

Avifaunal Diversity in Important Bird Areas of Western Nepal

Sony Lama, Saroj Shrestha, Ang Phuri Sherpa, Munmun Tamang & Dinesh Ghale

Keywords: avian community, bird checklist, Important Bird Area, threats

Abstract

The rural municipality of Barekot in Jajarkot district is an Important Bird Area (IBA) in Western Nepal. In recent years, illegal hunting and trapping have increased in this area. Additionally, a hydropower project with a capacity of 410 MW is being constructed within Barekot. The present study aims to update the preliminary checklist of birds and to identify the underlying threats to the bird populations in this region. The bird survey was conducted in Barekot over four days in the late winter/early spring of 2021. Direct field observation, surveys of key informants, a literature review and photography were the main tools used for data collection. The study revealed 87 bird species belonging to 10 orders and 34 families. The birds most commonly recorded belong to the Muscicapidae family, order Passeriformes. Among the recorded species, two are on the IUCN Red List of Nationally Vulnerable species, five are listed in CITES Appendix II, and one species features in CITES Appendix I. Approximately 82% of the bird species recorded were of resident types. Despite a decline in bird diversity, Barekot's unique geographical location still makes it an important IBA in Nepal. Bird numbers have plummeted due to human intrusion and disturbance, and modifications to natural systems. Based on our findings, we recommend landscape-level research on the impacts of hydropower projects, roads, poaching, and the Covid-19 pandemic. Future conservation efforts should also emphasize the prevention of habitat fragmentation and raising public awareness.

Introduction

Avifauna play a critical role in ecosystem processes and functioning, for example in pollination, control of insect pest populations and scavenging; they are indicators of ecosystem health, affect crop productivity, and are instrumental in nutrient cycling and formation (Prakash et al. 2001; Amat & Green 2010; Bensizerara et al. 2013; Sekercioglu et al. 2016; Morante-Filho & Faria 2017). Since 2020, the diversity of avifauna has decreased owing to habitat destruction and human interference.

Karnali (28° 53' 43"–30° 25' 22.06"E, 82° 0' 0.6"–82° 5' 17.02"N) in Western Nepal is the country's largest province (24,453 km²) and has the smallest population (1,570,418) of the seven federal provinces in Nepal (26° 22' 9"–30° 24' 54"E, 81° 24' 27"–88° 1' 56"N) (CBS 2012). The altitude of Karnali province ranges from 180 m to 7,348 m. The province harbours birds (56% of the total number of species in Nepal), mammals (42%), butterflies (22%), fishes (32%), reptiles (11%), amphibians (43%), and flowering plants (42%). Several of these species are endemic to Nepal and are threatened by human activities that cause habitat loss and fragmentation (Bista et al. 2017; Lama et al. 2020; Acharya & Paudel 2020; Shrestha et al. 2021(b)). Nepal is home to 886 bird species (DNPWC and BCN, 2018) and has a total of 27 Important Bird Areas (IBAs). Karnali is home to 496 different species of birds and has four IBAs: Barekot, Limi valley, Rara National Park and Shey Phokshundo National Park (Acharya & Paudel 2020).

Barekot (28° 54' 40"–29° 0' 45"E, 82° 16' 41"–82° 17' 43.53"N), Western Nepal, is in Jajarkot district (28° 59' 25"–28° 58' 42"E, 81° 52' 52"–82° 21' 43"N),

Karnali Province. The district lies in a region that is ecologically very fragile; it has an elevation range of 610 m to 5,412 m, and is ranked *very high* in the climate change vulnerability ranking index (MoFSC 2016; UNRCHCO 2021). The Government of Nepal has recently invested in hydropower projects in Jajarkot district, and one plant is currently under construction within Barekot's IBA. It is believed that this project will have adverse impacts on the local flora and fauna. Barekot is home to a number of endangered and rare mammals and birds (Bhusal & Singh 2017; Acharya & Paudel 2020). The study area is also plagued by hunting and trapping, poisoning, illegal logging, encroachment, overgrazing and overfishing (DNPWC 2017).

Despite the area's rich biodiversity and good bird habitats (Acharya & Paudel 2020), our knowledge of the status of bird species and their overall diversity in Barekot is very limited. The majority of bird studies in Nepal have focused on the southern foothills (Terai region; 60 m to 210 m). Only a handful of articles about bird species from Karnali province are available. In 2015, 146 bird species were recorded in Jajarkot district (Paudel & Bhusal 2015). The present study aims to update the bird checklists, for the first time since 2015, according to their taxa, IUCN status (i.e. critically endangered, endangered, or vulnerable), CITES Appendix status (Appendices I, II, III), occurrence status (resident or visitor), and associated threats.

Methods

Study area

Barekot, whose elevation ranges from 1,510 to 5,222 m a.s.l, is the largest rural municipality (RM) of Jajarkot district. Barekot has a total area of 57,526 hec-

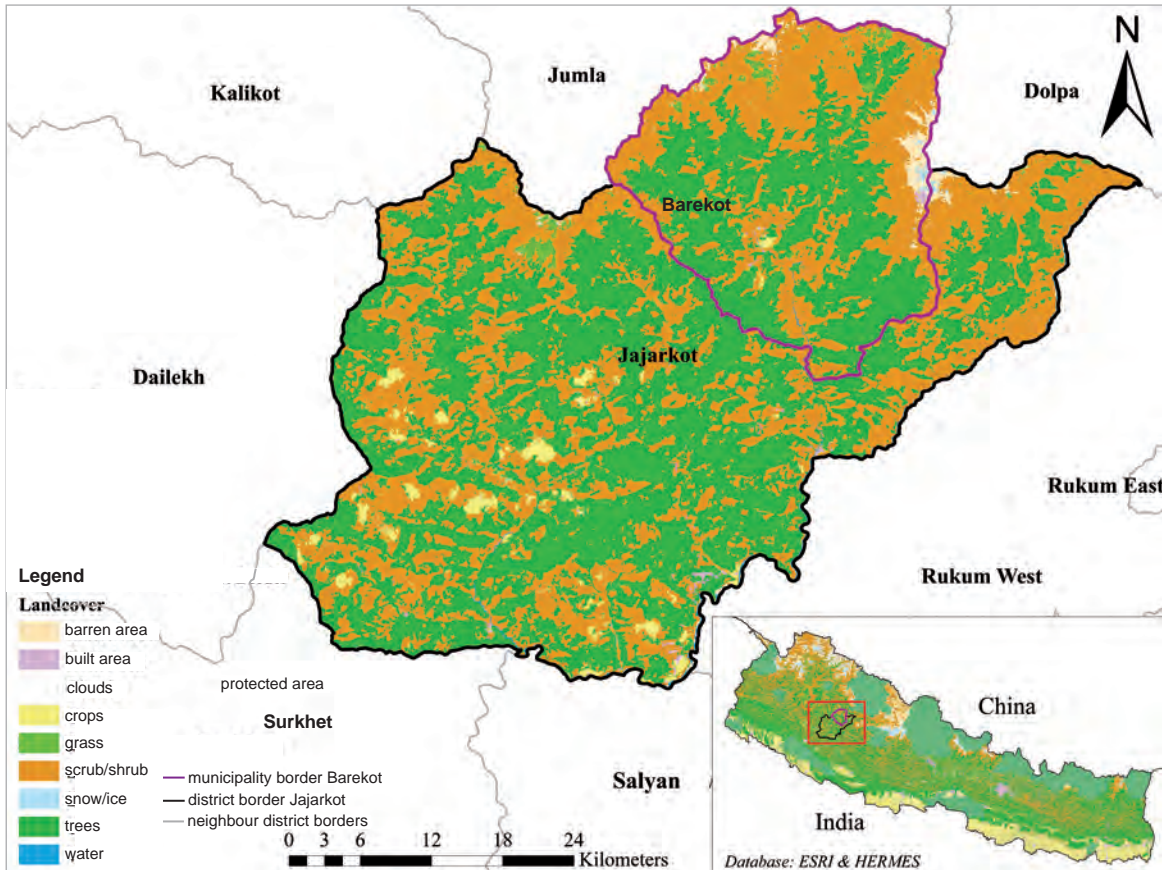


Figure 1– Study area: The rural municipality of Barekot in Nepal.

tares and a population of 18,083. The forest coverage of Barekot is 33,734 hectares, which is 0.54% of Nepal’s total forest area and 10.10% of that of Karnali province (Table 1). The region is highly vulnerable to ecological challenges such as landslides and fire, as well as to epidemics, including cholera, diarrhea and influenza (Bhandari et al. 2009; Upadhyay et al. 2016; UNRCHCO 2021).

Western Himalayan subalpine conifer forests make up the majority of Barekot’s habitat. There are also alpine shrub and grassland habitats in this region. The climate in most of the region is mild and temperate, with dry winters and warm summers. It also has snowy climate zones, with dry winters and cool summers.

Although this region does not have protected status, it lies in close proximity to several important protected areas, including Rara National Park, Khaptad National Park and Api Nampa Conservation Area to the west; Annapurna Conservation Area and Dhor-

patan Hunting Reserve to the east; Shey-Phoksundo National Park to the north, and Bardia National Park to the south (Figure 1). Barekot’s unique geographical location makes it a critical IBA in Nepal.

Barekot is home to many threatened species, including the Himalayan red panda (*Ailurus fulgens fulgens*), Himalayan black bear (*Ursus thibetanus*), musk deer (*Moschus spp.*), northern red deer (*Muntiacus vaginalis*), Himalayan tahr (*Hemitragus jemlabicus*), common goral (*Naemorbedus goral*), Himalayan serow (*Capriornis thar*), and blue sheep (*Pseudois nayaur*) (Acharya and Paudel 2020; Shrestha et al. 2021a; Shrestha et al. 2021b). Additionally, the study area is also home to various endangered avian species, such as the Cheer pheasant (*Catreus wallichii*), Red-headed Vulture (*Sarcogyps calvus*), and Egyptian Vulture (*Neophron percnopterus*); the nationally threatened Satyr Tragopan (*Tragopan satyra*), Bearded Vulture (*Gypaetus barbatus*), Himalayan Griffon (*Gyps himalayensis*), and Brown Fish Owl (*Bubo zeylonensis*); and the Himalayan Monal (*Lophophorus impejanus*), a Protected bird of Nepal (Paudel & Bhusal 2015). As Barekot has great conservation significance, particularly for birds, the local government has planned to designate the region a conservation area. The aim, while leveraging its tourism potential and promoting the local economy, is to preserve its rich biodiversity and landscape (NTNC 2019).

Table 1 – Adapted from CBS (2014) and DFRS (2018).

Region	Population (individuals)	Elevation (m a.s.l.)	Forest area (hectares)	Total area (hectares)
Barekot	18,083	1,510–5,222	33,734	57,526
Jajarkot	171,304	610–5,412	133,268	221,436
Karnali Province	1570418	180–7,348	3,061,752	1,177,033
Nepal	26,494,504	64–8,848	1,4262,567	6,230,537

Survey methods

A number of complementary methods were used to collect information about avian fauna and associated threats. These included (i) studying the literature; (ii) unstructured interviews with community members; (iii) consultations with experts and selected key stakeholders; (iv) field visits. A questionnaire was administered to 40 households selected randomly from the records of the community forests’ user group. The questionnaires, written in the Nepali language and administered orally, concerned the distribution of bird species and their habitat use.

Field survey

Field surveys were carried out over 4 days in late winter/early spring (23–26 April 2021), from 0700 hrs to 1700 hrs. A comprehensive list of the birds found in the area was recorded. We followed the Timed Species Count (TSC) approach by Bibby et al. (2000) to compile the bird survey data (see Appendix I). Additionally, we referred to a bird field guide by Richard Grimmett et al. (2016) and *Birds of Nepal* (2016) to identify the species. We surveyed birds in four blocks of Barekot RM (i.e. Eastern, Western, Southern and Northern blocks), which have an elevation range of 1,800 m to 2,400 m. These survey blocks were selected based on the land-cover patterns, potential as habitat for species, vegetation, and disturbance factors. A team of 10 individuals were involved in the survey.

Data analysis

A daily list of birds seen and heard was kept in a notebook. The final list of birds was produced using Excel by combining information from observations, consultations and surveys. Birds recorded were evaluated for their global and national importance or status (e.g. threatened), as well as their migratory status. Habitat information and bird records, particularly for threatened/migratory species, were correlated with each other.

Materials

Garmin eTrex-14 GPS and Nikon Monarch 7 8X42 binoculars were used to observe bird species closely; a Canon EOS 80D digital SLR camera with Canon RF 600mm f/11 IS STM lens was used to capture photos; measuring tapes and stationary materials were also used during the field survey. Maps and topographical sheets of the area were also used. Local people were interviewed to collect information on any prevailing threats.

Results

A total of 87 bird species (10 orders and 34 families) were recorded in the study area (see Appendix). The majority of the bird species documented belong to the order *Passeriformes* (Figure 2). *Muscicapidae* is the largest family (n=9 species), followed by *Phylloscopidae*

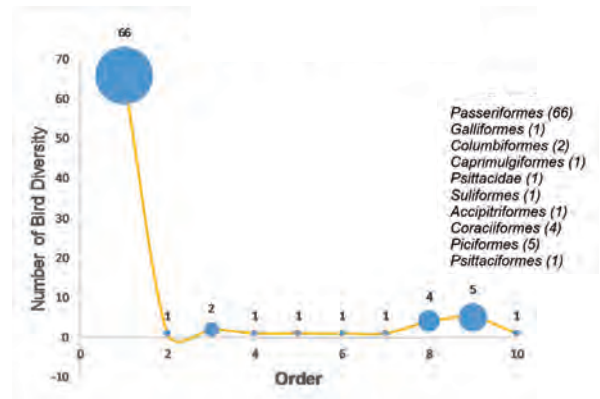


Figure 2 – Order-wise composition of birds in the rural municipality of Barekot, Jajarkot.

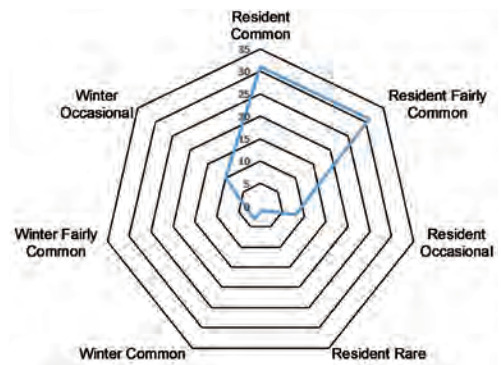


Figure 3 – Occurrence status of birds in the rural municipality of Barekot, Jajarkot.

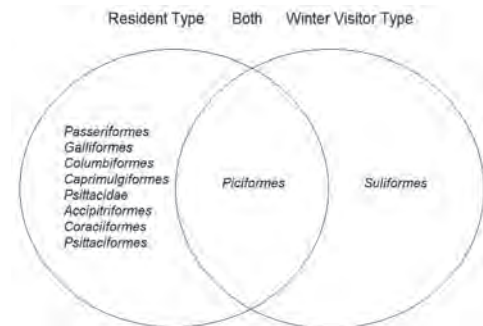


Figure 4 – Venn diagram showing bird occurrence status for species orders.

and *Leiotrichidae*, each with 7 species. Only one species was recorded for each of the following families: *Phasianidae*, *Apodidae*, *Ardeidae*, *Phalacrocoracidae*, *Psittacidae*, *Aegithalidae*, *Timaliidae*, *Cinclidae*, *Sturnidae*, *Turdidae*, *Chloropseidae*, *Dicaeidae* and *Emberizidae*. Among the reported bird species, 81.61% (n=71 species) were of the resident type, and 18.39% (n=16 species) were winter visitors. 34 species (39.08%) of birds were common or fairly common; 18 species (20.69%) were sporadic / occasional, and 1 species (1.15%) was rare (Figure 3). Species belonging to the *Piciformes* order included both residents and winter visitors, whilst species belonging to *Suliformes* were winter visitors only (Figure 4).

Two species, the Himalayan Griffon (*Gyps himalayensis*) and Bearded Vulture (*Gypaetus barbatus*), have



Figure 5 – Olive-Backed Pipit (*Anthus hodgsoni*). © Saroj Shrestha



Figure 6 – Grey bushchat (*Saxicola ferreus*) © Sony Lama

nationally vulnerable status in the International Union for Conservation of Nature and Natural Resources (IUCN) Red Data Book; 85 species are of *least concern* in the Data Book. Six species were listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); five are listed in Appendix II of the CITES Convention, and one in Appendix III of the CITES Convention. None of the recorded bird species are protected by Nepal's National Parks and Wildlife Conservation (NPWC) Act.

The field survey and interviews indicate that the primary threats to avian diversity and survival are poaching and habitat modification.

Discussion

Our study provides the first detailed checklist of birds from Barekot in Western Nepal (see Appendix), with information on species taxa, IUCN threatened species status (i.e. critically endangered, endangered, and vulnerable), CITES Appendix status (CITES Appendices I, II, III), occurrence status (i.e., resident type or visitor type), and associated threats. This study recorded 17.54% of the bird species found in the Karnali region and 9.81% of the total number of bird species found in Nepal. However, in a similar study by Paudel and Bhusal (2015), 146 bird species were identified in Jajarkot district, mostly in Barekot, indicating the drastic decrease in bird species diversity in the region.

Until 2019, the study area in Jajarkot district was not connected by a road usable by motorized vehicles, but the ongoing construction of the hydropower project within the IBA of Barekot has resulted in increased movement of vehicles and people in the area. This has been a key contributing factor to species habitat destruction. The most serious threats to Nepal's bird populations and diversity are habitat loss, degradation and fragmentation (Inskipp et al. 2017). Stephens et al. (2004) concluded that habitat fragmentation at larger scales may affect nesting success, thus reducing the bird populations. Bird species density is negatively as-

sociated with habitat fragmentation (Castelletta et al. 2005; Chace & Walsh 2006; Aronson et al. 2014). In India, dam-building has negatively affected montane birds in the Western Himalaya (Jolli 2017). Conservation biologists suggest that roads have a negative impact on adjacent habitats and their natural communities (Forman 2000; Rheindt 2003). In their study in Bhutan, Thinley et al. (2020) found that hydropower and roads pose a significant threat to wildlife. Rodrigues et al. (2018) suggest that high levels of noise adversely affect birds' behaviour and social communication. Perillo et al. (2017) found that anthropogenic noise can have a significant negative impact on bird diversity.

Illegal hunting and trapping are prevalent in this region (DNPWC & DFSC 2018). In the study area, Cheer pheasants are treated as gamebirds by local communities due to a lack of awareness and a negative attitude towards them (Biodiversity Conservancy Nepal 2016). The population of Galliformes has been reduced dramatically in many parts of Nepal, including protected areas like Kanchenjunga Conservation Area, as they are popular targets for hunters and trappers (Inskipp et al. 2008). In addition to all these factors, there are indications that the Covid-19 pandemic has forced locals to exploit forest resources more than ever, thus increasing the challenges of forest management. The majority of locals (84%) in the study area are engaged in the agricultural sector. Except for May and October (the two months of the agricultural season), most of the local youth head to India as migrant labour (UNRCHCO 2021). During lockdowns in Nepal, Covid-19-driven disruptions in global and regional supply chains, an economic recession, and negligible economic growth severely harmed the local economy and society (ILO 2020).

The impacts of the pandemic coupled with the escalating threats of poaching and habitat modification have serious implications for forest ecosystems in the region, especially bird diversity.

Conclusion

Although the study area accounts for only a small percentage of the entire Nepalese forest cover, it is rich in bird diversity. The geographical location of Berekot makes it an important IBA, despite the decrease in bird diversity. In recent years, populations of bird species in the study area have plummeted due to human activities and anthropogenic effects. This study provides information about the bird diversity of the study area during the early spring, but detailed all-season surveys are needed to evaluate precise bird diversity in Berekot. Further, in-depth longitudinal bird studies should also be carried out in Nepal, notably in Siwalik (~1,500 m) and Mahabharat lekh (600 m to 3,000 m). Also recommended are comprehensive studies of the impacts of the hydropower project, the construction of roads, illegal hunting and trapping, and Covid-19 on the local economy. Finally, awareness-raising campaigns to mitigate the effects of other harmful activities (notably killing or hunting bird species) are imperative.

References

- Acharya, K.P. & P.K. Paudel 2020. *Biodiversity in Karnali Province: Current status and conservation*. Ministry of Industry, Tourism, Forest and Environment, Karnali Province Government, Surkhet, Nepal.
- Amat, J.A. & A.J. Green 2010. Waterbirds as bioindicators of environmental conditions. In: Hurford, C., M. Schneider & I. Cowx, *Conservation monitoring in freshwater habitats*: 45–52. Dordrecht.
- Aronson, M.F.J., F.A. La Sorte, C.H. Nilon, M. Katti, M.A. Goddard, C.A. Lepczyk, P.S. Warren, N.S.G. Williams, S. Cilliers, B. Clarkson, C. Dobbs, R. Dolan, M. Hedblom, S. Klotz, J.L. Kooijmans, I. Kühn I. MacGregor-Fors, M. McDonnell, U. Mörtberg, P. Pyšek, S. Siebert, J. Sushinsky, P. Werner & M. Winter 2014. A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. *Proceedings of the Royal Society B*. 281: 20133330. Doi: 10.1098/rspb.2013.3330
- Bensizerara, D., H. Chenchouni, A.S. Bachir & M. Houhamdi 2013. Ecological status interactions for assessing bird diversity in relation to a heterogeneous landscape structure. *Avian Biology Research* 6(1): 67–77.
- Bhandari, G.P., S.M. Dixit, U. Ghimire & M.K. Maskey 2009. Outbreak investigation of diarrheal diseases in Jajarkot. *Journal of Nepal Health Research Council* 7(2): 66–68.
- Bhusal, K.P. & G.B. Singh 2017. First Breeding record of Great Cormorant *Phalacrocorax carbo* in Nepal. Available at: https://www.researchgate.net/publication/317258934_First_Breeding_record_of_Great_Cormorant_Phalacrocorax_carbo_in_Nepal (accessed: 24/03/2022)
- Bibby, C.J., N.D. Burgess, D.A. Hill, D.M. Hillis & S. Mustoe 2000. *Bird census techniques*. Biodiversity Conservancy Nepal 2016. Cheer Pheasants Conservation Initiative. Available from: <https://www.bioconnepal.org/project/detail/11/cheer-pheasants-conservation-initiative#> (accessed: 24/03/2022)
- Bird Conservation Nepal 2021. Bird Conservation Nepal. Available from: <https://www.birdlifeneपाल.org/birds/important-birds-areas> (accessed: 11/06/2021)
- Bista, D., S. Shrestha, P. Sherpa, G.J. Thapa, M. Kokh, S.T. Lama, K. Khanal, A. Thapa & S.R. Jnawali 2017. Distribution and habitat use of red panda in the Chitwan-Annapurna Landscape of Nepal. *PLoS one* 12(10): p.e0178797.
- Castelletta, M., J.M. Thiollay & N.S. Sodhi 2005. The effects of extreme forest fragmentation on the bird community of Singapore Island. *Biological conservation* 121(1): 135–155.
- Central Bureau of Statistics (CBS) 2012. *National Population and Housing Census*. Kathmandu, Nepal: National Planning Commission Secretariat, Government of Nepal.
- Central Bureau of Statistics (CBS) 2014. Population Monograph of Nepal. Available from: <https://nepal.unfpa.org/sites/default/files/pub-pdf/PopulationMonograph2014Volume1.pdf> [Accessed 11 June 2021].
- Chace, J.F. and Walsh, J.J., 2006. Urban effects on native avifauna: a review. *Landscape and urban planning*, 74(1), pp.46–69.
- DFRS, 2018. Forest Cover Maps of Local Levels (753) of Nepal. Department of Forest Research and Survey (DFRS), Kathmandu, Nepal. Available from: https://www.researchgate.net/publication/338689224_Forest_Cover_Maps_of_Local_Levels_753_of_Nepal (accessed: 11/06/2021)
- DNPWC 2017. *Profiling of Protected and Human Wildlife Conflicts Associated Wild Animals in Nepal*. Department of National Parks and Wildlife Conservation, Kathmandu, Nepal.
- DNPWC and BCN 2018. *Birds of Nepal: An official checklist*. Department of National Parks and Wildlife Conservation and Bird Conservation Kathmandu, Nepal. Available at: <http://www.himalayanwolvesproject.org/wp-content/uploads/2016/05/Birds-of-Nepal-An-Official-Checklist-2018.pdf> (accessed: 11/06/2021)
- DNPWC and DFSC 2018. *Pheasant Conservation Action Plan for Nepal (2019–2023)*. Department of National Parks and Wildlife Conservation and Department of Forests and Soil Conservation. Kathmandu, Nepal
- Forman, R.T. 2000. Estimate of the area affected ecologically by the road system in the United States. *Conservation Biology* 14(1): 31–35.
- Grimmett, R., C. Inskipp, T. Inskipp & H.S. Baral 2016. *Birds of Nepal*.
- Inskipp, C., H.S. Baral, T. Inskipp, A.P. Khatiwada, M.P. Khatiwada, L.P. Poudyal & R. Amin 2017. Nepal's National Red List of Birds. *Journal of Threatened Taxa* 9(1): 9700–9722.
- Inskipp, C., T. Inskipp, R. Winspear, P. Collin, A. Robin, J. Thakuri & M. Pandey 2008. *Bird survey of*

Kanchenjunga Conservation Area, April 2008. Kathmandu, Nepal and Sandy, UK. Bird Conservation Nepal and Royal Society for the Protection of Birds.

International Labour Organization (ILO) 2020. COVID-19 labour market impact in Nepal. Available at: https://www.ilo.org/kathmandu/whatwedo/publications/WCMS_745439/lang--en/index.htm (accessed: 11/06/2021)

Jolli, V. 2017. Hydro power development and its impacts on the habitats and diversity of montane birds of western Himalayas. *Vestnik zoologii* 51(4): 311.

Lama, S., S. Shrestha, N.P. Koju, A.P. Sherpa & M. Tamang 2020. Assessment of the Impacts of Livestock Grazing on Endangered Red Panda (*Ailurus fulgens*) Habitat in Eastern Nepal. *Open Journal of Ecology* 10(3): 97–110.

Ministry of Forests and Soil Conservation (MoF-SC) 2016. *Conservation Landscapes of Nepal*. Ministry of Forests and Soil Conservation, Singha Durbar, Kathmandu, Nepal.

Morante-Filho, J.C. & D. Faria 2017. An appraisal of bird-mediated ecological functions in a changing world. *Tropical Conservation Science* 10: 1940082917703339

National Trust for Nature Conservation (NTNC) 2019. Feasibility Study for Conservation Area in Jajarkot and Adjoining Areas. Available from: https://ntnc.org.np/sites/default/files/doc_notices/2019-02/EOI%20Document.pdf (accessed 25/03/2022)

Paudel, K. & K.P. Bhusal 2015. *Ecological Monitoring and Conservation of Vultures in Jajarkot District, Nepal*. A technical report submitted to Oriental Bird Club.

Perillo, A., L.G. Mazzoni, L.F. Passos, V.D. Goulart, C. Duca & R.J. Young 2017. Anthropogenic noise reduces bird species richness and diversity in urban parks. *Ibis* 159(3): 638–646.

Prakash, V., S. Sivakumar & J. Verghese 2001. *Avifauna as indicators of habitat quality in Buxa Tiger Reserve*. Quarterly Report IV. Bombay Natural History Society, Mumbai.

Rheindt, F.E. 2003. The impact of roads on birds: does song frequency play a role in determining susceptibility to noise pollution? *Journal für Ornithologie* 144(3): 295–306.

Rodrigues, A.G., M. Borges-Martins F. Zilio 2018. Bird diversity in an urban ecosystem: the role of local habitats in understanding the effects of urbanization. *Iheringia. Série Zoologia*: 108.

Sekercioglu, Ç.H., D.G. Wenny & C.J. Whelan (eds.) 2016. *Why birds matter: avian ecological function and ecosystem services*.

Shrestha, S., S. Lama, A.P. Sherpa, D. Ghale & S.T. Lama 2021a. The endangered Himalayan Red Panda: first photographic evidence from its westernmost distribution range. *Journal of Threatened Taxa* 13(5): 18156–18163.

Shrestha, S., A. Thapa, D. Bista, N. Robinson, A.P. Sherpa, K.P. Acharya, S. Jnawali & S. Lama 2021b. Distribution and habitat attributes associated with the Himalayan red panda in the westernmost distribution range. *Ecology and Evolution* 11(9): 4023–4034.

Stephens, S.E., D.N. Koons, J.J. Rotella, D.W. Willey 2004. Effects of habitat fragmentation on avian nesting success: a review of the evidence at multiple spatial scales. *Biological conservation* 115(1): 101–110.

Thinley, P., T. Norbu, R. Rajaratnam, K. Vernes, P. Dhendup, J. Tenzin, K. Choki, S. Wangchuk, T. Wangchuk, S. Wangdi & D.B. Chhetri 2020. Conservation threats to the endangered golden langur (*Trachypitecus geei*, Khajuria 1956) in Bhutan. *Primates* 61(2): 257–266.

UNRCHCO 2021. UNDAF District Profile: Jajarkot. Available at: <https://un.info.np/Net/NeoDocs/View/4202> (accessed 11/06/2021)

Upadhyay, S.K., P.M.S. Pradhan, R.K. Mahato, B. Marasini, B. Upadhyaya, G. Shakya, G. Baral & K.P. Baral 2016. Outbreak Investigation of Influenza in Pajura VDC of Jajarkot District of Nepal. *Journal of Nepal Health Research Council*.

Authors

Sony Lama¹

has been involved with the Red Panda Network (RPN) as program associate since 2018. Her expertise and interests lie in global changes and environmental governance. sonylama2016sony@gmail.com

Saroj Shrestha^{1,2}

specializes in conservation ecology. One of his areas of particular concern is the protection of endangered species and the Himalayas' unique flora and fauna. His research interests include reintroduction biology, and the monitoring and management of threatened species. saroj.stha44@gmail.com

Ang Phuri Sherpa¹

has decades of experience in the conservation sector, and has worked for WWF Nepal in different capacities for more than ten years. He has been involved with the RPN as a Country Director since 2014. ang.sherpa@redpandanetwork.org

Munmun Tamang¹

is involved with the RPN as a program associate. Use of Arc-GIS and academic writing are her fortes. munmun.tamang@redpandanetwork.org

Dinesh Ghale¹

previously worked with WWF Nepal in Central Nepal. He has been working for the RPN since 2016 and

is currently responsible for a red panda conservation project in Western Nepal. Project management and planning are his strong suits. Dinesh holds a Bachelor's degree in Forestry. dinesh.ghale@redpandanetwork.org

¹ Red Panda Network, 198, Dasarath Chand Marga, Baluwatar, Kathmandu, 44600, Nepal

² The Australian National University, Canberra ACT 0200, Australia

Appendix – Bird checklist for the study area. Notes on status: CITES Appendices: I – Appendix I, II – Appendix I, III – Appendix III; Conservation Status: VU – Nationally Vulnerable; Occurrence Status: R – Resident, W – Winter, 1 – Common.

SN	Order	Family	English name	Scientific name	Status
1	Galliformes	Phasianidae	Kalij Pheasant	<i>Lophura leucomelanos</i>	III, R, 2
2	Columbiformes	Columbidae	Snow Pigeon	<i>Columba leuconota</i>	R, 3
3			Oriental Turtle-dove	<i>Streptopelia orientalis</i>	R, 2
4	Caprimulgiformes	Apodidae	House Swift	<i>Apus nipalensis</i>	R, 1
5	Pelecaniformes	Ardeidae	Indian Pond-heron	<i>Ardeola grayii</i>	R, 1
6	Suliformes	Phalacrocoracidae	Great Cormorant	<i>Phalacrocorax carbo</i>	W, 1
7	Accipitriformes	Accipitridae	Crested Serpent-eagle	<i>Spilornis cheela</i>	II, R, 1
8			Himalayan Griffon	<i>Gyps himalayensis</i>	II, VU, R, 2
9			Bearded Vulture	<i>Gypaetus barbatus</i>	II, VU, R, 4
10			Black Kite	<i>Milvus migrans</i>	II, R, 1
11	Coraciiformes	Alcedinidae	Common Kingfisher	<i>Alcedo atthis</i>	R, 1
12			Crested Kingfisher	<i>Megaceryle lugubris</i>	R, 2
13			White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	R, 1
14	Piciformes	Megalaimidae	Great Barbet	<i>Psilopogon virens</i>	R, 1
15			Blue-throated Barbet	<i>Psilopogon asiaticus</i>	R, 1
16		Picidae	Scaly-bellied Woodpecker	<i>Picus squamatus</i>	R, 2
17			Black-naped Woodpecker	<i>Picus guerini</i>	R, 2
18	Psittaciformes	Psittacidae	Slaty-headed Parakeet	<i>Psittacula himalayana</i>	II, R, 3
19	Passeriformes	Campephagidae	Long-tailed Minivet	<i>Pericrocotus ethologus</i>	R, 2
20			Scarlet Minivet	<i>Pericrocotus flammeus</i>	R, 2
21		Corvidae	Yellow-billed Blue Magpie	<i>Urocissa flavirostris</i>	R, 2
22			Grey Treepie	<i>Dendrocitta formosae</i>	R, 1
23			Large-billed Crow	<i>Corvus macrorhynchos</i>	R, 1
24		Stenostiridae	Yellow-bellied Fairy-fantail	<i>Chelidorhynch hypoxanthus</i>	R, 2
25			Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	R, 2
26		Paridae	Green-backed Tit	<i>Parus monticolus</i>	R, 1
27			Great Tit	<i>Parus major</i>	R, 1
28			Black-lored Tit	<i>Machlolophus xanthogenys</i>	R, 1
29			Yellow-browed Tit	<i>Sylviparus modestus</i>	R, 3
30		Cisticolidae	Common Tailorbird	<i>Orthotomus sutorius</i>	R, 1
31			Grey-breasted Prinia	<i>Prinia hodgsonii</i>	R, 1
32		Hirundinidae	Barn Swallow	<i>Hirundo rustica</i>	R, 1
33			Red-rumped Swallow	<i>Cecropis daurica</i>	R, 2
34		Pycnonotidae	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	R, 1
35			Black Bulbul	<i>Hypsipetes leucocephalus</i>	R, 1
36			Mountain Bulbul	<i>Ixos mcclllandii</i>	R, 2
37			Red-vented Bulbul	<i>Pycnonotus cafer</i>	R, 1
38		Phylloscopidae	Ashy-throated Warbler	<i>Phylloscopus maculipennis</i>	W, 3
39			Grey-hooded Warbler	<i>Phylloscopus xanthoschistos</i>	R, 1
40			Lemon-rumped Leaf-warbler	<i>Phylloscopus chloronotus</i>	W, 3
41			Buff-barred Warbler	<i>Phylloscopus pulcher</i>	W, 3
42			Chestnut-crowned Warbler	<i>Phylloscopus castaniceps</i>	R, 3
43			Blyth's Leaf-warbler	<i>Phylloscopus reguloides</i>	W, 3
44			Chestnut-headed Tesia	<i>Cettia castaneocoronata</i>	R, 3
45		Aegithalidae	Red-headed Tit	<i>Aegithalos iredalei</i>	R, 1
46		Zosteropidae	Oriental White-eye	<i>Zosterops palpebrosus</i>	R, 1
47			Stripe-throated Yuhina	<i>Yuhina gularis</i>	R, 2
48			Whiskered Yuhina	<i>Yuhina flavicollis</i>	R, 2
49		Timaliidae	Black-chinned Babbler	<i>Cyanoderma pyrrhops</i>	R, 3
50		Leiostichidae	Chestnut-crowned Laughingthrush	<i>Trochalopteron erythrocephalum</i>	R, 2
51			Striated Laughingthrush	<i>Grammatoptila striata</i>	R, 2
52			White-throated Laughingthrush	<i>Garrulax albogularis</i>	R, 1
53			Blue-winged Minla	<i>Siva cyanouroptera</i>	R, 2
54			Bar-throated Minla	<i>Chrysominla strigula</i>	R, 2
55			Rufous Sibia	<i>Heterophasia capistrata</i>	R, 1
56		Sittidae	White-tailed Nuthatch	<i>Sitta himalayensis</i>	R, 2
57			Wallcreeper	<i>Tichodroma muraria</i>	W, 3
58		Cinclidae	Brown Dipper	<i>Cinclus pallasii</i>	R, 2
59		Sturnidae	Common Myna	<i>Acridotheres tristis</i>	R, 1
60		Turdidae	Long-billed Thrush	<i>Zoothera monticola</i>	W, 3

SN	Order	Family	English name	Scientific name	Status
61	Passeriformes	Muscicapidae	Blue Whistling-thrush	<i>Myophonus caeruleus</i>	R, 1
62			Himalayan Bush-robin	<i>Tarsiger rufilatus</i>	W, 3
63			White-capped Water-redstart	<i>Phoenicurus leucocephalus</i>	R, 1
64			Blue-fronted Redstart	<i>Phoenicurus frontalis</i>	W, 1
65			Plumbeous Water-redstart	<i>Phoenicurus fuliginosus</i>	R, 1
66			Black-backed Forktail	<i>Enicurus immaculatus</i>	R, 3
67			Little Forktail	<i>Enicurus scouleri</i>	R, 2
68			Rufous-gorgeted Flycatcher	<i>Ficedula strophata</i>	R, 2
69			Grey Bushchat	<i>Saxicola ferreus</i>	R, 2
70			Pied Bushchat	<i>Saxicola caprata</i>	R, 2
71		Chloropseidae	Orange-bellied Leafbird	<i>Chloropsis hardwickii</i>	R, 2
72		Dicaeidae	Fire-breasted Flowerpecker	<i>Dicaeum ignipectus</i>	R, 2
73		Nectariniidae	Green-tailed Sunbird	<i>Aethopyga nipalensis</i>	R, 2
74			Black-throated Sunbird	<i>Aethopyga saturata</i>	R, 2
75			Purple Sunbird	<i>Cinnyris asiaticus</i>	R, 1
76		Passeridae	Russet Sparrow	<i>Passer cinnamomeus</i>	R, 3
77			Eurasian Tree Sparrow	<i>Passer montanus</i>	R, 1
78			House Sparrow	<i>Passer domesticus</i>	R, 1
79		Motacillidae	Grey Wagtail	<i>Motacilla cinerea</i>	R, 2
80			Olive-backed Pipit	<i>Anthus hodgsoni</i>	W, 1
81	Rosy Pipit		<i>Anthus roseatus</i>	W, 2	
82	Fringillidae	Pink-browed Rosefinch	<i>Carpodacus rodochroa</i>	W, 2	
83		Dark-breasted Rosefinch	<i>Procarduelis nipalensis</i>	W, 2	
84		Spot-winged Rosefinch	<i>Carpodacus rodopeplus</i>	W, 3	
85		Scarlet Finch	<i>Carpodacus sipahi</i>	W, 3	
86		Yellow-breasted Greenfinch	<i>Chloris spinoides</i>	R, 2	
87	Emberizidae	Rock Bunting	<i>Emberiza cia</i>	W, 3	