Science Vision
Volume 19, issue 4, pages 109–119
31 December 2019
https://doi.org/10.33493/scivis.19.04.01

ORIGINAL ARTICLE

Diversity and abundance of birds in Reiek Biodiversity Spot, Mizoram, northeastern India

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Birds are one of the best-known classes of living organisms, they are important bioindicators of an ecosystem. This study was undertaken to determine the diversity and abundance of birds in Reiek Biodiversity Spot, Mizoram, northeastern India. An intensive study was carried out by line transect method. A total of 117 species of birds belonging to 37 families and 10 orders were recorded and the Shannon-Wiener Diversity index was calculated (H'= 3.85). Family Muscicapidae dominated the area comprising of 16 species, followed by Timaliidae with 6 species. Among all the species recorded, *Alcippe nipalensis* has the highest relative abundance (13.35%), followed by *Staphida castaniceps* (Striated Yuhina) and *Zosterops palpebrosus* (Oriental White Eye) with 8.6007% and 6.03337% each. Family-wise relative abundance revealed that Pycnonotidae has the highest relative abundance (17.45%), followed by Sylviidae (15.91%) and Timaliidae (13.35%). The area supports a rich and diverse avian community, therefore, recommended better management of the entire landscape.

Keywords: Abundance, birds, diversity, forest, Reiek Biodiversity Spot.

Received 23 September 2019
Accepted 16 December 2019

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Introduction

Birds are one of the best-known classes of living organisms and bird community is known to play crucial roles in the functioning of an ecosystem in which they are found.[1,2] They are cosmopolitan and uneven in their distributions; their distribution, diversity and densities depend on various factors such as climate, altitude, vegetation, water availability and anthropogenic activities.[3] India ranks among the top ten countries in the world in terms of the most number of bird species,[4] and harbors about 1200 species of birds which makes up about 13% of the world's bird species (9600).[5,6] Lepage recorded 662 species of birds in Mizoram among which 31 falls under the category of globally threatened species.[7] Despite birds being the best-known class of living organisms, there are still substantial gaps in our knowledge regarding their distributions, abundances and densities.[8] Studies on bird diversity are important as it raises an awareness of the need for global conservation of the avian community[9,10] and to understand the well-being of an ecosystem as a whole and help to delineate the importance of a regional or local landscape for avian conservation. Though Mizoram lies within the Indo-Myanmar biodiversity hotspot, studies on the avian community are scanty. Although there are a few existing studies that deal with pheasants and birds of a particular group and a specific area,[11-17] more studies are needed to be done in order to show the picture of the Mizoram avian community.

ISSN 0975-6175 (print) /2229-6026 (online) | CODEN SVCIC9

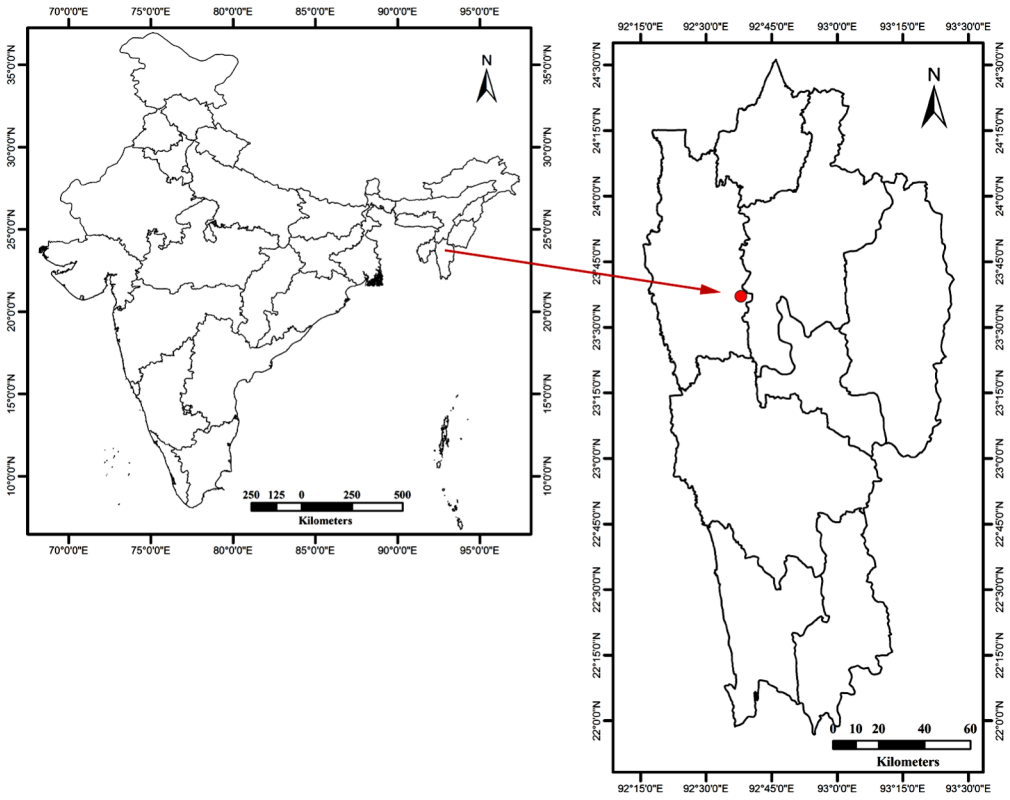

Figure 1 | Map showing study site and location of Reiek Biodiversity Spot.

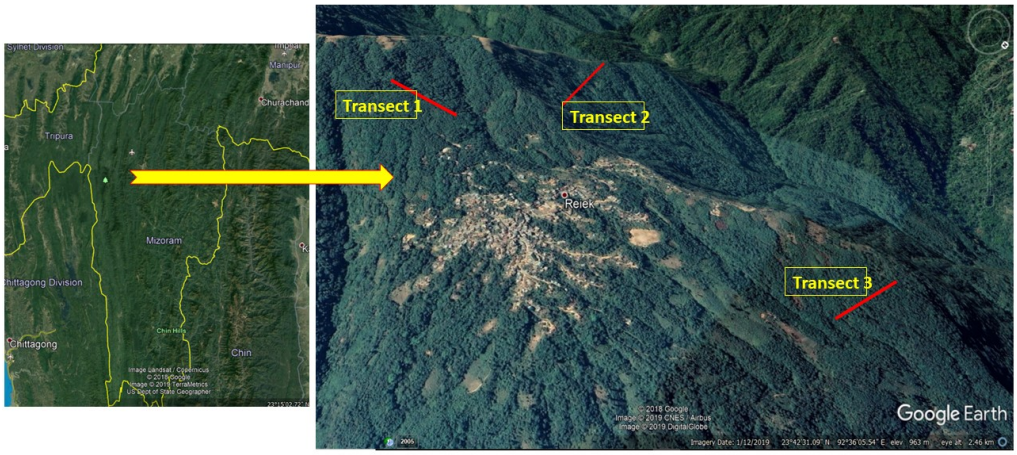

Figure 2 | Map showing study site and location of transects.

Keeping in view of the above points, the present study was carried out to add baseline information on avian species diversity and abundance in Reiek Biodiversity Spot, Mizoram, northeastern India and to create awareness for their conservation and help in strategic conservation planning. Considering the scarcity of information on the avian diversity as discussed above, the present study is designed to assess the species composition and to investigate the diversity and relative abundance of birds in Reiek Biodiversity Spot, Mizoram, India.

Materials and Methods

Study site

Reiek is a village located at 23°41'17.36" N longitude and 92°36'07.79" E latitude, Mizoram, northeastern India and lies within the Indo-Myanmar Biodiversity hotspot (Figures 1 & 2). It rests at an elevation of 1,325 m above mean sea level. The village is located at a distance of 28 km from the state capital, Aizawl. The area is covered by semi-evergreen, bamboo forest, and grasses. The major

plant species of the area are *Castanopsis tribuloides, Schima wallichii*, *Atalancia simplifolia* and different species of bamboos and orchids.

Some portions of the community forest and its fauna are protected and conserved by the community, with the community heads and members of various non-government organizations within the village playing a vital role in this effort. Despite their efforts, tribal hunting practices using traps, snares, guns and slingshots are still prevalent among some groups of people within the community. Felling of trees and collection of firewood are also still widely prevalent in the village. Recently, the area was declared as a 'Biodiversity Spot' by the village in collaboration with Association for Environment Protection (ASEP), one of the leading NGOs in Mizoram for protecting and conserving the environment, in an effort to protect and preserve the pristine state of the protected area and its surrounding.

Sampling method

Line Transect method was employed for counting and evaluating the abundance and diversity of birds in the study.[8] The study was conducted from January to March 2019. A total of three line transects were laid and followed for recording the presence of birds, *viz*. transect-1, transect-2 and transect-3 respectively. Transects were of different lengths and were laid on existing path, transect-1 was laid as long as 2 km passing through the core of the protected area at a geological point of 23°41'23.32" N and 92°36'19.22" E, at an altitude of 1290 m. Transect-2 was laid as long as 3.5 km, at a geological point of 23°41'29.72" N and 92°35'52.61" E at an altitude of 1077 m above sea level. Transect-3 covered a distance of 2 km, located at 23°42'31.09" N and 92°36'05.54" E, at an altitude of 963 m above mean sea level. Transect-3 was laid in a relatively disturbed area where agricultural practices and firewood collection are carried out.

Transects were walked in the morning (0530–0830 hrs) and evening (1400–1700 hrs) at an interval of six days for a period of three months. For each transect, we recorded the bird species and numbers encountered in the area. For the survey, SLR camera (Nikon P900) was used for photography, binocular (Nikon Sporter EX) and the calls of birds were used for observations, recording and identification. For identification and field diagnosis of birds, Grimmet *et al.*[17] and Grewal *et al.*[18] were consulted. For diversity study, in addition to the line transect method, simple bird watching (opportunistic sampling) within the study was also adopted.

Data analysis

PAST (**PA**leontological **ST**atistics) version 1.93 was used for estimating abundance and diversity indices. The relative abundance of a species was calculated by dividing the abundance of a species by the total abundance of all species combined.[8]

Bird diversity was calculated using both Shannon-Wiener and Simpson's diversity indices. Shannon-Wiener diversity Index was calculated using the formula:

$$H' = -\sum_{i=1}^{R} p_i \, lnp_i$$

Where p_i = proportion of individual species and R= total number of species of the community (numbers seen and heard)

Simpson's diversity index, D was calculated using the formula:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where n_i= the total no. of birds of each individual species and N = the total number of birds of all species

The value of D ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity.

Result and Discussion

Species composition

A total of 117 bird species, belonging to 37 families and 10 orders were recorded from Reiek Biodiversity Spot (Table 1). Altogether, 110 species were recorded from the transects, while the remaining 7 species were recorded outside the transects through opportunistic sampling. This record is fairly high despite the fact that the study site is being dominated by tribal communities who are known to indulge in various hunting practices and secondly, the site not being under the categories of protected area notified by the government. The relatively high avian species composition could be attributed to the availability of heterogeneous habitat, i.e., primary and secondary forests, grasses, bamboo forest, jhum land[15] and secondly to the conservation efforts of the community where the communal forest is protected and conserved providing home to large number of avifauna. The bird species composition in the present study is lesser than studies that have been carried out in various protected areas around the state such as- a study carried out by Sailo and Lalthanzara in Lengteng Wildlife Sanctuary recorded 126 species of birds belonging to 35 families, [15] while the famous Murlen Wildlife Sanctuary is known to harbor more than 150 species of birds.[16]

Another study executed by Lalthanzara and Sailo[17] in Lungleng-1, a non-protected area recorded 114 species of birds belonging to 40 families, though the number of species recorded is higher in the present study, the number of the family is higher in

Table 1 | Species composition of Reiek Biodiversity Spot (RBS).

Order	Family	Scientific Name	Common Name	Status (IUCN)
Accipitriformes	Accipitridae	*Accipiter badius*	Shikra	LC
		Accipiter virgatus	Besra	LC
		Pernis ptilorhycus	Oriental Honey Buzzard	LC
		Spilornis cheela	Crested Serpent Eagle	LC
Falconiformes	Falconidae	*Falco tinnunculus*	Common Kestrel	LC
		Falco peregrines	Peregrine Falcon	LC
Galliformes	Phasianidae	*Arborophila rufogularis*	Rufous-throated Hill Partridge	LC
		Bambusicola fytchii	Mountain Bamboo Partridge	LC
		Gallus gallus	Red Jungle Fowl	LC
Columbiformes	Culumbidae	*Streptopelia chinensis*	Spotted Dove	LC
		Ducula aenea	Green Imperial Pegion	LC
		Ducula badia	Mountain Imperial Pegion	LC
Strigiformes	Strigidae	*Glaucidium cuculoides*	Asian Barred Owlet	LC
		Strix leptogrammica	Brown Wood Owl	LC
Cuculiformes	Cuculidae	*Phaenicophaeus tristis*	Green-billed Malkoha	LC
		Hierococcyx varius	Common hawk-Cuckoo	LC
		Surniculus lugubris	Square-tailed drongo Cuckoo	LC
		Centropus sinensis	Greater Coucal	LC
Passeriformes	Pycnonotidae	*Ixos mcclellandii*	Mountain Bulbul	LC
		Pycnonotus cafer	Red-Vented Bulbul	LC
		Pycnonotus flavescens	Flavescent Bulkbul	LC
		Alophoixus flaveolus	White-Throated Bulbul	LC
		Hypsipetes leucocephalus	Black Bulbul	LC
		Hemixos flavala	Ashy Bulbul	LC
		Pycnonotus flaviventris	Black-crested Bulbul	LC
	Dicaeidae	*Dicaeum ignipectus*	Fire-breasted Flowerpecker	LC
	Zosteropidae	*Zosterops palpebrosus*	Oriental White-eye	LC
	Dicruridae	*Dicrurus remifer*	Lesser Racket-tailed Drongo	LC
		Dicrurus paradiseus	Greater Racket-tailed Drongo	LC
		Dicrurus macrocercus	Black Drongo	LC
		Dicrurus aeneus	Bronzed Drongo	LC
		Dicrurus leucophaeus	Ashy Drongo	LC
	Timaliidae	*Garrulax leucolophus*	White-crested Laughingthrush	LC
		Stachyris nigriceps	Grey-throated Babbler	LC
		Garrulax pectoralis	Greater Necklaced-laughingthrush	LC
		Staphida castaneiceps	Striated Yuhina	LC
		Timalia pileata	Chesnut-capped Babbler	LC
		Yuhina nigrimenta	Black-chinned Yuhina	LC
		Stachyris ruficeps	Rufous-capped Babbler	LC
		Pomatorhinus ferruginosus	Coral-billed scimatar Babbler	LC
		Pellorneum ruficeps	Puff-throated Babbler	LC
		Napothera brevicaudata	Streaked Wren Babbler	LC
	Muscicapidae	*Enicurus schistaceus*	Slaty-backed Forktail	LC
		Anthipes monileger	White-gorgeted Flycatcher	LC
		Saxicola ferreus	Grey Bushchat	LC
		Phoenicurus frontalis	Blue-fronted Redstart	LC
		Enicurus leschenaultia	White-crowned Forktail	LC
		Cyornis unicolor	Pale-blue Flycatcher	LC
		Muscicapa dauurica	Asian Brown Flycatcher	LC
		Niltava vivida	Vivet Niltava	LC
		Niltava grandis	Large Niltava	LC
		Niltava macgrigoriae	Small Niltava	LC
		Tarsiger rufilatus	Himalayan Blue Tail	LC
		Culicicapa ceylonensis	Grey-headed Canary Flycatcher	LC
		Niltava sundara	Rufous-bellied Niltava	LC
		Copsychus malabaricus	White-rumped Shama	LC
		Ficedula albicilla	Taiga Flycatcher	LC
		Ficedula hodgsoni	Slaty-backed Flycatcher	LC

	Nectariniidae	*Aethopyga gouldiae*	Mrs. Gould's Sunbird	LC
		Aethopyga siparaja	Crimson Sunbird	LC
		Aethopyga saturate	Black-throated Sunbird	LC
		Aethopyga ignicauda	Fire-tailed Sunbird	LC
		Arachnothera magna	Streaked Spiderhunter	LC
		Arachnothera longirostra	Little Spiderhunter	LC
	Corvidae	*Cissa chinensis*	Common Green Magpie	LC
		Corvus macrorhynchos	Jungle Crow	LC
		Dendrocitta formosae	Grey Treepie	LC
		Dendrocitta vagabunda	Rufous Treepie	LC
	Turdidae	*Zoothera dixoni*	Long-tailed Thrush	LC
		Myophonus caeruleus	Blue-whistling Thrush	LC
		Zoothera dauma	Scaly Thrush	LC
		Turdus obscures	Eye-browed Thrush	LC
	Campephagidae	*Pericrocotus flammeus*	Scarlet Minivet	LC
		Coracina melaschistos	Black-winged Cuckooshrike	LC
		Pericrocotus cinnamomeus	Small Minivet	LC
		Tephrodornis virgatus	Large Woodshrike	LC
		Tephrodornis pondicerianus	Common Woodshrike	LC
	Chloropseidae	*Choloropsis hardwickii*	Orange-bellied Leafbird	LC
		Chloropsis cochinchinensis	Blue-winged Leafbird	LC
		Chloropsis aurifrons	Gold-fronted Leafbird	LC
	Monarchidae	*Hypothymis azurea*	Black-naped Monarch	LC
	Oriolidae	*Oriolus chinensis*	Black-naped Oriole	LC
	Emberizidae	*Emberiza pusilla*	Little Bunting	LC
		Emberiza rutila	Chesnut Bunting	LC
	Cisticolidae	*Orthotomus sutorius*	Common tailorbird	LC
		Orthotomus cuculatus	Mountain tailorbird	LC
		Prinia atrogularis	Black-throated Prinia	LC
		Prinia crinigera	Striated Prinia	LC
		Prinia rufescens	Rufescent Prinia	LC
	Aegithinidae	*Aegithina tiphia*	Common Iora	LC
	Sittidae	*Sitta castanea*	Chesnut-bellied Nuthatch	LC
		Sitta frontalis	Velvet-fronted Nuthatch	LC
		Sitta hmialayensis	White-tailed Nuthatch	LC
	Eurylaimidae	*Psarisomus dalhousiae*	Long-tailed broadbill	LC
	Rhipiduridae	*Rhipidura albicollis*	White- throated Fantail	LC
	Vangidae	*Hemipus picatus*	Bar-winged flycatcher Shrike	LC
	Motacillidae	*Anthus hodgsoni*	Olive-backed Pipit	LC
	Sylviidae	*Phylloscopus xanthoschistos*	Grey-hooded Warbler	LC
		Alcippe nipalensis	Nepal Fulvetta	LC
		Phylloscopus inornatus	Yellow Browed Warbler	LC
		Phylloscopus trochiloides	Greenish Warbler	LC
		Phylloscopus whistleri	Whisler's Warbler	LC
		Seicercus poliogenys	Grey-cheeked Warbler	LC
	Laniidae	*Lanius schach*	Long-tailed Shrike	LC
	Passeridae	*Passer montanus*	Eurasian Tree Sparrow	LC
	Fringillidae	*Carpodacus erythrinus*	Common Rosefinch	LC
	Paridae	*Melanochlora sultanea*	Sultan Tit	LC
	Vireonidae	*Erpornis zantholeuca*	White bellied Erpornis	LC
Piciformes	Capitonidae	*Megalaima asiatica*	Blue-throated Barbet	LC
		Megalaima virens	Great Barbet	LC
		Megalaima haemacephala	Coppersmith Barbet	LC
	Picidae	*Picus flavinucha*	Greater Yellownaped Woodpecker	LC
		Sasia ochracea	White-browed Piculet	LC
		Picumnus innominatus	Speckled Piculet	LC
		Dendrocopos nanus	Brown-capped Pygmy Woodpecker	LC
		Blythipicus pyrrhotis	Bay-Woodpecker	LC
Apodiformes	Apodidae	*Apus acuticauda*	Dark-rumped Swift	VU
Coraciiformes	Upupidae	*Upupa epops*	Common Hoopoe	LC

Lungleng-1 community forest as compared to Reiek biodiversity Spot. A study executed by Syiem *et al.*[20] at Nongkhyllem landscape in Meghalaya which includes Nongkhyllem Wildlife Sanctuary and its surrounding matrix recorded a total of 94 species which is lesser than species recorded from the present study site.

Family-wise species composition indicates that Muscicapidae has the largest family comprising of 16 species, followed by Timaliidae comprising of 10 species, and Pycnonotidae with 7 species, Nectariniidae with 6 species. 5 families, *viz*. Dicruridae, Campephagidae, Cistocolidae, Sylviidae and Picidae were represented by 5 species. Accipitridae, Cuculidae, Turdidae and Corvidae were represented by 4 species each. Chloropsidae, Sittidae, Capatonidae, were represented by 3 species each. Strigidae and Emberizidae consist of 2 species each. 17 families were represented by single species (Figure 3). The recorded highest species richness in Muscicapidae family is in accordance with records from various parts of Mizoram,[17,21] as well as the entire Northeast region[22]. This could be due to their ability to adapt to different habitats including human -modified habitats. Meanwhile, it has been reported that Timaliidae family has the greatest number of species in Lengteng Wildlife Sanctuary, Mizoram in a study executed by Sailo and Lalthanzara[15]. Saikia and Saikia also reported that Sylvidae has the largest family in northeast India represented by 153 species and 44 genera. [23]

As expected, Passeriformes being the most diverse group of birds,[24] order-wise species composition revealed that Passeriformes has the highest species composition with 89 species recorded under this order, followed by Paciformes, comprising of 8 species, Accipitriformes and Cuculiformes came third in the list with 4 species each (Figure 4).

The family Passeriformes was represented by 27 families, topping the list of orders having the highest number of families, followed by Piciformes represented by 2 families. The remaining 8 orders were represented by 1 family each (Figure 5).

A total of 8 raptor species were recorded while 3 ground bird species and a species belonging to the most aerial birds of all families, i.e. Dark-rumped Swift were recorded from the present study. Of all the birds recorded, only Dark-rumped Swift (*Apus acuticauda*) falls under the Vulnerable category of the IUCN Red List of Threatened Species (2018),[25] while the remaining 116 species belong to the Least Concern category.

Most of the species recorded from Reiek Biodiversity Spot belong to the Least Concerned category of the IUCN Red List of Threatened Species could probably be due to the fact that the area is under constant interaction with human, and that species under Threatened, Near Threatened, Vulnerable and other special categories tend to avoid humans and are usually specialist species requiring certain conditions to thrive well in a place.[17]

Species diversity

The Shannon-Wiener diversity for Reiek Biodiversity Spot was calculated to be H'= 3.858. This record is fairly high and indicates that the area has great potential for avian conservation site, dominance D= 0.04146 and Simpson Diversity was calculated to be 0.9585. Reiek landscape, providing heterogeneous habitats could be the reason for the relatively high diversity index.

The result of the diversity index revealed that Transect-3 has the highest Shannon-Wiener diversity index, followed by Transect-1 and Transect-2 respectively (Table 2). Even though Transect-3 was laid in a fairly disturbed area where shifting cultivation site and secondary forest from shifting cultivation occurs, it recorded the highest Shannon-Wiener Diversity index as compared to the two transects. This could be attributed to the area is a mixture of secondary forest and agricultural land offering a more heterogeneous habitat than the other two transects, hence it allows various species of birds to co-exist[26] and bird species are easier to

Table 2 | Transect-wise diversity indices.

	Transect-1	Transect-2	Transect-3
Taxa	63	52	61
Individuals	263	297	219
Dominance	0.07811	0.07726	0.04072
Shannon,H'	3.339	3.167	3.622
Simpson_1-D	0.9219	0.9593	0.9593
Evenness_e^H/S	0.4473	0.4564	0.612

Table 3 | Family-wise diversity indices.

Family	Domi-nance	Shannon, H'	Simpson_1-D
Accitripidae	0.3333	1.242	0.6667
Strigidae	0.5556	0.6365	0.4444
Phasianidae	0.4489	0.8823	0.5511
Culumbidae	0.4286	0.9557	0.5714
Cuculidae	0.5	0.8676	0.5
Pycnonotidae	0.1948	1.774	0.8052
Dicruridae	0.2676	1.445	0.6779
Timaliidae	0.3221	1.475	0.6779
Muscicapidae	0.08587	2.598	0.9141
Nectariniidae	0.3979	1.203	0.6021
Corvidae	0.3086	1.273	0.6914
Turdidae	0.46	0.8979	0.54
Campephagidae	0.6966	0.6751	0.3034
Chloropseidae	0.4063	0.9743	0.5938
Emberizidae	0.625	0.5623	0.375
Cisticolidae	0.24	1.505	0.76
Sittidae	0.375	1.04	0.625
Sylviidae	0.7106	0.6571	0.2694
Capatonidae	0.4897	0.8	0.5103
Picidae	0.2711	1.415	0.7289

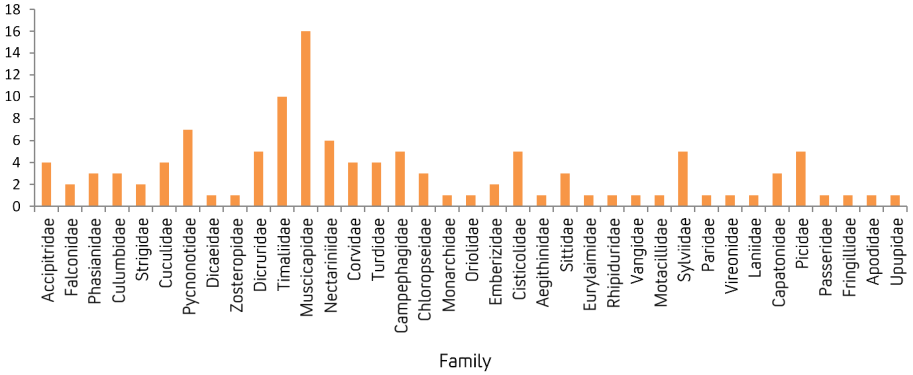

Figure 3 | Family-wise species composition.

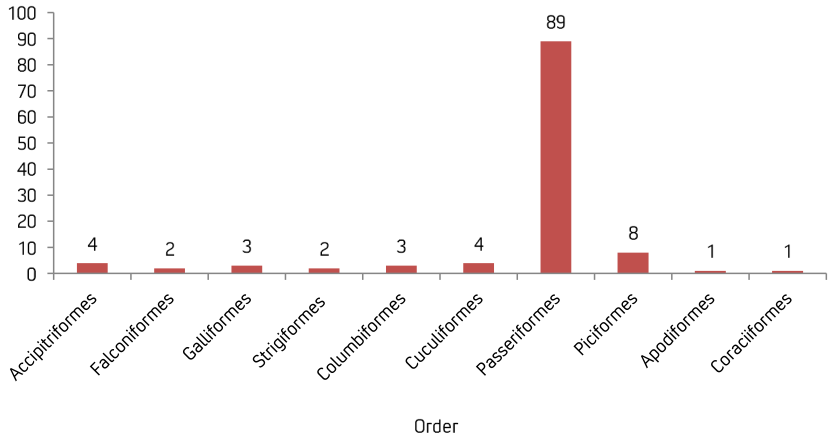

Figure 4 | Order-wise species composition.

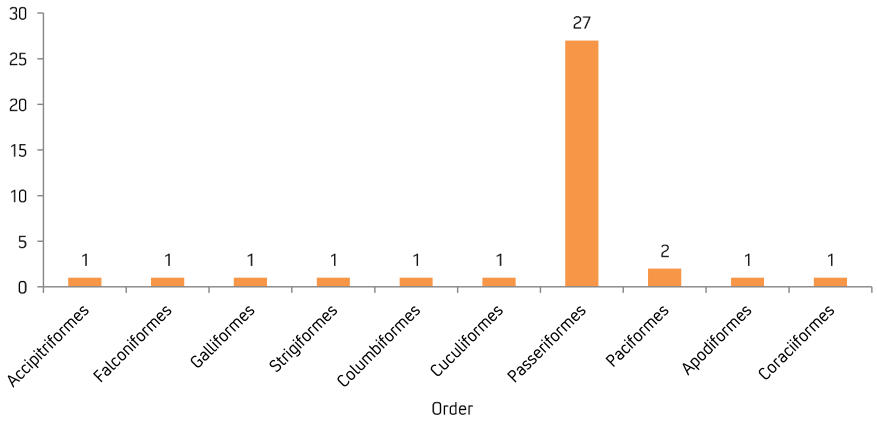

Figure 5 | Number of families belonging to different orders.

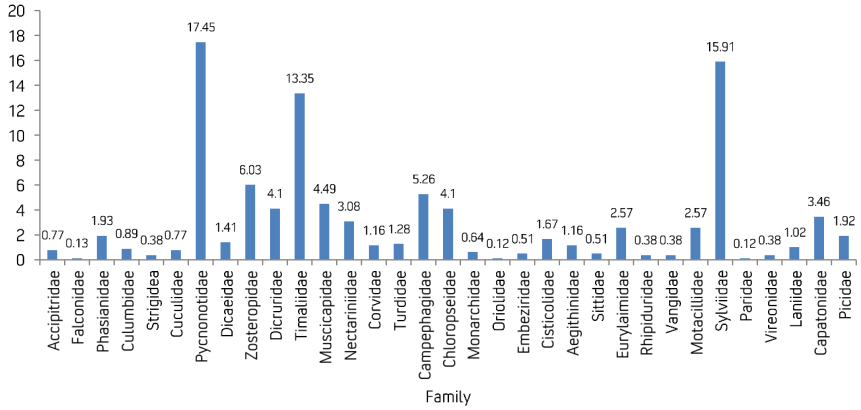

Figure 6 | Family-wise relative abundance.

Table 4 | Relative abundance of species.

Sl No	Scientific Name	Common name	Relative abundance %
1	*Accipiter badius*	Shikra	0.39
2	*Pernis ptilorhycus*	Oriental Honey Buzzard	0.13
3	*Spilornis cheela*	Crested Serpent Eagle	0.13
4	*Accipiter virgatus*	Besra	0.13
5	*Falco peregrines*	Peregrine Falcon	0.13
6	*Arborophila rufogularis*	Rufous-throated Hill Partridge	1.03
7	*Bambusicola fytchii*	Mountain Bamboo Partridge	0.77
8	*Gallus gallus*	Red-Jungle Fowl	0.13
9	*Streptopelia chinensis*	Spotted Dove	0.51
10	*Ducula aenea*	Green Imperial Pegion	0.13
11	*Ducula badia*	Mountain Imperial Pegion	0.26
12	*Glaucidium cuculoides*	Asian Barred Owlet	0.26
13	*Strix leptogrammica*	Brown Wood Owl	0.13
14	*Phaenico phaeustristis*	Green-billed Malkoha	0.51
15	*Hierococcyx varius*	Common hawk-Cuckoo	0.13
16	*Surniculus lugubris*	Square-tailed Drongo Cuckoo	0.13
17	*Ixos mcclellandi*	Mountain Bulbul	1.41
18	*Pycnonotus cafer*	Red-Vented Bulbul	5.13
19	*Pycnonotus flavescens*	Flavescent Bulbul	1.54
20	*Alophoixus flaveolus*	White-throated Bulbul	1.93
21	*Hypsipetes leucocephalus*	Black Bulbul	2.95
22	*Hemixos flavala*	Ashy Bulbul	1.54
23	*Pycnonotus flaviventris*	Black-crested Bulbul	2.95
24	*Dicaeum ignipectus*	Fire-breasted Flowerpecker	1.41
25	*Zosterops palpebrosus*	OrientalWhite-eye	6.03
26	*Dicrurus remifer*	Lesser Racket-tailed Drongo	0.51
27	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	0.77
28	*Dicrurus macrocercus*	Black Drongo	1.67
29	*Dicrurus aeneus*	Bronzed Drongo	0.90
30	*Dicrurus leucophaeus*	Ashy Drongo	0.26
31	*Garrulax leucolophus*	White-crested Laughingthrush	0.51
32	*Stachyris nigriceps*	Grey-throated Babbler	0.26
33	*Garrulax pectoralis*	Greater Necklaced-laughingthrush	1.67
34	*Staphida castaniceps*	Striated Yuhina	8.60
35	*Timalia pileata*	Chesnut-capped Babbler	0.39
36	*Yuhina nigrimenta*	Black-chinned Yuhina	0.51
37	*Stachyris ruficeps*	Rufous-capped Babbler	0.13
38	*Pomatorhinus ferruginosus*	Coral-billed scimatar Babbler	1.03
39	*Pellorneum ruficeps*	Puff-throated Babbler	0.13
40	*Napothera brevicaudata*	Streak wren Babbler	0.13
41	*Enicurus schistaceus*	Slaty-backed Forktail	0.51
42	*Anthipes monileger*	White-gorgeted Flycatcher	0.13
43	*Saxicola ferreus*	Grey Bushchat	0.13
44	*Phoenicurus frontalis*	Blue-fronted Redstart	0.13
45	*Cyornis unicolor*	Pale-blue Flycatcher	0.13
46	*Muscicapa dauurica*	Asian Brown Flaycatcher	0.26
47	*Niltava vivida*	VivetNiltava	0.26
48	*Niltava grandis*	Large Niltava	0.26
49	*Niltava macgrigoriae*	Small Niltava	0.51
50	*Tarsiger rufilatus*	Himalayan Blue Tailed	0.77
51	*Culicicapa ceylonensis*	Grey headedcanary Flycatcher	0.39
52	*Niltava sundara*	Rufous-bellied Niltava	0.13
53	*Copsychus malabaricus*	White-rumpedShama	0.26
54	*Megalaima asiatica*	Blue-throated Barbet	1.28
55	*Megalaima virens*	Great Barbet	2.05
56	*Megalaima haemacephala*	Coppersmith Barbet	0.13
57	*Picus flavinucha*	Greater Yellownaped	0.64
58	*Sasia ochracea*	White-browed Piculet	0.13
59	*Picumnus innominatus*	Speckled Piculet	0.64

60	*Dendrocopos nanus*	Brown-capped Pygmy Woodpecker	0.13
61	*Blythipicus pyrrhotis*	Bay-Woodpecker	0.39
62	*Aethopyga gouldiae*	Mrs. Gould's Sunbird	0.26
63	*Aethopyga siparaja*	Crimson Sunbird	0.13
64	*Aethopyga saturate*	Black-throated Sunbird	0.39
65	*Aethopyga ignicauda*	Fire-tailed Sunbird	0.13
66	*Arachnothera magna*	Streaked Spiderhunter	1.28
67	*Cissa chinensis*	Common Green Magpie	0.26
68	*Corvus macrorhynchos*	Jungle Crow	0.13
69	*Zoothera dixoni*	Long-tailed Thrush	0.13
70	*Myophonus caeruleus*	Blue-whisling Thrush	0.77
71	*Zoothera dauma*	Scaly Thrush	0.39
72	*Pericrocotus flammeus*	Scarlet Minivet	4.36
73	*Coracina melaschistos*	Black-winged Cuckooshrike	0.13
74	*Pericrocotu cinnamomeus*	Small Minivet	0.26
75	*Choloropsis hardwickii*	Orange-bellied Leafbird	2.05
76	*Chloropsis cochinchinensis*	Blue-winged Leafbird	0.51
77	*Chloropsis aurifrons*	Gold-fronted Leafbird	1.54
78	*Hypothymis azurea*	Black-naped Monarch	0.64
79	*Oriolus chinensis*	Black-naped Oriole	0.13
80	*Orthotomus sutorius*	Common Tailorbird	0.39
81	*Orthotomus cuculatus*	Mountain Tailorbird	0.26
82	*Prinia atrogularis*	Black-throated Prinia	0.77
83	*Emberiza pusilla*	Little Bunting	0.39
84	*Emberiza rutila*	Chesnut Bunting	0.13
85	*Aegithina tiphia*	Common Iora	1.16
86	*Sitta castanea*	Chesnut-bellied Nuthatch	0.13
87	*Sitta frontalis*	Velvet-fronted Nuthatch	0.13
88	*Psarisomus dalhousiae*	Long-tailed Broadbill	2.57
89	*Rhipidura albicollis*	White-throated Fantail	0.39
90	*Tephrodornis pondicerianus*	Common Woodshrike	0.39
91	*Hemipus picatus*	Bar-winged Flycatcher Shrike	0.39
92	*Anthus hodgsoni*	Olive-backed Pipit	2.57
93	*Phylloscopus xanthoschistos*	Grey-hooded Warbler	0.90
94	*Alcippe nipalensis*	Nepal Fulvetta	13.35
95	*Lanius schach*	Long-tailed Shrike	1.03
96	*Arachnothera longirostra*	Little Spiderhunter	0.90
97	*Dendrocitta formosae*	Grey Treepie	0.51
98	*Erpornis zantholeuca*	White-bellied Erponis	0.39
99	*Seicercus poliogenys*	Grey-Cheeked Warbler	0.13
100	*Phylloscopus whistleri*	Whisler Warbler	0.39
101	*Ficedula hodgsoni*	Slaty-backed Flycatcher	0.39
102	*Melanochlora sultanea*	Sultan Tit	0.13
103	*Ficedula albicilla*	Taiga Flycatcher	0.26
104	*Dendrocitta vagabunda*	Rufous Treepie	0.26
105	*Phylloscopus inornatus*	Yellow-browed Warbler	0.77
106	*Prinia rufescens*	Rufescent Prinia	0.13
107	*Prinia crinigera*	Striated Prinia	0.13
108	*Sitta hmialayensis*	White-tailed Nuthatch	0.26
109	*Tephrodornis virgatus*	Large Woodshrike	0.13
110	*Phylloscopus trochiloides*	Greenish Warbler	0.39

detect for the observer owing to the less dense characteristics. But this cannot rule out the fact that an intact, undisturbed area usually host specialist, important and conservation-worthy species,[27] as such Dark-rumped Swift and important ground birds such as Rufous-throated Hill Partridge, Mountain Bamboo Partridge and Red-jungle Fowl, in this case, were recorded from transect-1 and transect-2 within the protected site. This finding is parallel to the work of Syiem *et al.*[20] in Ri Bhoi district of Meghalaya, India where non-protected areas have higher diversity than protected areas, however, the protected area supports more special, conservation-worthy species. Raman *et al.*[28] in their study of avifauna in Dampa landscape, Mizoram also revealed that secondary forests clearly play the role of important habitat for birds.

Among the families of birds observed,

Muscicapidae has the highest Shannon- Wiener diversity index, H'=2.598, followed by Pycnonotidae with an index of H'= 1.774 and Cisticolidae with an index of H'= 1.505 (Table 3).

Relative abundance

In terms of relative abundance, Nepal Fulvetta (*Alcippe nipalensis*) has the highest relative abundance (13.35%) among all the species observed, which is followed by Striated Yuhina (*Staphida castaniceps*) with relative abundance of 8.6007% and Oriental White-eye (*Zosterops palpebrosus*) with relative abundance of 6.03337% (Table 4). Nepal Fulvetta (*A. nipalensis*) being the highest in terms of relative abundance could be attributed to their feeding habit, preference of habitat and behavior and the same applies for birds that came second and third in the list, Striated Yuhina and Oriental White-eye.[2] These birds are highly gregarious and forage in groups, and this gives them the advantages of foraging success, selection of mate, reduced predation and spotting of forage location.[29] Their relatively gregarious behavior also probably gives the observer an increased chance of sighting and recording them.

Of all the families recorded, Pycnonotidae has the highest relative abundance (17.45%), followed by Sylviidae 15.91% and Timaliidae 13.35% (Figure 6). Pycnonotidae, topping the list in terms of relative abundance could be probably due to the generalist characteristic of this family enabling them to adapt to various types of habitat, feeding on a wide variety of fruits and arthropods.[30] Some Bulbuls are known to have a high tolerance to disturbance,[31] Red-vented Bulbul, Black-crested Bulbul were recorded from all the three transects.

Conclusion

117 species of birds belonging to 37 families and 10 orders were recorded from Reiek Biodiversity Spot, and the Shannon-Wiener Diversity index was calculated to be H'= 3.85. Family-wise species composition shows that Muscicapidae has the largest family comprising of 16 species, followed by Timaliidae with 6 species. Among all the species recorded, *Alcippe nipalensis*has the highest relative abundance (13.35%), followed by *Staphida castaniceps* (Striated Yuhina) and *Zosterops palpebrosus* (Oriental White Eye) with 8.6007% and 6.03337% each. Family-wise relative abundance revealed that Pycnonotidae has the highest relative abundance (17.45%), followed by Sylviidae (15.91%) and Timaliidae (13,35%). Among the species recorded *Apus acuticauda* (Dark-rumped Swift) belongs to the Vulnerable Category of the IUCN Red List Category for Threatened Species while the remaining 116 belong to Least Concern category.

This shows that the area supports a rich and diverse bird community in spite of it being an area which is not notified as a protected site by the State Government and has a good potential for avian conservation site and for bird watching tourism as well. This high diversity could be attributed to the heterogeneous habitat of the area and the conservation effort of the people. The present study also revealed that the secondary forest and cultivation site supports a good diversity of birds. The distribution of birds across the landscape and their association with their habitats were not studied due to time and financial constraint, hence, further studies on these regards are recommended.

Better management of the community protected site along with the adjacent secondary forest and cultivation site is recommended. Conservation awareness among the communities should be enhanced especially among the hunters of the community.

Acknowledgement

We are grateful to Mr. C Lalthakima, Reiek, an avian expert and guide for his help during the field study, and Association for Environment Protection (ASEP) and Reiek Village Community for their cooperation and necessary permission.

Authors' contributions

H. Lalthanzara and S.S. Sundaravel designed the study; Lalruatkimi and L. Sailo collected the data; Betsy Zodinpuii, L. Sailo and Lalruatkimi analysed the data; Lalruatkimi, S.S. Sundaravel and H. Lalthanzara prepared the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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