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An annotated checklist of the birds of banj oak–chir pine forests in Kumaon, Uttarakhand

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Abstract

The banj oak *Quercus leucotrichophora*–chir pine *Pinus roxburghii* forest zone (1500–2200 m asl) of the Western Himalaya is a biodiversity-rich habitat that has undergone considerable modification and conversion over the last 20 years. Yet, there is little systematic information on its avifauna, particularly in the context of the observed impacts of global warming, land use change, forest modification, and fragmentation. In this study, we inventory the birds of this forest association based on intensive field studies carried out at 42 sites (in six geographical clusters) in the Nainital, and Almora Districts of Uttarakhand, along with collecting data on abundance status, breeding, habitat preferences, and endemism status. We recorded a total of 136 species over four years of study across these sites. Based on our observations, 104 species (76%) are likely to be breeding. The large number of broad-leaved forest specialists (35), primarily forest species that are relatively adaptable (69), and Himalayan endemics (51) recorded during the study indicates the high conservation value of this forest association. Based on our observations, and the existing literature, we suggest that the 19 Himalayan endemic species that are also oak forest specialists, are likely to be endangered due to the concordant threats of habitat degradation, fragmentation, and climate change.

Introduction

The Himalayas represent a biologically diverse region within India with extremely rich floral and faunal communities (Singh & Singh 1992). As an illustration, more than 50% of the total bird diversity of India has been recorded within the Himalayan state of Uttarakhand (Mohan & Sondhi 2014). Within Uttarakhand, the mountain region of Kumaon too boasts of a rich bird fauna: a compilation in 2000 listed 382 species from 19 different sites in its three districts (Sultana & Khan 2000). Birding surveys within Kumaon have revealed hotspots of bird diversity such as in Pawalgarh Conservation Reserve (approximately 350 species),¹ and Corbett Tiger Reserve (approximately 600 species),² both of which are located in the lower altitudes of the Terai–Shivalik Hills range. There is a need to carry out intensive surveys in other habitat types along the altitudinal gradient of the Himalayas.

The banj oak–chir pine forests (*Quercus leucotrichophora*–*Pinus roxburghii* association) form a distinct vegetation zone in the Western Himalayas, which is restricted to the mid-altitudinal zone from 1500 to 2200 m asl (Singh & Singh 1987). Chir pine [46] is a fast-growing early successional species, occurring in mono-dominant stands, which give way to oak-dominated hardwood stands under natural conditions (Singh & Singh 1987; Singh & Singh 1992). Banj oak occurs as the dominant species in the hardwood forest stands at this altitude, which occurs along with associates such as burans *Rhododendron arboreum*, angyar *Lyonia ovalifolia*, kaafal *Myrica esculenta*, and Indian horse chestnut *Aesculus indica*. This vegetation zone supports a host of local livelihoods, including subsistence agriculture, animal husbandry, horticulture, forestry, and tourism thanks to the rich



46. Chir pine *Pinus roxburghii* forest.

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resources available here (Singh and Singh 1992; Naudiyal and Schmerbeck 2016).

The banj oak–chir pine forest association, formally classified as Himalayan moist temperate forest (Champion & Seth 1968), forms part of the globally recognised Western Himalayan temperate forest biome (BirdLife International 2016a). This biome has been attributed high conservation importance having been designated as an ‘Endemic Bird Area’ due to the overlapping of ranges of eleven restricted-range species (EBA #128; BirdLife International 2016a, b). A few recognised Important Bird Areas (*henceforth*, IBAs), as well as Protected Areas are also located in this vegetation zone, such as Benog Mountain Quail Wildlife Sanctuary (IBA #IN100), Naina Devi Conservation Reserve and

1 <http://www.uttarakhandbirdfestival.in/about/about-pawalgarh>

2 http://www.corbettnationalpark.in/ctr_revealed_fauna.htm

Binsar Wildlife Sanctuary (IBA #IN101; Islam & Rahmani 2004; Mohan & Sondhi 2014).

The banj oak [47] forest association lies in a high rainfall zone, hosting high bird diversity due to its lush foliage, species-rich flora, and moist micro-climate (Naudiyal & Schmerbeck 2016). Additionally, a heterogeneous vegetation structure, both horizontally, and vertically, is created by high density and diversity of epiphytes such as mosses, lichens, fungi as well as creepers, ferns, saplings, shrubs, and herbs (Singh & Singh 1992). Further, unique features of banj oak forest, such as high transpiration rate (resulting in high humidity), dense leaf litter, complex branching, large tree size, and presence of cavities, create many niches for species (authors' *pers. obs.*). In comparison, chir pine forest has low structural, and compositional, diversity due to dry micro-climate, and soils, and a lack of multiple vegetation layers (Singh & Singh 1992; Naudiyal & Schmerbeck 2016), resulting in poor availability of niches for flora and fauna. However, chir pine stands, and banj oak stands form a forest continuum that bird species are found to use opportunistically.

While both, banj oak, and chir pine are native to this altitudinal zone, there is evidence that chir pine forests are extending their range at the cost of the oak forests (Singh & Singh 1987; Naudiyal & Schmerbeck 2016). This is thought to be caused by a combination of factors such as forest degradation (due to over-exploitation of banj oak forests for fuelwood, fodder, and leaf litter), climate change, diversion of springs for human uses, and frequent forest fires. Since the 1990's, the forests in this area have also been facing fragmentation due to widening of existing, and construction of new roads, expansion of tourism zones, and intensified horticultural activity (Narain 2013; authors' *pers. obs.*).

Despite facing a high degree of threat, and being of critical importance to rural livelihoods, there have been few avifaunal studies focused on the banj oak-chir pine forests. Only Sultana & Khan (2000) have comprehensively documented bird life in the oak forests of Kumaon, in a broad elevational band in which different vegetation associations were covered. The current study attempts to expand the understanding of the bird life of this forest association through surveys over multiple years, with the focused aim of profiling the bird community in terms of abundance, habitat preference, and conservation importance.

Study Area and Methods

The study area in the banj oak-chir pine belt, covering parts of Nainital, and Almora Districts, was selected in such a way that it fell within the area circumscribed by the coordinates 29.521°N–29.388°N, and 79.586°E–79.548°E. This area had adequate representation of both, banj oak, and chir pine along with adjoining land uses. Within this study area, six different clusters of sites were surveyed for birds (Figure 1; and Table 1).

Across these six clusters, a total of 42 sites were studied over varying numbers of years, and durations (refer to Table 1 for the site names and months of study). The surveys were



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47. Banj oak *Quercus leucotrichophora* forest.

carried out mainly in the spring and summer seasons when bird breeding is maximal (March to June), over four years from 2013–2016. In 2015, surveys were additionally carried out during the month of September.

In terms of management regimes, the 42 surveyed sites covered reserved forests, Van Panchayat forests, and private forests of the Indian Veterinary Research Institute. Once the study sites were selected and marked via GPS, bird observations were carried out in three different ways.

First, all possible trails at each of the sites, radiating up to a radius of 1–2 km, including bridle paths and jeep tracks, were walked, and trail-based observations noted. Second, opportunistic observations were made while driving from one site to another, and if required, birds were followed up on foot for identification. Observations were thus carried out from roughly 0700 to 1100 hrs, and from 0300 to 0630 hrs. Third, systematic point counts were undertaken with the aim of quantifying relative abundance of species during the period April–June 2016. During this period,

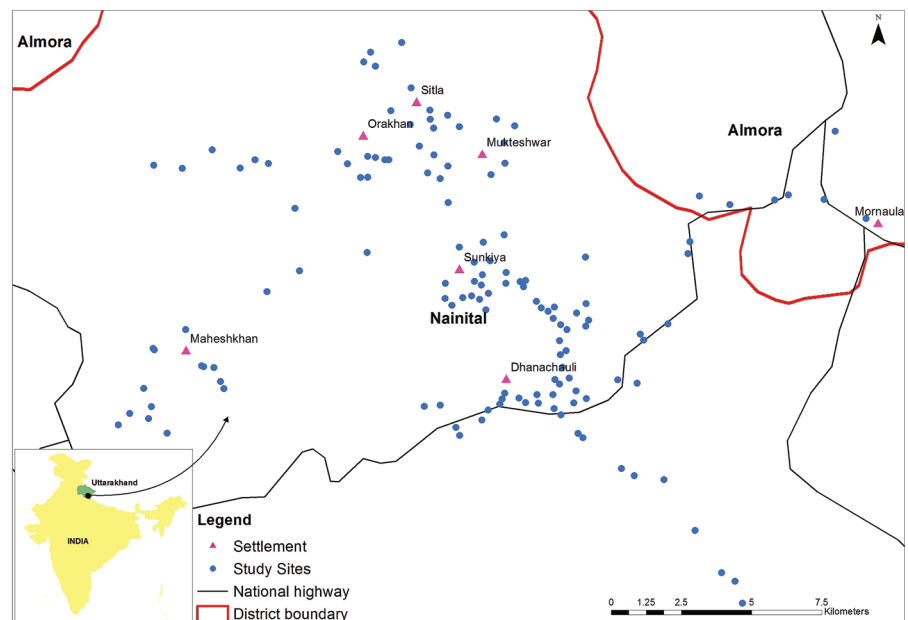


Fig. 1. Map of study area showing the location of study sites in Nainital and Almora Districts.

Table 1. Location and dates of bird surveys

Area/site cluster	Sites/reserved/village forests covered*	Month(s)	Year
Maheshkhan	Maheshkhan, Shyamkhet, Padampur, and Ramgarh	May	2014
		April, September	2015
		April–June	2016
Mukhteshwar	Mukhteshwar, Indian Veterinary Research Institute, and Sitala	May–June	2013
		May–June	2014
		April, September	2015
		April–June	2016
Orakhan	Orakhan, Sitala, Badhet, Meora, Dadim, Pokhara, Hartola, Nathuakhan, Gadgaon, Simayal, and Satkhol	May–June	2013
		May–June	2014
		April, September	2015
		March–June	2016
Sunkiya	Sunkiya, Chippa, Buribanna, Gangchaur, Parbara, Sargaghat, and Saatbunga	March–June	2016
Dhanachuli	Paharpani, Jarapani, Kwedal, Okhalkand, Edidhar, Soondarkhal, Kaalapaatal, Saliakot, Letibunga, Mangher, Gwalakol, and Dhari	April–June	2016
Mornaula	Sheherphatak, Motiathar, Punagarh, Lamgarha, Harinagar, and Dinitalli	April–June	2016

* Both village forests (Van Panchayats) and Reserved Forests were covered, in addition to village and other human-modified habitats. All sites were located between 1500 and 2200 m asl., within banj oak–chir pine forest elevational zone.

point counts were undertaken only from 0700 to 1030 hrs, and were distributed equally across six different habitat types: primary forest, degraded forest, heavily lopped forest, pine forest, horticultural plantations, and tourist resorts—in each of the 42 study sites (Table 1).

In terms of birding effort, during May–June 2013, observations were undertaken for 78 hrs, while during May–June 2014, for 100 hrs. In 2015, 28 hrs of surveys were carried out in April, and 80 hrs in September. During the period March–June 2016, 240 hrs of observations were done, of which 69 hrs were spent in systematic point counts (see above). Therefore, during the study's four years, 526 hrs of observation were carried out over ten months.

Throughout the surveys, birds were identified and recorded either by visual observations (using a standard field guide: Grimmett *et al.* 2011), or using auditory cues on the basis of bird vocalisations (calls, and songs). All unfamiliar calls were recorded in the field and later identified using reliable internet resources.³ After identifications were confirmed, the bird nomenclature was revised on the basis of Praveen *et al.* (2016), which takes into account recent global nomenclatural changes.

Notes were taken on breeding behaviour ('Br'), when observed. A bird was recorded as breeding if pairs were seen indulging in courtship display, building or tending their nests, if fledglings were seen, or if individuals were seen consistently displaying territorial behaviour. Since the surveys were mainly undertaken in the breeding season, territorial behaviour is highly likely to indicate breeding.

The bird species were assigned an abundance category—Uncommon (*henceforth*, UNC), Moderately Common (*henceforth*, MC), or Common (*henceforth*, C)—based mainly on surveys carried out during the systematic point counts during April–June 2016. The encounter frequency (as individuals encountered per hour) was calculated for each of the 111 species recorded during the point counts. Species were then assigned an

abundance category as given above, based on the encounter frequency (*henceforth*, EF) as follows: UNC (EF 0.01–0.16), MC (EF 0.17–0.84), and C (EF 0.93 to 5.25). For the remaining 25 species, which were seen outside this sampling period, the categories were assigned based on the observation records of the three authors.

Habitat preferences were assigned based on a combination of field observations, and the species description in Grimmett *et al.* (1998), and Ali (2002). Each species was thus assigned to one, or more, of the following categories (see Table 2): Oak Forest Specialist (*henceforth*, OAKFOR; seen primarily in dense oak forest), Forest and Edge (*henceforth*, FOREDG; seen in native forest, forest edge, gaps, gardens and horticulture), Open and Forested Valleys (*henceforth*, OPFL), Vagrant (*henceforth*, VAGR), Village area (*henceforth*, VILL), Cultivation (*henceforth*, CULT), and Commensal (*henceforth*, COMM; restricted to human settlements). It should be noted that the habitat preferences recorded here are strictly those seen in the studied forest association. Depending on the biology of the species, habitat preferences may be different at other altitudes.

In order to assign endemism status, if any, the global range of each species was taken from the updated species page on the website of BirdLife International (BirdLife International 2016c). Global range was recorded only for the species restricted to the Himalayan region or a part thereof. The oak forest belt represents the lower, or upper, range limit for many species; consequently this is indicated for such species, which was obtained from species descriptions in Grimmett *et al.* (1998).

Results

Over the four years of the study, 136 species were recorded from the 42 sites in the study area (Table 2). Of the 136 species, signs of breeding were seen in as many as 104 species (76%), which are therefore likely to be either residents or summer migrants in this forest association. This shows the importance of the banj oak–pine vegetation zone for montane bird conservation.

Many of the breeding species, such as Verditer Flycatcher *Eumyias thalassinus*, Himalayan Cuckoo *Cuculus saturatus*, Indian Cuckoo *Cuculus micropterus*, Hume's Leaf Warbler *Abornis humei*, Greenish Leaf Warbler *Seicercus trochiloides*, and Ultramarine Flycatcher *Ficedula superciliaris* breed in the Himalayas and winter in the plains of Indian Subcontinent. Other breeders are those that are restricted to the Himalayas both, during summer, and winter, such as: White-throated Laughing-thrush *Garrulax albogularis*, Greater Yellow-naped Woodpecker

Chrysophlegma flavinucha, and Rufous-bellied Woodpecker *Dendrocopos hyperythrus*. There are other species that migrate altitudinally, breeding in oak forest areas (and higher), and moving down to the Himalayan foothills in winter, such as the Rufous-bellied Niltava *Niltava sundara*, and Grey-hooded Warbler *S. xanthoschistos*.

Of the 136 species, 57 were assigned UNC category. Some of these species are naturally rare in this forest zone, such as Green Shrike-babbler *Pteruthius xanthochlorus*, White-browed

Table 2. List of bird species recorded in the study area (2013-16)

S.No.	Common name	Scientific name	Breeding	Abundance (Encounter rate)	Habitat preference	Global range
1	Common Hill Partridge	<i>Arborophila torqueola</i>	Br	MC (0.23)	OAKFOR	Him-3
2	Black Francolin*	<i>Francolinus francolinus</i>	Br	MC (0.43)	CULT	
3	Kalij Pheasant	<i>Lophura leucomelanos</i>	Br	MC (0.30)	OAKFOR	Him-3
4	Rock Pigeon	<i>Columba livia</i>		C (0.96)	COMM	
5	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	Br	C (2.62)	FOREDG	
6	Eurasian Collared Dove*	<i>S. decaocto</i>		UNC (0.03)	CULT; VILL	
7	Spotted Dove*	<i>S. chinensis</i>		MC (0.72)	CULT	
8	Wedge-tailed Green Pigeon	<i>Treron sphenurus</i>	Br	MC (0.02)	OAKFOR	Him-3
9	Emerald Dove*	<i>Chalcophaps indica</i>		UNC	FOREDG	
10	Large-tailed Nightjar*	<i>Caprimulgus macrurus</i>	Br	UNC	FOREDG	
11	Asian Koel*	<i>Eudynamis scolopaceus</i>		UNC (0.04)	FOREDG; VILL	
12	Large Hawk Cuckoo	<i>Hierococcyx sparveroides</i>	Br	UNC (0.03)	OAKFOR	
13	Indian Cuckoo	<i>Cuculus micropterus</i>	Br	UNC (0.12)	OAKFOR	
14	Common Cuckoo	<i>C. canorus</i>	Br	MC (0.22)	OAKFOR	
15	Himalayan Cuckoo	<i>C. saturatus</i>	Br	MC (0.29)	OAKFOR	
16	Indian Cormorant*	<i>Phalacrocorax fuscicollis</i>		UNC	VAGR	
17	Oriental Honey Buzzard*	<i>Pernis ptilorhynchus</i>		UNC	FOREDG	
18	Bearded Vulture**	<i>Gypaetus barbatus</i>		UNC (0.01)	OPFL	
19	Crested Serpent Eagle*	<i>Spilornis cheela</i>	Br	MC	FOREDG	
20	Himalayan Vulture	<i>Gyps himalayensis</i>		MC (0.08)	OPFL	
21	Cinereous Vulture	<i>Aegypius monachus</i>		UNC (0.01)	OPFL	
22	Mountain Hawk Eagle	<i>Nisaetus nipalensis</i>		UNC	OAKFOR	
23	Black Eagle	<i>Ictinaetus malaiensis</i>	Br	MC	OAKFOR	-
24	Steppe Eagle*	<i>Aquila nipalensis</i>		MC (0.01)	OPFL	
25	Shikra*	<i>Accipiter badius</i>		UNC	FOREDG	
26	Besra	<i>A. virgatus</i>		UNC (0.01)	FOREDG	
27	Black Kite*	<i>Milvus migrans</i>		UNC (0.01)	COMM	
28	Long-legged Buzzard	<i>Buteo rufinus</i>		UNC	FOREDG	
29	Upland Buzzard	<i>B. hemilasius</i>		UNC	FOREDG	
30	Collared Owlet	<i>Glaucidium brodiei</i>	Br	UNC (0.03)	OAKFOR	Him-3
31	Asian Barred Owlet	<i>G. cuculoides</i>		UNC (0.04)	OAKFOR	Him-3
32	Mountain Scops Owl	<i>Otus spilocephalus</i>	Br	UNC	OAKFOR	
33	Brown Wood Owl	<i>Strix leptogrammica</i>	Br	UNC (0.03)	OAKFOR	
34	Common Hoopoe*	<i>Upupa epops</i>		UNC (0.10)	CULT	
35	Speckled Piculet*	<i>Picumnus innominatus</i>		UNC (0.01)	OAKFOR	
36	Greater Yellow-naped Woodpecker	<i>Chrysophlegma flavinucha</i>	Br	UNC (0.04)	OAKFOR	
37	Lesser Yellow-naped Woodpecker*	<i>Picus chlorolophus</i>	Br	UNC (0.04)	FOREDG	
38	Grey-headed Woodpecker	<i>P. canus</i>	Br	MC (0.43)	OAKFOR	
39	Scaly-bellied Woodpecker	<i>P. squamatus</i>	Br	MC (0.23)	FOREDG	Him-2
40	Greater Golden-backed Woodpecker*	<i>Chrysocolaptes lucidus</i>	Br	UNC	OAKFOR	
41	Fulvous-Breasted Pied Woodpecker*	<i>Dendrocopos macei</i>		UNC (0.01)	FOREDG	
42	Brown-fronted Woodpecker	<i>D. auriceps</i>	Br	C (0.96)	FOREDG	Him-1

Table 2. List of bird species recorded in the study area (2013-16)

S.No.	Common name	Scientific name	Breeding	Abundance (Encounter rate)	Habitat preference	Global range
43	Himalayan Pied Woodpecker	<i>D. himalayensis</i>	Br	MC (0.72)	FOREDG	Him-1
44	Rufous-bellied woodpecker	<i>D. hyperythrus</i>	Br	MC (0.25)	OAKFOR	Him-3
45	Great Barbet	<i>Psilopogon virens</i>	Br	C (1.23)	FOREDG	Him-3
46	Blue-throated Barbet*	<i>P. asiaticus</i>	Br	UNC (0.01)	FOREDG	Him-3
47	Common Kestrel	<i>Falco tinnunculus</i>	Br	UNC	CULT	
48	Slaty-headed Parakeet	<i>Psittacula himalayana</i>		UNC (0.07)	FOREDG	Him-2
49	Plum-headed Parakeet*	<i>P. cyanocephala</i>		MC (0.84)	FOREDG	
50	Long-tailed Minivet	<i>Pericrocotus ethologus</i>	Br	C (1.62)	FOREDG	Him-3
51	Scarlet Minivet	<i>P. flammeus</i>		UNC (0.16)	FOREDG	
52	Black-winged Cuckooshrike	<i>Lalage melaschistos</i>	Br	MC (0.19)	FOREDG	
53	Himalayan Shrike-Babbler	<i>Pteruthius ripleyi</i>	Br	MC (0.32)	OAKFOR	
54	Green Shrike Babbler*	<i>P. xanthochlorus</i>		UNC (0.03)	FOREDG	Him-3
55	Maroon Oriole	<i>Oriolus trailii</i>	Br	MC (0.55)	OAKFOR	
56	Ashy Drongo	<i>Dicurus leucophaeus</i>	Br	C (1.46)	FOREDG	
57	Lesser Racket-tailed Drongo	<i>D. remifer</i>	Br	UNC (0.04)	OAKFOR	Him-3
58	Greater Racket-tailed Drongo*	<i>D. paradiseus</i>		UNC	OAKFOR	
59	White-throated Fantail	<i>Rhipidura albicollis</i>		UNC	FOREDG	
60	Long-tailed Shrike	<i>Lanius schach</i>		UNC (0.06)	CULT	
61	Grey Treepie	<i>Dendrocitta formosae</i>	Br	MC (0.23)	OAKFOR	
62	Red-billed Blue Magpie	<i>Urocissa erythroryncha</i>	Br	C (0.93)	FOREDG	Him-3
63	Eurasian Jay	<i>Garrulus glandarius</i>	Br	C (0.93)	OAKFOR	
64	Black-headed Jay	<i>G. lanceolatus</i>	Br	C (1.83)	FOREDG	Him-1
65	House Crow	<i>Corvus splendens</i>		UNC (0.03)	COMM	
66	Large-billed Crow	<i>C. macrorhynchos</i>	Br	C (0.84)	FOREDG	
67	Indian Paradise-flycatcher	<i>Terpsiphone paradisi</i>		UNC	FOREDG	
68	Fire-breasted Flowerpecker	<i>Dicaeum ignipectus</i>	Br	MC (0.49)	FOREDG	Him-3
69	Green-tailed Sunbird	<i>Aethopyga nipalensis</i>		UNC	FOREDG	Him-3
70	Scaly-breasted Munia	<i>Lonchura punctulata</i>		UNC	CULT	
71	House Sparrow*	<i>Passer domesticus</i>		C (2.83)	COMM	
72	Russet Sparrow	<i>P. cinnamomeus</i>	Br	C (3.41)	CULT; VILL	Him-3
73	Upland Pipit	<i>Anthus sylvanus</i>	Br	MC (0.25)	CULT	Him-3
74	Grey Wagtail	<i>Motacilla cinerea</i>		UNC	CULT	
75	White Wagtail	<i>M. alba</i>		UNC	CULT	
76	Common Rosefinch	<i>Erythrura erythrina</i>		C (0.96)	CULT; FOREDG	
77	Yellow-breasted Greenfinch	<i>Chloris spinoides</i>	Br	C (1.04)	CULT	Him-3
78	Rock Bunting	<i>Emberiza cia</i>		UNC	CULT	
79	Grey-headed Canary-flycatcher	<i>Culicicapa ceylonensis</i>	Br	MC (0.36)	FOREDG	
80	Coal Tit	<i>Periparus ater</i>	Br	MC (0.68)	OAKFOR	
81	Green-backed Tit	<i>Parus monticolus</i>	Br	C (2.62)	FOREDG	Him-3
82	Cinereous Tit*	<i>P. cinereus</i>		MC (0.17)	FOREDG	
83	Black-lored Tit	<i>Machlolophus xanthogenys</i>	Br	C (1.19)	FOREDG	
84	Striated Prinia	<i>Prinia crinigera</i>	Br	MC (0.39)	CULT	Him-3
85	Red-rumped Swallow	<i>Cecropis daurica</i>		C (1.09)	CULT; VILL	
86	Barn Swallow	<i>Hirundo rustica</i>	Br	C (3.03)	COMM	
87	Mountain bulbul	<i>Ixos mcclllandii</i>	Br	MC (0.33)	FOREDG	
88	Black Bulbul	<i>Hypsipetes leucocephalus</i>	Br	C (3.49)	FOREDG	Him-3
89	Himalayan Bulbul	<i>Pycnonotus leucogenis</i>	Br	C (3.25)	FOREDG; CULT	
90	Red-vented Bulbul*	<i>P. cafer</i>	Br	MC (0.36)	CULT	
91	Hume's Leaf Warbler	<i>Abornis humei</i>	Br	C (2.52)	FOREDG	
92	Lemon-rumped Warbler	<i>A. chloronotus</i>		MC (0.62)	OAKFOR	Him-2

Table 2. List of bird species recorded in the study area (2013-16)

S.No.	Common name	Scientific name	Breeding	Abundance (Encounter rate)	Habitat preference	Global range
93	Green-crowned Warbler	<i>Seicercus burkii</i>	Br	UNC (0.07)	FOREDG	
94	Greenish Leaf Warbler	<i>S. trochiloides</i>		MC (0.70)	FOREDG	
95	Blyth's Leaf Warbler	<i>S. reguloides</i>		UNC (0.01)	OAKFOR	Him-3
96	Grey-hooded Leaf Warbler	<i>S. xanthoschistos</i>	Br	C (5.28)	FOREDG	Him-2
97	Grey-sided Bush Warbler	<i>Cettia brunnifrons</i>		MC (0.28)	FOREDG	Him-2
98	Black-faced Warbler	<i>Abroscopus schisticeps</i>	Br	C (1.03)	OAKFOR	Him-3
99	Black-throated Tit	<i>Aegithalos concinnus</i>	Br	C (3.42)	FOREDG	Him-3
100	Whiskered Yuhina	<i>Yuhina flavicollis</i>	Br	MC (0.19)	FOREDG	Him-3
101	Oriental White-eye	<i>Zosterops palpebrosus</i>	Br	C (1.10)	FOREDG	
102	White-browed Scimitar Babbler*	<i>Pomatorhinus schisticeps</i>		UNC (0.01)	FOREDG	Him-3
103	Rusty-cheeked Scimitar Babbler	<i>Erythrogenys erythrogenys</i>	Br	MC (0.26)	FOREDG	Him-3
104	Black-chinned Babbler*	<i>Cyanoderma pyrrhops</i>	Br	UNC (0.13)	FOREDG	Him-1
105	Striated Laughingthrush	<i>Grammatoptila striata</i>	Br	MC (0.74)	OAKFOR	Him-2
106	Jungle Babbler*	<i>Turdoides striata</i>		UNC (0.28)	CULT	
107	White-crested Laughingthrush*	<i>Garrulax leucolophus</i>		MC (0.17)	OAKFOR	Him-3
108	White-throated Laughingthrush	<i>G. albogularis</i>	Br	C (3.20)	OAKFOR	Him-3
109	Streaked Laughingthrush	<i>Trochalopteron lineatum</i>	Br	C (2.25)	FOREDG	Him-3
110	Chestnut Crowned Laughingthrush	<i>T. erythrocephalum</i>	Br	UNC (0.10)	FOREDG	Him-3
111	Rufous Sibia	<i>Heterophasia capistrata</i>	Br	C (2.68)	OAKFOR	Him-2
112	Blue-winged Minla	<i>Siva cyanouroptera</i>	Br	MC (0.52)	FOREDG	Him-3
113	Bar-tailed Treecreeper	<i>Certhia himalayana</i>	Br	C (1.30)	FOREDG	
114	Chestnut-bellied Nuthatch*	<i>Sitta castanea</i>	Br	MC (0.28)	OAKFOR	
115	White-tailed Nuthatch	<i>S. himalayensis</i>	Br	C (1.42)	OAKFOR	Him-3
116	Common Myna	<i>Acridotheres tristis</i>	Br	C (1.72)	VILL	
117	Jungle Myna	<i>A. fuscus</i>	Br	C (1.33)	CULT; FOREDG	
118	Oriental Magpie Robin*	<i>Copsychus saularis</i>	Br	UNC (0.01)	FOREDG	
119	Asian Brown Flycatcher*	<i>Muscicapa dauurica</i>		UNC (0.04)	FOREDG	
120	Rufous-bellied Niltava	<i>Niltava sundara</i>	Br	MC (0.28)	OAKFOR	Him-3
121	Verditer Flycatcher	<i>Eumyias thalassinus</i>	Br	C (1.74)	FOREDG	
122	Spotted Forktail	<i>Enicurus maculatus</i>	Br	UNC (0.09)	OAKFOR	Him-3
123	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	Br	C (1.22)	FOREDG	Him-3
124	Rufous-gorgetted Flycatcher	<i>Ficedula strophiate</i>		UNC (0.01)	FOREDG	
125	Ultramarine Flycatcher	<i>F. supercilialis</i>	Br	C (1.70)	FOREDG	
126	Plumbeous Water Redstart	<i>Rhyacornis fuliginosa</i>	Br	UNC	FOREDG	
127	White-capped Water Redstart	<i>Chaimarornis leucocephalus</i>		UNC	FOREDG	
128	Hodgson's Redstart	<i>Phoenicurus hodgsoni</i>		UNC (0.03)	OAKFOR	Him-3
129	Blue-capped Rock Thrush	<i>Monticola cinclorhyncha</i>	Br	MC	CULT; VILL	
130	Chestnut-bellied Rock Thrush	<i>M. rufiventris</i>	Br	MC (0.22)	FOREDG	Him-3
131	Siberian Stonechat	<i>Saxicola maurus</i>	Br	MC (0.19)	CULT; VILL	
132	Grey Bushchat	<i>S. ferreus</i>	Br	C (1.43)	FOREDG	Him-3
133	Mistle Thrush	<i>Turdus viscivorus</i>	Br	UNC (0.10)	FOREDG	
134	Grey-winged Blackbird	<i>T. boulboul</i>	Br	C (0.96)	OAKFOR	Him-3
135	Tickell's Thrush	<i>T. unicolor</i>	Br	UNC (0.09)	FOREDG	
136	White-collared Blackbird	<i>T. albocinctus</i>		UNC	FOREDG	Him-3

Note: Bird species' names, and their order, are according to Praveen, Jayapal and Pittie (2016).

Legend:

*: Asterisk indicates the 1500-2200 m asl elevation represents Upper Range Limit (URL) for the species; ** - Lower Range Limit

Breeding Status: Breeding (Br)- seen courting/nesting/with fledglings/displaying territoriality

Abundance: Common (C); Moderately Common (MC); Uncommon (UNC)

Habitat Preference: CULT-Cultivation; COMM-Commensal; OAKFOR-Oak Forest Specialist; FOREDG-Forest and Edge Habitat;

VAGR-Vagrant; OPFL-Open/Forested Valleys; VILL-Village area

Endemism: HIM-1: Endemic to Western Himalayas and/or Central Himalayas; Him-2: Endemic to Himalayas of S. Asia (Pakistan eastwards to Myanmar)

HIM-3: Endemic to Himalayas; occurring from India to Indo-China and/or South-eastern China

Scimitar Babbler *Pomatorhinus schisticeps*, and Green-tailed Sunbird *Aethopyga nipalensis*. Of the other uncommon species, the White-collared Blackbird *Turdus albocinctus* is rare due to its being at the lower edge of its altitudinal range. Other notable species such as Greater Racket-tailed Drongo *Dicrurus paradiseus*, Emerald Dove *Chalcophaps indica*, and Blue-throated Barbet *Psilopogon asiaticus* are near the upper limit of their altitudinal range. Some species such as Grey-sided Bush Warbler *Cettia brunnifrons*, and Rock Bunting *Emberiza cia* are possibly passage migrants in this zone, given that they are occasionally sighted, in flocks, during early summer. These species are known to migrate uphill to their high-altitude breeding areas in spring. They descend to the Himalayan foothills, and plains during winter. A few commensals, common in the plains, such as House Crow, Common Myna *Acridotheres tristis*, and Black Kite were also recorded infrequently.

35 species (26% of those recorded) are oak forest specialists—such as: Maroon Oriole *Oriolus traillii*, White-throated Laughingthrush *Garrulax albogularis*, Chestnut-crowned Laughingthrush *Trochalopteron erythrocephalum*, Himalayan Shrike-Babbler *Pteruthius rileyi*, Blue-winged Minla *Siva cyanouroptera*, Spotted Forktail *Enicurus maculatus*, Greater Yellow-naped Woodpecker, Rufous-bellied Woodpecker, Black-faced Warbler *Abroscopus schisticeps*, and Rufous-bellied Niltava—corroborated by both field observations as well as the species descriptions in Grimmett *et al.* (1998). These species could arguably be the most vulnerable to the landscape-level changes caused by habitat degradation, fragmentation, or even climate change, as they are least resilient to any type of disturbance. The impact of global warming is likely to reduce the appropriate habitat for such species, making local extinction more likely.

69 species (51%), appear to be relatively adaptable forest species (assigned FOREDG category), having been seen in dense forest areas, but also utilising forest gaps, degraded forest, and orchards; such as Rufous Sibia *Heterophasia capistrata*, Red-billed Blue Magpie *Urocissa erythroryncha*, Tickell's Thrush *Turdus unicolor*, Grey-winged Blackbird *T. boulboul*, and Blue Whistling Thrush *Myophonus caeruleus*. Such species however, are still likely to be highly dependent on oak forest for their foraging and breeding (Grimmett *et al.* 2011), but take advantage of edge habitat or modified forest when resources are detected. Of the raptors recorded, Brown Wood Owl *Strix leptogrammica*, and Black Eagle *Ictinaetus malaiensis* [48] were seen only in dense-canopied oak forest while Common Kestrel *Falco tinnunculus*,

Crested Serpent Eagle *Spilornis cheela*, and Upland Buzzard *Buteo hemilasius* seem to be adapted to more open country, partially forested valleys, and forest edges.

Five commensal species—House Sparrow *Passer domesticus*, Rock Pigeon *Columba livia*, House Crow *Corvus splendens*, Barn Swallow *Hirundo rustica*, and Common Myna were recorded during the study and were seen mainly in and around human settlements such as villages and tourist resorts. In addition to such commensals, 22 species were restricted to agricultural areas, such as Siberian Stonechat *Saxicola maurus*, Striated Prinia *Prinia crinigera*, Grey Bushchat *Saxicola ferreus*, and Long-tailed Shrike *Lanius schach*. Such birds are typically found in grasslands (in the Indian plains, and alpine areas), and possibly find agricultural fields, at this elevational range, a conducive habitat. Surprisingly, other plains birds such as Red-vented Bulbul *Pycnonotus cafer*, and Jungle Babbler *Turdoides striata* were locally common at a few sites, in fields, and agricultural fallows. However, limited sightings of such plains generalists, mainly in and around villages, and resorts, may signify vagrancy, or upward range extension, aided by human modification of forest habitats.

In our checklist, a total of 51 Himalayan endemic species (38%) were recorded. Of these, four are narrow Himalayan endemics, with their global range confined to the Western, and / or Central Himalayas. These are the Brown-fronted Woodpecker *D. auriceps*, Black-headed Jay *Garrulus lanceolatus*, Black-chinned Babbler *Cyanoderma pyrrhops*, and Himalayan Pied Woodpecker *D. himalayensis*. Seven species are confined to the Himalaya of South Asia (eastern Pakistan to north-western Myanmar), such as Grey-hooded Warbler, Rufous Sibia, Scaly-bellied Woodpecker *Picus squamatus*, and Striated Laughingthrush *Grammatoptila striata*. As many as 40 species (29%) show a wider Himalayan distribution: from Western Himalayas, through Central/Eastern Himalayas, to the highlands of Indo-China and south-eastern China (BirdLife International 2016c; indicated as 'Him-3' in Table 2).

Only two species from our study site have been listed by IUCN in their Red List: the Steppe Eagle *Aquila nipalensis* (Endangered), and the Bearded Vulture *Gypaetus barbatus* (Near Threatened). However, all raptors found in our study site are afforded the highest level of protection under Schedule I of The Indian Wildlife (Protection) Act, 1972. It should be noted that none of the hardwood forest specialists are listed.

Summary

There is little information on the avifauna of the Western



48. Black Eagle, a broad-leaved forest specialist.



49. Native oak forests are being rapidly degraded and fragmented in Kumaon.

Himalayas, particularly in the context of the observed impacts of global warming in this ecosystem, land use change [49], forest modification, and fragmentation. The banj oak–chir pine belt is a biodiversity-rich habitat that has seen considerable modification and conversion over the last 20 years, and may be experiencing local, and landscape-level, bird extinctions that are as yet unstudied. The present study is the first to assess the conservation status of Himalayan avifauna based on intensive field studies in a specific forest association.

We believe our study provides a robust estimate of the relative abundance of bird species in the studied elevational range, based on encounter rates, despite the coverage of six separate geographic clusters of sites, and six different land use categories. This is because the elevational range, and forest type, were constant across the six clusters of sites. Further, bird survey effort was distributed equally across the six different habitat types within each cluster.

Yet, the narrow time-frame of the study, which was largely restricted to summer, and to the pine–oak forest association, may not be sufficient to understand the conservation status of species. Systematic monitoring all along the elevational gradient, and during at least two different seasons, is required in this context. This is because the bird species show seasonal movements along the altitudinal gradient, and their dependence on resources in different habitat types is yet unknown. Our study only provides pointers to supposedly vulnerable species, which will need much more study.

The banj oak–chir pine zone was found to be rich in species, with a total of 136 species recorded over four years of study. 104 species (76%) are likely to be breeding based on observations of territoriality (during breeding season), calls, and nesting behaviour during the summer. Our study indicates that this vegetation association has high conservation value, based on large numbers of broad-leaved forest specialists, forest species that also use edge habitat, and Himalayan endemics. The survey, having been conducted mainly in the breeding season, was able to identify the breeding residents from the non-breeders, and forest specialists from the relatively adaptable forest species, as well as generalist species, restricted to agricultural/village zones. Further, a number of commensals and open-country species were listed from this elevational zone, all of which were seen only in highly modified habitats. Some of these are likely to be in the process of upward range extension, aided by human modification of habitats.

From our observations, combined with information from existing literature, we conclude that the narrow Himalayan endemics that are also hardwood forest specialists, are most likely to be endangered due to the concordant threats of habitat degradation, fragmentation, and climate change. This list numbers 19 species (14% of total) such as the Striated Laughingthrush *Grammotopila striata*, Rufous-bellied Niltava, Black-faced Warbler, Rufous-bellied Woodpecker, White-throated Laughingthrush, White-tailed Nuthatch *Sitta himalayensis*, Common Hill Partridge *Arborophila torqueola*, Kalij Pheasant *Lophura leucomelanos*, and Wedge-tailed Green Pigeon *Treron sphenurus*. If relatively adaptable species (FOREDG species) are included, the number of vulnerable endemic species goes up to 47, or 35% of the bird assemblage. Thus many Himalayan bird species possibly need more protection than they currently enjoy under national laws in India.

Intensive bird studies, such as ours, can contribute to the updating of knowledge on species that are made annually by

IUCN (International Union for Conservation of Nature and Natural Resources) and can also form the basis for amendments in the Indian Wildlife (Protection) Act, 1972. Quantitative studies combining insights from remote sensing data, and systematic bird counts, are required to understand the impacts of anthropogenic change and also perhaps substantiate some of the observations on species vulnerability made in the current paper.

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