Preferential routes of bird dispersal to the Western Ghats in India: An explanation for the avifaunal peculiarities of the Biligirirangan Hills

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Introduction

The Biligirirangan Hills, or BR Hills (77°–77°16'E 11°47'–12°9'N), in peninsular India (Fig. 1 & 2) are a part of the hill ranges that connect the Eastern Ghats and Western Ghats (Ganeshaiah & Umashaanker 1998) with avifaunal elements derived from both these areas (Aravind *et al.* 2001). BR Hills comprises roughly four parallel hill ranges (600–1,816 m a.s.l.) running north–south, which support habitats ranging from wet evergreen to dry scrub. The major habitat types of BR Hills (Ramesh 1989) are—moist and dry deciduous (61.1%), scrub (28.2%), grassland (3.4%), evergreen (6.5%) and shola (0.8%). BR Hills receives rainfall from both the south-western and the retreating monsoon (north-eastern), with an average annual precipitation of *c.* 600 mm in the periphery and *c.* 3,000 mm in the higher elevations (Aravind et al. 2001).

This work examines the avifauna of BR Hills with reference to that of the Western Ghats. In doing so, we take into consideration bird distributions in peninsular India and the eastern Himalayas, with the premise that BR Hills is part of the area that links the Eastern and Western Ghats (Ganeshaiah & Umashaanker 1998) and is a corridor for movement of taxa between the two ranges, and that Sichuan-Yunnan, *via* the hill ranges of the eastern Himalayas, is the source area for faunal dispersion to the peninsula (Hora 1949, Mani 1976).

Three species of hornbills, namely the Great Pied Hornbill *Buceros bicornis*, Malabar Pied Hornbill *Anthracoceros coronatus* and Malabar Grey Hornbill *Ocyceros griseus* are restricted to the wet zone of the Western Ghats (Ali & Ripley 1987, Gupte et al. 2003). There is a noticeable absence of these hornbill species, as well as some other wet zone Western Ghats species in the avifauna of BR Hills, despite its habitat affinity with the Western Ghats (Ramesh 1989) and the occurrence of a majority of Western Ghats wet zone bird species.

Several hypotheses have been put forward to explain the dispersal of source species / taxa from the eastern Himalayas to the Western Ghats. The Satpura Hypothesis (Hora 1949, Ali 1949) envisages the Vindhya–Satpura range in central India as a 'corridor' for dispersal of taxa from the eastern Himalayas to the northern end of the Western Ghats. The route along the Eastern Ghats (Abdulali 1949, Mani 1976) proposes that some taxa dispersed from the eastern Himalayas along the Eastern Ghats to the southern tip of the Western Ghats. The 'southern route across the Indian Ocean' (Croizat 1949) hypothesizes that source taxa from the eastern Himalayas dispersed across what is today the Bay of Bengal to reach peninsular India. Karanth (2003) discusses the various faunal dispersal routes (and the 'relict populations' hypothesis or vicariance model) in the background of disjunct populations of wet zone species in north-eastern India and the peninsula. The vicariance model holds that present species distributions are 'relict populations' of a formerly continuous range, with species having suffered extinction in the intervening areas. It may be noted that no hypothesis dealing with faunal dispersal is contradictory to the other—while one may hold true for the dispersal of particular taxa, another may satisfactorily explain the dispersal of others. Other taxa may have adopted more than one route simultaneously to disperse to the Western Ghats.

Methodology

Several methods were employed to determine the resident avifauna of BR Hills. A thorough review of the available information on the birds of BR Hills was undertaken. In addition to this, from May 2003 to February 2006, over 60 field visits to all parts of the sanctuary were undertaken, covering all habitat types in all seasons. Extensive interviews with over 100 members of the Sholaga tribe were conducted. The Sholagas, a tribe indigenous to these forests, were first reported in scientific literature in the early part of the nineteenth century (Buchanan 1807, Koppad et al. 1961). Their traditional ecological knowledge is rich and includes vernacular names for over 70 species of forest birds (Somasundaram & Kibe 1990, Prashanth *in prep.*).

Contemporary and historical distribution maps and data from Ali & Ripley (1987), Grimmett et al. (1999), Kazmierczak (2000), Shyamal (2003) and, Rasmussen & Anderton (2005) were used to divide Western Ghats wet zone species i.e., species restricted to the moist deciduous, semi-evergreen and evergreen habitats (Ali 1942–43, Ali & Ripley 1987) into several categories namely,

Eastern Ghats dispersers (EGd)

Species that appear to have dispersed to the Western Ghats exclusively along the Eastern Ghats

This category (Table 1) comprises species that are resident in the eastern Himalayas, the Eastern Ghats and the Western Ghats, but are not recorded from the Satpuras, indicating the likelihood that their dispersal to the Western Ghats was exclusively along the Eastern Ghats route. Species resident in the Eastern Ghats (but not the eastern Himalayas) and the Western Ghats with no records from the Satpuras have also been included in this category. Isolated records anywhere along the Eastern Ghats have been considered to form this category of species.

Satpura dispersers (Sd)

Species that appear to have dispersed to the Western Ghats exclusively along the Satpuras

This category (Table 1) comprises species that are resident in the eastern Himalayas and / or the northern Eastern Ghats, the Satpuras, and the Western Ghats, but not in the southern Eastern Ghats, indicating dispersal to the Western Ghats along the Satpuras exclusively. Isolated records along the Satpuras have been considered to form this category of species.

Eastern Ghats and Satpura dispersers (EG & Sd)

Species that appear to have dispersed to the Western Ghats along both the Eastern Ghats and the Satpuras

Species resident in the eastern Himalayas, Eastern Ghats, Satpuras and the Western Ghats (Table 1), indicating dispersal to the Western Ghats along both the Satpuras and the Eastern Ghats. Isolated records anywhere along the Eastern Ghats and the Satpuras have been considered to form this category of species.

Endemic Western Ghats Species (WG End) (Stattersfield et al. 1998, BirdLife International 2001)

Species known poorly from the Western Ghats e.g. Jerdon's Baza *Aviceda jerdoni* (Ali & Ripley 1987, Rasmussen & Anderton 2005) have not been included. Dry zone species of the peninsula, which may occur additionally in the wet zone of the Western Ghats, but primarily occupy scrub or dry deciduous or cultivation / garden habitats (Ali & Ripley 1987) e.g. the Purple-rumped Sunbird *Nectarinia zeylonica* have not been taken into account.

Western Ghats wet zone species resident in the only in the Western Ghats and eastern Himalayas with no populations in the intervening areas have not been taken into account, as they cannot be assigned clearly to one category of dispersers or the other.

Taxonomy and nomenclature follow Manakadan & Pittie (2001).

Results

A total of 254 bird species from 51 families have been reported from BR Hills till date (Morris 1927, 1936, Ali 1942–1943, Baskaran 1992, Karthikeyan et al. 1995, Srinivasa et al. 1997, Uttangi 2000, Aravind et al. 2001, Shyamal et al. 2003, Srinivasan & Prashanth 2005). These include a majority of Western Ghats wet zone species (Ali 1942–1943, Ali & Ripley 1987).

However, there are distributional peculiarities in the avifauna of BR Hills. These peculiarities pertain to the total absence of some species of hole-nesters, especially wet zone hornbills. This is evident from a review of the past literature on the birds of BR Hills as well as from comprehensive field surveys by the authors, and interviews with members of the Sholaga tribe belonging to the area. In every case, the interview revealed a complete lack of any traditional knowledge regarding wet zone hornbills.

Of the 19 species in category 'EGd' (Eastern Ghats dispersers), 17 occur in BR Hills (Fig. 3). The Blue-eared Kingfisher *Alcedo meninting* and the Malabar Trogon *Harpactes fasciatus*, both uncommon species (Kazmierczak 2000), are yet to be recorded from the area.

Of the ten species in category Sd ('Satpura dispersers'), only three have been recorded from BR Hills (Fig. 3). The Black Bulbul *Hypsipetes leucocephalus* occurs erratically in large flocks, suggesting local movement to and from the area, and the Chestnut-bellied Nuthatch *Sitta castanea* is uncommon in the area (authors' observations). The Scarlet Minivet *Pericrocotus flammeus* is the third species of this category to occur in BR Hills. The two wet zone hornbill species have not been recorded from BR Hills. The Great Pied Hornbill is included, as in the case of the Black Bulbul on the basis of a doubtful record in central India. The Malabar Pied Hornbill is well distributed in the Satpuras [several specimens in the Field Museum, Chicago, Illinois from Belwani-Kisli (Koelz 1946) and Kanha (Anon. 1946), Madhya Pradesh; a record of "several breeding pairs" from Pench Tiger Reserve, Madhya Pradesh (Pasha 1997) and four disjunct populations in central, southern and eastern Madhya Pradesh (Jayapal et al. 2005)]. The two woodpeckers, The Great Black Woodpecker *Dryocopus javensis* and the Heart-spotted Woodpecker *Hemicircus canente*, and the Crimson Sunbird *Aethopygia siparaja* have not been recorded from BR Hills. The Black-crested Bulbul *Pycnonotus melanicterus*, which has been reported from the Satpuras (Pench) (Sterndale 1887) and from north Betul Division, Satpura Range (Jayapal et al. 2005), has also not been reported from BR Hills.

Of the 20 species in category EG & Sd (Eastern Ghats and Satpura dispersers), 19 have been recorded from BR Hills (Fig. 3). Only one species, the Drongo Cuckoo *Surniculus lugubris*, has not been recorded from the area.

By looking at categories EGd, Sd and EG & Sd, it appears that almost all species that seem to have dispersed along the Eastern Ghats (exclusively, or in addition to other routes) occur in BR Hills, whereas most species that appear to have dispersed exclusively along the Satpura trend do not occur in BR Hills (Table 1 & Fig. 3). Of the 'Satpura dispersers', both the genera *Hypsipetes* and *Pericrocotus* are represented in the Andamans and / or Nicobars, and thus, a crossing of the Bay of Bengal (Croizat 1949), in addition to the Satpura route, to reach the peninsula and the Western Ghats, with the BR Hills area en route, cannot be discounted.

Of the 16 endemic Western Ghats bird species (Table 1), ten have been recorded from BR Hills. The Laughingthrushes *Garrulax* sp. (three species), White-bellied Shortwing *Brachypteryx major* and Broad-tailed Grass-warbler *Schoenicola platyura* have limited ranges in the southern Western Ghats and have not been recorded from BR Hills. The Malabar Grey Hornbill, despite being distributed along the Western Ghats, has not been reported from BR Hills On the selective presence of the other Western Ghats endemics, more needs to be known to put forward a satisfactory explanation. However, the presence of certain endemic species in BR Hills may reflect the Eastern Ghats route of dispersal of ancestral species from the eastern Himalayas.

For instance, the Nilgiri Wood-Pigeon *Columba elphinstonii* has refugially speciated from its sister species, the Ashy Wood-Pigeon *C. pulchricollis* of the Himalayas (Beehler & Ripley 1990). The presence of the former in the Eastern Ghats, namely, Nandi Hills (Subramanya et al. 1994), may indicate the Eastern Ghats route of dispersal of ancestral stock from

the source area. Alternatively, the morphological similarity of *C. elphinstonii* with the Andaman Wood-Pigeon *C. palumboides*, may point to a southern and thence eastward route across the Bay of Bengal (Croizat 1949) to the peninsula, with the BR Hills area en route to the Western Ghats.

The Blue-winged Parakeet *Psittacula columboides* is treated as the sister species of the Grey-headed Parakeet *P.finschii* of north-eastern India (Beehler & Ripley 1990).

The White-bellied Treepie *Dendrocitta leucogastra*, being most similar morphologically to the congeneric Grey Treepie *D. formosa*, may be considered a sister species of the latter, following a dispersal mode of speciation from the Eastern Ghats to the Western Ghats.

The Small Sunbird *Nectarinia minima* may have refugially speciated from the Purple-rumped Sunbird *N. zeylonica*, the species to which it is morphologically most similar.

Discussion

Despite habitat affinity with the Western Ghats (Ramesh 1989), the avifauna of BR Hills is not strictly comparable with that of the former. The most striking peculiarity is the absence of wet zone hornbills and two woodpecker species (category Sd; Table 1) resident in the Western Ghats. The explanation for this may be ecological, especially with regard to breeding biology. These species are hole-nesters and prefer similar habitats (Ali & Ripley 1987). However, it must be noted that other hole-nesting genera e.g. *Chrysocolaptes, Megalaima* and *Picumnus* are well represented in BR Hills. A study into the possible ecological factors that prevent certain taxa from breeding in BR Hills may yield plausible explanations.

When seen from a zoogeographic standpoint, bird species appear to have taken two major routes to disperse to the Western Ghats.

a. Along the Eastern Ghats and then northward along the Western Ghats, or
b. Along the Satpura trend and then southwards along the Western Ghats

By looking at categories EGd, Sd and EG&Sd, it is evident that almost all bird species that appear to have dispersed along the Eastern Ghats route (exclusively or in addition to other routes) have been recorded from BR Hills (Table 1; Fig. 3). However, most species that appear to have dispersed along the Satpura trend exclusively have not been recorded from BR Hills. This conjecture, if true, indicates that the BR Hills area is indeed a 'link' between the Eastern and Western Ghats, at least regarding avifaunal dispersion. However, this link appears to be (or have been) an ornithological 'one-way' or 'valve', with species readily crossing over from the Eastern Ghats to the Western Ghats, but not vice versa, leading to the conclusion that the barrier to dispersal is more likely to be ecological in nature than physiographic. Thus, the probable ecological constraints that might have forced some hole-nesters to abandon the Eastern Ghats route and adopt the Satpuras to disperse to the Western Ghats may still be of relevance, preventing these species from crossing over eastwards into the BR Hills area. Alternatively, in view of the 'relict populations' hypothesis, and discounting the Satpuras and the Eastern Ghats as actual 'routes of dispersal' of avifauna, similarities in relict avifaunal populations of the Eastern Ghats and BR Hills would indicate a relatively greater ecological affinity between these two areas, than the Satpuras and BR Hills.

To go further, for species such as the Rufous-bellied Eagle *Hieraaetus kienerii*, Mountain Imperial-Pigeon *Ducula badia*, Forest Eagle-Owl *Bubo nipalensis*, Great Eared-Nightjar *Eurostopodus macrotis* and the Oriental Dwarf Kingfisher *Ceyx erithacus* (which are resident only in the eastern Himalayas and the Western Ghats with no populations in the intervening area), it may be possible to retrospectively hypothesize which species adopted which route to disperse to the Western Ghats, based on their presence or absence in the BR Hills area. Thus, the Rufous-bellied Eagle and Mountain Imperial-Pigeon probably followed the Eastern Ghats route (it may be noted that other pigeon taxa appear to have done the same, as have the parakeets), whereas the Oriental Dwarf Kingfisher probably did not disperse along the Eastern Ghats. Furthermore, species such as the Yellow-breasted Babbler *Macronous gularis* (of the eastern Himalaya, Eastern Ghats and Nagarahole) may be expected in the BR Hills area but have not been conclusively recorded from the same (the authors have one doubtful sight record from bamboo and deciduous forest in May 2004).

Table 1. Suggested categorization of Western Ghats wet zone species (Ali 1942–43, Ali & Ripley 1987) based on probable routes of bird dispersal to the Western Ghats

Species	Categories			
	EGd	Sd	EG & Sd	WG End
Black Baza* *Aviceda leuphotes*	*			
Crested Goshawk *Accipiter trivirgatus*			*	
Besra Sparrowhawk *A. virgatus*	*			
Black Eagle *Ictinaetus malayensis*			*	
Mountain Hawk-Eagle *Spizaetus nipalensis*		*		
Nilgiri Wood-Pigeon *Columba elphinstonii*				*
Orange-breasted Green-Pigeon *Treron bicincta*	*			
Pompador Green-Pigeon *T. pompadora*	*			
Green Imperial-Pigeon *Ducula aenea*	*			
Indian Hanging Parrot *Loriculus vernalis*	*			

Species	Categories			
	EGd	Sd	EG & Sd	WG End
Blue-winged Parakeet *Psittacula columboides*				*
Banded Bay Cuckoo *Cacomantis sonneratii*			*	
Drongo Cuckoo *Surniculus lugubris*			*	
Brown Wood-Owl *Strix leptogrammica*			*	
Jerdon's Nightjar *Caprimulgus atripennis*	*			
White-rumped Needletail-Swift *Zoonavena sylvatica*			*	
Malabar Trogon *Harpactes fasciatus*	*			
Blue-eared Kingfisher *Alcedo meninting*	*			
Blue-bearded Bee-eater *Nyctyornis athertonii*			*	
Chestnut-headed Bee-eater *Merops leschenaulti*	*			
Malabar Grey Hornbill *Ocyceros griseus*				*
Malabar Pied Hornbill *Anthracoceros coronatus*		*		
Great Pied Hornbill *Buceros bicornis*		*		
Speckled Piculet *Picumnus innominatus*	*			
Rufous Woodpecker *Celeus brachyurus*			*	
Great Black Woodpecker *Dryocopus javensis*		*		
Small Yellow-naped Woodpecker *Picus chlorolophus*			*	
Greater Golden-backed Woodpecker *Chrysocolaptes lucidus*			*	
Heart-spotted Woodpecker *Hemicircus canente*		*		
Nilgiri Pipit *Anthus nilghiriensis*				*
Scarlet Minivet *Pericrocotus flammeus*		*		
Pied Flycatcher-Shrike *Hemipus picatus*			*	
Large Woodshrike *Tephrodornis gularis*	*			
Black-crested Bulbul *Pycnonotus melanicterus*		*		
Grey-headed Bulbul *P. priocephalus*				*
Yellow-browed Bulbul *Iole indica*	*			
Black Bulbul *Hypsipetes leucocephalus*		*		
Gold-fronted Leafbird *Chloropsis aurifrons*			*	
Asian Fairy Bluebird *Irena puella*	*			
Malabar Whistling-Thrush *Myiophoneus horsfieldii*			*	
Eurasian Blackbird *Turdus merula*			*	
White-rumped Shama *Copsychus saularis*	*			
White-bellied Shortwing *Brachypteryx major*				*
Wynaad Laughingthrush *Garrulax cachinanns*				*
Nilgiri Laughingthrush *G. nilgiriensis*				*
Grey-breasted Laughingthrush *G. jerdoni*				*
Spotted Babbler *Pellorneum ruficeps*			*	
Indian Scimitar-Babbler *Pomatorhinus horsfieldii*			*	
Rufous Babbler *Turdoides subrufus*				*
Golden-headed Fantail-warbler *Cisticola exilis*			*	
Broad-tailed Grass-warbler *Schoenicola platyura*				*
Black-and-Orange Flycatcher *Ficedula nigrorufa*				*
Nilgiri Flycatcher *Eumyias albicaudata*				*
White-bellied Blue-Flycatcher *Cyornis pallipes*				*
Grey-headed Flycatcher *Culicicapa ceylonensis*			*	
Chestnut-bellied Nuthatch *Sitta castanea*		*		
Velvet-fronted Nuthatch *S. frontalis*			*	
Small Sunbird *Nectarinia minima*				*
Crimson Sunbird *Aethopyga siparaja*		*		
Little Spiderhunter *Arachnothera longirostris*	*			
Black-throated Munia *Lonchura kelaarti*	*			
Hill Myna *Gracula religiosa* & *G. indica*	*			
Bronzed Drongo *Dicrurus aeneus*	*			
Spangled Drongo *D. hottentottus*			*	
White-bellied Treepie *Dendrocitta leucogastra*				*

EGd: Species that appear to have dispersed to the Western Ghats exclusively along the Eastern Ghats.
Sd: Species that appear to have dispersed to the Western Ghats exclusively along the Satpuras.
EG & Sd: Species that appear to have dispersed to the Western Ghats along both the Eastern Ghats and the Satpuras.
WG End: Endemic Western Ghats species.
* Species recorded in BR Hills are indicated in bold type.

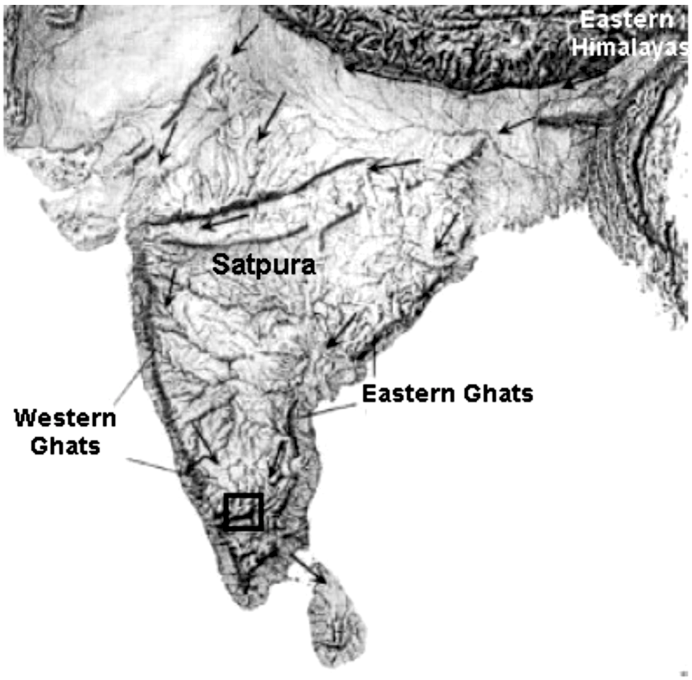

Figure 1. Map of India with major hill ranges and the BR Hills area (within the box) with probable routes of avifaunal dispersal to the Western Ghats indicated (*after* Karanth 2003).

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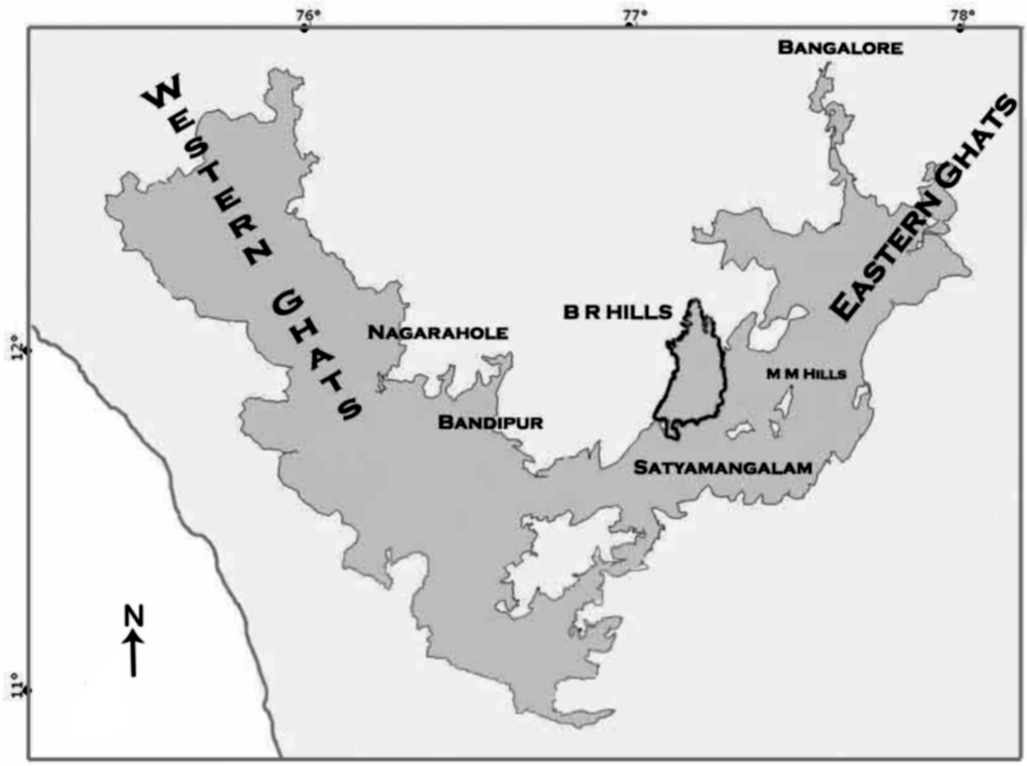

Figure 2. Enlarged view of box from Fig. 1 showing BR Hills in relation to the Eastern Ghats and Western Ghats

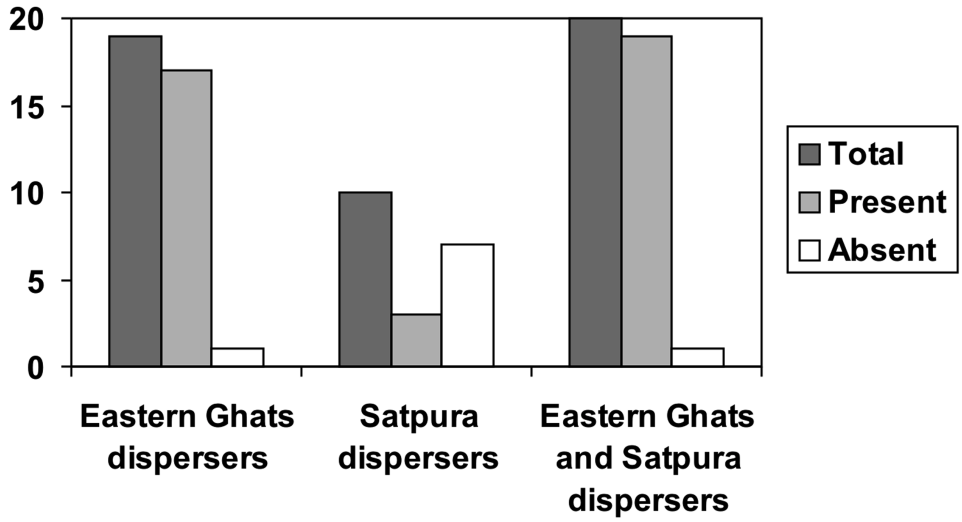

Figure 3. Proportion of species in Categories EGd (Eastern Ghats dispersers), Sd (Satpura dispersers) and EG & Sd (Eastern Ghats and Satpura dispersers) recorded or unrecorded from BR Hills.

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