and 36 families were recorded during winter season while 72 species including 849 individuals belonging to 11 orders and 35 families were recorded during summer seasons. Forty-five species were found common in both summer and winter seasons. The highest bird diversity and evenness was observed during winter season than in summer season (Table 2). However, there was no significant difference in seasonal diversity of birds (t=0.19, df=11, P=0.85) and seasonal abundance of birds (t=1.36, df=11, P=0.19).

Season	No. of species	No. of individuals	Shannon diversity index (H)	Evenness (E)
Winter	81	706	3.929	0.627
Summer	72	849	3.808	0.625

Table 2: Avian diversity index during summer and winter season.

Local occurrence, migratory and threatened status

On the basis of frequency of occurrence of bird species, seven species were very common, 15 species were common, 41 species were fairly common, and 45 species were rare. During the study period, 79 species were residential birds, 12 birds were summer visitors, 13 birds were winter visitors while four birds were passage migrants. Residential species were encountered higher during both season while similar number of summer and winter migrants were recorded.

Out of 108 species, only one species i.e. Asian Woollyneck (*Ciconia episcopus*), globally vulnerable was recorded. Similarly, only one species i.e. Alexandrine Parakeet (*Psittacula eupatria*) which was categorized as Near Threatened in IUCN Red List of Threatened Species. Likewise, Kaliz Pheasant (*Lophura leucomelanos*), and five more species were recorded.

Factors affecting bird diversity

The CCA ordination diagram showed the response type of bird species in the study area. First two axes were displayed where the first axis accounted for 48.6% and the second axis 28.8% of the variability. The result of CCA ordination revealed a strong species-habitat correlation on axes I and II. Majority of the species such as Black Bulbul (BB) (*Hypsipetes leucocephalus*), Scaly Thrush (ST) (*Zoothera dauma*), Collared Owlet (CO) (*Glaucidium brodiei*), Black-naped Woodpecker (GW) (*Picus guerini*), Yellow-bellied Fairy-Fantail (YBF) (*Chelidorhynx hypoxantha*), Velvet Fronted Nuthatch (VFN) (*Sitta frontalis*), Scarlet Minivet (SM) (*Pericrocotus lammeus*), etc. were closely associated with forest habitat. Species such as Indian Pond Heron (IPH) (*Ardeola grayii*), White Wagtail (WW) (*Motacilla alba*), Oriental Turtle Dove (OTD) (*Streptopelia orientalis*), Common Myna (CM) (*Acridotheres tristis*), Long-tailed Shrike (LTS) (*Lanius schach*) etc. preferred open habitats while species such as Paddy-field Pipit (PFP) (*Anthus rufulus*), Blyth's Leaf Warbler (BLW) (*Phylloscopus reguloides*), Blue-throated Barbet (BTB) (*Megalaima asiatica*) and Common Tailorbird (CT) (*Orthotomus sutorius*) were associated with shrub land (Figure 2).

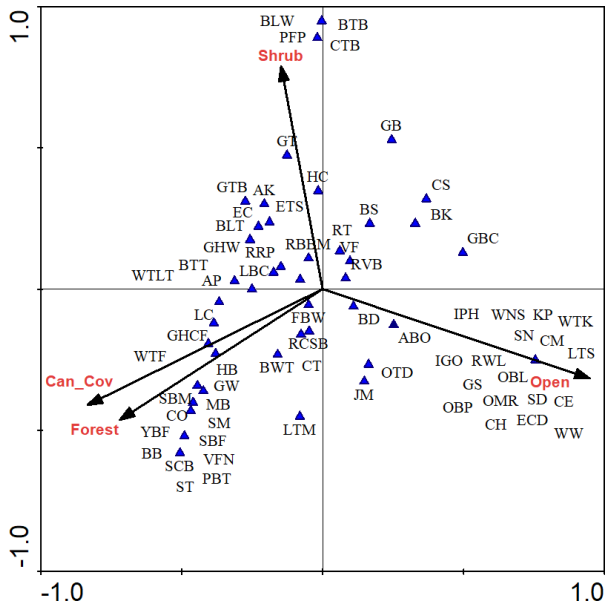

Figure 2: CCA ordination diagram (biplot) showing species response to different habitats in study area. Monte-Carlo permutation test of significance of all canonical axes: Trace=0.866, F=1.334, P=0.002 (with 499 permutations). Forest along with canopy cover, open area and shrub land are shown. Rest of the term represents the species common name. The blue triangle represents the species. The arrows represent each of the disturbance variables plotted pointing in the direction of maximum change of explanatory variables.

CCA diagram showed that the bird diversity was generally influenced by fodder collection, distance to nearest settlement, number of human trails and livestock grazing. There is strong correlation between the species- disturbance variables in axis I and axis II. First two axes were displayed where the first axis accounted for 34.3% and the second axis 25.3% of the variability. Species such as Slaty-backed Forktail (SBF) (*Enicurus schistaceus*), Black Bulbul (BB) (*Ardeola grayii*), Velvet-Fronted Nuthatch (VFN) (*Sitta frontalis*), Streak-breasted Schimitar Babbler (SCB) (*Pomatorhinus ruficollis*) showed more tolerant to distance to nearest settlement. Species such as Cattel Egret (CE) (*Bubulcus ibis*), Grey Bushchat (GB) (*Saxicola ferreus*), Indian Pond Heron (IPH) (*Ardeola grayii*), Olive-backed Pipit (OBP) (*Anthus hodgsoni*), White-breasted Kingfisher (WBK) (*Halcyon smyrnensis*), Common Hoopie (CH) (*Upupa epops*) showed more tolerant to the number of human trails while the species such as Oriental-Magpie Robin (OMR) (*Copsychus saularis*), Crimson Sunbird(CS) (*Aethopyga siparaja*), Eurasian-collared Dove (ECD) (*Stretopelia decaocto*), Kaliz Phesant (KP) (*Lophura leucomelanos*) showed more tolerant to fodder collection conditions. However, there was less influence of livestock grazing on the species (Figure 3).

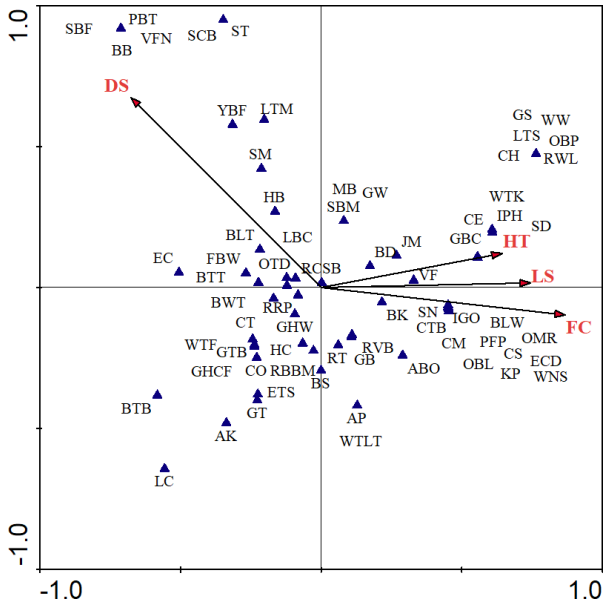

Figure 3: CCA ordination diagram (biplot) showing species response to disturbance variables in study area. Monte-Carlo permutation test of significance of all canonical axes: Trace=1.075, F=1.236, P=0.020 (with 499 permutations). (DS: Distance to nearest settlement, HT: Human Trail, LS: Livestock and FC: Fodder Collection). Rest of the term represents the species common name. The blue triangle represents the species. The arrows represent each of the disturbance variables plotted pointing in the direction of maximum change of explanatory variables.

Discussion

Species composition and seasonal variation

The study conducted for the first time in the study area revealed that bird diversity and evenness was higher during winter season than summer season. Our study revealed that the high species of avian fauna in the study area attributed to different habitat types which provided different array of foraging opportunities and nesting sites [15]. Order Passeriformes was the dominant order [16] which is similar with our study. Similarly, the present study found that the highest number of species was from Muscicapidae family followed by Corvidae and Cuculidae [17,18].

The present study showed that the higher bird diversity was seen in winter season than in summer season. This might be due toincrement in local movement of birds for searching food resources anddefoliation of plants that helps them for easy detection of birds. Our research agreed with the study conducted by [19,20] where the higher number of species was recorded in winter season than in summer season where there is defoliation of plants, some raptors and other species moved spatially to optimize their resources [21]. Open habitatswere favorable for foraging activity [22]. Hailu stated that open areas were favorable for avian fauna to sight easily for identifying andclassifying as well as counting [23]. Birds were unable to tolerate the high temperature in summer season which might lead to recording lowspecies in summer [24] which is similar with our study.

Local occurrence, migratory and threatened status

Although the diversity of bird was higher in winter season, the higher abundance of the birds in summer season than winter season which might be due to the availability of enough food resources and breeding behavior of birds. Breeding activities lead to the increase in the number of the species which is similar with the finding of [25]. The reason behind this was the higher species abundance in summer season as wet season which created favorable environmental condition for food, cover, and another habitat requirement.

In the present study, out of 108 species, 79 species were residential, 12 species were summer visitors, and 13 species were winter visitors while 4 species were passage migrants. Study conducted by [26] found 44 species were resident, 5 species were winter visitor, and 6 species were summer visitor out of 55 species which was comparatively lower with our study. Assemblage of similar number of migratory birds might be due to favorable ecological and climatic conditions in the study area during both seasons.

Factors affecting bird diversity

The maximum abundance of species was associated with shrub land followed by forest and open habitat. Similar pattern was observed by [27] which might be due to the vegetation composition. It created variations in food sources, nesting and protection opportunities based up on the bird's habitat preference and feeding habits. Likewise, the variation in species dominance among different habitats were attributed by the presence food availability, suitable cover and nesting sites, adaptation or tolerance level and the degree of the threats [28].

There is variation in tolerance of bird to different disturbance variables resulting in different bird assemblage as depicted in the current study [29]. The selected variables showed positive relationship on the species diversity as revealed by CCA. Nsor et al. reported farming activities, grazing pressure, and bushfires as the factors affecting bird diversity. Human settlement was another factor that limited avian productivity by decreasing resources, increasing nest predation, competition for resources, and brood parasitism [30]. However, informal settlements that are surrounded by a mosaic of vegetation types offer many opportunities for bird foraging and nesting [31]. The study conducted by Gillespie et al. in Central America asserted that cattle reduced the capacity of seeds to germinate and intensive grazing could generate spiny and unpalatable forests [32]. Stern et al. found that the diversity and structure of the forests have been significantly influenced by cattle grazing in two protected areas in Costa Rica [33]. Allowing large and repetitive livestock population in to unprotected area will also lead to loss of grassland specialist bird species [34].

Conclusion

The first study in Dhaneshwor Baikiwa Community forest, despite its small size, observed high bird diversity. Bird diversity and evenness was higher during winter season than during summer season suggesting that the area is preferred by winter migrants for their breeding grounds. We conclude that the bird assemblage with seasonality is determined by the strong influence of habitat type and disturbance variables including distance to nearest settlements, livestock, fodder collection and number of human trails. The presence of globally vulnerable species revealed the importance of the area to conserve these species. Further research on their habitat utilization and their ecology will be crucial in the conservation of globally threatened species. Minimizing the disturbance in the community forest can enhance the habitat qualities which will ultimately supports diversity of avian fauna.

Acknowledgement

We are greatly indebted to Central Department of Zoology for their academic and administrative co-operation during study period. We are also grateful to Professor Dr. Ramesh Prasad Sapkota for providing valuable suggestions. We would like to give sincere thanks to Department of Forests and Soil Conservation and Division Forest Office, Kavrepalanchowk for granting permission to carry out this study.

Funding

This research was supported by University Grants Commission (UGC) for providing Masters Research Support Award Number MRS-75/76-S&T-80 and Idea Wild for providing the binocular and GPS.

Author's Contributions

Aarati Nepali and Srijana Khanal designed the study, conducted the literature review, collected data, analyzed the data and prepared the first draft of the manuscript. Suman Sapkota collected and analyzed the data. Nanda Bahadur Singh supervised the project, contributed to study design and data interpretation, and revised the manuscript. All authors revised and agreed on the views expressed in the manuscript and they all have equal contributions to this manuscript.

Compliance with Ethical Standard

Conflict of Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The data sets supporting the conclusions of this article are available at the institutional repository of Tribhuvan University. According to the data protection regulation of Tribhuvan University, authors are not permitted to deposit the data elsewhere.

REFERENCES

1. Sekercioglu CH (2006) "Foreword," in Handbook of the Birds of the World: Old World Flycatchers to old world warblers, J. delHoyo, A. Elliott, and D. Christie, Eds., 1, p. 48, Lynx Edicions, Barcelona, Spain.
2. Schroth G, Fonseca GAB, Harvey CA, Gascon C, Vasconcelos HL, Et al. (2004) Agroforestry biodiversity conservation in tropical landscapes. Island Press, Washington, DC.
3. Department of national parks and wildlife conservation and bird conservation nepal (2018). Birds of Nepal: An Official Checklist, Kathmandu, Nepal.
4. Amador E, Mendoza-Salgado R, De Anda-Montanez JA (2006) Structure of the avifauna during the winter-spring season in Estero Rancho Bueno, Baja California Sur, Mexico. Rev Mex Biodivers 77: 251–259.
5. Grimmet R, Inskipp C. Inskipp T, Baral HS (2016) Birds of Nepal: Helm Field Guide, Bloomsbury Publishing India Pvt., Ltd., New Delhi, India.
6. Werema C, Howell KM (2016) Seasonal variation in University and abundance of understorey birds in Bunduki Forest Reserve, Tanzania: evaluating the conservation value of a plantation forest. Ostrich 87:89-93.
7. Sheta B, Orabi G, Bedir M, El-Bokl M, Habbk L (2011) Impact of some anthropogenic activities on the diversity of resident bird species at damietta region, Egypt. CATRINA 6: 59-74.
8. Banks-Leite C, Ewers RM, Metzger JP (2012) Unraveling the drivers of community dissimilarity and species extinction in fragmented landscapes. Ecology 93: 2560-2569.
9. Division Forest Office Kavrepalanchok (2014). Annual publication of 2071/72. District Forest Office, Dhulikhel, Kavrepalanchowk.
10. Mackinnon J, Philips K (1993) A field Guide to the birds of summatra, Java and Bali. Oxford University Press, Oxford, United Kingdom.
11. Sutherland WJ (2006) Ecological census techniques a handbook. Second Edition. Cambridge University Press, New York, Unites States of America.
12. Shannon CE (1949) The mathematical theory of communication. Bell Syst Tech 27: 379-423.
13. Hammer O, Harper DAT, Ryan PD (2001) PAST: Paleontological statistics software package for education and data analysis. Palaeontol. Electron 4: 1-9.
14. Bull J (1974). Birds of new york state. Published by doubleday/ natural history press. Edited by Emanuel Levine 1985. Cornell University Press, p:622.
15. Girma Z, Mamo Y, Mengesha G, Verma A, Asfaw T (2016) Seasonal abundance and habitat use of bird species in and around Wondo Genet Forest, South-Central Ethiopia. Ecol Evol 7: 3397–3405.
16. Chaudhari UK, Kafle G, Baral HS (2009) Avifaunal diversity of khata corridor forest. Journal of Wetlands Ecology 2: 48-56.
17. Kandel P, Thapa I, Chettri N, Pradhan R, Sharma E (2018) Birds of the kangchenjunga landscape, the Eastern Himalaya: status, threats and implications for conservation. Avian Research 9.
18. Thakuri JJ, Nyegaard T, Jorgensen MF. Joshi AB (2018) Bird survey of Madane Protected Forest, Gulmi District, West Nepal. Report submitted to Oriental Bird Club, UK.
19. Katuwal HB, Pradhan NMB, Thakuri JJ, Bhusal KP, Aryal PC, Thapa I (2018) Effect of urbanization and seasonality in Bird Communities of Kathmandu Valley, Nepal. Proceedings of the Zoological Society 71: 103-113.
20. Tzortzakaki O, Kati V, Kassara C, Tietze DT, Giokas S (2018). Seasonal patterns of urban bird diversity in a mediterranean coastal city: the positive role of open green spaces. Urban Ecosystem 21: 27–39.
21. Almazan-Nunez RC, Arizmendi MDC, Eguiarte LE, Corcuera P (2015) Distribution of the community of frugivorous birds along a successional gradient in a tropical dry forest in south-western Mexico. J Trop Ecol 31: 57–68.
22. Otieno NE, Gichuki N, Farwig N, Kiboi S (2011) The role of farm structure on bird assemblages around a Kenyan tropical rainforest. Afr J Ecol 49: 410– 417.
23. Hailu S (2008) Species composition, distribution, relative abundance and habitat association of avifauna of wof washa national forestry priority area, Ethiopia. MSc. Thesis, Addis Ababa University.
24. Pokherel U (2015) Diversity and conservation status of birds in betana wetland area belbari, morang, nepal. Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal.
25. Abie K, Tilahun B, Feyisa A, Kumssa T, Amare A (2019) Bird species diversity and distribution in case of protected area. Species 20: 90-100.
26. Pokherel U (2015) Diversity and conservation status of birds in Betana wetland area Belbari, Morang, Nepal. Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal.
27. Kiros S, Afework B, Legese K (2018) A preliminary study on bird diversity and abundance from Wabe fragmented forests around Gubresubcity and Wolkite town, Southwestern Ethiopia. Int. j. avian wildl 3:333–340. Marzluff JM, Bowman R, Donnelly R (2001) Avian Ecology and Conservation in an Urbanizing World. Kluwer, New York.
28. Girma Z, Mengesha G, Asfaw T (2017) Diversity, relative abundance and distribution of avian fauna in and around Wondo genet forest, South-Central Ethiopia. Research Journal of Forestry 11: 1-12.
29. Nsor CA, Obodai EA (2014) environmental determinants influencing seasonal variations of bird diversity and abundance in wetlands, northern region (Ghana). Int J Zool 2: 17-30.
30. Marzluff JM, Bowman R, Donnelly R (2001) Avian Ecology and Conservation in an Urbanizing World. Kluwer, New York.
31. Jokimaki J, Kaisanlahti-Jokimaki MJ (2012) The role of residential habitat type on the temporal variation of wintering bird assemblages in northern Finland. Ornis Fennica 89:20-23.
32. Gillespie TW, Grijalva A, Farris CN (2000) Diversity, composition, and structure of tropical dry forests in Central America. Plant Ecol 147:37–47.

33. Stern M, Quesada M, Stoner KE (2000) Changes in composition and structure of a tropical dry forest following intermittent cattle grazing. Rev Biol Trop 50:1021–1034.
34. Asefa A, Mengesha G, Shimelis A, Mamo Y (2015) Livestock grazing afromontane grasslands in the northern bale mountains, ethiopia: implications for bird conservation. science, Technologyand Arts Research Journal 4:112–121.

35. Stern M, Quesada M, Stoner KE (2000) Changes in composition and structure of a tropical dry forest following intermittent cattle grazing. Rev Biol Trop 50:1021–1034.

36. Thakuri JJ, Nyegaard T, Jorgensen MF, Joshi AB (2018) Bird survey of madane protected forest, gulmi district, west nepal. Report submitted to Oriental Bird Club, UK.