Sustainability and Biodiversity Conservation

Avifaunal Diversity in Urban-Sprawl along the Rispana River Basin in Dehradun, Uttarakhand

Hritik Nautiyal[1] , Sunny Joshi*[2] , Suneet Naithani[3]

[1]Himalayan Institute for Sustainable Environment and Research Society, Dehradun
[2]Raptor Conservation Program, WWF-India
[3]School of Environment & Natural Resources, Doon University, Dehradun, Uttarakhand, India
1. Hritik Nautiyal: hritiknautiyal14@gmail.com

*Email: sjoshi@wwfindia.net

3. Dr. Suneet Naithani: suneetnaithani@gmail.com

Received: 28 July 2023 / Revised: 25 August 2023/ Accepted: 01 c 2023/ Published online: 01 September 2023.
How to cite: Nautiyal, H., Joshi, S., Naithani. (2023). Avifaunal Diversity in Urban-Sprawl along the Rispana River Basin in Dehradun, Uttarakhand. Sustainability and Biodiversity Conservation, 2(1), 1-11**. DOI:** https://doi.org/10.5281/zenodo.8352330

Abstract

The current study focuses on the observation of avifauna in the catchment area of the Rispana River and its surrounding urban spaces in Dehradun. Direct observations were made to record the diversity of the avifauna to create a checklist. The study was carried out from January 2022 to December 2022. A total of 214 species were recorded belonging to 64 families during the study period. The maximum number of species belonged to the Muscicapidae family with the highest relative density of 10.74%, followed by Accipitridae and Picidae both with a relative density of 7.47% and 4.67%.
Keywords: Avifauna, Rispana, Dehradun

Introduction

The avifaunal diversity of an ecosystem is an imperative factor in knowing the robustness of that specified ecosystem(Callaghan et al., 2018). The proper management and conservation of avifauna can be achieved by regular monitoring and valuation(Knick et al., 2003). The diversity of avifauna has been decreasing in recent years this is due to the widespread degradation of natural habitat. It is critical to protect the avifauna hence understanding the deteriorating trend requires a deep study of ecology (Saklani et al., 2018). The study area is a part of the Himalayan foothills, which is a mega hotspot for avifauna and other biological

diversities (Kumar, 2021). The variation of vegetation and plant species at different altitudes makes the Himalayan foothills a great site of habitation for various kinds of birds and other animal species(Singh & Rawat, 1999). Estimation of bird species of a specific area indicates the health of the ecosystem of that area and it can also help in understanding the major changes an ecosystem is going through(Wheeler et al., 2015). The present study also focused on the aspects of urbanization and its repercussions on the avian diversity of the region. Birds, unlike other vertebrates, are easily observed by competent observers and provide a vehicle for investigating urban effects and reactions to various urban designs (Chace & Walsh, 2006). In many regions of the world, studies on the effect of intensifying urbanisation, i.e., the rural-to-urban gradient, on bird variety have been conducted, and it has been discovered that the most diversified bird groups are found in settings with an intermediate level of human disturbance.(Blair, 1996). Avian species show a direct response to different vegetation structures and their diversity increases with quality of vegetation composition (Shahi et al., 2017). In comparison to nearby natural regions, urban environments had a low bird species richness and a high total density or biomass (Verma & Murmu, 2015). Avifauna biodiversity of a specific area has its own significance as birds contribute to various ecological functions and services which are essential for preserving a sustainable ecosystem(Whelan et al., 2015). Various scientific studies have provided evidence by establishing a relation of climate change and its associated causes with avifauna diversity and distribution(Chambers et al., 2005). Weather has a significant impact on bird population dynamics, but the consequences of climate change have only lately been explored(Crick, 2004). There is already solid evidence that recent climate change has had an impact on birds. Early breeding; changes in migratory timing; variations in breeding performance (egg size, nesting success); changes in population numbers; changes in population distributions; and changes in selection differentials between components of a population are examples of effects caused by climate change (Crick, 2004). Birds are an integral part of the aquatic food chain(Nakano & Murakami, 2001). They eat plants, fish, and other animals in the reservoir, while birds such as Kingfishers, Storks, Cormorants, and Herons eat fish, frogs, tadpoles, and terns eat in deeper waters (Donar et al., 2012). The main purpose of this study is to document the avian diversity Rispana River still carries, despite being heavily polluted. This study also explains the ecological importance of the Rispana river.

Materials and methods

Study Area

The present study was carried out at the banks of Rispana river (30.2915° N, 78.0543° E). The Rispana river is one of numerous tributaries of the Ganga which flows through Dehradun. It originates from the Mussoorie hills and flows through Dehradun before joining the Bindal river in Mothrowala (B. K. Pandey et al., 2021). The Rispana River has served Dehradun City's requirements ever since antiquity. But as Dehradun city grew, it transformed into a contaminated watercourse with ephemeral features (R. P. Pandey et al., 2021). The Rispana catchment's annual water budgeting estimates that rainfall contributes to a total input of around 120.102 MCM, of which about 55.607 MCM and 40.939 MCM flow out as evapotranspiration and runoff, respectively. The total amount of water used by springs and river flow tapping is 5.200 MCM. For the lean season, Rispana River needs 38.447 MCM of water per year to maintain flow (November to May).(Pandey et al., 2021) What was once a wide, pristine river was damaged by the city's expanding population. People started tossing household waste into the river. Following the establishment of Dehradun as the state capital, slums housing migrant labour arose along its banks. These slums have evolved into long-term settlements at this point. The river was formerly 100 metres wide, but it is now just 10 to 20 metres wide. Its numerous tributaries have all suffered from unplanned development around the city. This study's major goal was to highlight how much avifaunal diversity Rispana still had despite its extreme pollution and terminal condition.

Materials and Methods

The surveys were conducted fortnightly from January 2022 to December 2022 excluding the rainy days. The data was collected from 06:00 AM to 09:00 AM in the morning and 03:00 PM to 05:30 PM in the evening. Point count method and line transect methods were used to carry out the surveys, the linear transects were upto 200-500 metres depending on accessibility along the river bank. The observations were carried out by the help of Canon EOS 1300D with a zoom lens of 55-250 mm and Nikon acuflow 8x42 binoculars were also used. ‘Birds of the Indian subcontinent’ by ‘Carol Inskipp’, ‘Richard Grimmett’ and ‘Tim Inskipp’ was used as a field guide. Some naked eye observations and opportunistic sightings also contribute to this study.

Results and Discussion

A total of 214 species were recorded which belonged to 64 families. The present study discussed that out of 64 families, Muscicapidae family dominated the study area by a total of 23 species achieving highest relative density of 10.74%. The other two dominant families were Accipitridae, with a total of 16 species and achieving a relative density of 7.47% and Picidae with a total of 10 species and achieving a relative density of 4.67%. There were 22 families which were the least dominant with only a single species achieving a relative density of 0.46%. The study also found 2 endangered species i.e., Egyptian vulture and Steppe eagle, which were spotted only once and 4 near threatened species i.e., Cinereous Vulture, Himalayan Griffon, River lapwing and Alexandrine Parakeet and these species were spotted several times. The study also provided analysis on migratory status of avian species which revealed that out of 216 avian species, 20 species were winter migrants, 38 species were summer migrants, 10 were passage migrants and the 166 were residents. Forest, shrub, and agricultural patches are more important habitats for bird groups, and these types of habitats attract a greater number of avian species due to abundant food and nesting opportunities. Streams of water gave an appropriate habitat for a variety of waterbird species, including kingfishers and cormorants (Arya et al., 2019). The presence of an Egyptian vulture at a specific location suggests that this species has a major habitat. Vultures, as scavengers, play a crucial ecological role in preserving ecosystem balance. They remove animal waste from the environment, including livestock corpses, wild animal carcasses, and carrion (Singh & Bisht, n.d.). We found that most of the species were insectivorous, indicating that the research area contains a diverse insect population. Different types of habitats are also responsible for increasing insect diversity, which in turn increases bird diversity and population in specific places.

Table 1. Checklist of the recorded bird species (*WM = Winter migrants, SM = summer migrants, PM = passage migrants, R = residents, LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, CR = critically endangered)*

Accipitridae	Black winged kite	*Elanus Caeruleus*	R	LC
	Shikra	*Accipiter badius*	R	LC
	Black kite	*Milvus migrans*	R	LC
	Egyptian Vulture	*Neophron percnopterus*	R	EN
	Cinereous vulture	*Aegypius monachus*	WM	NT
	Booted eagle	*Hieraaetus pennatus*	R/PM	LC
	Steppe eagle	*Aquila nipalensis*	WM	EN
	Besra	*Accipiter virgatus*	R	LC
	Crested serpent eagle	*Spilornis cheela*	R	LC
	Changeable hawk-eagle	*Nisaetus cirrhatus*	R	LC
	Mountain hawk eagle	*Nisaetus nipalensis*	R	LC

	Himalayan griffon	*Gyps himalayensis*	R	NT
	Eurasian griffon	*Gyps fulvus*	WM	LC
	Oriental Honey buzzard	*Pernis ptilorhynchus*	R	LC
	Long legged buzzard	*Buteo rufinus*	WM	LC
	Eurasian sparrow hawk	*Accipiter nisus*	R	LC
Acrocephalidae	Blyth's reed warbler	*Acrocephalus dumetorum*	PM	LC
Aegithalidae	Black throated tit	*Aegithalos concinnus*	R	LC
Alaudidae	Ashy-crowned sparrow-lark	*Eremopterix griseus*	R	LC
Alcedinidae	Common kingfisher	*Alcedo atthis*	R/SM	LC
	White-throated Kingfisher	*Halcyon smyrnensis*	R	LC
	Stork-billed kingfisher	*Pelargopsis capensis*	R	LC
	Crested kingfisher	*Megaceryle lugubris*	R	LC
	Pied kingfisher	*Ceryle rudis*	R	LC
Ardeidae	Cattle Egret	*Bubulcus ibis*	R	LC
	Indian Pond-Heron	*Ardeola grayii*	R	LC
Apodidae	Common swift	*Apus*	SM	LC
	Himalayan swiftlet	*Aerodramus brevirostris*	R	LC
Bucerotidae	Indian Gray Hornbill	*Ocyceros birostris*	R	LC
	Oriental pied hornbill	*Anthracoceros albirostris*	R	LC
Campephagidae	Long tailed minivet	*Pericrocotus ethologus*	R/SM/ WM	LC
	Large cuckooshrike	*Coracina macei*	R	LC
Certhiidae	Bar tailed treecreeper	*Certhia himalayana*	R	LC
Cettiidae	Grey sided bush warbler	*Cettia brunnifrons*	SW/WM	LC
	Chestnut crowned bush warbler	*Cettia major*	R	LC
	Chestnut headed tesia	*Cettia castaneocoronata*	R	LC
Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	R	LC
	River lapwing	*Vanellus duvaucelii*	R	NT
Chloropseidae	Golden-fronted leafbird	*Chloropsis aurifrons*	R	LC
	Orange bellied leafbird	*Chloropsis hardwickii*	R	LC
Cinclidae	Brown dipper	*Cinclus pallasii*	R	LC
Cisticolidae	Ashy Prinia	*Prinia socialis*	R	LC
	Common Tailorbird	*Orthotomus sutorius*	R	LC
	Grey breasted prinia	*Prinia hodgsonii*	R	LC
Columbidae	Rock Pigeon	*Columba livia*	R	LC
	Oriental Turtle-Dove	*Streptopelia orientalis*	R/SM	LC
	Eurasian Collared-Dove	*Streptopelia decaocto*	R/SM	LC
	Spotted Dove	*Streptopelia chinensis*	R	LC
	Laughing Dove	*Spilopelia senegalensis*	R	LC
	Red collared dove	*Streptopelia tranquebarica*	SM	LC
	Common Emerald Dove	*Chalcophaps indica*	R	LC
	Wedge tailed green pigeon	*Treron sphenurus*	R	LC
	Yellow footed green pigeon	*Treron phoenicoptera*	R	LC
Coraciidae	Indian roller	*Coracias benghalensis*	R	LC
	Oriental dollarbird	*Eurystomus orientalis*	R	LC
Corvidae	House Crow	*Corvus splendens*	R	LC
	Large billed crow	*Corvus macrorhynchos*	R	LC
	Rufous Treepie	*Dendrocitta vagabunda*	R	LC
	Indian jungle Crow	*Corvus culminatus*	R	LC
	Grey treepie	*Dendrocitta formosae*	R	LC
	Red billed blue magpie	*Urocissa erythroryncha*	R	LC
Cuculidae	Greater Coucal	*Centropus sinensis*	R	LC
	Jacobin cuckoo	*Clamator jacobinus*	R	LC
	Common Cuckoo	*Cuculus canorus*	SM	LC
	Asian Koel	*Eudynamys scolopaceus*	SM	LC

	Indian cuckoo	*Cuculus micropterus*	R	LC
	Lesser Coucal	*Centropus bengalensis*	R	LC
	Common Hawk-Cuckoo	*Hierococcyx varius*	R	LC
	Banded bay cuckoo	*Cacomantis sonneratii*	R	LC
	Grey-bellied cuckoo	*Cacomantis passerinus*	SM	LC
Dicruridae	Black Drongo	*Dicrurus macrocercus*	R	LC
	Ashy Drongo	*Dicrurus leucophaeus*	SM	LC
	Bronzed drongo	*Dicrurus aeneus*	R	LC
	Hair crested drongo	*Dicrurus hottentottus*	R	LC
Dicaeidae	Thick billed flowerpecker	*Dicaeum agile*	R	LC
	Fire breasted flowerpecker	*Dicaeum ignipectus*	R	LC
Emberizidae	Crested bunting	*Melophus lathami*	SM	LC
	White capped bunting	*Emberiza stewarti*	R	LC
Estrildidae	Red Avadavat	*Amandava*	R	LC
	Scaly-breasted Munia	*Lonchura punctulata*	R	LC
Eurylaimidae	Long tailed broadbill	*Psarisomus dalhousiae*	R	LC
Fringillidae	Scarlet rosefinch	*Carpodacus erythrinus*	WM	LC
	Yellow breasted greenfinch	*Chloris spinoides*	SW/WM	LC
Falconidae	Eurasian Kestrel	*Falco tinnunculus*	R/SM	LC
Hirundinidae	Streak throated swallow	*Petrochelidon fluvicola*	R	LC
	Barn swallow	*Hirundo rustica*	SM/WM/PM	LC
	Wire-tailed Swallow	*Hirundo smithii*	SM/PM	LC
	Dusky crag martin	*Ptyonoprogne concolor*	R	LC
Laniidae	Long-tailed Shrike	*Lanius schach*	R	LC
	Bay backed shrike	*Lanius vittatus*	R	LC
Leiothrichidae	White crested laughing thrush	*Garrulax leucolophus*	R	LC
	Streaked laughing thrush	*Trochalopteron lineatum*	R	LC
	Red billed leiothrix	*Leiothrix lutea*	R	LC
	Jungle Babbler	*Turdoides striata*	R	LC
	Large grey babbler	*Turdoides malcolmi*	R	LC
	Striated babbler	*Turdoides earlei*	R	LC
	Rufous sibia	*Heterophasia capistrata*	R	LC
Megalaimidae	Brown-headed Barbet	*Psilopogon zeylanicus*	R	LC
	Great barbet	*Megalaima virens*	R	LC
	Coppersmith Barbet	*Megalaima haemacephala*	R	LC
	Blue throated barbet	*Megalaima asiatica*	R	LC
Meropidae	Blue-bearded bee-eater	*Nyctyornis athertoni*	R	LC
	Chestnut-headed Bee-eater	*Merops leschenaulti*	R	LC
	Asian green bee-eater	*Merops orientalis*	R	LC
	Blue tailed bee eater	*Merops philippinus*	SM	LC
Monarchidae	Indian Paradise-Flycatcher	*Terpsiphone paradisi*	SM	LC
Motacillidae	Grey Wagtail	*Motacilla cinerea*	SM	LC
	White-browed Wagtail	*Motacilla maderaspatensis*	WM	LC
	White Wagtail	*Motacilla alba*	WM	LC
	Rosy pipit	*Anthus roseatus*	SM	LC
	Tree pipit	*Anthus trivialis*	PM/SM	LC
	Paddy field pipit	*Anthus rufulus*	R	LC
Muscicapidae	Pied bush chat	*Saxicola caprata*	R/SM	LC
	Indian rock chat	*Oenanthe fusca*	R	LC
	Common Stonechat	*Saxicola Torquatus*	WM	LC
	Siberian stonechat	*Saxicola maurus*	SM/PM	LC
	Oriental magpie robin	*Copsychus saularis*	R	LC

	Indian robin	*Copsychus fulicatus*	R	LC
	Blue whistling thrush	*Myophonus caeruleus*	R	LC
	Blue capped rock thrush	*Monticola cinclorhynchus*	SM	LC
	Chestnut bellied rock thrush	*Monticola rufiventris*	R	LC
	Black redstart	*Phoenicurus ochruros*	R	LC
	Plumbeous redstart	*Rhyacornis fuliginosa*	R	LC
	White capped redstart	*Chaimarrornis leucocephalus*	R/SM	LC
	Blue capped redstart	*Phoenicurus caeruleocephala*	R	LC
	Grey bushchat	*Saxicola ferreus*	R	LC
	Himalayan rubythroat	*Luscinia pectoralis*	R	LC
	Slaty blue flycatcher	*Ficedula tricolor*	SM	LC
	Dark sided flycatcher	*Muscicapa sibirica*	SM	LC
	Little forktail	*Enicurus scouleri*	R	LC
	Spotted forktail	*Enicurus maculatu*	R	LC
	Ultramarine flycatcher	*Ficedula superciliaris*	SM	LC
	Verditer flycatcher	*Eumyias thalassinus*	SM	LC
	Small niltava	*Niltava macgrigoriae*	R	LC
	Rufous bellied niltava	*Niltava sundara*	R	LC
Nectariniidae	Crimson Sunbird	*Aethopyga siparaja*	R	LC
	Purple Sunbird	*Cinnyris asiaticus*	R/SM	LC
Oriolidae	Eurasian golden Oriole	*Oriolus*	SM	LC
	Black hooded Oriole	*Oriolus xanthornus*	R	LC
	Maroon oriole	*Oriolus traillii*	R	LC
Paradoxornithidae	Yellow-eyed Babbler	*Chrysomma sinense*	R	LC
Paridae	Cinereous Tit	*Parus cinereus*	R	LC
	Himalayan black-lored tit	*Parus xanthogenys*	R	LC
Passeridae	House Sparrow	*Passer domesticus*	R/SM	LC
	Russet Sparrow	*Passer cinnamomeus*	R	LC
Pellorneidae	Puff throated babbler	*Pellorneum ruficeps*	R	LC
Phalacrocoracidae	Little Cormorant	*Microcarbo niger*	R	LC
Phasianidae	Indian Peafowl	*Pavo cristatus*	R	LC
	Red junglefowl	*Gallus*	R	LC
	Grey Francolin	*Ortygornis pondicerianus*	R	LC
	Black Francolin	*Francolinus*	R	LC
	Jungle bush quail	*Perdicula asiatica*	R	LC
	Kalij pheasant	*Lophura leucomelanos*	R	LC
	Common Fowl	*Gallus domesticus*	R	LC
Phylloscopidae	Grey hooded warbler	*Phylloscopus xanthoschistos*	R	LC
	Greenish warbler	*Phylloscopus trochiloides*	SM	LC
	Hume's warbler	*Phylloscopus inornatus*	SM/WM	LC
	Lemon rumped warbler	*Phylloscopus chloronotus*	R	LC
	Common chiffchaff	*Phylloscopus collybita*	WM	LC
Picidae	Streak throated woodpecker	*Picus xanthopygaeus*	R	LC
	Lesser yellownape	*Picus chlorolophus*	R	LC
	Greater yellownape	*Chrysophlegma flavinucha*	R	LC
	Black-rumped Flameback	*Dinopium benghalense*	R	LC
	Greater flameback	*Chrysocolaptes guttacristatus*	R	LC
	Grey capped pygmy woodpecker	*Dendrocopos canicapillus*	R	LC
	Brown fronted woodpecker	*Leiopicus auriceps*	R	LC
	Fulvous breasted woodpecker	*Dendrocopos macei*	R	LC
	Speckled piculet	*Picumnus innominatus*	R	LC
	Grey headed woodpecker	*Picus canus*	R	LC
Ploceidae	Baya Weaver	*Ploceus philippinus*	R	LC
Psittaculidae	Rose-ringed Parakeet	*Psittacula krameri*	R	LC

	Alexandrine parakeet	*Psittacula eupatria*	R	NT
	Slaty headed parakeet	*Psittacula himalayana*	R	LC
	Plum-headed Parakeet	*Psittacula cyanocephala*	R	LC
Pycnonotidae	Red-whiskered Bulbul	*Pycnonotus jocosus*	R	LC
	Red-vented Bulbul	*Pycnonotus cafer*	R	LC
	Ashy bulbul	*Hemixos flavala*	R	LC
	Himalayan Bulbul	*Pycnonotus leucogenys*	R	LC
	Himalayan black Bulbul	*Hypsipetes leucocephalus*	R	LC
Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*	R	LC
	Common Moorhen	*Gallinula chloropus*	R	LC
Rescurvirostridae	Black-winged Stilt	*Himantopus*	WM	LC
Rhipiduridae	White-throated Fantail	*Rhipidura albicollis*	R	LC
	Yellow bellied Fantail	*Cheliodorhynx hypoxanthus*	R	LC
	White browed fantail	*Rhipidura aureola*	R	LC
Rostratulidae	Greater painted-snipe	*Rostratula benghalensis*	R	LC
Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	SM	LC
	Common Snipe	*Gallinago*	WM/PM	LC
	Common Greenshank	*Tringa nebularia*	WM/PM	LC
Sittidae	Chestnut bellied nuthatch	*Sitta cinnamoventris*	R	LC
Stenostiridae	Grey headed canary flycatcher	*Culicicapa ceylonensis*	SM	LC
Strigidae	Spotted Owlet	*Athene brama*	R	LC
	Jungle owlet	*Glaucidium radiatum*	R	LC
	Asian barred owlet	*Glaucidium cuculoides*	R	LC
Sturnidae	Chestnut-tailed Starling	*Sturnia malabarica*	SM	LC
	European starling	*Sturnus vulgaris*	WM	LC
	Asian Pied Starling	*Gracupica contra*	R	LC
	Spot winged starling	*Saroglossa spiloptera*	SM	LC
	Common Myna	*Acridotheres tristis*	R	LC
	Bank myna	*Acridotheres ginginianus*	R	LC
	Jungle Myna	*Acridotheres fuscus*	R	LC
	Brahminy Starling	*Sturnia pagodarum*	R	LC
Sylviidae	Lesser whitethroat	*Sylvia curruca*	WM/PM	LC
Tichodromidae	Wallcreeper	*Tichodroma muraria*	WM	LC
Timaliidae	Indian scimitar babbler	*Pomatorhinus horsfieldi*	R	LC
	Black chinned babbler	*Stachyridopsis pyrrhops*	R	LC
	Rusty cheeked scimitar babbler	*Pomatorhinus erythrogenys*	R	LC
Tytonidae	Barn Owl	*Tyto alba*	R	LC
Turdidae	Orange headed thrush	*Geokichla citrina*	SM	LC
Upupidae	Eurasian Hoopoe	*Upupa epops*	SM	LC
Vangidae	Common woodshrike	*Tephrodornis pondicerianu*	R	LC
Zosteropidae	Indian White-eye	*Zosterops palpebrosus*	R	LC
	Whiskered yuhina	*Yuhina flavicollis*	R	LC

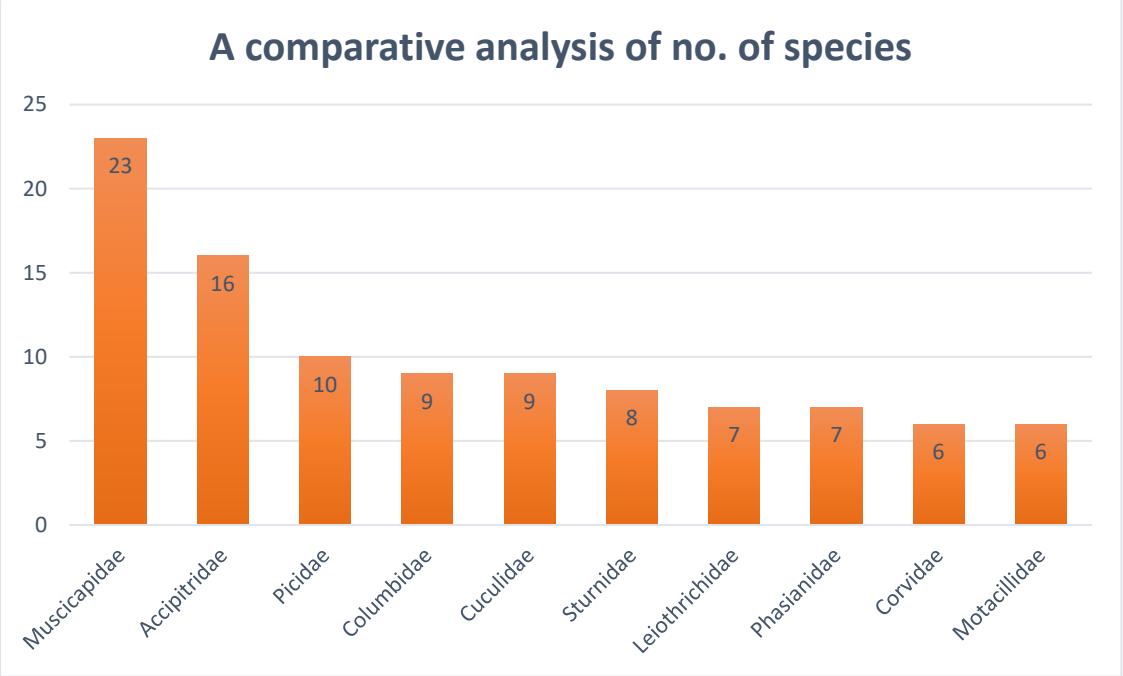

Figure 1. A comparative analysis of no. of the reported species

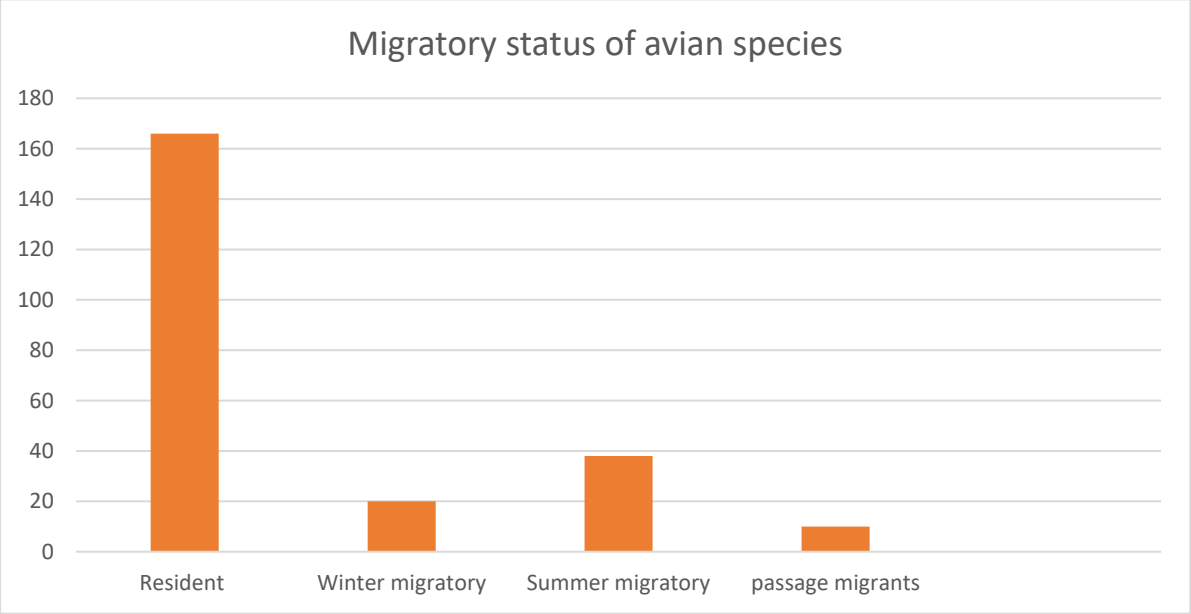

Figure 2. Migratory status of the reported bird species

References

Arya, A. K., Bhatt, D., Singh, A., Saini, V., Verma, P., Rathi, R., & Bhatnagar, P. (2019). Diversity and status of migratory and resident wetland birds in Haridwar, Uttarakhand, India. *Journal of Applied and Natural Science*, *11*(3), 732–737.

Chace, J. F., & Walsh, J. J. (2006). Urban effects on native avifauna: A review. *Landscape*

and Urban Planning, *74*(1), 46–69. https://doi.org/10.1016/j.landurbplan.2004.08.007

Crick, H. Q. P. (2004). The impact of climate change on birds. *Ibis*, *146*(SUPPL.1), 48–56. https://doi.org/10.1111/j.1474-919X.2004.00327.x

Donar, A. S., Reddy, K. R., & Deshpande, D. P. (2012). Avifaunal diversity of Nipani reservoir, Belgaum district Karnataka. *The Ecoscan*, *1*, 27–33.

Kumar, P. (2021). Avifaunal diversity from shahpur campus of the central university, himachal pradesh india. *Indian Journal of Ecology*, *48*(1), 138–146.

Pandey, B. K., Singh, R., Pandey, R. P., Das, S., Kumar, J., Kumar, P., Kumar, S., & Pandey, V. K. (2021). Water quality appraisal of a Mountainous River: A case study of Rispana river, Dehradun. *Water and Energy International*, *64*(1), 14–23.

Pandey, R. P., Kumar, P., Panday, B. K., Tyagi, J. V, Singh, R., Kumar, S., & Saini, S. (2021). Development of Rejuvenation Plan for Rispana River System, Uttarakhand, India. *Water and Energy International*, *64*(2), 6–18.

Saklani, A., Shree, T., & Nathani, S. (2018). *Birds of Dhauladhar range of western Himalayas in northern India : A checklist*. *March*, 41–45.

Shahi, R., Balodi, K. N., & Naithani, S. (2017). *Birds of Kassergуppe village in the western region of Bannerghatta National Park : A checklist*. *5*(6), 2576–2579.

Singh, V., & Bisht, S. S. (n.d.). Records of Critically Endangered Species of Avian fauna: Vultures Gyps indicus (Scopoli, 1786) and Sarcogyps calvus (Scopoli, 1786) from Surai Reserved Forest at Foot Hills of Kumaun Himalaya. *Experimental Animal Science-Birds and Insect*, 140–147.

Verma, S. K., & Murmu, T. Das. (2015). Impact of environmental and disturbance variables on avian community structure along a gradient of urbanization in Jamshedpur, India. *PLoS ONE*, *10*(7), 1–15. https://doi.org/10.1371/journal.pone.0133383

Blair, R. B. (1996). Land use and avian species diversity along an urban gradient. *Ecological Applications*, *6*(2), 506–519. https://doi.org/10.2307/2269387

Callaghan, C. T., Major, R. E., Lyons, M. B., Martin, J. M., & Kingsford, R. T. (2018). The effects of local and landscape habitat attributes on bird diversity in urban greenspaces. *Ecosphere*, *9*(7). https://doi.org/10.1002/ecs2.2347

Chambers, L. E., Hughes, L., & Weston, M. A. (2005). Climate change and its impact on Australia's avifauna. *Emu*, *105*(1), 1–20. https://doi.org/10.1071/MU04033

Crick, H. Q. P. (2004). The impact of climate change on birds. *Ibis*, *146*(SUPPL.1), 48–56. https://doi.org/10.1111/j.1474-919X.2004.00327.x

Knick, S. T., Dobkin, D. S., Rotenberry, J. T., Schroeder, M. A., Vander Haegen, W. M., & Van Riper, C. (2003). Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. *Condor*, *105*(4), 611–634. https://doi.org/10.1650/7329

Nakano, S., & Murakami, M. (2001). Reciprocal subsidies: Dynamic interdependence between terrestrial and aquatic food webs. *Proceedings of the National Academy of Sciences of the United States of America*, *98*(1), 166–170. https://doi.org/10.1073/pnas.98.1.166

Pandey, R. P., Kumar, P., Panday, B. K., Tyagi, J. V, Singh, R., Kumar, S., & Saini, S. (2021). Development of Rejuvenation Plan for Rispana River System, Uttarakhand,

India. *Water and Energy International*, *64*(2), 6–18.

Singh, S. K., & Rawat, G. S. (1999). Floral diversity and vegetation structure in Great Himalayan National Park, Western Himalaya. *GHNP FREEP Report*, *2*(5), 1–125.

Wheeler, B. W., Lovell, R., Higgins, S. L., White, M. P., Alcock, I., Osborne, N. J., Husk, K., Sabel, C. E., & Depledge, M. H. (2015). Beyond greenspace: An ecological study of population general health and indicators of natural environment type and quality. *International Journal of Health Geographics*, *14*(1), 1–17. https://doi.org/10.1186/s12942-015-0009-5

Whelan, C. J., Şekercioğlu, Ç. H., & Wenny, D. G. (2015). Why birds matter: from economic ornithology to ecosystem services. *Journal of Ornithology*, *156*(1), 227–238. https://doi.org/10.1007/s10336-015-1229-y