

Birds Of Three Different Forest (Sal, Pine And Oak) Habitats In Nainital District (Western Himalaya) Of Uttarakhand, India

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Abstract: The present study were made to estimate the avian fauna in terms of species richness and diversity and guild structure in forest habitats of Nainital district of Uttarakhand (350 - 2450m asl; 29⁰ N). Field studies were conducted during January 2006 to December 2007. Total 88, 106 and 95 species were recorded from Nainital, Bhowali and Haldwani forest habitats. A checklist of 160 avian species has produced of Nainital district forest habitat. It is suggested that this study provide a base line structure for further study on species distribution in different forest habitat in Nainital district.

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1. Introduction:

In the global scale the Himalayan regions are rich in biodiversity because these regions are surrounded with broad leaf mixed, dry deciduous, moist deciduous and conifer forest areas. Therefore, conservation of forest area of Himalayan region is imperative. Infact Western Himalayan forests provide good shelter for animals to flourish, rich food sources and develop a productive ecosystem. These forests have large number of endemic and globally threatened species also. The avifauna of this region has been extensively documented from Jerdon's (1862-64) pioneering investigation to Ali & Ripley's (1983) authoritative hand book.

In the context of avian diversity many studies have identified the factors responsible for variation in avifauna from habitat to habitat in India (Beehler *et al.*, 1987; Daniels, 1989; Johnsingh *et al.*, 1986). These studies also emphasized the value of avifaunal studies in quantifying and monitoring forest degradation.

The history of ornithology in this hilly region is brief and last comprehensive field work in the area was carried out in 1930 by Hudson corrie who compiled a checklist. After Hudson, a detailed work was carried out by the famous Indian ornithologist

Salim Ali, who published his work in a book entitled "Indian Hill Birds" (1984). However, work on avian species abundance and community structure in forest habitat has hardly been published from Himalayan region. Although in the last decades a few studies have also been conducted to look at avian diversity in some South Indian forests (Price, 1979; Johnsingh and Joshua, 1994; Pramod *et al.*, 1997; Kunte *et al.*, 1999; Singh, 2000).

In the light of the above background, it was decided to prepare the avian specie check list in three different forest habitats in Nainital district of Western Himalaya.

2. Study area:

The survey was carried out in forest habitats in Nainital district of Uttarakhand for a period of two years during January 2006 to December 2007. The Nainital district occupies the southern portion of the Kumaun division (latitude 28 44' N and 30 49' N and 78 45' E and 81 01' E longitude). Geographically the Nainital district is a most heterogeneous, the northern portion consists of hill and the southern portion consists of the alluvial plain called Bhabar (Valdia and Bartarya, 1980). The study was conducted three different forests of Nainital district (see Fig 1, Table 1).

Table 1 Showing the Vegetation zone and elevation sections of the study areas

S.No.	Study area	Vegetation zone	Approximate Elevation	Climate Zone	Annual mean temp. (°C)
1	Nainital	Oak - Conifer forest	1900 – 2450 m asl	Temperate	14.73
2	Bhowali	Pine - Oak mixed	1450 - 1700 m asl	Subtropical	16.03
3	Haldwani	Broad leaf mixed	350 – 500 m asl	Tropical	23.45

The study site of Nainital forest is dominant with four species of oak Rainj (*Quercus lannginosa*), Banj (*Q. inacana*), Karkshul (*Q. semicarpifolia*), Tilonj (*Q. dilatata*) Oak, Himalayan cypress (*Cupressus torulosa*), and Deodar (*Cedrus deodarus*) are present in the study area. Among Oak *Q. inacana* (Banj) is most common. The forest habitat of Bhowali is rich in Chir Pine (*Pinus roxburghii*) and Banj oak (*Q. inacana*) species and the shrubs Lantana (*Lantana camarana*) are wide spread in this area.

Immediately below the foot of the Nainital hills is known as Bhabar belt (Haldwani). This belt is waterless forest land. The Haldwani forest area is dominant with valuable trees such as Sal (*Shorea robusta*), Sain (*Terminalia tomrntosa*) and Haldu (*Adiva cordifolia*), Dhauri (*Lagerstroemia parviflora*), Shisham (*Dalbergia sissoo*) and Khair (*Acacia catechu*). The shrub Lantana is widely spread in the study area.

3. Methods:

The present study was carried out in three forest habitats of Nainital district (Western Himalaya; 29⁰ N) namely (A) Nainital, (B) Bhowali and (C) Haldwani along different sections of the elevational gradient. Forest habitat of the study areas consisted of Oak (*Quercus leucotrichophora*) and Deodar (*Cedrus deodara*) (Nainital), Pine (*Pinus roxburghii*), Oak (*Quercus leucotrichophora*), mix (Bhowali) and Sal (*Shorea robusta*), Khair (*Acacia catechu*) mix (Haldwani).

Field studies were conducted for two years during January 2006 to December 2007 using field binoculars (7x50) and GPS (e-trex Vista). Fixed width Line-transect count method (Verner, 1985) was used for measuring bird abundance. Pattern of bird census in habitat was same. We recorded all birds seen with in 50m on each side of the transect line. Observation of birds in each Line transect was made by walking on foot. Transect lines were not straight; at Bhowali and Nainital forest there were a lot of uphill and downhill, a band here and a band there. However, transects did not cross transects.

At each study area in each habitat three transects (one km. each) were laid and each transect was visited monthly. The total transects laid were 108 [12 months x 3 transects per forest types x 3 study

areas = 108]. The same transects were revisited in the following year separately in all sites.

The time of sampling was between 07h30-10h30 a.m. and 05h00-08h00 a.m. in morning and 16h00- 18h00 during winter and summer respectively. Sampling was avoided during rainy days. The identification of birds in the field was based on Grimmett et al. (1998).

4. Data Analysis:

Bird species diversity was measured using Shannon's index (H') (MacArthur and MacArthur, 1961). The average of monthly mean abundance of both the years was accounted for calculating total abundance of the species. This value was then used to measure BSD and BSR during the study.

To know the similarity among the species composition in different forest types Sorensen's quantitative index (Magurran, 1988) was used. Species can be categorized as rare depending on the criteria used to define rarity. Species those had less than five observations per sighting were categorized as rare Gaston, 1994, Maguran, 1988).

To determine the guild structure foraging birds were observed in the field. The frequency of foraging on a given foraging substrate and whenever possible types of food obtained were ascertained for each species on the basis of at least ten observations per species. Species were then accordingly classified into insectivores, frugivores, granivores, carnivores and nectarivores guild.

5. Results:

A total of 160 bird species belonging to 24 families were recorded in forest habitat (see appendix). Among these 160 species, maximum numbers of species 63; 39.24% were found in site B (Bhowali forest) and minimum 42; 26.26% at site A (Nainital forest). The site C (Haldwani forest) supported 55; 34.17% species. Among the 24 families Muscicapidae (32.09%) was the largest family followed by Picidae (18.20%), Phasianidae (7.31%) and Accipitridae (4.82%). Table 2 indicate the species diversity indices (BSR and BSD) and maximum rare (19.31%) species in site A, minimum rare species (12.26%) in site B and (13.68%) site C. which were recorded fewer than 5 individuals per sighting; categorized as rare species of the study sites.

Table 2: Showing the comparative diversity indices of species in forest habitat along elevational gradient (2006-2007)

	Site A (Nainital forest)	Site B (Bhowali Forest)	Site C (Haldwani forest)
Dominant Tree species	Deodar, Oak	Pine, Oak	Khair, Sal
Shannon's diversity index (H')	3.72	3.86	3.77
Species richness (R)	10.21	11.67	10.43
Exclusive species in forest habitat	26	39	34
Rare species (n<5)	17	13	13
Species individuals (N)	5029	8064	8170

Maximum similarities of avian species were observed between Oak and Pine forest (Site A and Site B); followed by Pine and Sal forest (Site B and Site C). Study of the guild structure revealed that insectivores dominated in among the forest types and followed by omnivores (Table 3).

Table 3 Matrix of number of species in common (upper right) and percentage similarity (Sorensen's index) (lower left) for birds of different study areas forest

Study areas forest	Site A	Site B	Site C
A (Nainital)	0	62 (no. of common species)	40 (no. of common species)
B (Bhowali)	49 (% similarity)	0	55 (no. of common species)
C (Haldwani)	31 (% similarity)	43 (% similarity)	0

The percentage of feeding guild structure (i.e. carnivores, granivores, frugivores and nectarivores) among forest type habitats indicating differential availability of the resources in the habitat studied (Table 4a, b).

Table 4 (a) Showing the species feeding guilds in forest habitat at different study sites (2006 -2007)

Main feeding guilds	Sub feeding guilds	Nainital	Bhowali	Haldwani
Insectivore	6	58 (65.90%)	58 (54.71 %)	51 (53.68 %)
Omnivore	2	9 (10.22 %)	13 (12.26 %)	14 (14.73 %)
Frugivore	2	7 (7.95 %)	9 (8.49 %)	14 (14.73 %)
Carnivore	4	6 (6.81 %)	8 (7.54 %)	7 (7.36 %)
Granivore	2	6 (6.81 %)	15 (14.15 %)	7 (7.36 %)
Nectarivore	2	2 (2.27 %)	3 (2.83 %)	2 (2.10 %)

Table 4 (b) Showing the species sub feeding guilds in forest habitat among different study sites (2005 – 2006)

Main feeding guilds	Sub feeding guilds	Site A (Nainital)	Site B (Bhowali)	Site C (Haldwani)
Insectivore	Aerial insectivore	22 (25%)	20 (18.86%)	19 (20%)
	Bark gleaning insectivore	9 (10.22%)	7 (6.60%)	12 (12.63%)
	Foliage gleaning insectivore	6 (6.81%)	6 (5.66%)	2 (2.10%)
	Sallying insectivore	9 (10.22%)	10 (9.43%)	9 (9.47%)
	Under-storey insectivore	8 (9.09%)	9 (8.49%)	5 (5.26%)
	Grass land insectivore	4 (4.54%)	6 (5.66%)	4 (4.21%)
	Omnivore	Terrestrial omnivore	4 (4.54%)	7 (6.60%)
Arboreal terrestrial omnivore		5 (5.68%)	6 (5.66%)	8 (8.42%)
Granivore	Granivore seed eater	4 (4.54%)	9 (8.49%)	4 (4.21%)
	Frugivore granivore insectivore seed eater	2 (2.27%)	6 (5.66%)	3 (3.15%)
Frugivore	Frugivore seed eater	4 (4.54%)	6 (5.66%)	10 (10.52%)
	Frugivore insectivore	3 (3.40%)	3 (2.83%)	4 (4.21%)
Carnivore	Sallying carnivore	1 (1.13%)	4 (3.77%)	4 (4.21%)
	Arboreal terrestrial carnivore	2 (2.27%)	1 (0.94%)	1 (1.05%)
	Terrestrial carnivore	1 (1.13%)	3 (2.83%)	1 (1.05%)
	Wading carnivore	2 (2.27%)	0	1 (1.05%)
Nectarivore	Nectarivore insectivore	1 (1.13%)	1 (0.94%)	1 (1.05%)
	Nectarivore	1 (1.13%)	2 (1.88%)	1 (1.05%)

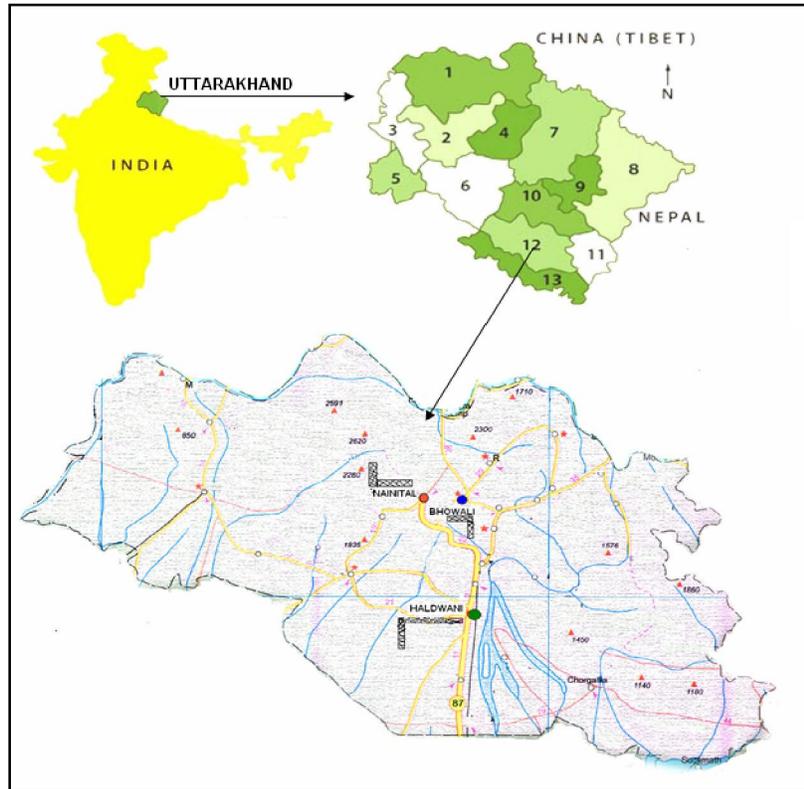


Fig.1. Study location map of Nainital district (Western Himalayas; India)

Appendix

A combined List of the avian species recorded during the present study (2006-2007) in the forest habitat among the sites by authors

Family	Common Name	Scientific Name	Feeding guild	Distribution status	Conservation status (IWPA)
Muscicapidae					
	Aberrant bush warbler	<i>Cettia flavolivacea</i>	SI	r	Schedule IV
	Ashy prinia	<i>Prinia socialis</i>	USI	r	Schedule IV
	Asian Paradise fly catcher	<i>Terpsiphone paradisi</i>	AI	sv	Schedule IV
	Blue throated flycatcher *	<i>Cyornis unicolor</i>	SI	sv	Schedule IV
	Buff - barred warbler	<i>Phylloscopus pulcher</i>	USI	wv	Schedule IV
	Fantail warbler	<i>Cisicola exilis</i>	AI	r	Schedule IV
	Greenish warbler	<i>Phylloscopus trochiloides</i>	USI	wv	Schedule IV
	Grey - head canary flycatcher	<i>Culicicapa ceylonensis</i>	USI	r/am	Schedule IV
	Grey winged black bird	<i>Turdus boulboul</i>	FGI	r/am	Schedule IV
	Lemon - rumped warbler	<i>Phylloscopus chloronotus</i>	USI	r/am	Schedule IV
	Lesser whitethroat warbler *	<i>Sylvia curruca</i>	USI	wv	Schedule IV
	Pale footed bush warbler	<i>Cettia pallidipes</i>	USI	r	Schedule IV

	Red - throated flycatcher	<i>Ficedula parva</i>	SI	wv	Schedule IV
	Rufous bellied niltava	<i>Niltava sundara</i>	SI	r/am	Schedule IV
	Rufous sibia	<i>Heterophasia capsistrata</i>	BGI	r	Schedule IV
	Rusty checked sumiter babbler	<i>Pomatorhinus erthrogenys</i>	BGI	r	Schedule IV
	Small niltava	<i>Niltava macgrigoriae</i>	SI	r	Schedule IV
	Striated babbler	<i>Turdoides earlei</i>	FSI	r	Schedule IV
	Thick - billed flower pecker	<i>Dicaeum agile</i>	BGI	wv	Schedule IV
	Ticklle's leaf warbler	<i>Phylloscopus affinis</i>	BGI	wv	Schedule IV
	Whiskered yuhnia	<i>Yuhina flavicollis</i>	SI	r/am	Schedule IV
	White - crested laughing thrush	<i>Garrulax leucolophus</i>	FGI	r	Schedule IV
	White - tailed rubythroat *	<i>Luscinia pectoralis</i>	SI	sv	Schedule IV
	Yellow - bellied fantail	<i>Rhipidura hypoxantha</i>	USI	r/am	Schedule IV
	Yellowish - bellied bush warbler *	<i>Cettia acanthizoides</i>	USI	r	Schedule IV
Picidae					
	Black rumped flameback	<i>Dinopium benghalense</i>	FGI	r	Schedule IV
	Brown - fronted woodpecker	<i>Dendrocopos auriceps</i>	FGI	r/am	Schedule IV
	Brown capped pygmy woodpecker	<i>Dendrocopos nanus</i>	FGI	r	Schedule IV
	Common flameback *	<i>Dinopium javanense</i>	FGI	sv	Schedule IV
	Fulvous breasted woodpecker	<i>Dendrocopos macei</i>	FGI	r	Schedule IV
	Great slaty woodpecker *	<i>Mulleripicus pulverulentus</i>	FGI	r	Schedule IV
	Greater flameback	<i>Chrysocolaptes lucidus</i>	FGI	r	Schedule IV
	Grey capped pygmy woodpecker	<i>Dendrocopos canicapillus</i>	FGI	r	Schedule IV
	Grey headed woodpecker	<i>Picus canus</i>	FGI	r	Schedule IV
	Himalayan flameback	<i>Dinopium shorii</i>	FGI	r	Schedule IV
	Himalayan woodpecker	<i>Dendrocopos himalayensis</i>	FGI	r	Schedule IV
	Lesser yellownape woodpecker	<i>Picus chlorolophus</i>	FGI	r	Schedule IV
	Slaty - bellied woodpecker	<i>Picus squamatus</i>	FGI	r	Schedule IV
	Streak throated woodpecker *	<i>Picus xanthopygaeus</i>	FGI	r	Schedule IV
Phasianidae					
	Cheer pheasant (* Vocal)	<i>Catreus wallichii</i>	FGSI	e	Schedule 1

	Common quail	<i>Coturnix Coturnix</i>	FGSI	r	Schedule IV
	Indian peafowl	<i>Pavo cristatus</i>	FGSI	r	Schedule 1
	Kalij pheasant	<i>Lophura leucomelanos</i>	FGSI	am	Schedule IV
	Koklass pheasant	<i>Pucrasia macrolopha</i>	FGSI	am	Schedule IV
	Red jungle fowl	<i>Gallus gallus</i>	FGSI	r	Schedule IV
Campephagidae					
	Long tail minivet	<i>Pericrocotus ethologus</i>	SI	wv	Schedule IV
	Large cuckoo shrike	<i>Coracina macei</i>	TO	r/am	Schedule IV
	Small tail minivet	<i>Pericrocotus cinnamomeus</i>	AI	r	Schedule IV
					Schedule IV
Accipitridae					
	Besra sparrow hawk	<i>Accipiter virgatus</i>	SC	R	Schedule IV
	Black shoulder kite	<i>Neophron percnopterus</i>	SC	R	Schedule IV
	Booted hawk eagle *	<i>Hieraaetus pennatus</i>	ATC	R	Schedule IV
	Common buzzard	<i>Buteo buteo</i>	ATC	wv	Schedule IV
Alaudidae					
	Eurasian skylark	<i>Alauda arvensis</i>	GSE	wv	Schedule IV
	Oriental skylark	<i>Alauda gulgula</i>	GSE	wv	Schedule IV
Corvidae					
	Black head jay	<i>Garrulus lanceolata</i>	ATO	r/am	Schedule IV
	Eurasian jay	<i>Garrulus glandarius</i>	FGIS	r/am	Schedule IV
Cuculidae					
	Greater coucal	<i>Centropus sinensis</i>	TO	r	Schedule IV
	Lesser coucal	<i>Centropus benglensis</i>	TO	r	Schedule IV
Motacillidae					
	Paddy field pipit	<i>Anthus rufulus</i>	GSE	r	Schedule IV
	Tree pipit	<i>Anthus trivialis</i>	GSE	wv	Schedule IV
Oriolidae					
	Black hooded oriole	<i>Oriolus xanthornus</i>	FR	r	Schedule IV
	Common iora	<i>Aegithina tiphia</i>	USI	r	Schedule IV
Paridae					
	Green backed tit	<i>Parus monticolus</i>	USI	r	Schedule IV
	Grey crested tit	<i>Parus dichrous</i>	USI	r	Schedule IV

Passeridae					
	Chestnut shouldered petronia	<i>Petronia xanthocollis</i>	TGI	r	Schedule IV
	Russet sparrow	<i>Passer rutilanus</i>	FGSI	am	Schedule IV
Strigidae					
	Brown wood owl	<i>Strix leptogrammica</i>	ATC	r	Schedule IV
	Spotted owlet	<i>Athene brama</i>	ATC	r	Schedule IV
Campephagidae					
	Common wood shrike	<i>Tephrodornis pondicerianus</i>	USI	r	Schedule IV
Capitonidae					
	Brown - headed barbet *	<i>Megalaima zeylanica</i>	FGI	r	Schedule IV
Certhiidae					
	Eurasian treecreeper	<i>Certhia familiaris</i>	BGI	r/am	Schedule IV
Columbidae					
	Emerald dove *	<i>Chalcophaps indica</i>	GSE	r	Schedule IV
Dicaeidae					
	Fire breasted flower pecker	<i>Dicaeum ignipectus</i>	BGI	am	Schedule IV
Dicruridae					
	Spangled drongo	<i>Dicrurus hottentottus</i>	AI	r	Schedule IV
Fringillidae					
	Common rose finch	<i>Carpodacus erythrinus</i>	GSE	r	Schedule IV
Nectariniidae					
	Crimson sunbird	<i>Aethopyga siparaja</i>	NA	r/am	Schedule IV
Psittacidae					
	Alexandrine parakeet	<i>Psittacula eupatria</i>	FSE	r	Schedule IV
Pycnonotidae					
	Himalayan bulbul	<i>Pycnonotus leucogenys</i>	FI	r	Schedule IV
Sturnidae					
	Chestnut-tailed starling	<i>Sturnus malabaricus</i>	AI	r/am	Schedule IV

Abbreviation: **ai** = aerial insectivore, **bgi** = bark gleaning insectivore, **fgi** = foliage gleaning insectivore, **si** = sallying insectivore, **usi** = under-storey insectivore, **gli** = grass land insectivore, **to** = terrestrial omnivore, **ato** = arboreal terrestrial omnivore, **gse** = granivore seed eater, **fgse** = frugivore granivore insectivore seed eater, **fse** = frugivore seed eater, **fi** = frugivore insectivore, **sc** = sallying carnivore, **atc** = arboreal terrestrial carnivore, **tc** = terrestrial carnivore, **wc** = wading carnivore, **ni** = nectarivore insectivore, **n** = nectarivore, **r** = resident, **am** = altitudinal migratory, **sv** = summer visitor, **wv** = winter visitor, **vu** = vulnerable, **e** = endemic, **cr** = critical rare, * Rare species of the sites (N < 5), IWPA = Indian wildlife protection Act

6. Discussion:

The Results indicate that Pine mix forest has high number of unique species as compared to other forests. This shows that pine mixed forest has its own bird community. According to Thiolly *et al.* (1988), each forest type has its own species. Similarity indices indicate the similarity between species associated with vegetation types. The distribution and abundance of many bird species are determined by the configuration and composition of the vegetation that comprises a major element of their habitat (Cody, 1985; Morrison, 1992; Block and Brennan, 1993). It is interesting to know that the abundance of Red jungle fowl (*Gallus gallus*) was good in site C forest showing less human interruption/ poaching in this area.

In this study it was found that insectivore species were dominant in forest habitat, indicating rich abundance and easy availability of insects in the forest habitat. The variation in bird community consistent with the distribution of food resources was reported by Lefebvre and Poulin, (1997) also. Some studies conducted in the Indian subcontinent (Johnsingh *et al.*, 1994; Kropil, 1996; Sharma, 2001; Singh, 2004) have also shown that the insectivore guild is dominant in the forest habitat.

The district Nainital is untouched about avian knowledge very few study have been conducted in this area. Hudson (1930), documented 124 bird species in Nainital (seven hills); Briggs (1931) documented 83 avian species in Ranikhet forest; Tak (1995) documented 127, 94 and 82 species of birds from Nainital, Almora and Pithoragarh districts and Sultana (1997) documented 182, 81 and 162 bird species from Almora, Nainital and Pithoragarh respectively. However, the present study covered district Nainital three sites (Bhowali, Haldwani and Nainital forest) which had avoided in previous studies.

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