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COMPARISON OF AVIFAUNA AT THE EDGES OF CONTRASTING FOREST PATCHES IN WESTERN GHAT HILLS OF INDIA

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ABSTRACT

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Avifauna of shola and semi-evergreen forest patches belonging to three different sanctuaries and National Parks in the southern part of Western Ghat range of Tamil Nadu and Kerala was studied. Altogether 36 species from 17 families were recorded. One globally threatened species (*A1*), two restricted range species (*A2*) and one Palearctic-Asian migrant species have been recorded from forest edges during the relatively short study period. The highest population density of 47.59 ind./ha at Varagaliar Shola was followed by 43.69 ind./ha at Anapaddy, 27.53 ind./ha at Karian Shola, and 23.25 ind./ha at Punnumalai Shola. As Punnumalai Shola is least disturbed by human activity it got the highest number of avian families (15) and was followed by Karian Shola (9) and Vargaliar Shola and Anapaddy – 8 in both cases. Punnumalai Shola having varied bird families showed lower dominance (0.075) and higher evenness value (0.957). In contrast, the edge of semi-evergreen forest at Anapaddy, although very much disturbed by various human activities, showed almost comparable diversity value (2.890) to that of Punnumalai Shola (2.913). More open canopy and much vegetational intergradations at the ecotone of semi-evergreen biotope inherently shelter avian community of high diversity. Conversely, the edges of Karian Shola and Varagaliar Shola having much anthropogenic interferences and with edges showing much lower intergradations of vegetations, exhibited a low avian diversity.

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Key words: shola, edge species, Western Ghats, hotspot, EBA 123, Biome 10, Palearctic-Asian migrant

INTRODUCTION

In the southwest of peninsular India, we find the majestic southern blocks of the Western Ghats, a biodiversity hotspot of India and an Endemic Bird Area (EBA 123), well watered by the south-western and north-eastern monsoons (rainfall 500-5000 mm), harbouring the unique humid forests. Climatic features of this region have made a boundary of its own, encouraging an abode for a number of endemic species of both flora and fauna. The result indicates the physical as well as biological diversity of the habitats. The region harbours varied forest types. These are: tropical, wet evergreen, semi-evergreen, subtropical broad-leaved hill forests, montane wet temperate forests, patches of moist bamboo brakes, moist deciduous, southern tropical thorn forests and grasslands. Such variedly forested environment usually attracts a variety of bird species (Mukhopadhyay *et al.* 1996, Pramod *et al.* 1997, Kannan 1998, Johnsing 2001, Raman 2003). A number of streams, impoundments and large lakes have added advantage to water-dependent birds of this region. However, during the past years this pristine forests have experienced anthropogenic alterations in many forms and as a consequence a definite impact on avian community was recorded as reported by Daniels *et al.* (1990) and Kumar *et al.* (1995). Objectives of the present investigation was to record and compare the avian densities and their community structures at the edges of shola and semi-evergreen forests that experienced varied degree of human activities.

MATERIALS AND METHODS

The montane closed evergreen (called as shola forests) and semi-evergreen forests in the Western Ghat Hills above 1800 m a.s.l. have a distinct vegetation type and these areas are identified as one of the Important Bird Areas (IBA) of India within the Indian Peninsula Tropical Moist Forest Biome (Biome 10). The studies were made in shola and semi-evergreen forest patches of three different Wildlife Sanctuaries and National Parks of Tamil Nadu and Kerala. The location codes, along with latitudes, longitudes, forest types and human activities are given below:

1. Indira Gandhi Wildlife Sanctuary (IGWLS), Tamil Nadu, IBA Site Code: IN-TN-10; 10°12.5'-11°7'N, 76°-77°56.5'E; systematic investigations were made at the edges of Karian Shola and Varagaliar Shola; anthropogenic interferences mainly at Karian Shola due to tourists, vegetation alterations, and at Varagaliar Shola as a result of tribal settlements and activities in relation to elephant training camp.
2. Parambikulam Wildlife Sanctuary (PWLS), Kerala, IBA Site Code: IN-KL-14; 10°20'-10°26'N, 76°35'-76°50'E; systematic investigations were made at the edge of Anapaddy tropical semi evergreen patch; high tourist activities and vegetation alterations.
3. Silent Valley National Park (SVNP), Kerala, IBA Site Code: IN-KL-20; 11°4'-11°13'N, 76°24'-76°29'E; systematic investigations were made at the edge of Punnumalai Shola; barring light tourist activities, relatively little anthropogenic interferences.

A total of 108 point counts (9 counts on each day for 3 consecutive days at 4 sites) during the first three hours after sunrise (5.30-8.30 *a.m.*), during noon (11.30 *a.m.* – 2.30 *p.m.*) and in the evening (4.30 *a.m.* – 7.30 *p.m.*) between 11 January and 2 February 2002 were carried out. A fixed radius circular-plot method was used to record the detections and to calculate the density of the avian species (Hutto *et al.* 1986, Sutherland 1997, Bibby *et al.* 2000, Raman 2003) at the inherent edges (always at a distance between 30 and 40 m from the adjacent contrasting habitats) of the selected study sites. At each point three kinds of data within a specified time period (10 min) were recorded: firstly, the number of individuals of each species detected within a 30-m radius surrounding the observer, secondly, the abundance of individuals of each species detected beyond the 30-m radius but still within the habitats of interest, and finally, the identity of individuals were carefully detected while the observer walked between count points to have a complete species list for the study sites within our study duration. Birds that originally were detected outside the 30-m radius circle but later moved to within 30 m of the observer were recorded as occurring within the fixed-radius circle. As it was assumed that all birds within 30 m were detected, the census would facilitate comparisons among vegetatively different habitats. Birds were detected immediately upon arrival at the centre of the count area and we continued to record for 10 min. All birds seen (perched or flying under the canopy) or calls heard were recorded. Raman (2003) emphasized variable radius point count considering 5 min recording time in studying the rainforest bird densities. However, at the edges with sparse but intergraded vegetation, fixed radius point counts allowing 10 min recording time proved to be rewarding. For the names of the families Grimmett *et al.*(1998) was followed in general. However, both Grimmett *et al.* (1998) and Kazmierczak (2000) were followed for identification work and common and scientific names. Shannon Wiener index of general diversity, Pielou's evenness index, Margalef's richness index, Simpson's dominance index and Sorensen's similarity index were calculated to analyse the avian community structure using DINDEX 4.0. For commenting on the relation between the study sites, a dendrogram was constructed using SPSS 13.0.

RESULTS

Altogether 36 bird species from 17 families have been recorded at the study sites. The bird densities recorded at different study sites are given in Table 1. The highest number of families was observed in Punnumalai (15 families), while the other three locations, *i.e.* Karian Shola, Varagaliar Shola and Anapaddy had 9, 8 and 8 families, respectively. It is apparent from Table 2 that the number of birds observed was maximum in Varagaliar Shola (47.6 ind./ha) – the number of Blossom-headed Parakeets (*Psittacula roseata)* observed there was the highest (13.7 ind./ha), followed by Red-whiskered Bulbuls (*Pycnonotus jocosus)* (10.3 ind./ha) and both these species were common. In Anapaddy, however, maximum number (7.1 ind./ha) of birds observed were Indian Rollers (*Coracias benghalensis)*, Greater Racket-tailed Drongos (*Dicrurus paradiseus)* and Spotted Doves (*Streptopelia chinensis)*. In Karian Shola, the Southern Hill Myna (*Gracula religiosa indica)* was regular (7.1 ind./ha). In Karian Shola, the all

the 9 families observed were found to be almost evenly represented. However, in Varagaliar Shola, *Psittacidae* (41%) constituted most of birds, followed by *Pycnonotidae* (21%). Punnumalai Shola having much more similar biotope to that of Karian Shola and Varagaliar Shola showed almost comparable representation of *Corvidae*, *Pycnonotidae*, *Cisticolidae* and *Nectariniidae* (16%, 13%, 15% and 11%, respectively) and other families were almost equally represented (2-10%). Anapaddy showed high representation of *Corvidae*, *Coraciidae*, *Columbidae*, *Sturnidae*. It may be noted that Anapaddy site, being the semi-evergreen forest edge with more open canopy, exhibited higher vegetational intergradation and, therefore, the representation of drongos belonging to 3 species, *i.e.* Ashy Drongo (*Dicrurus leucophaeus*), Black Drongo (*D. macrocercus*) and Greater Racket-tailed Drongo, which were observed there to collect flying insects abundant at the study sites.

Table 1
Bird densities (ind./ha) ± *SD* at four different study sites;
percentage of representation per site are given in parentheses

Families	Scientific names	Karian Shola	Varagaliar Shola	Anapaddy	Punnumalai Shola
Picidae	*Dinopium javanense*	-	-	-	0.59 ± 0.73 (2.5)
Megalaimidae	*Magalaima zeylanica*	-	-	-	1.35 ± 1.00 (6.0)
	Magalaima viridis	4.19 ± 2.44 (15.0)	-	-	0.87 ± 0.60 (4.0)
Bucerotidae	*Ocyceros griseus*	1.76 ± 0.83 (6.4)	-	-	-
Coraciidae	*Coracias benghalensis*	-	-	7.05 ± 2.12 (16.0)	-
Psittacidae	*Psittacula columboides*	4.19 ± 2.44 (15.0)	5.82 ± 1.92 (12.0)	-	0.59 ± 0.73 (2.5)
	Psittacula roseata	-	13.68 ± 1.87 (29.0)	-	-
Columbidae	*Chalcophaps indica*	-	-	-	0.88 ± 0.60 (4.0)
	Streptopelia chinensis	-	-	7.05 ± 2.12 (16.0)	-
	Ducula badia	1.76 ± 0.83 (6.4)	-	-	0.88 ± 0.60 (4.0)
Accipitridae	*Pernis ptilorhyncus*	1.76 ± 0.83 (6.4)	-	1.76 ± 0.83 (4.0)	-
	Elanus caeruleus	-	1.76 ± 0.83 (4.0)	-	-
	Haliastur indus	-	-	1.76 ± 0.83 (4.0)	-
	Accipiter badius	-	-	-	0.59 ± 0.73 (2.5)
	Gyps bengalensis	-	-	-	0.59 ± 0.73 (2.5)

Families	Scientific names	Karian Shola	Varagaliar Shola	Anapaddy	Punnumalai Shola
Corvidae	*Corvus macrorhynchos*	-	4.19 ± 2.44 (9.0)	-	-
	Dendrocitta leucogastra	1.76 ± 0.83 (6.4)	-	-	-
	Oriolus xanthornus	-	1.54 ± 1.01 (3.0)	-	-
	Dicrurus paradiseus	-	-	7.05 ± 2.12 (16.0)	0.48 ± 0.73 (2.0)
	Dicrurus leucophaeus	-	-	3.53 ± 1.81 (8.0)	2.53 ± 1.13 (11.0)
	Dicrurus macrocercus	-	-	2.05 ± 1.30 (5.0)	-
	Pericrocotus flammeus	1.54 ± 1.01 (5.6)	-	4.19 ± 2.44 (9.0)	0.59 ± 0.73 (2.5)
Muscicapidae	*Myophonus horsfieldii*	1.76 ± 0.83 (6.4)	-	-	0.59±0.73 (2.5)
	Eumyas thalassina	-	7.05 ± 2.12 (15.0)	1.76 ± 0.83 (4.0)	0.59 ± 0.73 (2.5)
Sturnidae	*Sturnus malabaricus*	-	1.54 ± 1.01 (3.0)	-	-
	Gracula religiosa indica	7.05 ± 2.12 (26.0)	-	-	0.59 ± 0.73 (2.5)
	Acridotheres tristis	-	-	4.19 ± 2.44 (9.0)	-
Sittidae	*Sitta frontalis*	-	-	1.76 ± 0.83 (4.0)	0.59 ± 0.73 (2.5)
Pycnonotidae	*Pycnonotus jocosus*	1.76 ± 0.83 (6.4)	10.25 ± 1.31 (21.0)	-	0.54 ± 0.73 (2.0)
	Pycnonotus xantholaemus	-	-	-	2.64 ± 1.13 (11.0)
Cisticolidae	*Prinia inornata*	-	-	-	3.41 ± 1.59 (15.0)
Zosteropidae	*Zosterops palpebrosus*	-	-	-	0.59 ± 0.73 (2.5)
Sylviidae	*Pomatorhinus horsfieldii*	-	-	-	0.59 ± 0.73 (2.5)
	Turdoides striatus	-	7.05 ± 2.12 (15.0)	1.76 ± 0.83 (4.0)	0.59 ± 0.73 (2.5)
Nectariniidae	*Nectarinia zeylonica*	-	1.76 ± 0.83 (4.0)	-	2.59 ± 1.13 (11.0)
Passeridae	*Motacilla flava*	-	-	-	0.59 ± 0.73 (2.5)

Table 2 depicts some of the useful indices to comment on the avian community structure. Shannon Wiener index of general diversity (H') was calculated as it provides a means of objective comparison of community structure being independent of sample size. The H' index was maximum at Punnumalai Shola, followed by Anapaddy

(2.890), while at Karian Shola (2.180) and Varagaliar Shola (1.944) diversity was much less and was almost in comparable range. However, evenness index values were almost in comparable range for all the study locations (0.885-0.957). The maximum evenness was noted at Punnumalai while the minimum – at Varagaliar. Maximum value for richness index was also observed at Punnumalai (5.939) while the minimum at Varagaliar (2.055). Conversely, the dominance index was minimum at Punnumalai (0.075) and maximum at Varagaliar (0.155). Table 3 depicts the similarities between the different families occurring at the 4 different study sites. The highest similarity index value was calculated between Anapaddy and Punnumalai Shola (0.48) followed by 0.47 (between Punnumalai and Karian Shola), 0.43 (Karian Shola and Varagaliar Shola), 0.40 (Varagaliar Shola and Punnumalai Shola), 0.35 (Anapaddy and Karian Shola) and 0.30 (Anapaddy and Varagaliar Shola). Dendrogram analysis showed that Karian Shola and Punnumalai Shola were nearer to each other while the semi-evergreen forest of Anapaddy was the farthest. Diversity indices support such distribution of the study sites.

Table 2
Different diversity indices to comment on the species structure of the study sites

Study sites	No. of families	Species per site	Total birds (ind./ha)	Shannon Wiener diversity index	Pielou's evenness index	Margalef's richness index	Simpson's dominance index
Karian Shola	9	10	27.5	2.180	0.947	2.673	0.139
Varagaliar Shola	8	10	47.6	1.944	0.885	2.055	0.155
Anapaddy	8	12	43.7	2.890	0.943	2.890	0.113
Punnumalai Shola	15	23	23.2	2.913	0.957	5.939	0.075

Table 3
Sorensen's similarity index values to comment on the similarities between the avian community structures at the four different study locations

	Karian Shola	Varagaliar Shola	Anapaddy	Punnumalai Shola
Karian Shola	-	0.43	0.35	0.47
Varagaliar Shola	0.43	-	0.30	0.40
Anapaddy	0.35	0.30	-	0.48
Punnumalai Shola	0.47	0.40	0.48	-

DISCUSSION

Despite the inaccessible location of the closed evergreen and semi-evergreen forests in the Western Ghat tract, they are still under anthropogenic pressure leading to continued habitat degradation and loss of biodiversity (Chandrashekara *et al.* 2006).

Levels of anthropogenic disturbances on evergreen/semi-evergreen forests of Western Ghats have been reported by Bhat and Murali (2001). Chandrashekara *et al.* (2006) recorded that anthropogenic disturbance in the shola forest had impact on vegetation structure, composition and recovery process. Tourism-related anthropogenic pressure on the habitats have increased manifold in the locations under study. Tribal settlements and vegetation alterations have also affected the edges of Varagaliar Shola. Diversity indices clearly indicated the differences in avian community structures between study sites. Punnumalai Shola edge, the least disturbed by human activity, sheltered the richest avian community that had the maximum evenness and the lowest dominance. Anapaddy, on the other hand, although very much disturbed by varied forms of human activity, exhibited comparable values for diversity indices with that of Punnumalai site. Such apparent anomaly could be best explained by the inherent quality of the ecotone zone at the edge of the semi-evergreen biotope. Much vegetational intergradation at Anapaddy study location allowed the activity of birds from varied families and thereby the diversity indices were comparable with those of the undisturbed Punnumalai Shola edge. Had there not been under anthropogenic threats, avian diversity at Anapaddy would surely be much higher than at Punnumalai study site. Study locations at Karian Shola and Varagaliar Shola edges, which were also under different forms of anthropogenic interferences, showed lower H', evenness and richness and higher dominance values. As the shola edges exhibit minimum vegetational intergradation and almost sharply break into grassy slopes, a lower avian diversity is expected. Such low diversity parameters might be influenced more negatively by the human activity and habitat alterations. Therefore, such activities at the shola edges may prove to be suicidal for the communities in pristine shola patches in the southern Western Ghat Hills.

Present work includes one globally threatened species (*A1*) – the White-rumped Vulture (*Gyps bengalensis*). In EBA 123, 16 avian species have been recorded to have restricted distribution range of less than 50 000 km^2. Of these 16 restricted range species (*A2*), this study records two species, *i.e.* White-cheeked Barbet (*Megalaima viridis*) and Indian Scimitar-Babbler (*Pomatorhinus horsfieldii*). Such recordings in these study sites, under Biome 10 (Indian Peninsula Tropical Moist Forest; Biome Restricted Assemblage – *A3*), even for a short duration, amply suggest that population sizes of these species in the forest edges are fairly large.

As the studies were conducted in winter, we expected to record different Palearctic-Asian migrant bird species in the study locations. A good number of avian species are on record to migrate in winter from the Palearctic ecozone that includes mostly boreal and temperate climate ecoregions running across Eurasia from western Europe to the Bering Sea (Beaman 1994). The Palearctic-Asian avian winter migrants migrate between the temperate and boreal regions of eastern Asia and the Asian Tropics. However, in the present study sites a single species of Palearctic-Asian migrant, the Yellow Wagtail (*Motacilla flava*), has been recorded during the study period. Recently, a number of studies have considered the effect of climate in tropical staging or wintering areas on the timing of migration, focusing mainly on the possible effects of annual variation in temperature and rainfall in the tropics on the spring arrival schedule of temperate breeding migrants (Gordo *et al*. 2005). Gordo *et al*. (2005) con-

sidered that the environmental factors operating in the wintering areas of trans-Saharan migrants might affect their ability to adjust migration in response to the changing climate of breeding areas in Europe.

Within many habitats in African winter-quarters the relations between local birds and migrants from the Palearctics influence bird community structure and functioning. To look into this phenomenon more precisely, the 'migrants as fugitive species' hypothesis focused on site fidelity, habitat use and resource use was taken into account. In fact, wintering migrants showed no fidelity to particular wintering sites – populations seemed rather to move from site to site at random during the course of the season, *i.e.* pursuing a 'nomadic' or 'wandering' habit of tropical resources and habitat exploitation. Wintering migrants did not use primary habitat types in the tropics, most notably lowland rainforests, and seemed to be excluded from use of such habitats by resident 'ecological counterparts', they were rather forced to use secondary, marginal, or disturbed habitats. These winter migrants were prevented from using the stable resources of tropical communities by tropical residents to whom they were subordinate, and they were forced to subsist on superabundant resources, *e.g.* fruits, seeds, nectar, or insect swarms (Rappole and Jones 2002).

It may be noted that only a few selected patches of forests were studied; a more intensive study would surely result in identifying many more species from the edges of the Western Ghat evergreen and semi-evergreen biotopes. Although the density of some of the species was low in the present study, these might appear in higher numbers during other seasons or if the study was of more intensive nature. The short list of species from certain families was due to the limitations in study duration. However, the present effort compares the avian assemblages of contrasting forest edges of Western Ghats with varied degree of human activity. Considering the comparison of the avian community structure as a launching ground, more detailed studies could be made to enrich the list of avian species and to ascertain their characteristic distribution in different types of forest edges. The impact of anthropogenic alteration of the habitats in the Western Ghat Hills is also to be studied intensively.

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