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Comparative study of bird community structure and function in two different forest types of Corbett National Park, Uttarakhand, India

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ABSTRACT

Point count method was used to estimate the population structure of avian fauna in two different forest types in Bijrani, Serpdulli and Dhikala ranges of Corbett national Park, Uttarakhand, India. A total of 38 plots were randomly laid by four teams of two each in a period of ten days covering both mixed and Sal forests equally. DISTANCE 6.0 was used to determine density of birds and various bird guilds. Richness and diversity was estimated through SPECDIVERS. A total of 47 species were recorded from mixed and 27 species from Sal forest. Highest and lowest densities (±SE) in Sal forest were of Plum headed parakeet (11.63±2.30/km^2) and blue whistling thrush (0.06±0.01/ km^2) respectively. Whereas, in mixed forest, the highest density was of chestnut headed bee eater (13.84±3.25/ km^2) and lowest density was of Hoopoe (0.09±0.01/ km^2). In mixed forest, density, diversity and richness of insectivorous birds was found to be highest (42.91±6.27/ km^2, 0.89±0.08 and 3.57±0.53 respectively), while, in Sal forests, omnivorous birds had highest density (76.73±4.22/ km^2) and insectivorous birds had highest diversity (±SE) and richness (±SE) (0.88±0.14 and 3.15±0.49 respectively). Carnivorous birds showed least density in both Sal (0.19±0.08/ km^2) and mixed forests (0.32±0.12/ km^2).

Key words: Birds, Corbett, density, diversity, richness

INTRODUCTION

The use of population size as a measure of health of a species has been a very common tool of ornithologists for many years (Lack 1954, 1966; Hutchinson 1978). This study, however, was conducted to determine the health of two different forest types in Corbett National Park.

Corbett National Park (CNP) is among the best pristine for flora and fauna in the Himalayan region. This reserve has the unique distinction of being the first and foremost wildlife conservation centre in India (Dhakate, Patil & Bhartari 2008). Visitors are often amazed by the wide variety of wildlife residing in the forest including some of the rarely occurring species now. To see these species co-existing with man in intensively utilized habitat is a matter of surprise and admiration. Corbett National Park is a bird watcher's heaven. Out of the approximate 1300 species of birds found in the Indian subcontinent, 40% have been recorded in CNP (Dhakate *et al.,* 2008). The aim of this study was 1) to compare the densities of different terrestrial birds utilizing two different types of forests 2) along with comparing the degree of preference of a specific guild in a specific forest type 3) and determining the overall health of both the forest types.

STUDY AREA

The CNP is situated at the foothills of the Western Himalayas in the civil district of Nainital and Pauri Garhwal in Uttarakhand, India (Figure 1) at Latitudes 29°25 29°40' N and Longitude 78°5–79° 5' E. On August 8, 1936 it was established as India's First National Park, and christened Hailey's National Park. Post independence, its name was changed to Ramganga National Park

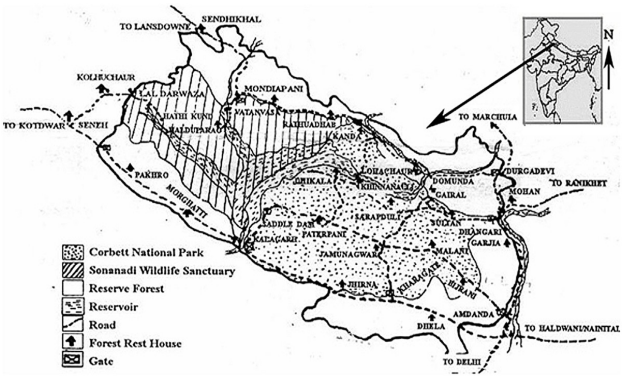

Figure 1. Map showing the details of the study area

in 1954 and then in 1957 to its present name Corbett National Park, in memory of Jim Corbett, the legendary hunter and naturalist who had helped in marking out its boundaries and setting it up. The area of the National Park was increased from 323.75 km^2 to its present size of 520.82 km^2 in 1966. The area of the Reserve was further increased to 1288.32 km^2 by adding 301.18 km^2 of Sonanadi Wildlife Sanctuary and the remaining 466.32 km^2 as buffer area. In 1973–1974, together with Sonanadi Wildlife Sanctuary it was designated a 'Tiger Reserve', under 'Project iger' of the Government of India, and it is now a premier protected area with a high density of tigers (Jhala, Gopal, & Qureshi 2008).

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The vegetation of the area is a mosaic of dry and moist deciduous forest, scrub savannah and alluvial grassland. Five broad vegetation communities are found in the area (Champion & Seth, 1986): (1) Sal (*Shorea robusta*)-dominated forest, (2) Sal mixed forest, (3) riverine forest, (4) mixed or miscellaneous forest, and (5) plantation. Two additional vegetation types, namely grassland and open scrub, are also found. The most dominant and widely distributed species is S. robusta followed by *Mallotus philippensis* and *Syzygium cumini*. Plantations constitute a significant part of the landscape, with species such as Tectona *grandis* and *Dalbergia sissoo*. The park is home to rich and diverse fauna, which includes 50 species of mammals, 575 species of birds, 33 species of reptiles, and 7 species of amphibians. The park has a high density of tigers (*Panthera tigris*) and a sizeable population of Asian elephants (*Elephas maximus*) (Badola *et al*. 2010).

METHODS

Among the principal techniques developed and used for censusing birds are transects, point counts and territory mapping (Verner 1985, Bibby, Burgess, & Hill1992). To select the best technique for a given objective, many studies have compared different methods to assess their relative accuracy, bias, precision and convenience of application in the field (Ralph & Scott 1981,Verner & Ritter 1985, DeSante 1986).

Point counts (Blondel, Ferry and Frochet, 1981) are used to estimate population of birds when line transect method does not work. Counts can be made when topography of the area is not 'open' (Gregory, Gibbons & Donald 2004). A point count, or circular-plot survey, involves a series of points or stations at which birds are counted.

The study was carried out for 10 days as a part of Master's training programme from 24th March to 4th April, 2008. Vantage points were randomly chosen in two different habitats – mixed forest and Sal forest (at least 500 meters apart), in the Corbett National Park and collected data. The data were collected in four groups of two students each. Birds were enumerated from 0 – 360 degrees of the position of the observer. The distance of each bird from the vantage point is measured through a range finder and noted. The mean distance acts as radius of the circle from which, the area and bird density are computed. Birds from both the habitats were counted and the density of individual birds was taken for both the habitats separately. The data was collected in mixed forest (type locality – Ringora and Chorpani- Bijrani Range), and in Sal forest (type locality – near Garjia temple – Serpdulli range and Dhikala – Dhikala range). A total of 38 plots were randomly laid during the study period.

Data were analysed using the programme DISTANCE 6.0 (Thomas *et al.*, 2010). Four key functions (uniform, half-normal hazard rate and negative exponential all with cosine series adjustment) were considered for analysis. Key function selection was evaluated using Akaike's Information Criteria (AIC) (Akaike 1974, Burnham & Anderson 2002), and chi-squared statistics were used to assess the 'goodness of fit' of each function (Burnham, Anderson & Laake 1980; Buckland *et al.,* 1993).The shape criteria were examined for heaping or cluster bias (Buckland *et al.,* 1993).

Species diversity and richness of grasses for each plot were calculated by using Shannon Weiner index (H') for species diversity and Margelef's index (R1) for species richness by using the formulae.

$(H') = -\sum pi \times \log pi$ and $(R_1') = s-1/ \ln N$.

Where, pi = proportion of i^{th} species in sample and S = number of species in sample and N = number of individuals.

RESULTS

a. Density estimation of birds in Corbett National Park

The data computed with the Software DISTANCE 6.0. It was found that the density of species in mixed forest was higher than the density of species in the Sal forest (Table 1a and 1b). A total of 47 species are recorded in mixed forest whereas; 27 species are noted from Sal forest. The mean distances were calculated for a particular species recorded at separate occasions which was then plotted along with their individual densities for both the habitats (Figure 2a & 2b).

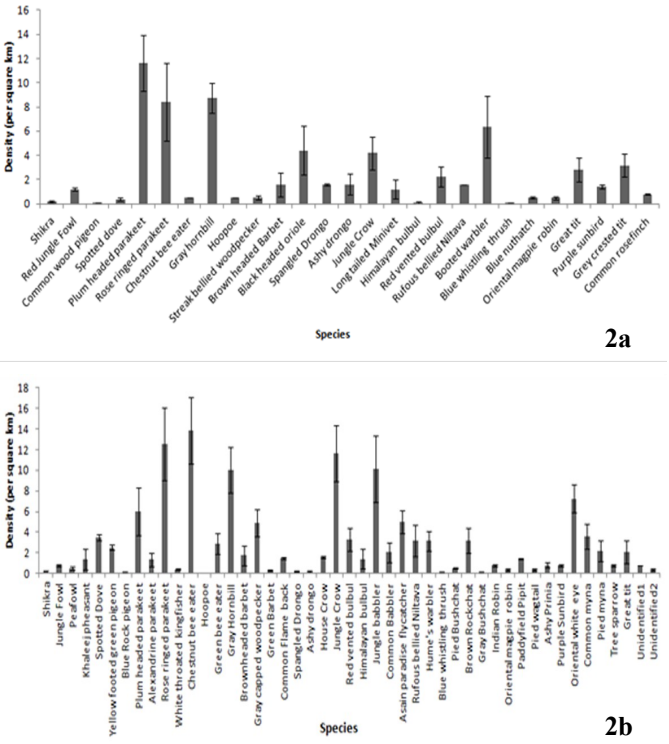


Figure 2 (a & b). Comparison of densities and mean distances of various species of birds in Sal and mixed forest of CTR.

In Sal forest, highest density (±SE) is of Plum headed parakeet (i.e. 11.63±2.30/ km^2) and lowest density is of blue whistling thrush (i.e. 0.06±0.01/ km^2). Whereas, in mixed forest, the highest density was of chestnut headed bee eater (i.e. 13.84±3.25/ km^2) and lowest density is of Hoopoe (i.e. 0.09±0.01/ km^2).

b. Density, diversity and richness estimates of avian guilds in Corbett national Park

The density of birds according to their specific guilds was

also calculated by DISTANCE 6.0 to determine the difference in abundance of specific guild type than the other. The analysis for richness and diversity estimation was done in SPECDIVERS; a DOS-based modified module of statistical ecology (Ludwing and Reynolds, 1988) was used to calculate these values (Table 2a and 2b).

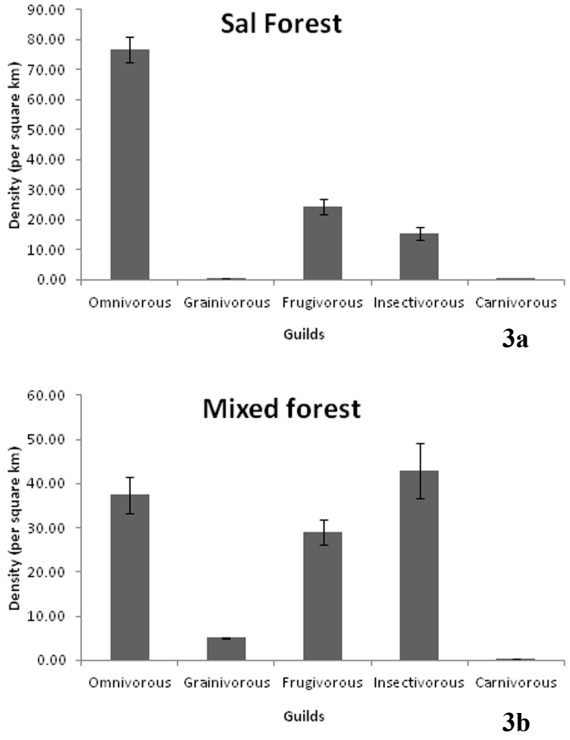
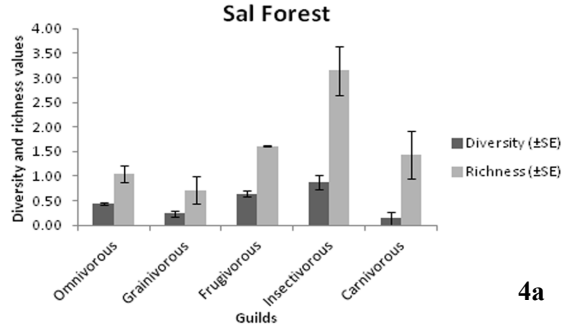


Figure 3. Comparison of guild-wise bird densities in CTR between a) Sal and b) Mixed Forest.

In mixed forests, insectivorous birds showed highest density (±SE) (42.91±6.27/ km^2), whereas, in Sal forests, omnivorous birds were higher in density than the others (76.73±4.22/ km^2). While the carnivorous birds showed least density in Sal (0.19±0.08/ km^2) and mixed forests (0.32±0.12/ km^2) respectively.

Diversity (±SE) and richness (±SE) of insectivorous birds was found to be highest both in mixed (0.89±0.08 and 3.57±0.53 respectively) and Sal forest (0.88±0.14 and 3.15±0.49 respectively) than the other guild of birds. However, the least diversity (±SE) and richness (±SE) was observed to be of carnivorous and grainivorous birds in Sal forest (0.14±0.13 and 0.72±0.28 respectively), and of grainivorous birds in mixed forest (0.40±0.06 and 0.94 ±0.2).



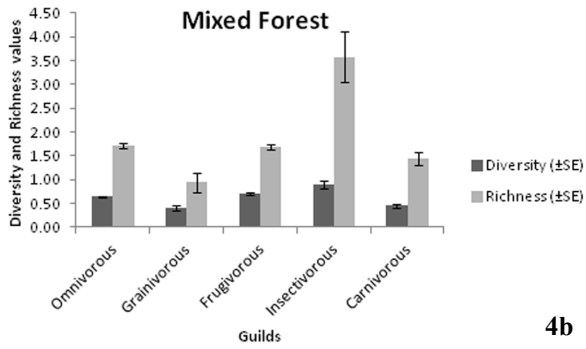


Figure 4. Comparison of guild-wise bird diversity and richness in CTR between a) Sal and b) Mixed Forest.

DISCUSSION

Structural characteristics derived from different vegetal compositions in discontinuities might cause remarkable changes in their animal community assemblages (Odum, 1958). Increase in vegetation structure complexity and floristic composition quite often are related to enrichment of associated bird communities (Wiens, 1989; Monkkonen, 1994; Hobson & Bayne, 2000a,b; Shochat, Abramsky & Pinshow, 2001; Laiolo, 2002; Machtans & Latour, 2003). Mixed forest along with more types of breeding sites, provides a variety of habitat for different tree dwelling species of birds which is not provided by a pure woodland forest (Diaz, 2006).

Present study showed that since Sal forest provided with a limited food source for the birds, only few specialist species used to visit these forests. Whereas, since a variety of trees and shrubs are available in a mixed forest providing a kind of *edge habitat* for different guilds of birds (Diaz, 2006), the diversity of birds is greater in them along with the greater number of individuals of a species than the Sal forest.

Same species have different densities in both types of forests which could be attributed to the difference in the presence of their preferred habitats or resource availability. For e.g. Rose ringed parakeet have a density of about 8 individuals per square km in Sal forest and 12.55 individuals per square km in a mixed forest indicating it as a generalist species. Similarly, Spangled drongo have a density of about 0.2 individuals per square km in mixed forest whereas; its density in Sal forest is about 1.5 individuals per square km attributing to the fact of it being more of a specialist species than a generalist one.

The structure of a Sal forest was found to be more of a stable fixed pattern entertaining more specialist species, whereas, mixed forest was found to be of more varying composition indicating the importance of both the habitat types for a series of different kind of birds. Since few species were found to be exclusive for the Sal forests, it can be safely said that preservation of those patches are without a doubt, an important action. Similarly, the mixed forest indicates its importance by supporting a number of bird species from different guilds. Hence, elimination of either of these habitats may cause a serious damage in the Corbett's diversity of birds. It is therefore, required to maintain a proper conservation measure against deforestation in

Table 1a. Density estimates (birds per km^2) and corresponding Standard error values (SE) generated by program DISTANCE 6.0 based on the number of birds detected (n) and their detection probabilities (p) during 18 point counts during the study period in Sal forests of Corbett National Park. Half Normal model was selected depending on lowest AIC value.

Sl No.	Species	Number of individuals detected (n)	Detection probability (p)	Density (per square km)	Std Error (±SE)
1	Shikra Accipiter badius	1	0.03	0.17	0.06
2	Red Jungle Fowl Gallus gallus	4	0.33	1.21	0.11
3	Common wood pigeon Columba palumbus	1	0.07	0.07	0.02
4	Spotted dove Spilopelia chinensis	3	0.50	0.38	0.10
5	Plum headed parakeet Psittacula cyanocephala	28	0.27	11.59	2.30
6	Rose ringed parakeet Psittacula krameri	24	0.30	8.39	3.22
7	Chestnut headed bee eater Merops leschenaulti	1	0.25	0.51	0.03
8	Gray hornbill Ocyceros birostris	29	0.33	8.74	1.24
9	Hoopoe Upupa epops	1	0.03	0.51	0.01
10	Streak throated woodpecker Picus xanthopygaeus	1	0.02	0.51	0.14
11	Brown headed Barbet Megalaima zeylanica	7	0.37	1.59	1.02
12	Black headed oriole Oriolus larvatus	13	0.30	4.42	1.98
13	Spangled Drongo Dicrurus bracteatus	2	0.02	1.59	0.11
14	Ashy drongo Dicrurus leucophaeus	4	0.03	1.59	0.86
15	Jungle Crow Corvus macrorhynchos	9	0.59	4.20	1.35
16	Long tailed Minivet Pericrocotus ethologus	4	0.32	1.19	0.77
17	Himalayan bulbul Pycnonotus leucogenys	1	0.05	0.13	0.09
18	Red vented bulbul Pycnonotus cafer	13	0.43	2.24	0.85
19	Rufous bellied Niltava Niltava sundara	2	0.20	1.59	0.03
20	Booted warbler Iduna caligata	2	0.10	6.37	2.55
21	Blue whistling thrush Myophonus caeruleus	1	0.07	0.06	0.01
22	Blue nuthatch Sitta azurea	1	0.05	0.51	0.05
23	Oriental magpie robin Copsychus saularis	1	0.08	0.51	0.12
24	Great tit Parus major	2	0.15	2.83	0.99
25	Purple sunbird Cinnyris asiaticus	1	0.11	1.42	0.17
26	Grey crested tit Lophophanes dichrous	1	0.10	3.18	0.93
27	Common rosefinch Carpodacus erythrinus	1	0.04	0.80	0.07

Table 1b. Density estimates (birds per km^2) and corresponding Standard error values (SE) generated by program DISTANCE 6.0 based on the number of birds detected (n) and their detection probabilities (p) during 18 point counts during the study period in mixed forests of Corbett National Park. Half Normal model was

Sl No.	Species	Number of individuals detected (n)	Detection probability (p)	Density (per square km)	Std Error (±SE)
1	Shikra Accipiter badius	2	0.93	0.26	0.03
2	Red Jungle Fowl Gallus gallus	1	0.20	0.80	0.09
3	Peafowl Pavo cristatus	1	0.25	0.51	0.12
4	Khaleej pheasant Lophura leucomelanos	1	0.15	1.42	1.01
5	Spotted Dove Spilopelia chinensis	15	0.37	3.47	0.33
6	Yellow footed green pigeon Treron phoenicoptera	4	0.23	2.52	0.25
7	Blue Rock pigeon Columba livia	7	1.25	0.14	0.07
8	Plum headed parakeet Psittacula cyanocephala	30	0.40	6.00	2.34
9	Alexandrine parakeet Psittacula eupatria	7	0.41	1.33	0.66
10	Rose ringed parakeet Psittacula krameri	49	0.35	12.55	3.54
11	White throated kingfisher Halcyon smyrnensis	2	0.20	0.40	0.06
12	Chestnut headed bee eater Merops leschenaulti	22	0.23	13.84	3.25
13	Hoopoe Upupa epops	1	0.60	0.09	0.01
14	Green bee eater Merops orientalis	4	0.21	2.89	0.99
15	Gray Hornbill Ocyceros birostris	38	0.35	10.02	2.22
16	Brown-headed barbet Megalaima zeylanica	6	0.33	1.75	0.97
17	Gray capped woodpecker Dendrocopos canicapillus	3	0.14	4.87	1.32
18	Green Barbet Stactolaema olivacea	2	0.45	0.31	0.04
19	Common Flameback Dinopium javanense	2	0.21	1.44	0.09
20	Spangled Drongo Dicrurus bracteatus	2	0.55	0.21	0.06
21	Ashy drongo Dicrurus leucophaeus	1	0.45	0.16	0.07
22	House Crow Corvus splendens	2	0.20	1.59	0.11
23	Jungle Crow Corvus macrorhynchos	34	0.31	11.64	2.74
24	Red vented bulbul Pycnonotus cafer	6	0.24	3.32	1.12
25	Himalayan bulbul Pycnonotus leucogenys	1	0.15	1.42	0.99
26	Jungle babbler Turdoides striata	17	0.23	10.16	3.22
27	Common Babbler Turdoides caudata	9	0.38	2.04	0.98
28	Asian paradise flycatcher Terpsiphone paradisi	1	0.08	4.98	1.10
29	Rufous bellied Niltava Niltava sundara	1	0.10	3.18	1.51
30	Hume's warbler Phylloscopus humei	1	0.10	3.18	0.96
31	Blue whistling thrush Myophonus caeruleus	1	0.45	0.16	0.04
32	Pied Bushchat Saxicola caprata	1	0.25	0.51	0.02
33	Brown Rockchat Cercomela fusca	1	0.10	3.18	1.21
34	Gray Bushchat Saxicola ferreus	2	0.80	0.10	0.04
35	Indian Robin Saxicoloides fulicatus	1	0.20	0.80	0.11

Table 1b. (contd)

Sl No.	Species	Number of individuals detected (n)	Detection probability (p)	Density (per square km)	Std Error (±SE)
36	**Oriental magpie robin *Copsychus saularis***	**1**	**0.30**	**0.35**	**0.07**
37	Paddyfield Pipit *Anthus rufulus*	1	0.15	1.42	0.09
38	Pied wagtail *Motacilla alba*	1	0.30	0.35	0.13
39	Ashy Prinia *Prinia socialis*	1	0.20	0.80	0.25
40	Purple Sunbird *Cinnyris asiaticus*	3	0.35	0.78	0.12
41	Oriental white eye *Zosterops palpebrosus*	8	0.19	7.25	1.35
42	Common myna *Acridotheres tristis*	25	0.47	3.63	1.21
43	Pied myna *Sturnus contra*	3	0.21	2.17	0.98
44	Tree sparrow *Passer montanus*	1	0.20	0.80	0.08
45	Great tit *Parus major*	2	0.18	2.08	1.07
46	Unidentified1	1	0.20	0.80	0.02
47	Unidentified2	7	0.80	0.35	0.08

Table2a. Number of individuals recorded along with density (±SE) per square km, diversity (±SE) and richness (±SE) of bird species belonging to separate guilds in a Sal forest. Half Normal model was selected depending on the lowest AIC value by program DISTANCE for calculating the density.

Guilds	Number of species	Density (±SE)(/ km^2)	Diversity (±SE)	Richness (±SE)
Omnivorous	45	76.73(±4.22)	0.45 (±0.02)	1.051 (±0.17)
Grainivorous	4	0.39(±0.10)	0.24 (±0.06)	0.721 (±0.28)
Frugivorous	76	24.39(±2.57)	0.64 (±0.06)	1.616 (±0.01)
Insectivorous	33	15.35(±2.03)	0.88 (±0.14)	3.146 (±0.49)
Carnivorous	2	0.19(±0.08)	0.14 (±0.13)	1.443 (±0.48)

Table2b. Number of individuals recorded along with density (±SE) per square km, diversity (±SE) and richness (±SE) of bird species belonging to separate guilds in a Mixed forest. Half Normal model was selected depending on the lowest AIC value by program DISTANCE for calculating the density.

Guilds	Number of species	Density (±SE)(/ km^2)	Diversity (±SE)	Richness (±SE)
Omnivorous	108	37.41(±4.14)	0.64 (±0.01)	1.71 (±0.05)
Grainivorous	24	5.12(±0.11)	0.40 (±0.06)	0.94 (±0.2)
Frugivorous	114	29.07(±2.91)	0.71 (±0.02)	1.69 (±0.05)
Insectivorous	38	42.91(±6.27)	0.89 (±0.08)	3.57 (±0.53)
Carnivorous	4	0.32(±0.12)	0.45 (±0.05)	1.44 (±0.13)

these areas to avoid any local extinction of species relying on a particular forest type.

Since even in this short term study, a total of 54 different species were recorded from both the forest types indicating a healthy ecosystem and important refuge for these native birds.

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