Journal of Biosphere, 8: 24-31, 2019 ISSN 2278 – 3342

Effect of Altitude on Bird Diversity and their Altitudinal Distributional Range, in Trikuta Hills (Vaishno Devi), J&K, India

Rahul Kait and Sanjay Kotwal

Abstract: Altitude determines various environmental variables like, temperature, humidity, rainfall, wind and snowfall, which have direct effect on the biodiversity. A total of 90 species were reported from study area and their altitudinal rang of distribution was recorded. It was found that only 15 species were altitudinal generalists where as many birds have got different altitudinal ranges of the distribution. The bird species diversity was found to decrease with the increase in altitude while dominance showed positive correlation with the altitude.

Key words. Trikuta hills, altitudinal rang of distribution, altitudinal generalists, Vaishno Devi hills

1. Introduction

Altitude determines various environmental variables like, temperature, humidity, rainfall, wind and snowfall, which have direct effect on the biodiversity. It is accepted that contemporary climate change is already causing shifts in species' distributions (Hughes, 2000) and that there is the potential for these changes to be devastating in the future (Peterson et al., 2002).

Rahul Kait(✉)
Department of Zoology,
Govt. College for Women,
Parade, Jammu (J&K) India.

Sanjay Kotwal
Department of Zoology,
Govt Degree College,
Paloura, Jammu (J&K) India

Received 12.01.2019; Revised 20.03.2019; Accepted 20.03.2019; Published 01.05.2019.

Various studies on altitudinal distribution have been carried out in different regions and different results have been found by different workers. Most studies have shown a general pattern of decreasing species richness with increasing altitude. While other studies have suggested that species richness may show a non-monotonic, hump-shaped pattern with diversity peaking at mid-altitudes (Janzen 1973).

2. Material and Methods

2.1 Study Area

The Present study was carried out in Trikuta hills, popularly known as Vaishno Devi hills, which constitute a part of outermost hills of Jammu Shivaliks. The present study area has great altitudinal variation. Trikuta hills are very famous because of Mata Vaishno Devi Ji. It lies at a distance of 48 km from Jammu city which is the winter capital of Jammu and Kashmir State.

Geographical Location

The Study area lies between 32° 59′ and 33° 10′ N latitudes and 74° 55′ and 75° 50′ E

longitudes, in district Reasi of erstwhile district Udhampur of Jammu and Kashmir state. Altitude of the study area ranges between 750 -2170m amsl. Trikuta hills are characterised by a highly mountainous terrain, the tract being quite rugged and cut into deep gorges and high ridges. The hills suddenly emerge from the Katra valley, situated at an altitude of 750m above mean sea level on north bank of Banganga River. They arise steeply up to Surajkund above Bhairon Ghatti (2167m amsl). The area drains into Chenab through two perennial streams namely Banganga and Pei Nallah.

Climate

In the study area, there is a great variation in altitude, topography, degree of slope and aspects, which provide a variety of climatic conditions varying from sub-tropical to temperate. The low lying areas experience a subtropical type of climate while at the higher elevations it is temperate. Climate is also affected greatly by the amount of snowfall in the area and duration for which it stays on ground.

December and January are the coldest months and May-June are the hottest months of the year. In the study area, snowfall is experienced only at higher elevations. It is heaviest in the areas situated above the altitude of 1900m especially on slopes between Sanjichat and Surajkund. The first snow fall usually occurs towards the end of December. It falls during the months of January and February. There are four well defined seasons: Winter season (Mid November to March), Summer season (March to end of June),

Monsoon season (July to September) and Autumn season (October to Mid November).

Study Stations: The study area was divided into eight study stations, which are described as under:

Station-1 (S1). Area: Magal Pangot. **Habitat: Pinus Forest.** It lies at an average altitude of 750m and is situated at a distance of 7 Km from Katra city on Katra-Jammu National Highway.

Vegetation: The station has medium to high density of *Pinus roxburghii*, under story vegetation includes sparse and unevenly scattered thorny bushes like *Ziziphus* sp., *Adhatoda*, *Carissa*, etc. Small open meadows were also present at this station.

Station-2 (S2). Area: Banganga. Habitat: Riverine Habitat. The station S2 is located on the river Banganga at an altitude of 750m. It starts from Gulshan Kumar Hotel to the bridge on Reasi road on the river. It is a small river. The study area drains into it and its volume changes considerably during summer, spring, monsoon and winter. Katra city, which is very populous due to the pilgrimage is situated on the left bank of the river.

Vegetation: vegetation includes herbs like *Micromeria biflora*, *Gallium* sp., *Verbascum thapsus*, *Tulipa stellata*, *Fumaria indica*, *Stellaria media*, *Achyranthes aspera*, *Cassia tora* and species of *Amaranthus*, and shrubs like *Lantana*, *Adhatoda vasica*, *Carissa opaca*, *Indigofera pulchella*, *Woodfordia fruiticosa* and *Zizyphus* sp. which form a thicket on the banks besides bushes and few sparsly scattered tree species of *Mallotus philippensis, Rhus continus* and *Bauhinia variegata*.

Station-3, (S3). Area: Katra City. Habitat: Urban. Katra Town lies at the foot of Trikuta Mountains, which is 48 kms from Jammu. It has an average elevation of 754 metres (2,474 feet). It serves as the base camp for visiting the famous shrine of Shri Mata Vaishno Devi, which is approachable on foot along a 13 kms long well laid footpath. Every year, more than 6 million pilgrims pass through Katra on their way to the holy shrine.

Vegetation: Natural vegetation in the city has been destroyed; however, there are some tree of *Populus alba, Bombax ceiba, Melia azadirach* besides some ornamental vegetation and few fruit plants.

Station-4, (S4). Habitat: Scrubby Forest. The station S4 lies at an altitude of 800m. It has gentle slope and is Kandi in characteristic i.e., there is scarcity of the water during pinch periods.

Vegetation: Vegetation cover is fairly dense and comprise admixture of herbs, shrubs and trees. *Micromeria biflora*, *Gallium* sp., *Verbascum thapsus*, *Tulipa stellata*, *Fumaria indica*, *Stellaria media*, *Achyranthes aspera*, *Cassia tora* and species of *Amaranthus, Chenopodium, Medicago, Diclipetra* and *Polygonum* are herbs*, Adhatoda vasica*, *Carissa opaca*, *Indigofera pulchella*, *Woodfordia fruiticosa* and *Zizyphus* sp., followed by the dominance of *Rubus* sp., *Lespedeza eriocarpa*, *Lepidagathis cuspidata*, *Debregeasia salicifolia* and *Colebrookea oppositifolia* are common shrubs in this zone and *Mallotus philippensis*, *Rhus continus* and *Bauhinia variegata* are common plant species.

Station-5 (S5). Area: Adhkunwari. The Adhkunwari is located at an altitude 1530m, at a distance of 6 km from Katra town, which is the most important stop on enroute to Bhawan. Besides, its religious significance, it marks the halfway mark on way to the holy cave.

Vegetation: The vegetation in this station includes the herbs like *Ajuga parviflora*, *Polygala* sp., *Impatiens balsamina*, *Oenothera rosea* and *Gallium aparine,* shrubs like *Woodfordia fruiticosa* and *Zizyphus* sp.*, Rubus species*, *Lespedeza eriocarpa*, *Lepidagathis cuspidata*, *Debregeasia salicifolia* and *Colebrookea oppositifolia* besides *Berberis lyceum* and the trees like *Pinus roxburghii, Olia cuspidata, Grewia optiva, Ficus palmata* and *Phyllanthes emblica.*

Station-6, (S6). Area: Sanjichat. It is located at an altitude 1900m, at a distance of 9 km from Katra town.

Vegetation: Herbs at the site are represented by *Valeriana jatamansi*, *Viola odorata*, *Fragaria vesca*, *Agrimonia eupatoria*, *Ligusticum elatum* and *Geranium* sp. At certain moist and shady locations various species of ferns are *Pteris*, *Asplenium* and *Onychium species.* Shrubs are represented by *Berberis lycium*, *Viburnum* sp., *Principia utilis* and species of *Rubus* where as the trees in this region are represented by *Pinus roxburghii*, *Olia cuspidata, Grewia optiva, Ficus palmata, Phyllanthes emblica, Quercus leucotrichophora, Litsea umbrosa*, *Comus macrophylla* and *Toona serrata*.

Station-7 (S7). Area: Bhawan. It is the most famous religious place in north India and is situated at an altitude of 1825m. It entails a 13.5 km trek from Katra.

Vegetation: Herbs at the site are represented by *Valeriana jatamansi*, *Viola odorata*, *Fragaria vesca*, *Agrimonia eupatoria*, *Ligusticum elatum* and *Geranium* sp. At certain moist and shady locations various species of ferns are *Pteris*, *Asplenium* and *Onychium* sp. Shrubs are represented by *Berberis lycium*, *Viburnum* sp., *Principia utilis* and species of *Rubus* where as the trees in this region are represented by *Pinus roxburghii*, *Olia cuspidata, Grewia optiva, Ficus palmata, Phyllanthes emblica, Quercus leucotrichophora*, *Litsea umbrosa*, *Comus macrophylla* and *Toona serrata*.

Station-8 (S8). Area: Bhairon Ghatti. It is about 2.5 km from Vaishno Devi cave at an altitude of 2170m from mean sea level.

Vegetation: herbs are represented by *Valeriana jatamansi*, *Viola odorata*, *Fragaria vesca*, *Agrimonia eupatoria*, *Ligusticum elatum* and *Geranium* sp. At certain moist and shady locations various species of ferns are, *Pteris*, *Asplenium* and *Onychium* sp. whereas the shrubs are represented by reaches *Berberis lycium*, *Viburnum* sp., *Principia utilis* and species of *Rubus* abound and the tree at the site are *Quercus leucotrichophora*, *Pinus roxburghii, Litsea umbrosa*, *Comus macrophylla, Toona serrata*, *Pinus wallichiana, Quercus leucotrichophora* and a few trees of *Rhododendron arborum*.

2.2 Methodology

2.2.1 Identification

For identification and field diagnosis of birds, colourful plates of Ali and Ripley (1968-74), Ali (1996), Grimmett *et al.* (1998)

and Grewal *et al.* (2002) have been used. Colours are usually the best indicators of identity of a species at a close range or through binoculars. Calls also served as an important clue in identifying and locating birds in their habitat.

2.2.2 Determination of the Altitudinal Range of Bird

The method used by Price *et al.* (2003) for determining the altitudinal range of distribution of birds was followed in present study, which involves repeated field trips along the entire altitudinal gradient (in the study area) by halting for 2 minutes at an interval of every 25 m altitude (measured using an altimeter) and recording all the birds seen or heard.

2.2.3 Diversity Indices

Diversity index is a mathematical measure of species diversity in a community. Diversity indices provide more information about community composition than simply species richness (i.e., the number of species present); they also take the relative abundances of different species into account. Diversity indices provide important information about rarity and commonness of species in a community. Species richness, Shannon Wiener diversity index (Shannon and Wiener, 1963), Simpson dominance index (Simpson, 1949), evenness (Pielou, 1966) and Berger–Parker diversity index (Berger and Parker, 1970) were calculated. Abundance values (number of individuals of a species in a particular site) were used to calculate these indices by using PAST software.

3. Results and discussion

A special effort to assess altitudinal range of distribution of birds was made. However, the altitudinal distribution must always be approximate as they vary even within a valley (Price *et al.*, 2003).

In the present study a strong relationship was found between altitude and various species distribution factors like number of individuals (highest at S2), richness, Shannon-Wiener's diversity index (highest at S4 and lowest at S8) and evenness (highest at S1 and lowest at S8). All these parameters decreased with increase in altitude. Number of individuals or the density of birds was the most affected parameter, showing strong negative correlation at first axis. Concentration of dominance (highest at S8 and lowest at S4) and Berger-Parker's indices (highest at S8 and lowest at S4) of species increased with altitude, which means that as the altitude increases the dominance of few species having wider niche increases (Table 1).

Table 1. Bird species richness, diversity and evenness of various sites of Trikuta Hills.

Diversity indices	Sites							
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
Species richness	31	69	24	63	51	31	33	27
Shannon-Wiener's index	3.10	3.27	2.27	3.76	3.30	2.51	2.35	1.85
Simpson's dominance	0.06	0.09	0.17	0.03	0.05	0.19	0.23	0.36
Berger- Parker's index	0.11	0.28	0.32	0.10	0.12	0.41	0.46	0.59
Evenness	0.77	0.42	0.31	0.70	0.53	0.38	0.33	0.24

A total of 15 species of birds i.e., (16.67 %) were altitudinal generalists, found along the whole gradient. Melo-Junior *et al.* (2001) reported 31 species (11.4%) as altitudinal generalists in their study at Minas Gerais, Brazil. Altitudinal Generalists bird in the study area included, Indian Long Billed Vulture, Indian Blue Rock Pigeon, Rufous

Turtle Dove, Himalayan Great Barbet, Brown Fronted Woodpecker, Indian Myna, Himalayan Jungle Crow, White-Cheeked Bulbul, Himalayan Whistling Thrush, Indian White Eye, Yellow-Backed Sunbird, Indian House Sparrow, Great Tit and Himalayan Rock Bunting (Annexure-I).

It was found that there is high species diversity at low altitudes and it decreases continuously as we climb up the altitude (Fig. 1), these observations go well with those of Adolfo and Navarro (1992). The parameters responsible for this decrease in species diversity with altitude (ascending) are abrupt change in habitat (vegetation), gradual changes in environmental parameters (temperature, rainfall, wind etc.) and competition for scarce resources.

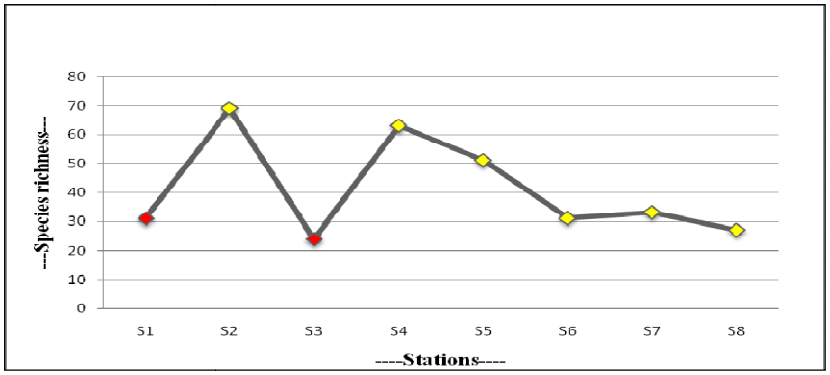

Fig. 1. Species richness along altitudinal gradient in Vaishno Devi Hills

It was further concluded from the studies of altitudinal distribution of bird species that maximum number of the bird species have lower altitudinal range limits, starting from the altitude of 700m amsl but the upper limits of their range differ in most of the species in the study area thus they have different ranges of distribution .

References

Adolfo, G. and Navarro, S. (1992). Altitudinal Distribution of Birds in the Sierra Madre Del Sur, Guerrero, Mexico. J. *The Condor*, 94:29-39.

Alfred, J. R. B, Kumar, A., Tak, P. C., and Sati, J. P. (2001). *Water birds of Northern India*. Zoological Survey of India.

Ahmed, A. (2009). Studies on Diversity of avian fauna of District Doda (J&K). *Ph.D Thesis* submitted to Univ. of Jammu, Jammu.

Ali, S. (1941). *The Book of Indian Birds. Bomb. Nat. Hist. Soc.*

Ali, S. (1996).*The Book of Indian Birds* (12th and enlarged centenary edition). *J. Bomb. Nat. Hist. Soc.* Oxford Univ. Press, New Delhi.

Ali, S. and Ripley, S. D. (1968-74). *The Handbook of Birds of India and Pakistan.* Ten Volumes. Oxford University Press, Bombay.

Ali, S. and Ripley, S. D. (1983). *Compact Handbook of Birds of India and Pakistan*. Oxford Univ. Press, Bombay.

Ali, S. and Ripley, S. D. (1983). *Handbook of Birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. Compact eds.* Oxford Univ. Press, New York.

Berger, W. H. and Parker, F. L.(1970). Diversity of planktonic forminifera in deep– sea sediments. *Science*, 168: 1345–1347.

Choudhary, N. J. (2010). Diversity and status of wildlife fauna of District Rajouri, J&K State. Ph.D Thesis submitted to Univ. of Jammu, Jammu.

Grimmett, R., Inskipp, C. and Inskipp, T. (1998). *Birds of The Indian Subcontinent.* Oxford Univ. Press, Delhi.

Grewal, B., Harvey, V. and Pfister, O. (2002). *A Photographic guide to the Birds of India.* Periplus Editions (HK) Ltd. Singapore.

Hughes L (2000). Biological consequences of global warming: is the signal already apparent? Trends. Ecol. Evol., 15: 56–61

Janzen, 1973. D.H. Janzen (1973). Tropical agroecosystems. Science, 182, pp. 1212-1219

Jerdon, T.C. (1862-64). *The Birds of India*. 2 Vol. (3 parts) published by author. Calcutta.

Jerdon, T.C. (1862-64). *The Birds of India*. 2 Vol. (3 parts) published by author. Calcutta.

Melo-Junior, T. A., De Vasconcelos, M. F., Fernandes, G. W. and Marini, M.A. (2001). Bird species distribution and conservation in Serra do Cipo, Minas Gerais, Brazil. *J. Bird Conservation International*. 11: 189-204.

Noon, B. R. (1981). Distribution of an avian guild along a temperate elevational gradient: the importance and expression of competition. *Ecol.Mongor*. 51:105-124

Peterson, T. C., *et al*., Recent changes in climate extremes in the Caribbean region, J. Geophys. Res., 107(D21), 4601, doi:10.1029/2002JD002251, 2002.

Pielou, E. C. (1966). The measurement of diversity in different types of biological collections. *J Theoretical Biology*, 13: 131 – 144.

Price, T., Zee, J. and Jamdar, N. (2003). Bird species diversity along the Himalayas: a comparision of Himachal Pradesh with Kasshmir. *J Bomb. Nat. Hist. Soc.* 100: 394-409.

Shannon, C. E. and Wiener, W. 1963. *The Mathematical Theory of Communities*. University of Illinois Press, Urbana. p. 117.

Simpson, E. M. (1949). Measurement of diversity. Nature, 163: 688.

Terborgh and Weske (1975). Role of competition in distribution of Andean birds. *Ecology*,56:562-576.

Wani, A. A., Aggarwal, S. and Sahi, D. N.(2009). Vertical Stratification of birds in temperate forest of tehsil Doda (J&K). J. *Natcon*. 21(1): 185-188.

ANNEXURE-I

Altitudinal range of distribution, resident/migrant status and feeding habits of avifauna of Trikuta Hills (Vashno Devi hills) J&K.

S. No.	Name of Species	Altitudinal Range	Rst/Mgt Status	Feeding Guild
1.	Indian Pond Heron	700-1000m	Rst	WC
2.	Cattle Egret	700-1000m	Rst	WC/UI
3.	Little Egret	700-750m	Rst	WC
4.	Pariah Kite	700-1500m	Rst	ATC
5.	Indian Shikra	700-1600m	Rst	ATC
6.	Indian Long Billed Vulture	700-2200m	Rst	TC
7.	Himalayan Griffon Vulture	1200-2200m	Rst	TC
8.	Red Wattled Lapwing	700-1250m	Rst	SIP/TI
9.	Indian Red Jungle Fowl	700-1250m	Rst	G, I
10.	Grey Partridge	700-800m	Rst	G, I
11.	Black Partridge	700-900m	Rst	G, I
12.	Kalij Pheasant	1250-2200m	Rst/AM	G, I
13.	Cheer Pheasant	1250-2000m	Rst/AM	G, I
14.	Indian Peafowl	700-800m	Rst	G, I
15.	Indian Blue Rock Pigeon	700- 2200m	Rst	G
16.	Indian Ring Dove	700-1500m	Rst	G
17.	Indian Spotted Dove	700-1500m	Rst	G
18.	Little Brown Dove	700-1000m	Rst	G
19.	Rufous Turtle Dove	700-2200m	Rst/AM	G
20.	Large Indian Parakeet	700-1000m	Rst/AM	F
21.	Rose Ringed Parakeet	700-1000m	Rst/	F
22.	Blossom Headed Parakeet	700-1500m	Rst/AM	F
23.	Indian Koel	700-1250m	Rst	F, I
24.	Pied Crested Cuckoo	700-950m	SM	AI/TI
25.	Northern Spotted Owlet	700-1900m	Rst	ATC
26.	Great Horned Owl	700-900m	Rst	ATC
27.	White Breasted Kingfisher	700-1250m	Rst	ATC/AAqC
28.	Pied Kingfisher	700-800m	Rst	AAqC
29.	Indian Small Green Bee-Eater	700-1000m	Rst	AI
30.	Blue Jay	700-1250m	Rst	ATC
31.	European Hoopoe	700-1250m	Rst/AM	G/UI
32.	Large Green Barbet	700-1500m	Rst/AM	F
33.	Copper Smith	700-1250m	Rst/AM	F
34.	Himalayan Great Barbet	700-2200m	Rst/AM	F
35.	Lesser Golden-Backed Woodpecker	700-650m	Rst	T/BF
36.	Brown Fronted Woodpecker	700-2200m	Rst	T/BF
37.	Rufous-Backed Shrike	700-1250m	SM	ATC
38.	Indian Golden Oriole	700-1250m	SM	F, I
39.	Black Drongo	700-1600m	Rst	AI
40.	Indian Myna	700-2200m	Rst	G, F, I
41.	Bank Myna	700-1250m	Rst	G, F, I
42.	Northern Jungle Myna	700-2200m	Rst	G, F, I
43.	Brahminy Myna	700-1100m	Rst	G, F, I
44.	Starling	700-1600m	WM	G, F, I
45.	House Crow	700-800m	Rst	O
46.	Himalayan Jungle Crow	700-2200m	Rst	O
47.	Northwestern Tree Pie	700-1600m	Rst	O
48.	North Indian Scarlet Minivet	700-2200m	Rst/AM	CI
49.	Red Vented Bulbul	700-1250m	Rst	F, I
50.	White-Cheeked Bulbul	700-2200m	Rst	F, I
51.	Black Bulbul	1200-2200m	Rst	F, I
52.	Jungle Babbler	700-1600m	Rst	UI
53.	Common Babbler	700-1600m	Rst	UI
54.	Paradise Flycatcher	700-1600m	SM	AI
55.	Verditer Flycatcher	700-1400m	Rst/AM	AI
56.	Indian Tailor Bird	700-1250m	Rst	CI/TI

57.	Himalayan Whistling Thrush	700-2200m	Rst/AM	O/UI
58.	Blue Rock Thrush	1500-2200m	Rst	UI
59.	Indian Magpie Robin	700-1250m	Rst	TI
60.	Indian Robin	700-1600m	Rst	TI
61.	White Caped Redstart	700-1800m	Rst	AqI
62.	Plumbeous Redstart	700-1800m	Rst	AqI
63.	Kashmir Black Redstart	700-1800m	WM	AqI
64.	Pied Bush Chat	700-1500m	Rst	TI
65.	Collared Bush Chat	1400-2200m	WM	TI
66.	Brown Rock Chat	700-1250m	Rst	TI
67.	Indian White Wagtail	700-1300m	WM	SIP/TI
68.	Grey Wagtail	700-1600m	WM	SIP/TI
69.	Indian Pied Wagtail	700-1200m	WM	SIP/TI
70.	Blue Headed Yellow Wagtail	1000-2200m	WM	SIP/TI
71.	Purple Sunbird	700-1400m	Rst	NI
72.	Yellow-Backed Sunbird	700-2200m	Rst/AM	NI
73.	Indian White Eye	700-2200m	Rst	C,I
74.	Indian House Sparrow	700-2200m	Rst	G,I
75.	Himalayan Cinnamon Tree Sparrow	1000-2200m	Rst	G,I
76.	Indian Baya	700-900m	Rst	G
77.	Spotted Munia	700-1900m	Rst	G
78.	Red Munia	700-900m	Rst	G
79.	Great Tit	700-2200m	Rst/AM	C, I, F
80.	Green Backed Tit	1250-2200m	Rst	C, I, F
81.	Himalayan Tree creeper	700-1800m	Rst	T/BF
82.	Himalayan Rock Bunting	700-2200m	Rst/AM	G, I
83.	Crested Bunting	700-1500m	Rst/AM	G, I
84.	Red Rumped Swallow	700-1500m	Rst	A I
85.	Himalayan Brown Dipper	700-1000m	Rst	AqI/DC
86.	Pink Browed Rosefinch N	1500-2200m	Rst	G
87.	Streaked Laughing Thrush N	1800-2200m	Rst	TI,G
88.	Chestnut Thrush N	1700-2200m	Rst	I, F
89.	Grey Winged Blackbird N	1700-2200m	Rst	I, F
90.	Himalayan/Altai Accentor N	1700-2200m	WM	G,F,I

Feeding Guilds: AI – Aerial Insectivore; **AqI** – Aquatic Insectivore; **CI** – Canopy Insectivore; **UI** – Under storey Insectivore; **TI** – Terrestrial Insectivore; **T/BF** – Trunk or Bark Feeder; **SIP** – Shore Insect Plover; **ATC** – Arboreal Terrestrial Carnivore; **TC** – Terrestrial Carnivore; **AAqC** – Arboreal Aquatic Carnivore; **DC** – Diving Carnivore; **WC** – Wading Carnivore; **F** – Frugivore; **O –** Omnivore; **G** – Grainivore; **N** – Nectarivore ; **I** – Insectivore.