

## The bird community of Shingba Rhododendron wildlife sanctuary, Sikkim, Eastern Himalaya, India

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**Abstract:** Here we describe the bird community of Shingba Rhododendron sanctuary, a high altitude protected area (> 3200 m) and an Important Bird Area (IBA) in Sikkim in the Eastern Himalaya, India. Altogether 332 points were sampled using a point count method. A total of 2545 birds belonging to 100 species and 22 families were recorded, including three new records for Sikkim. Non-parametric estimators Jackknife 1 and Jackknife 2 estimated 112 and 110 species, respectively. The observed species combined with previous records yielded 114 total species of birds in the sanctuary. Bird species richness in Shingba is higher compared to other parts of the Himalaya at similar elevations. Bird species richness and abundance showed significant variation among seasons with a peak during monsoon. Species abundance data followed a truncated log normal distribution, indicative of a diverse community. Due to heavy tourist influx, the sanctuary is subjected to various threats. Conservation issues and management measures of the sanctuary are discussed in brief with some recommendations.

**Resumen:** Aquí describimos la comunidad de aves del santuario Shingba Rhododendron, una zona protegida de alta elevación (> 3200 m) y un área importante para las aves (IBA, siglas en inglés) en Sikkim, Himalaya Oriental, India. En total se muestrearon 332 puntos usando un método de conteo en puntos. Se registró un total de 2545 aves pertenecientes a 100 especies y 22 familias, incluyendo tres nuevos registros para Sikkim. Por medio de los procedimientos no paramétricos Jackknife 1 y Jackknife 2 se estimaron las cifras de 112 y 110 especies, respectivamente. Las especies observadas, en combinación con registros previos, arrojaron un total de 114 especies de aves en el santuario. La riqueza de especies de aves en Shingba es mayor comparada con la de otras partes de los Himalaya en altitudes similares. La riqueza y la abundancia de especies de aves variaron significativamente entre estaciones, con picos durante el monzón. Los datos de abundancias de especies se conformaron a una distribución log-normal truncada, indicadora de una comunidad diversa. Debido a un flujo intenso de turistas, el santuario está sujeto a varias amenazas. Se discuten brevemente los temas de conservación y las medidas de manejo del santuario, junto con algunas recomendaciones.

**Resumo:** Este trabalho descreve a comunidade avícola do santuário Shingba Rhododendron, uma área protegida de alta altitude (> 3200 m) e uma área avícola importante (IBA) em Sikkim no Himalaia Oriental, Índia. No seu conjunto foram amostrados 332 pontos usando o método de contagem de pontos. Registrou-se um total de 2545 aves pertencendo a 100 espécies e 22 famílias, incluindo 3 registros novos para Sikkim. Estimadores não paramétricos, Jackknife 1 e Jackknife 2, estimaram 112 e 110 espécies, respectivamente. As espécies observadas, combinadas com os registros anteriores, produziram um resultado de 114 espécies de aves no santuário. A riqueza específica de espécies avícolas em Shingba é mais alta em comparação com outras partes dos Himalaias em elevações similares. A riqueza específica e abundância mostraram uma variação significativa entre estações com um pico durante a monção. Os dados da abundância específica seguiram uma distribuição log normal truncada, indicadora de uma comunidade diversa. Devido à elevada afluência de turistas, o santuário está sujeito a várias ameaças. As

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questões da conservação e as medidas de gestão do santuário são brevemente discutidas com algumas recomendações.

**Key words:** Bird community, conservation, Himalaya, seasonality, Shingba Rhododendron sanctuary, Sikkim, tourism, Yumthang.

## Introduction

Bird communities have been studied fairly well both in temperate and tropical forests (Blake 2007; Keast 1990; Latta *et al.* 2003; MacArthur & MacArthur 1961; Perrins & Birkhead 1983; Robinson *et al.* 2000; Terborgh *et al.* 1990; Thiollay 1994; Wiens 1989; Willson & Comet 1996a, b). Understanding the diversity and structure of bird communities is essential to delineate the importance of regional or local landscapes for avian conservation (Kattan & Franco 2004).

Past studies have documented the bird communities of the Himalayan region, mostly in the western part (Khan *et al.* 1993; Price *et al.* 2003; Safiq *et al.* 1997; Sultana & Khan 1999, 2000; Sultana *et al.* 2007) and a few in the eastern region (Acharya 2008; Chettri *et al.* 2001; Chettri *et al.* 2005; Raman *et al.* 1998). The Eastern Himalaya, a global hotspot of biodiversity and an Endemic Bird Area (Mittermeier *et al.* 2005; Myers *et al.* 2000; Stattersfield *et al.* 1998), is biologically the most diverse region in India probably because of varied climatic conditions, marked altitudinal zonation of vegetation (Hooker 1854; Mani 1974), unique plate tectonic and palaeoclimatic history, and its location at the transition zone of Oriental and Palaearctic realms and Indian, Indochinese and Indomalayan zoogeographical regions (Olson *et al.* 2001). The state of Sikkim in India is situated in the western part of the Eastern Himalaya. More than 46 % of the geographic area of Sikkim is under a protected area network which includes a biosphere reserve and a national park, and six wildlife sanctuaries (Government of Sikkim 2003). The forests within and outside the protected areas are experiencing intense disturbances that may jeopardize the avifauna due to anthropogenic pressures such as logging, firewood collection, livestock grazing, developmental activities and a growing tourism industry. Hence, documentation of the bird community and identification of potential threats are the primary concerns of conservation at present.

Previous studies on the birds of Sikkim were surveys that focused mostly on taxonomy and distribution, with notes on the general ecology of some species (Ali 1962). Systematic study of the bird community in any of the protected areas in Sikkim are lacking except Kanchandzonga biosphere reserve (Chettri *et al.* 2001; Chettri *et al.* 2005). Shingba Rhododendron wildlife sanctuary, an Important Bird Area (IBA) in Sikkim (Islam & Rahmani 2004), represents a unique mountain system comprising temperate mixed coniferous forest, tree line and snowline. No attempt has been made to study the avifauna of the sanctuary except a few casual observations and listing of species (Islam & Rahmani 2004). The present study investigates the bird community of this sanctuary, highlights conservation problems and management measures, and provides a comprehensive checklist of birds with their status.

## Study area

The Shingba Rhododendron wildlife sanctuary (27° 42' 06" to 27° 50' 35" N and 88° 44' 21" to 88° 42' 51" E), spreads over an area of 43 km<sup>2</sup>, and is located between the Lachung and Yumthang valley in the North Sikkim, Eastern Himalaya, India (Fig. 1). The vegetation is characterized by mixed conifer forest comprising *Abies webbiana*, *Tsuga dumosa*, *Picea spinulosa*, *Pinus excelsa*, *Larix griffithiana*, *Taxus wallichiana*, *Acer caudatum*, *Rhododendron arboreum*, *R. camp-nulatum*, *R. grande* and *Betula utilis*. Numerous undergrowth taxon such as *Berberis*, *Ilex*, *Pyrus*, *Ribes*, *Rubus*, *Spiraea*, *Viburnum* and herbaceous *Arisaema*, *Potentilla*, *Anemones*, *Primula*, *Ligularia* and *Pedicularis* are common. The ground is covered with mosses above which rich ground flora such as primulas, potentillas, gentians, saxifrages, poppies and aconites blossom during summer. As the sanctuary is located at higher elevations only about 27 % area is forested, whereas permanent snow and moraines cover about 13 %, alpine scrub covers 10.3 % and barren rocky slopes constitutes

48 % area of the sanctuary (Delhi University 2006). The climate is cold and temperate. Temperature remains negative during winter (December-March) but rises during rest of the year with maximum of 15 °C during May. Rainfall varies from 800 mm to 1400 mm annually and begins from May-June and continues till the end of September. Precipitation in winter occurs in the form of snow.



**Fig. 1.** Sikkim showing Shingba Rhododendron wildlife sanctuary (hatched area) and other important locations.

## Materials and methods

### *Bird sampling*

The bird community of Shingba Rhododendron wildlife sanctuary was studied during September 2003 to November 2005. A variable radius point count method (Bibby *et al.* 2000) was used along pre-determined transects for sampling of birds

because of its efficiency in mountainous terrain where steepness and poor visibility prevails. The point count method has been widely used for the study of bird communities in both tropical and temperate regions (Bibby *et al.* 2000; Raman 2003; Sorace *et al.* 2000; Verner 1985). Depending upon the accessibility, six transects (600-1000 m length) were laid within the sanctuary at different elevations between 3200 and 3700 m (Table 1). The distance between any two transects varied from 2-3 km. Permanent sampling points were established in each transect maintaining a minimum of 100 m distance between the points. Sampling was conducted mostly in the morning (07 30 to 09 30 hrs) and occasionally in the afternoon (15 00 to 16 30 hrs) covering three major seasons, namely summer (March-May), monsoon (June-August) and post monsoon (September-November). Due to harsh weather conditions and heavy snowfall, counting was not possible during winter months (December-February). Five minute counts (see Raman 2003), recording all the birds seen or heard during sampling, were done at every point distributed along transects. In total there were 43 regular points, which were sampled 1-3 times a season making a total of 332 point counts (110, 103 and 119 point counts in summer, monsoon and post monsoon, respectively). In addition, data on threats to vegetation and birds were also gathered using qualitative methods throughout the study period.

### *Data analysis*

Species richness was calculated as cumulative number of species observed in the study area. Since it is not possible to encounter all the species during sampling, non-parametric estimators (obtained using statistical software EstimateS, version 7; Colwell 2004) were used to estimate the total species richness. Non-parametric estimators Jackknife 1 and Jackknife 2 were selected based on previous literature (Hortal *et al.* 2006; Walther & Moore 2005). Species accumulation patterns (ob-

**Table 1.** Details of transects laid in the Shingba Rhododendron Sanctuary, Sikkim for bird sampling.

| Transects | Elevation (m) | Microhabitat                | Latitude (° ' N) | Longitude (° ' E) |
|-----------|---------------|-----------------------------|------------------|-------------------|
| 1         | 3200          | Rhododendron-conifer forest | 27 42.1          | 88 44.2           |
| 2         | 3360          | Rhododendron-conifer forest | 27 45.2          | 88 43.8           |
| 3         | 3450          | Rhododendron-conifer forest | 27 46.8          | 88 43.5           |
| 4         | 3500          | Rhododendron-conifer forest | 27 48.4          | 88 42.9           |
| 5         | 3630          | Conifer forest + moraines   | 27 49.3          | 88 42.7           |
| 6         | 3700          | Conifer forest + moraines   | 27 50.2          | 88 42.5           |

served and estimated) were used to test the completeness of sampling using number of transects sampled as an indicator of effort. The bird list (Appendix Tables 1 & 2) was compiled based on present observations as well as previous records by Islam & Rahmani (2004). We followed Inskipp *et al.* (1996) for common English and scientific names of the birds.

One way Analysis of Variance (ANOVA) was performed to test the variation of species richness and abundance of birds per point among different seasons. Shannon-Wiener diversity and Shannon evenness were calculated. Relative abundance of each species of birds was also computed. The four main models of species distribution (see Magurran 1988) were tested using statistical software 'Species Diversity and Richness' version 2.65 (Henderson & Seaby 2001) to investigate the best fit curve for species abundance data. This software uses the actual abundance to calculate observed and expected number of species in each abundance level.

All individual sightings of birds from each transect were pooled and bird species were ranked according to following abundance categories: 1 = rare (1 - 5 sightings), 2 = common (6 - 25 sightings), 3 = abundant (26 - 100 sightings) and 4 = very abundant (> 100 sightings). Similarly, birds were also categorized according to their feeding guilds and migratory status based on Ali (1962), Ali & Ripley (2001) and field observations.

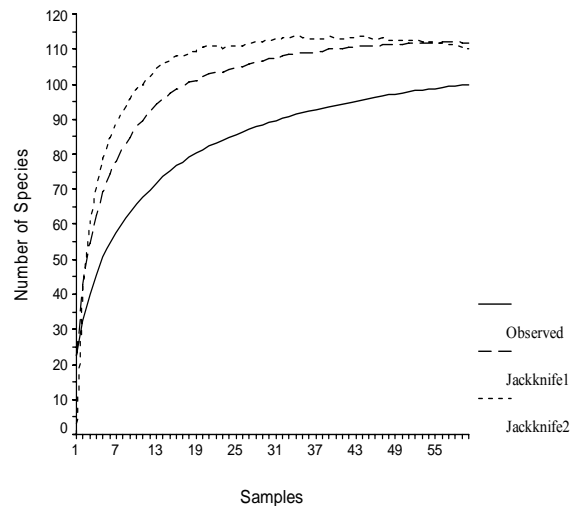
## Results

A total of 2545 individual birds representing 100 species and 22 avian families were observed from the sanctuary during the study period. Among the total species observed, the Eastern Crowned Warbler *Phylloscopus coronatus*, Rufous-naped Tit *Parus rufonuchalis* and Slaty-blue Flycatcher *Ficedula tricolor* were new records for Sikkim. A species accumulation curve approached an asymptote after 50 transect counts, suggesting our sampling was rigorous enough to detect most species present (Fig. 2). The curve for observed species lies slightly below the estimators indicating probability of encountering a few species with increasing effort (Fig. 2) but the rate of addition declined subsequently after 50 samples. The estimated richness was 112 and 110 species for Jackknife 1 and Jackknife 2, respectively. Shannon-Wiener diversity and evenness of birds was 3.61 and 0.78, respectively. Family Sylviidae had the highest number of species (23) followed by

Muscicapidae (21). Eleven families were represented by single species (Appendix Table 1).

Out of the 100 species recorded, 69 were resident, 17 altitudinal migrant, six summer visitor, six winter visitor and two passage migrant (Appendix Table 1). The birds of Shingba sanctuary showed distinct seasonal variation with a peak during monsoon representing 971 individuals of 64 species. Similarly, 59 species with 843 birds and 46 species with 731 birds were observed during summer and post monsoon, respectively. ANOVA showed significant variation in mean number of species ( $F_{2, 329} = 39.81$ ;  $p < 0.01$ ) and abundances ( $F_{2, 329} = 10.46$ ;  $p < 0.01$ ) of birds among seasons.

The species abundance pattern of birds followed a truncated lognormal distribution model displaying no significant difference ( $\chi^2 = 5.419$ ;  $p = 0.60$ ;  $df = 7$ ) in observed and expected number of species in each abundance level (Fig. 3). Around 42 % of birds were rare with less than six individuals per species followed by 36 % species having 6-25 individuals. Only six species were abundant, each having > 25 individuals. Coal Tit *Parus ater* was the most



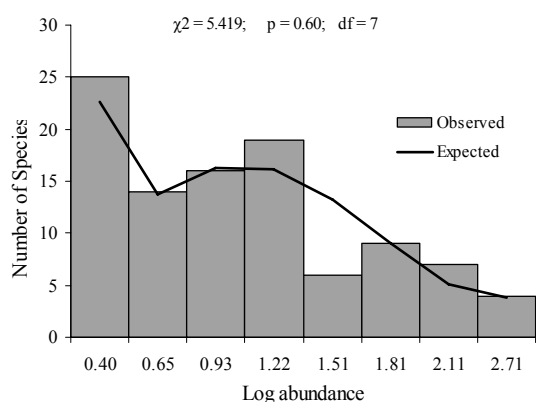
**Fig. 2.** Species accumulation pattern of birds in Shingba Rhododendron sanctuary, Sikkim. Species richness - observed and estimated (Jackknife 1 and Jackknife 2) are shown.

abundant species in the study area (relative abundance = 12.65) followed by Rufous-vented Tit *Parus rubidiventris* (7.85), Greenish Warbler *Phylloscopus trochiloides* (7.11) and Grey-crested Tit *Parus dichrous* (6.09).

Among foraging groups, insectivores dominated the bird community, representing more than 60 % species and individuals. Omnivores comprised 21 % of species and 29 % of the total abundance. Carnivores and nectarivores were least represented in the avian community of Shingba Rhododendron sanctuary.

## Discussion

The ornithological wealth of Shingba Rhododendron sanctuary, one of the Important Bird Areas in the Eastern Himalaya, remained relatively unexplored until now. Our two-year study observed 100 species from the sanctuary. Islam & Rahmani (2004) have provided a list of 42 species found in this IBA site of which 14 were not seen during the present study. We observed 72 additional species including three new records for Sikkim totaling 114 species of birds (Appendix Tables 1 & 2), which is around three times higher than the previously reported number. Jackknife 1 and Jack-knife 2 estimators yielded 112 and 110 species, respectively which is close to the total birds found in the sanctuary. Out of 114 species, the Wood Snipe *Gallinago nemoricola* and Rusty-bellied Shortwing *Brachypteryx hyperythra* are globally threatened species, and the latter is endemic to



**Fig. 3.** Species abundance distribution pattern of birds in Shingba Rhododendron sanctuary, Sikkim. Data fitted to truncated lognormal distribution, showing no significant difference in observed and expected number of species at each abundance level.

Eastern Himalaya Endemic Bird Area (BirdLife International 2001; Stattersfield *et al.* 1998).

The sanctuary consists of only 0.6 % of the geographical area but harbors more than 20 % of the 548 bird species in Sikkim (Acharya 2008).

Similarly, Shingba sanctuary supports 80 % of the 143 bird species reported from Kanchandzonga biosphere reserve (area 2655 km<sup>2</sup>), the largest protected area in Sikkim (Chettri *et al.* 2001). This sanctuary is very rich in avifauna compared to other high altitude protected areas of the Himalaya. For example, 41 species of birds are reported from Sagarmatha National Park in Nepal (Laiolo 2003), 81 species in Manali sanctuary in Himachal Pradesh and 70 species in Overa sanctuary in Kashmir (Price *et al.* 2003). Shingba Rhododendron sanctuary is located at the interface of Biome-5 and Biome-7 (see Islam & Rahmani 2004) and harbors bird species representative of both of these biomes including its own endemic fauna. Species such as the Robin Accentor *Prunella rubeculoides* and Brandt's Mountain Finch *Leucosticte brandti* are true Palaearctic fauna, which occur in this sanctuary. Notable observations of low elevation species are Long-tailed Minivet *Pericrocotus ethologus*, Short-billed Minivet *Pericrocotus brevirostris* and Ashy Drongo *Dicrurus leucophaeus*. In addition, the sanctuary comprises a unique ecosystem type of Rhododendron-Conifer forest, tree line and snowline which likely contributes to the high avifaunal richness.

More than 70 % of the birds are breeding residents in the Shingba sanctuary. Species such as Blood Pheasant *Ithaginis cruentus*, Snow Pigeon *Columba leuconota*, Speckled Wood Pigeon *Columba hodgsonii*, Oriental Turtle Dove *Streptopelia orientalis*, Grey-backed Shrike *Lanius tephronotus*, Scaly Thrush *Zoothera dauma*, Plain-backed Thrush *Zoothera mollissima*, White-collared Blackbird *Turdus albocinctus* and various species of tits and warblers were found breeding in the Fir-Rhododendron forests of the sanctuary. The Ibisbill *Ibidorhyncha struthersii* and White throated Dipper *Cinclus cinclus* used riverine beds for nesting. This shows that mosaic habitats comprising forests, glacial moraines and river beds are crucial for conservation of birds of the sanctuary.

Seasonal fluctuations of birds occur due to changes in weather conditions or fluctuations in food productivity and habitat quality (Loiselle & Blake 1991; Norris & Marra 2007). Species richness and abundance of birds in Shingba sanctuary peaked during the monsoon season. An increase of insect abundance due to rain and favorable temperatures may have influenced the seasonality of birds in the study area.

Although the number of species recorded was

high compared to the area surveyed, more than 42 % of species were rare in abundance (Appendix Table 1). Only six species had more than 100 sightings during two years of the study. The species abundance data fit a truncated lognormal distribution, as is typically observed in tropical forests (Jayson & Mathew 2000; Magurran 1988; Terborgh *et al.* 1990; Wiens 1989). This result signifies high diversity and equitability of the avian community (see Magurran 1988; Wiens 1989) in the sanctuary.

The domination of the bird community by insectivores is a common trend and observed by other studies in the Himalaya (Chettri 2000; Khan *et al.* 1993; Sultana *et al.* 2007). Due to their specialized diet and low availability of preferable food resources, nectarivores and carnivores are generally less represented (Perrins & Birkhead 1983; Wiens 1989).

### *Conservation*

The Sanctuary is a gateway to the Yumthang valley, a famous tourist's destination, which is located at the fringe of the sanctuary at the northern side (Fig.1). The valley of Lachung lies south of the sanctuary, and is inhabited by the local Lachungpa tribe. Due to increasing tourist inflow, most of the local people are involved with tourism activities. Also, cattle herders and laborers engaged in road construction are associated with the sanctuary. The current threats from these groups are illegal felling and removal of original dense strands of firs, birchs and rhododendrons for timber, firewood and construction materials.

Tourism is the fast growing industry in the Himalaya. The increasing tourism activity has immense pressure on the vegetation and birds of the Himalayan region (Chettri *et al.* 2001; Chettri *et al.* 2002; Laiolo 2003). Yumthang valley attracts domestic and international tourists with around 1000 tourists per day during March-May and September-November (personal observation). The tourism pressure is intense in comparison to Kanchandzonga biosphere reserve (Chettri *et al.* 2001) and Sagarmatha national park (Laiolo 2003).

Road construction and mining of river beds for sands, gravel and stones posed serious threat to birds, especially those that breed at the river beds. Livestock grazing, although officially banned (Government of Sikkim 2003), is still a major conservation problem in north Sikkim. Many yak and

cattle sheds exist within the sanctuary and nomadic herders leave their animals freely roaming in the sanctuary.

Conservation measures need to be strengthened and practically implemented. As the regeneration is slow due to cold climate, cattle grazing should be banned completely. Alternative fuel such as LPG (liquefied petroleum gas) and kerosene should be made available to the local communities to control deforestation. The forest staff should be increased for deployment in the sanctuary. Tourist's influx should be regulated at a number of visitors the region can sustain without degradation. A code of conduct for tourists and stake holders should be established and followed strictly. The formation of biodiversity management and ecotourism committees with the involvement of local people, as in west Sikkim (Chettri *et al.* 2002), would be an effective step in the implementation of conservation measures. An awareness program dealing with importance of forests and wildlife should regularly be conducted targeting villagers, students, tourist entrepreneurs, herders, defense personnel and laborers. Capacity building programmes such as a tourism management course, training in bird-watching and exposure tour for local communities are important tools for quality tourism as well as biodiversity conservation in this region. Since high elevation regions in the Himalaya including Shingba sanctuary represent a potential tourism destination with unique landscapes and rich avifauna, conservation of birds and their habitat with such initiatives provides a sustainable livelihood option for the people at local and regional levels.

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**Appendix Table 1.** Bird species recorded in Shingba Rhododendron sanctuary, Sikkim, India during September 2003-November 2005. A = Abundance (number of individuals observed); M = Migratory status (R = resident, AM = altitudinal migrant, WV = winter visitor, SV = summer visitor, PM = passage migrant).

| Family                    | English name                 | Scientific name                  | A   | M  |
|---------------------------|------------------------------|----------------------------------|-----|----|
| Phasianidae               | Blood Pheasant               | <i>Ithaginis cruentus</i>        | 15  | R  |
| Picidae                   | Darjeeling Woodpecker        | <i>Dendrocopos darjellensis</i>  | 5   | R  |
|                           | Rufous-bellied Woodpecker    | <i>Dendrocopos hyperythrus</i>   | 7   | R  |
| Upupidae                  | Common Hoopoe                | <i>Upupa epops</i>               | 4   | SV |
| Cuculidae                 | Common Hawk Cuckoo           | <i>Hierococyx varius</i>         | 1   | R  |
| Apodidae                  | White-rumped Needletail      | <i>Zoonavena sylvatica</i>       | 3   | R  |
| Columbidae                | Snow Pigeon                  | <i>Columba leuconota</i>         | 112 | R  |
|                           | Speckled Wood Pigeon         | <i>Columba hodgsonii</i>         | 2   | R  |
|                           | Ashy Wood Pigeon             | <i>Columba pulchricollis</i>     | 21  | R  |
|                           | Oriental Turtle Dove         | <i>Streptopelia orientalis</i>   | 7   | R  |
| Charadriidae              | Ibisbill                     | <i>Ibidorhyncha struthersii</i>  | 6   | R  |
| Accipitridae              | Black Eagle                  | <i>Ictinaetus malayensis</i>     | 2   | LM |
|                           | Crested Goshawk              | <i>Accipiter trivirgatus</i>     | 1   | R  |
| Falconidae                | Peregrine Falcon             | <i>Falco peregrinus</i>          | 1   | AM |
| Laniidae                  | Grey-backed Shrike           | <i>Lanius tephronotus</i>        | 1   | AM |
| Corvidae                  | Yellow-billed Blue Magpie    | <i>Urocissa flavirostris</i>     | 7   | R  |
|                           | Spotted Nutcracker           | <i>Nucifraga caryocatactes</i>   | 13  | R  |
|                           | Yellow-billed Chough         | <i>Pyrrhocorax graculus</i>      | 10  | AM |
|                           | Red-billed Chough            | <i>Pyrrhocorax pyrrhocorax</i>   | 19  | R  |
|                           | Large-billed Crow            | <i>Corvus macrorhynchos</i>      | 33  | R  |
|                           | Long-tailed Minivet          | <i>Pericrocotus ethologus</i>    | 2   | AM |
|                           | Short-billed Minivet         | <i>Pericrocotus brevirostris</i> | 2   | R  |
|                           | White-throated Fantail       | <i>Rhipidura albicollis</i>      | 2   | R  |
|                           | Yellow-bellied Fantail       | <i>Rhipidura hypoxantha</i>      | 45  | R  |
|                           | Ashy Drongo                  | <i>Dicrurus leucophaeus</i>      | 2   | AM |
| Cinclidae                 | White-throated Dipper        | <i>Cinclus cinclus</i>           | 5   | R  |
|                           | Brown Dipper                 | <i>Cinclus pallasii</i>          | 7   | R  |
| Muscicapidae              | Blue Whistling Thrush        | <i>Myophonus caeruleus</i>       | 4   | R  |
|                           | Plain-backed Thrush          | <i>Zoothera mollissima</i>       | 10  | R  |
|                           | Scaly Thrush                 | <i>Zoothera dauma</i>            | 13  | R  |
|                           | White-collared Blackbird     | <i>Turdus albocinctus</i>        | 74  | R  |
|                           | Gould's Shortwing            | <i>Brachypteryx stellata</i>     | 1   | R  |
|                           | Rusty-bellied Shortwing*     | <i>Brachypteryx hyperythra</i>   | 2   | R  |
|                           | Dark-sided Flycatcher        | <i>Muscicapa sibirica</i>        | 4   | AM |
|                           | Ferruginous Flycatcher       | <i>Muscicapa ferruginea</i>      | 1   | R  |
|                           | Rufous-gorgeted Flycatcher   | <i>Ficedula strophiiata</i>      | 50  | R  |
|                           | <b>Slaty-blue Flycatcher</b> | <b><i>Ficedula tricolor</i></b>  | 15  | AM |
|                           | Siberian Rubythroat          | <i>Luscinia calliope</i>         | 2   | WV |
| Orange-flanked Bush Robin | <i>Tarsiger cyanurus</i>     | 13                               | AM  |    |
| Golden Bush Robin         | <i>Tarsiger chrysaesus</i>   | 7                                | AM  |    |

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Appendix Table 1. Continued.

| Family       | English name                    | Scientific name                      | A   | M  |
|--------------|---------------------------------|--------------------------------------|-----|----|
|              | Black Redstart                  | <i>Phoenicurus ochruros</i>          | 4   | PM |
|              | White-winged Redstart           | <i>Phoenicurus erythrogaster</i>     | 3   | WV |
|              | White-throated Redstart         | <i>Phoenicurus schisticeps</i>       | 6   | WV |
|              | Blue-fronted Redstart           | <i>Phoenicurus frontalis</i>         | 9   | R  |
|              | White-capped Water Redstart     | <i>Chaimarrornis leucocephalus</i>   | 54  | AM |
|              | Plumbeous Water Redstart        | <i>Rhyacornis fuliginosus</i>        | 2   | R  |
|              | Grandala                        | <i>Grandala coelicolor</i>           | 20  | R  |
|              | Common Stonechat                | <i>Saxicola torquata</i>             | 7   | R  |
| Certhiidae   | Eurasian Treecreeper            | <i>Certhia familiaris</i>            | 121 | R  |
|              | Winter Wren                     | <i>Troglodytes troglodytes</i>       | 12  | R  |
| Paridae      | Fire-capped Tit                 | <i>Cephalopyrus flammiceps</i>       | 4   | R  |
|              | <b>Rufous-naped Tit</b>         | <b><i>Parus rufonuchalis</i></b>     | 30  | SV |
|              | Rufous-vented Tit               | <i>Parus rubidiventris</i>           | 200 | R  |
|              | Coal Tit                        | <i>Parus ater</i>                    | 322 | R  |
|              | Grey-crested Tit                | <i>Parus dichrous</i>                | 155 | R  |
|              | Green-backed Tit                | <i>Parus monticolus</i>              | 3   | R  |
| Aegithalidae | Rufous-fronted Tit              | <i>Aegithalos iouschistos</i>        | 6   | R  |
| Regulidae    | Goldcrest                       | <i>Regulus regulus</i>               | 1   | R  |
| Sylviidae    | Chestnut-crowned Bush Warbler   | <i>Cettia major</i>                  | 2   | R  |
|              | Aberrant Bush Warbler           | <i>Cettia flavolivacea</i>           | 4   | R  |
|              | Spotted Bush Warbler            | <i>Bradypterus thoracicus</i>        | 6   | R  |
|              | Smoky Warbler                   | <i>Phylloscopus fulgiventis</i>      | 14  | AM |
|              | Blyth's Leaf Warbler            | <i>Phylloscopus reguloides</i>       | 1   | SV |
|              | Western Crowned Warbler         | <i>Phylloscopus occipitalis</i>      | 2   | R  |
|              | <b>Eastern Crowned Warbler</b>  | <b><i>Phylloscopus coronatus</i></b> | 8   | WV |
|              | Greenish Warbler                | <i>Phylloscopus trochiloides</i>     | 181 | R  |
|              | Hume's Warbler                  | <i>Phylloscopus humei</i>            | 9   | SV |
|              | Buff-barred Warbler             | <i>Phylloscopus pulcher</i>          | 14  | R  |
|              | Large-billed Leaf Warbler       | <i>Phylloscopus magnirostris</i>     | 42  | SV |
|              | Golden-spectacled Warbler       | <i>Seicercus burkii</i>              | 10  | R  |
|              | Broad-billed Warbler            | <i>Tickellia hodgsoni</i>            | 52  | R  |
|              | Striated Laughingthrush         | <i>Garrulax striatus</i>             | 2   | R  |
|              | Spotted Laughingthrush          | <i>Garrulax ocellatus</i>            | 6   | R  |
|              | Black-faced Laughingthrush      | <i>Garrulax affinis</i>              | 99  | R  |
|              | Chestnut-crowned Laughingthrush | <i>Garrulax erythrocephalus</i>      | 4   | R  |
|              | Scaly-breasted Wren Babbler     | <i>Pnoepyga albiventer</i>           | 4   | R  |
|              | Red-tailed Minla                | <i>Minla ignotincta</i>              | 2   | AM |
|              | Chestnut-tailed Minla           | <i>Minla strigula</i>                | 12  | R  |
|              | White-browed Fulvetta           | <i>Alcippe vinipectus</i>            | 14  | R  |
|              | Rufous-vented Yuhina            | <i>Yuhina occipitalis</i>            | 72  | R  |
|              | Stripe-throated Yuhina          | <i>Yuhina gularis</i>                | 5   | R  |

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**Appendix Table 1.** Continued.

| Family                  | English name           | Scientific name                 | A                             | M  |
|-------------------------|------------------------|---------------------------------|-------------------------------|----|
| Alaudidae               | Hume's Short-toed Lark | <i>Calandrella acutirostris</i> | 30                            | WV |
| Nectariniidae           | Fire-tailed Sunbird    | <i>Aethopyga ignicauda</i>      | 55                            | R  |
| Passeridae              | Grey Wagtail           | <i>Motacilla cinerea</i>        | 10                            | PM |
|                         | White Wagtail          | <i>Motacilla alba</i>           | 61                            | SV |
|                         | Olive-backed Pipit     | <i>Anthus hodgsoni</i>          | 14                            | R  |
|                         | Blyth's Pipit          | <i>Anthus godlewskii</i>        | 22                            | WV |
|                         | Rosy Pipit             | <i>Anthus roseatus</i>          | 93                            | R  |
|                         | Maroon-backed Accentor | <i>Prunella immaculata</i>      | 4                             | R  |
|                         | Robin Accentor         | <i>Prunella rubeculoides</i>    | 95                            | AM |
|                         | Fringillidae           | Plain Mountain Finch            | <i>Leucosticte nemoricola</i> | 64 |
| Brandt's Mountain Finch |                        | <i>Leucosticte brandti</i>      | 11                            | AM |
| Dark-rumped Rosefinch   |                        | <i>Carpodacus edwardsii</i>     | 6                             | R  |
| Dark-breasted Rosefinch |                        | <i>Carpodacus nipalensis</i>    | 13                            | AM |
| Common Rosefinch        |                        | <i>Carpodacus erythrinus</i>    | 3                             | AM |
| Red-headed Bullfinch    |                        | <i>Pyrrhula erythrocephala</i>  | 1                             | R  |
| White-winged Grosbeak   |                        | <i>Mycerobas carnipes</i>       | 1                             | R  |
| Collared Grosbeak       |                        | <i>Mycerobas affinis</i>        | 2                             | R  |
| Spot-winged Grosbeak    |                        | <i>Mycerobas melanozanthos</i>  | 2                             | R  |
|                         | Gold-naped Finch       | <i>Pyrrhoplectes epauletta</i>  | 3                             | R  |

\*Vulnerable species; Species in bold letters are new records for Sikkim.

**Appendix Table 2.** Species reported by Islam & Rahmani (2004) from Shingba Rhododendron sanctuary, Sikkim but not observed during the present study.

| Family       | English name                  | Scientific name               |
|--------------|-------------------------------|-------------------------------|
| Phasianidae  | Snow Partridge                | <i>Lerwa lerwa</i>            |
|              | Tibetan Snowcock              | <i>Tetraogallus tibetanus</i> |
|              | Tibetan Partridge             | <i>Perdix hodgsoniae</i>      |
|              | Himalayan Monal               | <i>Lophophorus impejanus</i>  |
| Charadriidae | Wood Snipe*                   | <i>Gallinago nemoricola</i>   |
| Corvidae     | Hume's Groundpecker           | <i>Pseudopodoces humilis</i>  |
| Paridae      | Yellow-browed Tit             | <i>Sylviparus modestus</i>    |
| Hirudinidae  | Nepal House Martin            | <i>Delichon nipalensis</i>    |
| Alaudidae    | Tibetan Lark                  | <i>Melanocorypha maxima</i>   |
| Sylviidae    | Hoary-throated Barwing        | <i>Actinodura nipalensis</i>  |
|              | Rufous-chinned Laughingthrush | <i>Garrulax rufogularis</i>   |
| Passeridae   | Altai Accentor                | <i>Prunella himalayana</i>    |
| Fringillidae | Yellow-breasted Greenfinch    | <i>Carduelis spinoides</i>    |
|              | Great Rosefinch               | <i>Carpodacus rubicilla</i>   |

\*Vulnerable species.