Avifaunal Distribution within Different Habitats of Karnala Bird Sanctuary, Maharashtra

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Abstract : Western Ghats is considered to be one of the biodiversity rich areas not only in India but also in the World. It possesses great diversity of flora and fauna and also endemism (Pramod, Daniels, Joshi, & Gadgil, 1997 and Watwe & Thakur, 2006)) to get counted in biodiversity hotspots of the world (Biodiversity hotspots - Western Ghats and Shrilanka, 2007) Karnala Bird Sanctuary (KBS) lies within these stretches of Western Ghats and comprises of an area of 12.11 km^2. Its close proximity towards city of Mumbai and on NH 17 Highway makes it a tourist attraction, not for the birds but for the fort. This situation has led to various problems including road widening issue faced by this forest. But the conservation efforts are limited due to lack of documentation and studies on this forest. This study was designed not only to document species richness of this small forest but also to find out distribution patterns of these birds along various microhabitats along the forest. Results obtained in study showed total of 144 bird species belonging to 46 families comprising of 16 orders throughout the study period. Results found during study suggest that different habitats of KBS are characteristically different from one another in terms of species distribution both horizontal as well as vertical. Results from study put an emphasis on habitat wise conservation of forest rather than forest as a whole is a key to better forest management.

Key words : Avifauna, Karnala Bird Sanctuary, Western Ghats, Sahyadri, Habitat, Bray Curtis analysis

Introduction

India has a great diversity of habitats, ranging from Alpine meadows in Himalaya to tropical forests, from wetland ecosystem to desert ecosystems. It also harbours 2 out of 34 biodiversity hotspots of the worlds, one of which being Western Ghats. Western Ghats has a great avifaunal diversity found in various habitats, harboring ca. 580 species of Birds (Pramod, Daniels, Joshi, & Gadgil, 1997**,** Daniels, 1997**,** Pandey , S.; Tambe, S.; Fransis, C. F.; Sant, N., 2003)**)** which is 47% of avifaunal diversity of entire country as India has 1237 species of birds **(Daniels, 1997).** Whereas Northern Western Ghats harbors ca. 168 bird species **(Gole, 1996).** The Karnala Bird Sanctuary is located within this Western Ghats. The sanctuary is quite small with an area of 14.12sq.km. Like other forests of India this forest also faces pressing issues due to development and tourism. Some of the pressing issues of this park include illegal lopping within forest, disturbances and pollution created by tourists and last but definitely not the least is the government proposal to widen the NH 17 that passes through the heart of this forest. All these activities are built on the belief that this park being smaller in size harbours no major population of birds and is being put under further pressure. To add to this strife this forest lacks scientific documentation which further jeopardises conservation efforts.

The problem of adequately describing and measuring complex habitats has always plagued students of ecology and evolution. Certain physical and chemical aspects of the environment are readily measurable, and their analyses have provided the basis for important ecological principles, particularly for plants and lower animals. Higher vertebrates, however, especially birds, seem to respond to broader and more elusive aspects of the habitat. Within an outer limit of physiological tolerance, a bird apparently responds psychologically to general features in the environment such as the physiognomy of the vegetation (Emlen, 1956) Bird species diversity is known to be affected by forest structure; therefore, several indices of forest structure have been proposed for the evaluation of birds' habitats (MacArthur & MacArthur, 1961). Higher vertical diversity of foliage distribution that can be numerically expressed based on these indices improves bird species diversity because each species can find their own ecological niche divided by feeding height. Birds have been considered good predictors of habitat quality, as they relate to changes in their associated habitats in numerous ways because they respond to habitat

structure (MacArthur & MacArthur, 1961) and represent several trophic groups or guilds. Habitat dimensions are important more often than food-type dimensions which are more important than temporal dimensions in resource partitioning. (Schoener, 1974)

After carrying out primary survey it was observed that the KBS was mainly formed form mosaics of 5 habitats viz. Grassy, Riparian, Evergreen, Deciduous and Rocky habitats. Conservation of this forest becomes less accurate if these microhabitats are not studied. Keeping all these things in mind this study was designed to document bird population within the park along with their distribution patterns within the microhabitats that form this park and also their vertical distribution.

Methods

The study was undertaken at Karnala Bird Sanctuary which located in Panvel Taluka of Raigad District, Maharashtra (18° 53' 15.89'' N and 73° 06' 52.14''). The sanctuary is quite small with an area of 14.12 sq.km. This forest is mainly classified under mixed deciduous forest and is majorly comprised of five distinct micro habitats.

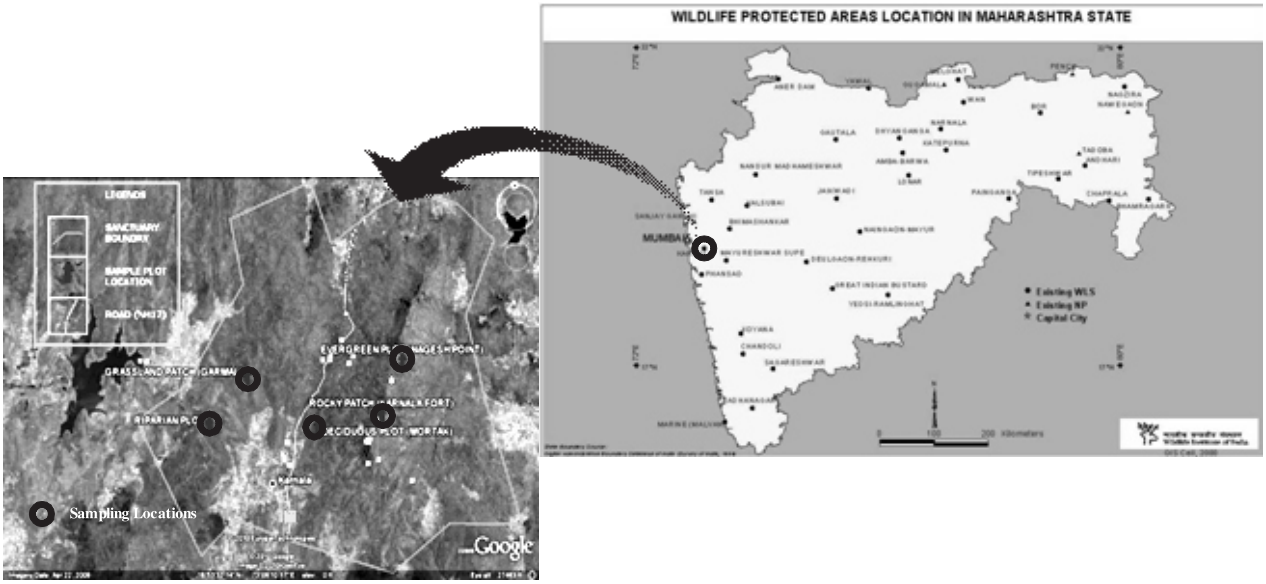


Fig. 1.1 Location of Karnala and Sampling locations map

To provide a more accurate representative sampling units of the forest a stratified sampling technique was undertaken after preliminary study in which five major microhabitats were located viz. Grassy, Riparian, Evergreen, Deciduous and Rocky, as mentioned in fig. 1.1.

Initially a vegetation structure and similarity at these locations was checked using quadrate method. Five random plots of 15m X 15m Quadrates were laid in each of the above said habitats to study the composition of trees. Four plots of 5m X 5m were laid in four different corners of this 15X15 m quadrate to study the shrub composition. Within each 5x5m quadrate, one 1x1m quadrate was laid for herb composition. Total count of trees, shrubs and major herb species was done. The herb plants species were identified (Kehimkar, 2000) and local herbarium as well as with the help of plant taxonomists at Wildlife Institute of India.

To study the bird diversity, random transects were undertaken on foot and on every sighting birds were carefully observed by checking the key characters. Standard reference books were used to identify the bird species. For the estimation of densities of birds in each habitat, Point count method (Hutto, Plerschet, & Hendricks, 1986) was used with a plot of 15m radius (decided according to actual visibility). The time period for each point count was two hours that is from 8:00 a.m. to 10:00 a.m. In the point count estimation, criteria such as species name, number of individuals, distance from the observer and height at which bird was located, were recorded in standard sheets. (Hostetler & Martin, 2009). Sampling was carried out for five months to compensate for seasonal variations in bird and vegetation distribution.

Data obtained was then analysed for density, abundance and species richness. Sampling efforts were slightly lesser than what is required for conclusive statistical analysis. Hence the species richness was adjusted using first order Jackknife 1 estimator was used to estimate the bird species richness across the Karnala BS (Heltshe & Forrester, 1983) using Colwell EstimateS 7.5 software (Colwell, 2009), with classic formula for Chao 1 and Chao 2 and

randomization at 1000 runs. Error plots were used to study the overall distribution of birds along vertical gradient in Karnala BS (Fig. 6).

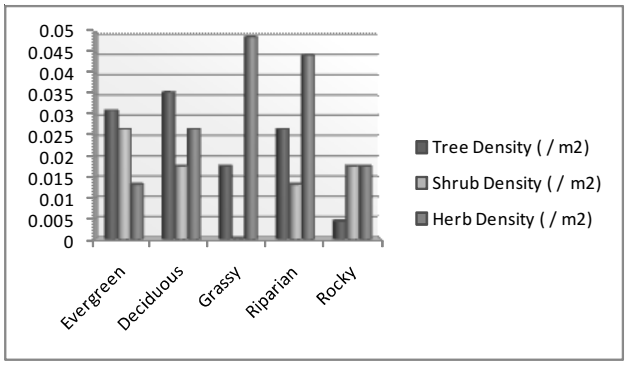
Error plots are used to indicate the uncertainty in data points. Here the main usage was to check the range of vertical gradient which are used by different species of birds throughout the Karnala BS. With the help of this graph, one can categorise bird into three different communities, like, those residing in upper canopy, middle canopy, lower canopy and ground dwelling birds. Sampling effort for this study is too low hence more study is needed on this aspect to conclude comprehensively about the particular vertical gradient used by a particular bird.

Further to check whether bird distribution was indeed affected by habitats; a comparison of similarities between these microhabitats was carried out by Bray Curtis cluster analysis using Biodiversity Pro (version 2) software

Results

Initially tree, herb, shrub densities were estimated for the five microhabitats to confirm the vegetative vertical gradient present in each of these habitats. This showed that all five habitats were considerably different from one another.

Figure: 1.2 Graph showing Densities of trees, herbs and shrubs at various Microhabitats



A total of 146 species of birds belonging to 46 families of 16 orders were observed during study period along the trail routes and in sampling units. Checklist of these birds has been published in the paper *"Avifaunal Diversity in Karnala Bird Sanctuary, Panvel, Maharashtra, "which is not considered for this paper.* But during study

A total of 101 bird species were observed during sampling whereas 146 species were observed during the whole span of work As the sampling effort was low, first order Jackknife 1 estimator was used (Heltshe & Forrester, 1983) to estimate the bird species richness across the Karnala, The estimated species richness was found to be 128 against the observed species richness of 101

Figure 1.3: Estimated Species Richness using Jackknife 1

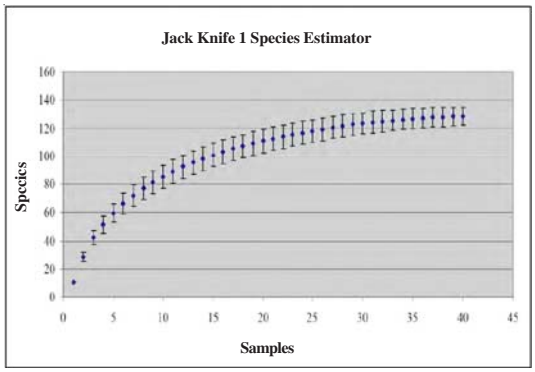
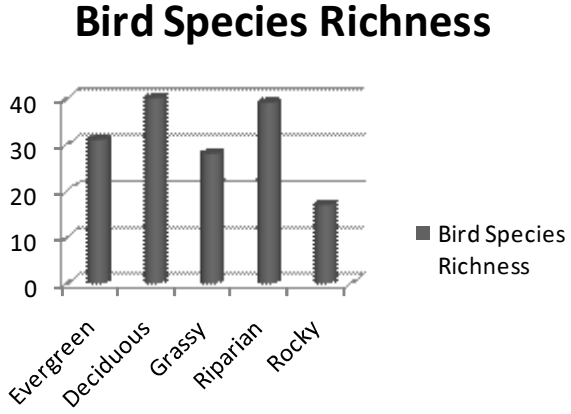


Figure 1.4: Species richness in Microhabitats



Across different habitats, highest bird species richness was found in deciduous forest habitat with 40 species, followed by 39 species in riparian habitat, 31 species in evergreen forest habitat, 28 species in grasslands and 17 species in rocky habitat (Refer Fig 1.4). On the other hand, highest bird density was found in the deciduous forest habitats, followed by Riparian habitat, evergreen forest habitats, grassland and lowest species richness was found in rocky habitat. The bird abundance in different habitats was in the following order: deciduous forest habitat > grassland habitat > riparine habitat > evergreen forest habitat > Rocky habitat.

Comparison among birds in the Karnala BS showed that Asian Black Drongo had highest density followed by Thick billed flowerpecker and Golden fronted leaf bird, whereas lowest density was shown by Asian Koel, Black Naped Oriole and Bronze Drongo

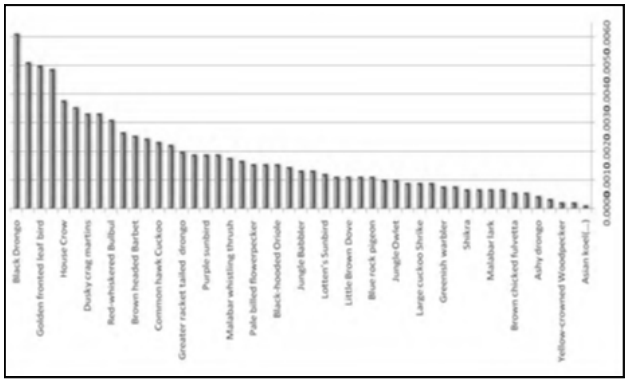


Fig. 1.5: Comparison of densities of bird species throughout Karnala Bird Sanctuary

Distribution of birds along vertical gradient in the forest habitat was studied. In all the habitats maximum birds were found at a height of 5 – 9.99 feet

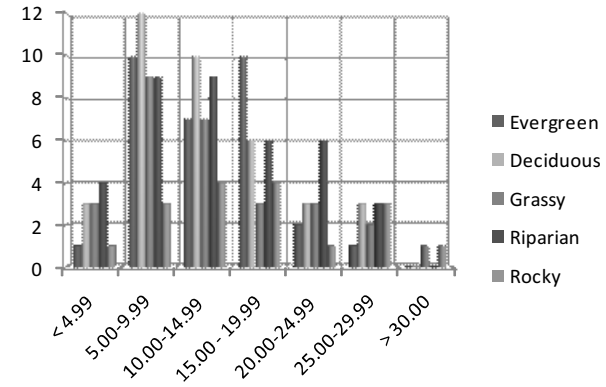


Figure 1.6: Bird distribution along vertical gradient in different forest habitats

In the error plots that were drawn Oriental honey buzzard, White eye Buzzard, Dusky crag Martin, Crested serpent Eagle and Asian palm swift prefers the highest vertical gradient whereas bird species like, Jungle Babbler, Eurasian Blackbird, Forest wagtail, Grey jungle fowl, Grey wagtail, Indian Pond Heron, Jerdons night jar, Jungle bush Quails, Malabar lark, Orange headed thrush, Oriental magpi Robin, Red wattled lapwing and White breasted waterhen prefers the lowest strata along the vertical gradient. Some of these birds of lower strata are ground dwelling birds.

Sampling effort for this study is too low hence more study is needed on this aspect to conclude comprehensively about the particular vertical gradient used by a particular bird. But this surely gives us abroad idea.

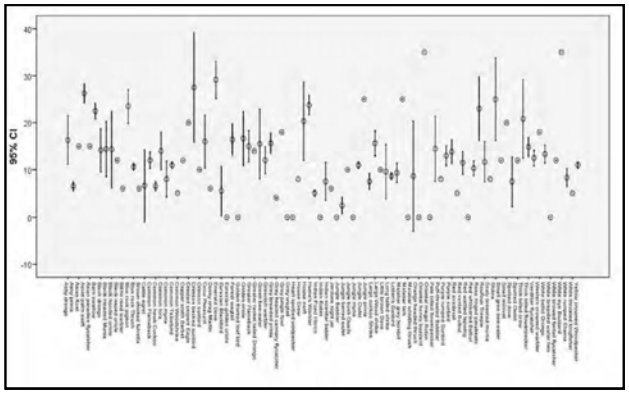
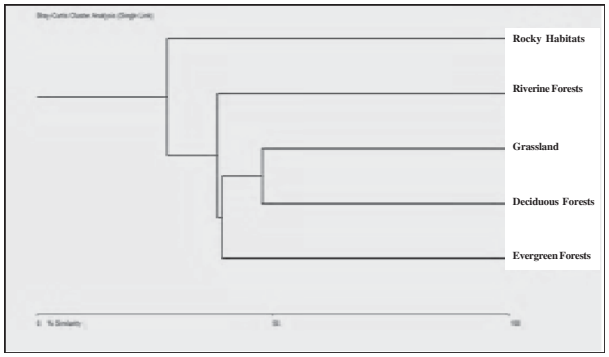


Figure 1.7 Error plot showing bird distribution along vertical gradient in Karnala Bird Sanctuary

During bray Curtis analysis, across different habitat types of Karnala BS, it is revealed from figure 1.8 that the species composition differs significantly. Bird species composition in Rocky habitats greatly differs from other habitats with only 27.5 % of common species. Riparian habitat shows 38.3% similarity in species composition when compared with other habitats. Grassy and Deciduous habitat shows maximum similarity in bird species composition with each other (47.8%) whereas evergreen habitat shows 39.39% similarity with grassy and deciduous habitats. On the whole, there is approximately 50% of bird species unique to each habitat which in turn depicts the uniqueness of each habitat too.

Figure 1.8: Bray-Curtis Cluster Analysis with respect to bird species composition similarity in microhabitats.



Discussion

During study it was found that evergreen patch and deciduous patch showed well-formed canopy structure with upper canopy made up of trees, middle strata made up of shrubs and ground cover of herbs and grasses. These habitats did not show similarity in species types and/or species composition. Five major habitat types were classified, namely, Evergreen forest habitat, Riparian forest habitat, deciduous forest habitat, Grasslands and Rocky Habitats. Tree density was highest in deciduous forests, where as it was lowest in rocky habitats. Shrub density was

highest in evergreen forest habitats, where as it was lowest in grasslands. Herb density was highest in grasslands and lowest in evergreen forest habitats.

Further the avifaunal studies indicated that Bird species richness was highest in deciduous forest habitats (40) where as it was lowest in rocky habitats (17). Bird density was found to be highest in deciduous forest habitats where as it was lowest in rocky habitats. Bird abundance was highest in deciduous forest habitats (0.0047) and lowest in rocky habitats (0.0011). High bird density as well as species richness could be higher in deciduous owing to the availability of wide range of micro habitats due to high tree density and openness of canopy. When the density of bird across the sanctuary was compared, Asian Black Drongo showed highest density whereas lowest density was shown by Bronze Drongo. Comparatively fewer birds had higher density. This was probably due to disturbed habitat in the region as little lesser disturbed areas showed greater densities as compared to disturbed areas. Also during the study period a record of 'Eurasian black bird' was reported which was recorded after 12 years within these areas.

Distribution of birds along the vertical gradient in the forest habitats of Karnala BS was studied. Comparatively, most preferred height by bird species was 5 – 9.99 feet in all the habitats. Across different habitats there seems to be a kind of formation of zones along vertical gradient. Some of these zones are used by majority of the birds. Just for example, predator birds will prefer greater heights for easy visibility of their prey; on the other hand, smaller birds which may be preys to predators will prefer lower zones to enable them to hide from their predators and also to save much of their energy to fly higher. But this aspect needs to be studied in detail so as to come up to proper conclusion.

Bray-Curtis cluster analysis showed distinction of habitats with respect to their bird species composition. The main reason which may be attributed to this fact is that the bird species are habitat specific some of which are very specific even about their food plant or insects (monophagous) where as there are birds which feeds on multiple food plants or insects (polyphagous). This shows that there is a need to protect these, each and every microhabitat to conserve the forest ecosystem and diversity. Also a change in these microhabitats could lead to permanently damaging biodiversity of this area. Hence there is a need to conserve these microhabitats in order to preserve the forest and further research is required to determine the nutritional niche of the bird species in order to check for the vegetative and food preferences of these species and hence a key to conserve these species.

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