

Birds of Lansdowne forest division and adjacent suburban landscapes, Garhwal Himalayas, Uttarakhand, India: Community structure and seasonal distribution

MOHAN KUKRETI[✉], DINESH BHATT^{✉✉}

Department of Zoology and Environmental Science, Gurukula Kangri University, Haridwar, Uttarakhand, India. Tel. +91-1334-240982, Fax. +91-1334-246366, e-mail: [✉]mohankukreti@gmail.com; ^{✉✉}dineshharidwar@gmail.com

Manuscript received: 27 January 2014. Revision accepted: 3 April 2014.

ABSTRACT

Kukreti M, Bhatt D. 2014. Birds of Lansdowne forest division and adjacent suburban landscapes, Garhwal Himalayas, Uttarakhand, India: Community structure and seasonal distribution. *Biodiversitas* 15: 80-88. This study of bird species diversity aims at understanding the distribution patterns and structures of avifauna of the two forest ranges and adjoining suburban areas of the Lansdowne forest division, Uttarakhand, India. Data on the abundance and richness were collected by standardized Verner's line transect method for two years (January 2011 to December 2012). A total of 216 species were recorded from the study area. Family Muscipidae with 30 species was found to be dominant in the forest habitats, while family Corvidae with 10 species was found to be dominant in the suburban areas. Results indicate that the forests had more complex bird community structure in terms of higher species richness (8.95 vs 8.59), higher species diversity (Shannon's index 3.86 vs 3.74), higher evenness (0.085 vs 0.080) and more rare species (74 vs 15) as compared to urban habitats. Bird species richness (BSR) and bird species diversity (BSD) fluctuated across seasons but not across habitat types. In order to sustain avian diversity, it is recommended that anthropogenic disturbance should be reduced and traditional agroforestry should be developed in the study area.

Key words: Avian diversity, Garhwal Himalayas, Lansdowne forest, species richness, suburban

INTRODUCTION

Biodiversity is a contraction of 'biological diversity'. It has been defined by many scientists, governmental and non governmental organizations usually as species richness, which is distributed unequally around the earth (Mittermeier et al. 1998; Myers et al. 2000; Barthlott and Winger 2001). According to the Millennium Ecosystem Assessment report (2005), the current extinction rates for mammals, birds and amphibians is up to one thousand times higher than the one witnessed in the fossil records. Hence, there is a need for long term documentation of diversity in natural environment. In the Indian subcontinent, approximately 1300 avian species are found which constitute about 13% of the world bird assembly (Grimmett et al. 1998). In the Western Himalayas, one of the Endemic Bird Areas (EBAs) (Birdlife International 2012), some recent studies focus on avian diversity and describes the extensive biodiversity assessments (Singh 2000; Chettri et al. 2001; Laiolo 2002; Price et al. 2003; Sultana et al. 2007; Acharya et al. 2011). At this point of time there are some published research works in the Pauri Garhwal district on avian community ecology with special reference to diversity, abundance, distribution and other ecological gradients (Naithani and Bhatt 2010, 2012). However, there is hardly any report from the study area comparing the forest avian biodiversity with the

suburban/rural landscapes. In the present study, an attempt is being made to find out the patterns and distributions of the bird communities in different forest sites and adjoining suburban areas of the Kotdwar and Laldhang forest ranges of the Lansdowne forest division (Pauri Garhwal, Uttarakhand, Western Himalaya, India).

MATERIALS AND METHODS

Study area

Lansdowne forest division is located on 29°37' to 30°2' North latitude and 78°19'13'' to 78°43'0'' East longitudinally in the south west portion of district Pauri Garhwal. The forest division is located on Rajaji National Park towards its western side and Corbett Tiger Reserve towards its east (Figure 1). In the north eastern part of Lansdowne range, Chir (*Pinus roxburghii*) and Banj (*Quercus leucotrichophora*) forests can be found. The remaining parts are occupied by Sal (*Shorea robusta*) and associated species: *Acacia catechu*, *Dalbergia sissoo*, *Cassia fistula*, *Holoptelea integrifolia*, *Syzygium cumini*, *Mallotus philippensis*, *Aegle marmelos*, *Ziziphus mauritiana*, *Ougeinia oojeinensis*, *Bombax ceiba*, *Albizia odoratissima*, *Anogeissus latifolia*, *Holarrhena pubescens*, *Ficus benghalensis* and *Adina cordifolia*. Major Shrubs of the sites studied are *Lantana camara*, *Murraya koenigii*, *Parthenium hysterophorus*, *Ardisia solanacea*, *Desmodium triflorum* and *Asparagus adscendens*. Climatically the area

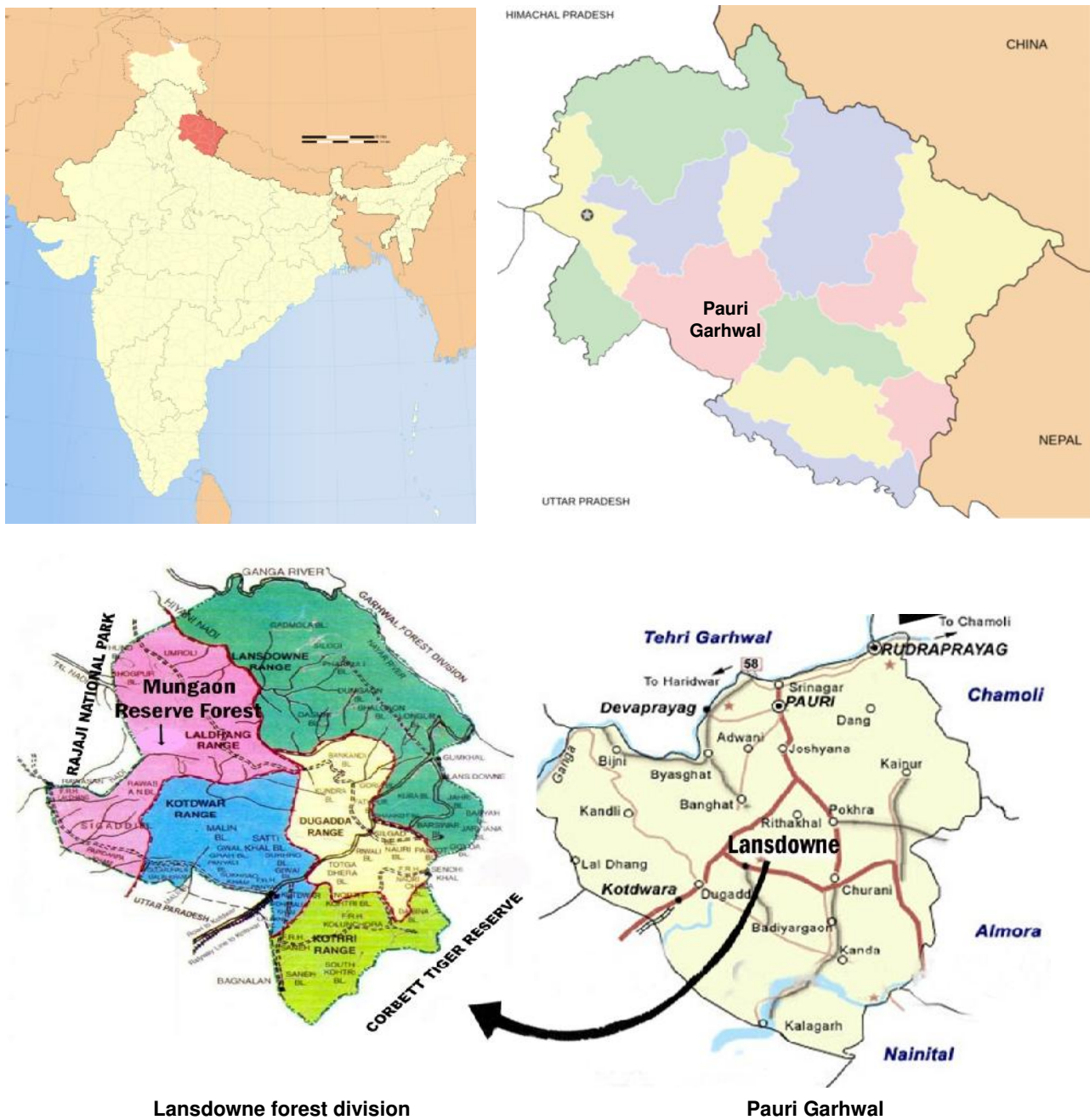


Figure 1. Showing location of Lansdowne forest division, Pauri Garhwal district in Uttarakhand, India.

can be divided into three distinct seasons viz., rainy season (July to October), winter (November to February), summer (March to June).

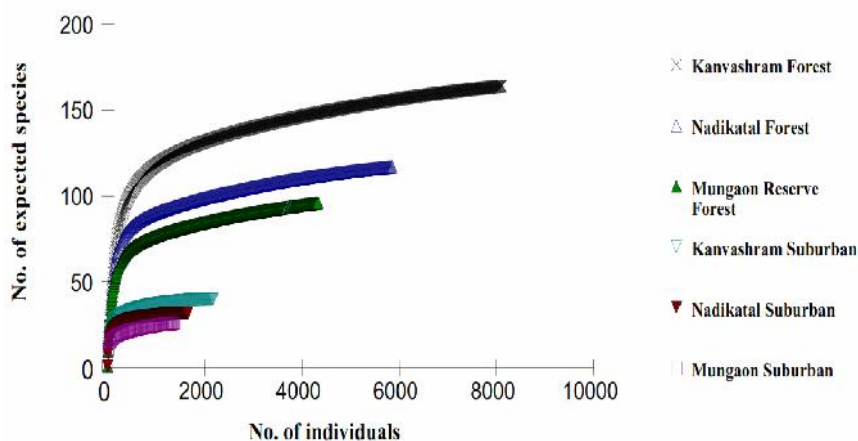
Field procedure

The biodiversity assessment was carried out in the three forest and adjacent suburban habitat types (Table 1) using Verner’s (1985) variable line transect method. Altogether 288 visits (24 months × 6 transects × 2 habitats) were made in total of 24 transects for consecutive two years i.e. January 2011 to December 2012, covering all the seasons. All transects within forest and suburban habitats were of equal length (1Km. each). Observation of birds in each

predefined transects/routes was made by walking once a month. In summer, bird counts were undertaken between 05:00 AM and 08:00 AM and 04:00 PM to 06:00 PM, while in winters, predefined transects were covered from 06:30 AM to 09:30 AM and 03:00 PM to 06:00 PM on fine days. Birds were not surveyed in extreme weather, like when wind or rain interfered with the audibility of bird calls, when fog or rain impaired visibility, partly cloudy sky or when cold weather limited bird activity. We maintained the same survey protocol in subsequent years. Bird field guide by Grimmett et al. (2001) and Ali (2002) were used for identification of birds. For nomenclature, we followed Inskipp et al. (1996). We used the Gaston (1994)

Table 1. Showing geographical information of study sites.

Sites	Geographical position		Elevation
	N	E	
Forest			
Site A (Kanvashram)	29° 47' 49.98''	78° 27' 39.09''	200-600 m
Site B (Nadikatal)	29° 54' 40.38''	78° 26' 13.96''	600-900 m
Site C (Mungaon)	29° 54' 25.43''	78° 25' 49.70''	900-1200 m
Suburban			
Site A (Bhimsinghpur)	29° 47' 14.26''	78° 27' 01''	200-600 m
Site B (Nisni)	29° 54' 55.01''	78° 26' 21.42''	600-900 m
Site C (Mungaon)	29° 54' 18.58''	78° 26' 00.67''	900-1200 m

**Figure 2.** Rarefaction curves for bird species richness estimated from forest and suburban habitats in the study area.

criteria to define the rarity, below 10 individuals observed per sighting was categorized as rare species of the study area. We also categorized each species as common (c), fairly common (f), uncommon (u) and rare (r) based on our sighting records.

Bird species diversity (BSD) and bird species richness (BSR) were measured using Shannon's index (H') and Margalef's index (R), respectively (MacArthur and MacArthur 1961; Magurran 2004). To estimate evenness, we used evenness index (E) (Magurran 2004) between forest and suburban habitats. BioDiversity Pro software (McAleece et al. 1997) was to generate rarefaction curve in order to determine whether sampling efforts was adequate. The data was obtained as mean of transects at each site for each month and pooled for two consecutive years at each zone. Two way-ANOVA was also used to test for inter-seasonal differences in BSR, BSD values across study areas. To quantify the similarity among species composition at different sites, Sorensen's index (Magurran 2004) was used. Beta diversity ($\beta = S/\alpha$) where S is the total number of species recorded and α is the average sample diversity; scale 0 (minimum β diversity) to 1 (maximum β diversity) (Whittaker 1960) value was obtained between habitats of each study area to know extent of variation between habitat types.

RESULTS AND DISCUSSION

Avian community structure

A total of 216 bird species belonging to 43 families were observed in suburban and forest habitats. 124 species (57%) were found exclusively in forest, 15 species (6%) were restricted to suburban habitat and 80 species (37%) were common to both habitat types. The details of abundance, resident status and threatened category according to International Union for the Conservation of Nature (IUCN) have been given in Table 2. Three threatened species (IUCN 2012) having poor abundance such as River Lapwing (*Vanellus duvaucelii* (Near Threatened; 11 individual) found in study site A, Kanvashram forest near Malini river; Figure 1.A.), White Rumped Vulture (*Gyps bengalensis* (Critically Endangered; 8 individuals)), Egyptian Vulture (*Neophron percnopterus* (Endangered; 5 individual)) were found in the study area.

The analysis of Variance (ANOVA-Two way) revealed that forest bird community was found more diverse than adjoining suburbs in terms of BSD (3.86 vs 3.74; $F = 1.895$, $df = 11$, $P < 0.05$) and BSR (8.95 vs 8.59; $F = 1.479$, $df = 11$, $P < 0.05$) and more rare species (74 vs

15). Species rarefaction curves (Figure 2) from different habitats also showed that forest habitats had a higher number of avian species than suburban habitats. In both the habitats, the BSD, BSR and BSE were maximum during summer (April to May) and minimum in late winter (December to January) seasons {(Forest: BSR range from 8.50 ± 0.10 to 9.60 ± 0.17 ; BSD: 3.75 ± 0.14 to 4.02 ± 0.26 and BSE: 0.080 ± 0.13 to 0.094 ± 0.01); for suburbanized areas: BSR ranges from 8.32 ± 0.61 to 9.12 ± 0.52 ; BSD: 3.12 ± 0.10 to 3.89 ± 0.92 ; BSE: 0.080 ± 0.25 to 0.094 ± 0.20 }.

The similarity index showed greater overlap/similarity (65.50%) between bird communities for forest and suburban at site B (Nadikatal, Nisni) and site A (Kanvashram, Bhimsinghpur) than between site C {Mungaon (village and forest)} and site A (31%) or between site C and site B (35%). A comparison of bird communities between forest and suburban habitats revealed low values of beta diversity in each study area (site C: 0.33, site B and site A: 0.70) indicating lesser similarity in species composition between habitat types. However, when bird communities were compared among study areas, a relatively high beta diversity values (0.76 for suburban and 0.70 for forest) were observed between site C and site A (showing greater species variation between these two study

Table 2. Checklist of the birds observed in Lansdowne forest division (Kotdwar and Laldhang range) and adjacent suburban/rural areas with their status, abundance and habitat.

Family/Scientific name	Common name	Status	Abundance	Habitat
PHASIANIDAE				
<i>Pavo cristatus</i>	Indian Peafowl	R	c	Common
<i>Gallus gallus</i>	Red Jungle fowl	R	f	Forest
<i>Lophura leucomelanos</i>	Kalij Pheasant	R	f	Forest
<i>Francolinus francolinus</i>	Black Francolin	R	r	Forest
<i>Francolinus pondicerianus</i>	Grey Francolin	R	u	Forest
<i>Perdicula asiatica</i>	Jungle Bush Quail	R	u	Forest
PICIDAE				
<i>Celeus brachyurus</i>	Rufous Woodpecker	R	r	Forest
<i>Dendrocopos macei</i>	Fulvous-breasted Woodpecker	R	f	Forest
<i>Dendrocopos canicapillus</i>	Grey-capped Pygmy Woodpecker	R	c	Forest
<i>Dendrocopos hyperythrus</i>	Rufous-bellied Woodpecker	R	f	Forest
<i>Picus chlorolophus</i>	Lesser Yellownap	R	r	Forest
<i>Picus canus</i>	Grey-headed Woodpecker	R	f	Forest
<i>Picus flavinucha</i>	Greater Yellownap	R	r	Forest
<i>Picus xanthopygaeus</i>	Streak-throated Woodpecker	R	r	Common
<i>Dinopium benghalense</i>	Black-rumped Flameback	R	c	Common
<i>Dinopium shorii</i>	Himalayan Flameback	R	r	Forest
<i>Chrysocolaptes lucidus</i>	Greater Flameback	R	u	Forest
MEGALAIMIDAE				
<i>Megalaima zeylanica</i>	Brown-headed Barbet	R	c	Common
<i>Megalaima virens</i>	Great Barbet	R	r	Forest
<i>Megalaima asiatica</i>	Blue-throated Barbet	R	f	Common
<i>Megalaima haemacephala</i>	Coppersmith Barbet	R	r	Forest
<i>Megalaima lineata</i>	Lineated Barbet	R	r	Forest
BUCEROTIDAE				
<i>Ocyrceros birostris</i>	Indian Grey Hornbill	R	c	Common
UPUPIDAE				
<i>Upupa epops</i>	Common Hoopoe	R	c	Common
CORACIIDAE				
<i>Coracias benghalensis</i>	Indian Roller	R	f	Forest
<i>Eurystomus orientalis</i>	Dollarbird	R	r	Forest
ALCEDINIDAE				
<i>Alcedo atthis</i>	Common Kingfisher	R	f	Forest
HALCYONIDAE				
<i>Halcyon capensis</i>	Stork-billed Kingfisher	R	r	Forest
<i>Halcyon smyrnensis</i>	White-throated Kingfisher	R	c	Common
CERYLIDAE				
<i>Ceryle rudis</i>	Pied Kingfisher	R	f	Forest
<i>Megaceryle lugubris</i>	Crested Kingfisher	WM	r	Forest
MEROPIDAE				
<i>Merops orientalis</i>	Green Bee-Eater	R	c	Common
<i>Merops leschenaulti</i>	Chestnut-headed Bee-Eater	R	f	Common
<i>Nyctornis athertoni</i>	Blue-bearded Bee-Eater	R	r	Forest
CUCULIDAE				
<i>Hierococcyx varius</i>	Common Hawk Cuckoo	R, AM	f	Forest
<i>Clamator jacobinus</i>	Pied Cuckoo	SM	u	Rural
<i>Phaenicophaeus leschenaultii</i>	Sirkeer Malkoha	SM	r	Forest
<i>Eudynamys scolopacea</i>	Asian Koel	R	c	Common
CENTROPODIDAE				
<i>Centropus sinensis</i>	Greater Coucal	R	u	Forest
PSITTACIDAE				
<i>Psittacula eupatria</i>	Alexandrine Parakeet	R	f	Common
<i>Psittacula krameri</i>	Rose-ringed Parakeet	R	c	Common
<i>Psittacula himalayana</i>	Slaty-headed Parakeet	R, AM	u	Common
<i>Psittacula cyanocephala</i>	Plum-headed Parakeet	R	c	Common
APODIDAE				
<i>Apus affinis</i>	House Swift	R	f	Rural
STRIGIDAE				

<i>Glaucidium cuculoides</i>	Asian Barred Owlet	R	r	Common
<i>Glaucidium radiatum</i>	Jungle Owlet	R	u	Forest
<i>Otus sunia</i>	Oriental Scops Owl	R	r	Forest
CAPRIMULGIDAE				
<i>Caprimulgus macrurus</i>	Large-tailed Nightjar	R	r	Forest
COLUMBIDAE				
<i>Columba livia</i>	Rock Pigeon	R	c	Rural
<i>Streptopelia chinensis</i>	Spotted Dove	R	c	Rural
<i>Streptopelia orientalis</i>	Oriental Turtle Dove	R, AM	f	Forest
<i>Streptopelia decaocto</i>	Eurasian Collared Dove	R	u	Rural
<i>Streptopelia tranquebarica</i>	Red Collared Dove	SM	r	Forest
<i>Chalcophaps indica</i>	Emerald Dove	R	r	Forest
<i>Treron sphenura</i>	Wedge-tailed Green Pigeon	R, AM	r	Common
<i>Treron phoenicoptera</i>	Yellow-footed Green Pigeon	R, AM	r	Forest
<i>Treron apicauda</i>	Pin-tailed Green Pigeon	R	u	Forest
RALLIDAE				
<i>Amauornis phoenicurus</i>	White-breasted Waterhen	R	r	Forest
SCOLOPACIDAE				
<i>Actitis hypoleucos</i>	Common Sandpiper	WM	r	Forest
<i>Tringa ochropus</i>	Green Sandpiper	WM	r	Forest
CHARADRIDAE				
<i>Vanellus duvaucelii</i>	River Lapwing	R	f	Forest
<i>Vanellus indicus</i>	Red-wattled Lapwing	R	c	Common
ACCIPITRIDAE				
<i>Pernis ptilorhynchus</i>	Oriental Honey-buzzard	R	u	Forest
<i>Elanus caeruleus</i>	Black-shouldered Kite	R	f	Common
<i>Milvus migrans</i>	Black Kite	R, AM	c	Common
<i>Neophron percnopterus</i>	Egyptian Vulture	R	u	Common
<i>Gyps bengalensis</i>	White-rumped Vulture	R	r	Forest
<i>Gyps himalayensis</i>	Himalayan Griffon	WM	r	Forest
<i>Spilornis cheela</i>	Crested Serpent Eagle	WM	u	Forest
<i>Accipiter badius</i>	Shikra	R	f	Common
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	WM	u	Forest
<i>Accipiter gentilis</i>	Northern Goshawk	WM	r	Common
<i>Butastur teesa</i>	White-eyed Buzzard	R	u	Forest
<i>Spizaetus cirrhatus</i>	Changeable Hawk Eagle	SM	u	Forest
FALCONIDAE				
<i>Falco tinnunculus</i>	Common Kestrel	WM	r	Common
PHALACROCORACIDAE				
<i>Phalacrocorax niger</i>	Little Cormorant	UC	r	Forest
ARDEIDAE				
<i>Egretta garzetta</i>	Little Egret	WM	f	Forest
<i>Mesophoyx intermedia</i>	Intermediate Egret	WM	r	Forest
<i>Bubulcus ibis</i>	Cattle Egret	R	c	Rural
<i>Ardeola grayii</i>	Indian Pond Heron	R	r	Forest
PITTIDAE				
<i>Pitta brachyura</i>	Indian Pitta	SM	r	Forest
EURLAIMIDAE				
<i>Psarisomus dalhousiae</i>	Long-tailed Broadbill	SM	r	Forest
IRENIDAE				
<i>Chloropsis hardwickii</i>	Orange-bellied Leafbird	WM	r	Common
<i>Chloropsis aurifrons</i>	Golden-fronted Leafbird	R	u	Forest
LANIDAE				
<i>Lanius cristatus</i>	Brown Shrike	WM	u	Forest
<i>Lanius schach</i>	Long-tailed Shrike	R	c	Common
<i>Lanius tephronotus</i>	Grey-backed Shrike	WM	r	Forest
CORVIDAE				
<i>Urocissa erythrorhyncha</i>	Red-billed Blue Magpie	R, AM	u	Common
<i>Cissa chinensis</i>	Common Green Magpie	R	r	Forest
<i>Dendrocitta vagabunda</i>	Rufous Treepie	R	c	Common
<i>Dendrocitta formosae</i>	Grey Treepie	R, AM	f	Forest
<i>Corvus splendens</i>	House Crow	R	c	Rural
<i>Corvus macrorhynchos</i>	Large-billed Crow	R	c	Common
<i>Oriolus oriolus</i>	Eurasian Golden Oriole	SM	r	Common
<i>Oriolus xanthornus</i>	Black-hooded Oriole	R	f	Forest
<i>Oriolus traillii</i>	Maroon Oriole	R, AM	r	Forest

<i>Coracina macei</i>	Large Cuckooshrike	R	u	Forest
<i>Coracina melaschistos</i>	Black-winged Cuckooshrike	R, AM	r	Forest
<i>Coracina melanoptera</i>	Black-headed Cuckooshrike	R	f	Forest
<i>Pericrocotus roseus</i>	Rosy Minivet	SM	r	Common
<i>Pericrocotus cinnamomeus</i>	Small Minivet	R	f	Forest
<i>Pericrocotus ethologus</i>	Long-tailed Minivet	R, AM	f	Common
<i>Pericrocotus flammeus</i>	Scarlet Minivet	R, AM	r	Common
<i>Hemipus picatus</i>	Bar-winged Flycatcher-shrike	R	f	Forest
<i>Rhipidura hypoxantha</i>	Yellow-bellied Fantail	R, AM	f	Forest
<i>Rhipidura albicollis</i>	White-throated Fantail	R	c	Common
<i>Dicrurus macrocercus</i>	Black Drongo	R	c	Common
<i>Dicrurus leucophaeus</i>	Ashy Drongo	WM	r	Forest
<i>Dicrurus caerulescens</i>	White-bellied Drongo	R	r	Forest
<i>Dicrurus aeneus</i>	Bronzed Drongo	R, AM	r	Forest
<i>Dicrurus hottentottus</i>	Spangled Drongo	R, AM	f	Forest
<i>Hypothymis azurea</i>	Black-naped Monarch	R	r	Forest
<i>Terpsiphone paradisi</i>	Asian Paradise-flycatcher	R, AM	f	Common
<i>Aegithina tiphia</i>	Common Iora	R	r	Forest
<i>Tephrodornis pondicerianus</i>	Common Woodshrike	R	f	Forest
CINCLIDAE				
<i>Cinclus pallasii</i>	Brown Dipper	R	r	Forest
MUSCICAPIDAE				
<i>Monticola cinclorhynchus</i>	Blue-capped Rock Thrush	SM	r	Common
<i>Monticola solitarius</i>	Blue Rock Thrush	WM	r	Common
<i>Myophonus caeruleus</i>	Blue Whistling Thrush	R, AM	c	Forest
<i>Zoothera citrina</i>	Orange-headed Thrush	SM	r	Forest
<i>Turdus boulboul</i>	Grey-winged Blackbird	R, AM	u	Common
<i>Muscicapa sibirica</i>	Dark-sided Flycatcher	WM	f	Forest
<i>Muscicapa dauurica</i>	Asian Brown Flycatcher	SM	r	Forest
<i>Ficedula strophiiata</i>	Rufous-gorgeted Flycatcher	WM	r	Forest
<i>Ficedula parva</i>	Red-throated Flycatcher	WM	r	Forest
<i>Ficedula westermanni</i>	Little Pied Flycatcher	R	f	Forest
<i>Ficedula tricolor</i>	Slaty-blue Flycatcher	WM	r	Forest
<i>Eumyias thalassina</i>	Verditer Flycatcher	R, AM	f	Common
<i>Niltava sundara</i>	Rufous-bellied Niltava	R, AM	u	Forest
<i>Cyornis unicolor</i>	Pale Blue Flycatcher	WM	r	Forest
<i>Cyornis rubeculoides</i>	Blue-throated Flycatcher	SM	f	Forest
<i>Culicicapa ceylonensis</i>	Grey-headed Canary-Flycatcher	R, AM	c	Forest
<i>Luscinia pectoralis</i>	White-tailed Rubythroat	WM	r	Forest
<i>Luscinia svecica</i>	Bluethroat	WM	f	Forest
<i>Copsychus saularis</i>	Oriental Magpie Robin	R	c	Common
<i>Copsychus malabaricus</i>	White-rumped Shama	R	r	Forest
<i>Saxicoloides fulicata</i>	Indian Robin	R	c	Common
<i>Phoenicurus caeruleocephalus</i>	Blue-capped Redstart	WM	r	Forest
<i>Phoenicurus ochruros</i>	Black Redstart	WM	f	Forest
<i>Chaimarrornis leucocephalus</i>	White-capped Water Redstart	WM	f	Forest
<i>Rhyacornis fuliginosus</i>	Plumbeous Water Redstart	WM	r	Forest
<i>Enicurus maculatus</i>	Spotted Forktail	R	f	Forest
<i>Saxicola torquata</i>	Common Stonechat	WM	f	Forest
<i>Saxicola caprata</i>	Pied Bushchat	R	f	Common
<i>Saxicola ferrea</i>	Grey Bushchat	R, AM	u	Common
<i>Cercomela fusca</i>	Brown Rock Chat	R	c	Common
STURNIDAE				
<i>Sturnus malabaricus</i>	Chestnut-tailed Starling	R, AM	f	Common
<i>Sturnus pagodarum</i>	Brahminy Starling	R	c	Rural
<i>Sturnus contra</i>	Asian Pied Starling	R	c	Rural
<i>Acridotheres tristis</i>	Common Myna	R	c	Rural
<i>Acridotheres fuscus</i>	Jungle Myna	R	c	Common
SITTIDAE				
<i>Sitta castanea</i>	Chestnut-bellied Nuthatch	R	u	Common
<i>Sitta frontalis</i>	Velvet-fronted Nuthatch	R	u	Common
<i>Tichodroma muraria</i>	Wallcreeper	WM	u	Common
CERTHIIDAE				
<i>Certhia himalayana</i>	Bar-tailed Treecreeper	WM	r	Common
PARIDAE				
<i>Parus major</i>	Great Tit	R	c	Common
<i>Parus monticolus</i>	Green-backed Tit	R, AM	u	Forest
<i>Parus xanthogenys</i>	Black-lored Tit	R	r	Common
AEGITHALIDAE				
<i>Aegithalos concinnus</i>	Black-throated Tit	R	r	Forest

HIRUNDINIDAE				
<i>Riparia paludicola</i>	Plain Martin	R	u	Forest
<i>Hirundo concolor</i>	Dusky Crag Martin	R	f	Rural
<i>Hirundo daurica</i>	Red-rumped Swallow	R	f	Rural
PYCNONOTIDAE				
<i>Pycnonotus melanicterus</i>	Black-crested Bulbul	R, AM	r	Forest
<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	R	u	Common
<i>Pycnonotus leucogenys</i>	Himalayan Bulbul	R	c	Common
<i>Pycnonotus cafer</i>	Red-vented Bulbul	R	c	Common
<i>Hypsipetes leucocephalus</i>	Black Bulbul	R, AM	f	Common
CISTICOLIDAE				
<i>Prinia criniger</i>	Striated Prinia	WM	u	Forest
<i>Prinia flaviventris</i>	Yellow-bellied Prinia	WM	r	Forest
<i>Prinia hodgsonii</i>	Grey-breasted Prinia	R	c	Common
<i>Prinia socialis</i>	Ashy Prinia	R	f	Common
<i>Prinia inornata</i>	Plain Prinia	R	f	Forest
ZOSTEROPIDAE				
<i>Zosterops palpebrosus</i>	Oriental White-eye	R	c	Common
SYLVIIDAE				
<i>Cettia pallidipes</i>	Pale-footed Bush Warbler	WM	u	Common
<i>Orthotomus sutorius</i>	Common Tailorbird	R	c	Common
<i>Phylloscopus collybita</i>	Common Chiffchaff	WM	f	Common
<i>Phylloscopus inornatus</i>	Yellow-browed Warbler	WM	r	Common
<i>Phylloscopus humei</i>	Hume's Warbler	WM	u	Forest
<i>Phylloscopus trochiloides</i>	Greenish Warbler	R, AM	u	Common
<i>Phylloscopus reguloides</i>	Blyth's Leaf Warbler	WM	r	Forest
<i>Seicercus burkii</i>	Golden-spectacled Warbler	WM	u	Forest
<i>Seicercus xanthoschistos</i>	Grey-hooded Warbler	R, AM	f	Common
<i>Garrulax albogularis</i>	White-throated Laughingthrush	R	u	Forest
<i>Garrulax leucolophus</i>	White-crested Laughingthrush	R, AM	u	Common
<i>Garrulax lineatus</i>	Streaked Laughingthrush	R	u	Common
<i>Pellorneum ruficeps</i>	Puff-throated Babbler	R, AM	u	Forest
<i>Pomatorhinus erythrogeus</i>	Rusty-cheeked Scimitar Babbler	R, AM	u	Forest
<i>Pomatorhinus schisticeps</i>	White-browed Scimitar Babbler	R, AM	u	Forest
<i>Stachyris pyrrhops</i>	Black-chinned Babbler	R	f	Forest
<i>Turdoides striatus</i>	Jungle Babbler	R	c	Common
<i>Macronous gularis</i>	Striped Tit-Babbler	SM	u	Forest
<i>Leiothrix lutea</i>	Red-billed Leiothrix	R, AM	f	Common
<i>Minla cyanouroptera</i>	Blue-winged Minla	R	r	Forest
<i>Sylvia curruca</i>	Lesser Whitethroat	WM	u	Forest
ALAUDIDAE				
<i>Alauda gulgula</i>	Oriental Skylark	WM	r	Forest
NECTARINIIDAE				
<i>Dicaeum erythrorhynchos</i>	Pale-billed Flowerpecker	R	f	Forest
<i>Dicaeum ignipectus</i>	Fire-breasted Flowerpecker	WM	r	Common
<i>Nectarinia asiatica</i>	Purple Sunbird	R	c	Common
<i>Aethopyga siparaja</i>	Crimson Sunbird	R	f	Common
<i>Aethopyga ignicauda</i>	Fire-tailed Sunbird	WM	u	Forest
PASSERIDAE				
<i>Passer domesticus</i>	House Sparrow	R	c	Rural
<i>Passer rutilans</i>	Russet Sparrow	R	r	Forest
<i>Petronia xanthocollis</i>	Chestnut-shouldered Petronia	R	f	Common
<i>Motacilla alba</i>	White Wagtail	WM	f	Forest
<i>Motacilla maderaspatensis</i>	White-browed Wagtail	R	f	Common
<i>Motacilla citreola</i>	Citrine Wagtail	WM	r	Forest
<i>Motacilla flava</i>	Yellow Wagtail	WM	u	Forest
<i>Motacilla cinerea</i>	Grey Wagtail	R, AM	u	Common
<i>Anthus rufulus</i>	Paddyfield Pipit	SM	r	Rural
<i>Anthus hodgsoni</i>	Olive-backed Pipit	WM	f	Common
<i>Prunella strophiatea</i>	Rufous-breasted Accentor	WM	f	Rural
<i>Lonchura striata acuticauda</i>	White-rumped Munia	WM	r	Forest
<i>Lonchura punctulata</i>	Scaly-breasted Munia	R	f	Common
<i>Ploceus philippinus</i>	Baya Weaver	R	f	Common
<i>Serinus pusillus</i>	Fire-fronted Serin	WM	r	Forest
FRINGILLIDAE				
<i>Carpodacus erythrinus</i>	Common Rosefinch	WM	f	Forest

Note: R: Resident, WM: Winter Migratory, SM: Summer Migratory, RAM: Resident Altitudinal Migrant, UC: Uncertain, c: Common, f: Fairly Common, u: Uncommon, r: Rare.



Figure 3. Some birds of Lansdowne forest division and adjacent suburban landscapes, Garhwal Himalayas, Uttarakhand, India. A. River Lapwing (near threatened avian species), B. Indian Pitta (forest bird), C. House Sparrow (suburban bird), D. Red-vented Bulbul (common to suburban and forest habitats)

areas) than between site B and site A (0.63 for suburban and 0.41 for forest) or between site C and site B (0.57 for suburban and 0.41 for forest). Photographs of a near threatened and three selected exemplary bird species representing forest area, suburban habitat and common habitat have been appended as Figures 3.A to 3.D.

Discussion

This study noticeably suggests that bird species richness was significantly higher in natural than suburban habitat which is understandable because vegetation provides food as well as shelter to the birds (Palomino and Carrascal 2006). Other workers also found higher species richness, diversity and dominance in the forest habitat as compared to urbanized habitat (Beissinger and Osborne 1982; Catterall et al. 2010; Shochat et al. 2010). However, in the present study, species richness and diversity slightly differed in the forest and suburban landscapes, perhaps because of the presence of traditional agroforestry systems in the area. The result was in congruence to Scherr and McNeely (2008) who indicated that these agroforests supports good numbers of wild plants and animal species as in natural forests. Lawler (2001) reported that these traditional agro-ecosystems contribute to sustain the regional biodiversity of many invertebrate and vertebrate species. Similarly, Loss et al. (2009) concluded that the mere presence of small patches of landscapes in urban landscapes can increase the species richness in urban ecosystems. Presence of good numbers of the birds

common in forest and suburban habitats suggest that many species that occur in the rural habitat can persist only in the nearby presence of the native forest. Similar observations have been made by earlier workers (Perfecto and Vandermeer 2002; Sekercioglu et al. 2007).

Results also indicated that the species diversity and richness were found to be high in summer (April to May) to late monsoon (August to September). This fluctuation in the species diversity may be due to the summer migratory birds and more visibility of birds due to breeding season. According to Hurlbert and Haskell (2003), the increase in diversity or abundance may also be due to high resource supply (Connell and Orias 1964; Wright 1983; Currie 1991) or increased temperature which may reduce thermoregulatory loads and allow organisms to allocate more energy to growth and reproduction (Turner et al. 1988; Lennon et al. 2000) and leads to higher equilibrium in avian community. However, in this study, there was no significant difference in BSR and BSD values between habitat types.

The family Accipitridae with two threatened species needs high conservation priorities in the study area. Animal carcasses which usually available near suburbs as food should be collected and tested for the presence of diclofenac drug which may be used for treatment of livestock on regular basis to provide safe zones for feeding and breeding. According to Thiollay (1994) raptors which are important as bioindicator of habitat quality and pollution, are also crucial for maintaining the dynamics and

diversity of ecosystems by lowering numbers of dominant prey species, thereby allowing less common prey species to survive. The poor presence of River Lapwing (Near Threatened) may be due to high anthropogenic disturbance in and around rivers and small streams, through activities like mining of river beds for boulders and sand because of high demand for construction works like houses, industrial areas, dams etc. The over river bed mining/quarrying sometimes damage the river bank due to access ramps to river bed, causing eyesore, damage to the vegetation, soil erosion, and micro disturbance to ground water. Noise and vibrations because of the moving trucks and tractor trolleys, loading and unloading from collection areas creates disturbances that affects the normal migratory routes of birds or may even cause them to stay in human habitats, thus causing increase in human-wildlife conflicts.

CONCLUSION AND RECOMMENDATIONS

This report indicates the current status of avian community composition (abundance, richness and diversity) in the study area. The biodiversity assessment of the area will help wildlife managers and other stakeholders to tailor conservation policies in the area as there is great threat to avian biodiversity of these lower Shivalik foothills, which are more prone to anthropogenic disturbances. The traditional agroforestry practices in Garhwal hills should be encouraged, as diversification in plant species contributes to species richness and sustains the regional biodiversity of avian and other species.

REFERENCES

- Acharya BK, Sanders NJ, Vijayan L, Chettri B. 2011. Elevational Gradients in bird diversity in the Eastern Himalaya: An evaluation of distribution patterns and their underlying mechanisms. *PLoS ONE* 6: e29097.
- Ali S. 2002. The book of Indian birds. 13th revised edition. Bombay Natural History Society, Mumbai.
- Barthlott W, Winger M. 2001. Biodiversity: a challenge for development and policy. Springer, Berlin.
- Beissinger SR, Osborne DR. 1982. Effects of urbanization on avian community organization. *Condor* 84: 75-83.
- Birdlife International. 2012. Data Zone. < www.birdlife.org>. Accessed on 14 June 2012.
- Catterall CP, Cousin JA, Piper S, Johnson G. 2010. Long-term dynamics of bird diversity in forest and suburb: decay, turnover or homogenization? *Divers Distrib* 16: 559-570.
- Chettri N, Sharma E, Deb DC. 2001. Bird community structure along a trekking corridor of Sikkim Himalaya: a conservation perspective. *Biol Conserv* 102: 1-16.
- Connell JH, Orias E. 1964. The ecological regulation of species diversity. *Am Nat* 98: 399-414.
- Currie DJ. 1991. Energy and large scale patterns of animal and plant species richness. *Am Nat* 137:27-49.
- Gaston KJ. 1994. Rarity, population and community biology. Series 13. Chapman and Hall Ltd., London.
- Grimmett R, Inskipp C, Inskipp T. 1998. Birds of the Indian subcontinent. Oxford University Press, New Delhi, India.
- Grimmett R, Inskipp C, Inskipp T. 2001. Pocket guide to the birds of Indian Subcontinent. Oxford University Press, New Delhi, India.
- Hurlbert AH, Haskell JP. 2003. The effect of energy and seasonality on avian species richness and community composition. *Am Nat* 161: 83-97.
- Inskipp T, Lindsey N, Duckworth W. 1996. An annotated checklist of the birds of the oriental region. Oriental Bird Club, Sandy.
- IUCN [International Union for Conservation of Nature]. 2012. IUCN Red List of Threatened Species. Version 2012.1. <www.iucnredlist.org>. Downloaded on 12 July 2012.
- Laiolo P. 2002. Effects of habitat structure, floral composition and diversity on a forest bird community in north-western Italy. *Folia Zool* 51: 121-128.
- Lawler SP. 2001. Rice fields as temporary wetlands: A review. *Isr J Zool* 47: 513-528.
- Lennon JJ, Greenwood JJD, Turner JRG. 2000. Bird diversity and environmental gradients in Britain: a test of the species-energy hypothesis. *J Anim Ecol* 69: 581-598.
- Loss SR, Ruiz MO, Brawn JD. 2009. Relationships between avian diversity, neighborhood age, income, and environmental characteristics of an urban landscape. *Biol Conserv* 142: 2578-2585.
- MacArthur RH, MacArthur JW. 1961. On bird species diversity. *Ecology* 42: 594-598.
- Magurran AE. 2004. Measuring Biological Diversity. Blackwell, Oxford.
- McAleece N, Gage JDG, Lamshead PJD, Paterson GLJ. 1997. BioDiversity Professional statistics analysis software. <www.sams.ac.uk>.
- Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC.
- Mittermeier RA, Myers N, Thompson JB, da Fonseca GAB, Olivieri, S. 1998. Biodiversity hotspots and major tropical wilderness areas: approaches to setting conservation priorities. *Conserv Biol* 12: 516-520.
- Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GAB, Kent J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.
- Naithani A, Bhatt D. 2010. A checklist of birds of Pauri district, Uttarakhand, India. *Indian BIRDS* 6: 153-157.
- Naithani A, Bhatt D. 2012. Bird community structure in natural and urbanized habitats along an altitudinal gradient in Pauri district (Garhwal Himalaya) of Uttarakhand state, India. *Biologia* 67: 800-808.
- Palomino D, Carrascal LM. 2006. Urban influence on birds at a regional scale: A case study with the avifauna of northern Madrid province. *Landscape Urban Plan* 77: 276-290.
- Perfecto I, Vandermeer J. 2002. Quality of agroecological matrix in a tropical montane landscape: Ants in coffee plantations in southern Mexico. *Conserv Biol* 16: 174-182.
- Price T, Jennifer Z, Kartika J, Nitin J. 2003. Bird species diversity along Himalaya: a comparison of Himachal Pradesh and Kashmir. *J Bombay Nat Hist Soc* 100: 394-409.
- Scherr SJ, McNeely JA. 2008. Biodiversity conservation and agricultural sustainability: towards a new paradigm of 'ecoagriculture' landscapes. *Philos T Roy Soc B* 363: 477-494.
- Sekercioglu CH, Loarie SR, Oviedo Brenes F, Ehrlich PR, Daily GC. 2007. Persistence of forest birds in the Costa Rican agricultural countryside. *Conserv Biol* 21: 482-494.
- Shochat E, Lerman SB, Anderies JM, Warren PS, Faeth SH, Nilon CH. 2010. Invasion, competition, and biodiversity loss in urban ecosystems. *Bioscience* 60: 199-208.
- Singh AP. 2000. Birds of lower Garhwal Himalayas: Dehra Dun valley and neighbouring hills. *Forktail* 16: 101-123.
- Sultana A, Hussain MS, Khan JA. 2007. Bird communities of the proposed Naina and Pindari Wildlife Sanctuaries in the Kumaon Himalaya, Uttarakhand, India. *J Bombay Nat Hist Soc* 104: 19-29.
- Thiollay JM. 1994. Family Accipitridae (hawks and eagles). In: del Hoyo J, Elliott A and Sargatal J (eds) Handbook of the Birds of the World. Lynx Edicions, Barcelona.
- Turner JRG, Lennon JJ, Lawrenson JA. 1988. British bird species distributions and the energy theory. *Nature* 335: 539-541.
- Verner J. 1985. Assessment of counting techniques. *Curr Ornithol* 2: 247-302.
- Whittaker RH. 1960. Vegetation of the Siskiyou Mountains, Oregon and California. *Ecol Monogr* 30: 279-338.
- Wright DH. 1983. Species-energy theory: an extension of species-area theory. *Oikos* 41: 496-506.