

Research

Avifaunal Diversity of Khata Corridor Forest

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Abstract

The study was carried out to assess the species diversity of birds, habitat types, presence/absence of birds in different habitats and to produce a distribution map of globally threatened species in Khata Corridor forest of Bardia district. Species discovery curve and richness curve were produced through McKinnon list method in which each list contains 15-species. Habitat type was distinguished by modified DAFOR scale. Riverine Sissoo-Khair forest, Moist Mixed forest, and Riverine grassland were found to be prominent habitat types in the intensive study area. Distribution map of threatened species was prepared through Arc View 3.2a. Shannon's Index of Diversity ($H = 3.114$) and Species Evenness (0.629) indicate the high species diversity of birds in Khata corridor forest. Further bird survey is recommended in the remaining part of the corridor forest on seasonal basis.

Key words: Avifauna, corridor, species diversity, habitat

Introduction

Species diversity refers to the frequency and variety of species (wild or domesticated) within a geographical area. Species diversity, most commonly used parameter in quantifying the biodiversity also depends on the richness and evenness (Raven 1992). Species richness, Shannon information, and Simpson diversity are the three most commonly used nonparametric measures of species diversity. Avian diversity is thus measured through its richness and evenness in a certain habitat type or different habitat as a whole.

Corridors are the green belts and include forests, grasslands or other natural terrestrial habitats which link two geographically and ecologically isolated habitats that contain the ecological conditions necessary for potential wildlife movement. The corridors are crucial for the survival, development, and mobility of birds and animals by linking the fragmented habitat. The Khata Corridor Forest (KCF) is the only transboundary ecological zone which connects Bardia National Park (BNP) of Nepal with Katarniaghat Wildlife Sanctuary (KWS) of India. Floral and faunal diversity of corridor forest should be maintained for sustaining the ecological balance. The KCF represents a good example of sustainably maintained ecosystem looking at its history. The corridor forest is home for many residential as well as migratory birds and animals. It becomes a continuous route for the passage migrants for flagship species like tiger, rhino, and also for many migratory as well as vagrant bird species.

Large mammals alone may not be a very good assessment of biodiversity of an area because they are not diverse and have either been exterminated or had their ranges reduced by people where in direct conflict

with them. By contrast, it has been shown that using birds can be a highly efficient way to identify a set of national conservation priorities (Howard et al. 1998 cited in Baral and Inskipp 2005) because they are very sensitive to little change in an ecosystem. The measurement of species diversity of birds and animals, and their presence/absence in different habitat type undoubtedly reveals the present scenario of the corridor forest which has been explained in this paper using bird species diversity (alpha diversity) as a measure of biodiversity through this article.

General objective of the study was to explore the avifaunal diversity of the khata corridor.

Specific objective of the study were to:

1. assess the species diversity of the avifauna in the Khata Corridor Forest (KCF),
2. find out the threatened and near-threatened species and estimate their population within the KCF,
3. prepare the distribution map of globally threatened and near-threatened species in the KCF, and
4. explore the habitat association of avifauna in the KCF.

Methodology

Study Site

The study was carried out in Khata corridor (28°18'30"N to 28°27'30"N and 81°10'30"E to 81°18'30"E) forest of Terai Arc Landscape of Bardia district. The northern part of the area is bordered by the Bardia National Park (BNP) of Nepal and in south KWS of India, the remaining boundary is touched with other VDCs. of Nepal. The area covered by the corridor is 82.61 sq.km and effective area of the forest is 31.86 sq.km. The intensive study area surveyed was approximately 15 sq.km. (1500 ha) of the total effective area.

Methods

Bird survey was conducted only once in the summer season (May–June) using McKinnon list method (McKinnon and Phillips 1993). 15-species list was prepared i.e. each list contains 15 species. For the very first list, it contains 15 new species or 15 singletons. If any species was replicated in the same list it was counted for relative abundance but not listed as a new species in the existing list. Consecutively other species lists were made to generate the data of species abundance of the area. Altogether 40 lists were produced for the study area.

Two field methodologies were adapted for the McKinnon list.

A) Simple point counts along an encounter transect (RIC 1999)

For the purpose of maximizing species detection a combination of simple point counts along an encounter transects was carried out. The species list was filled at point stations and while traveling between stations by foot with an average speed of 2 km/hr.

All the birds visible and/or any identified calls were recorded as a species in McKinnon list. The interval of point stations were taken as 500 meter. In each interval of 500 meter birds were listed in that point station as well as habitat description was taken.

B) Area search

Area search method was carried out on those area where walking in transects was not possible due to deep river and in dense forest where canopy cover was 90-100%. In such cases species listing was carried out by random walking on the area of forest with due consideration of area proportionate to time.

Habitat Description

The habitat details was recorded in point stations of circular plot having radius of 12.62m (approx: 500 sq.m.) for trees, 5.64m (100 sq.m.) for saplings, shrubs and bushes, and 2.82 (25 sq.m.) for grasses, lianas and other ground covers. The habitat details include species composition, degree of canopy, understorey and ground cover, density of lianas, and proximity to water.

GIS Application

With the help of a bitmap image onscreen digitization was carried out using Cartalynx software. Themes such as river, forest area and non-forest area were separately digitized. Using ArcView 3.2a all themes were imported from Cartalynx and then map of the Khata Corridor was prepared. The X-Y coordinates taken for the transects in the field were put to make transect lines in the map. Distribution map of the globally near-threatened species, Oriental Darter (*Anhinga melanogaster*) was prepared using ArcView 3.2a.

Results and Discussion

Species Diversity

Species diversity of birds of Khata Corridor Forest was reckoned through two apparent parameters i.e. species richness and evenness of the species.

The simplest way to describe a community is to list the species in it. Species richness (S) is the number of species on that list. Each list represents richness for the sampled area thus total 40 list represents the observed species richness of the corridor forest which is equivalent to 141 species.

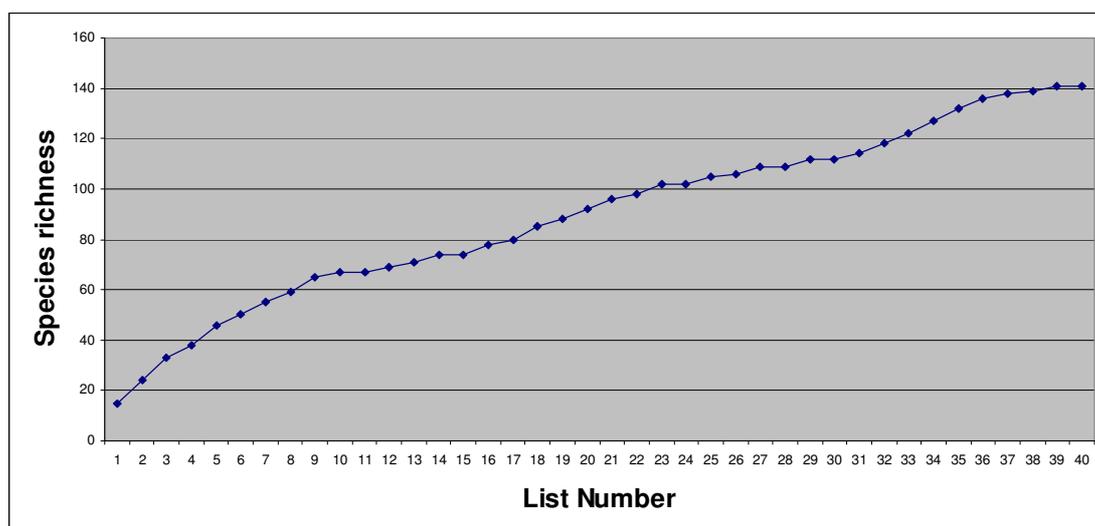


Figure 1: Species richness curve

The position of the plateau of the curve reflects species richness and the shape indicates how many more species are still likely to be found in the locality. The KCF supports a total of 141 bird species belonging to 12 orders of 43 families. In total 1935 individuals of all species were observed during the field study period.

Passeriformes formed the largest order with 15 families, among them Corvidae family was the largest one with 15 species followed by Passeridae with 11 species.

Ciconiformes was the second largest order with 10 families covering 26 species.

Gruiformes was the smallest order with one family of Rallidae with only one species, White-breasted Waterhen (*Amaurornis phoenicurus*).

Bucerotiformes, Psittaciformes, Columbiformes were the orders each with only one family, Bucerotidae with two species of Hornbills, Psittacidae with three species of Parrots, Columbidae with seven species of Doves and Pigeons respectively falling in Bucerotiformes, Psittaciformes and Columbiformes orders.

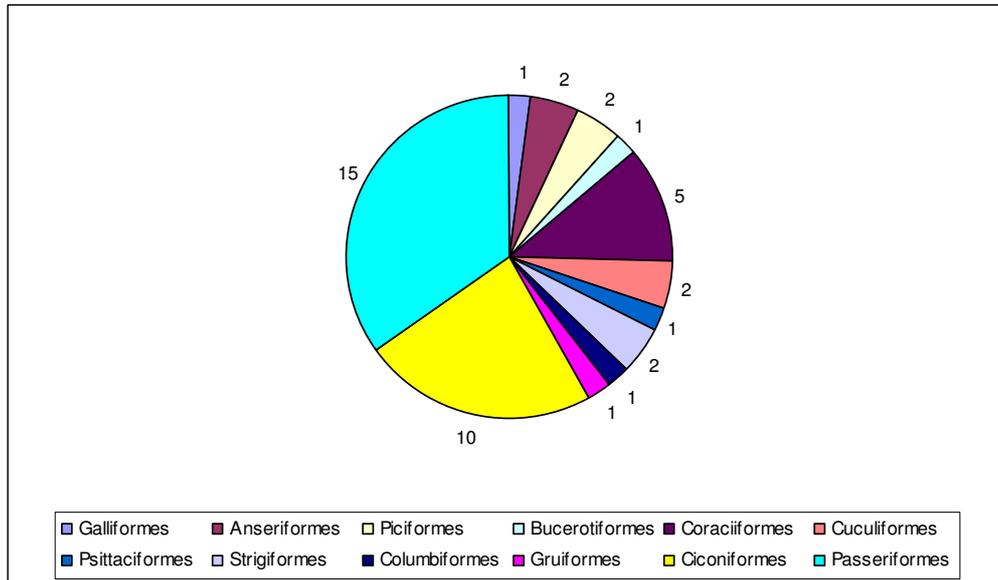


Figure 2: Orders of Birds with Family Numbers recorded in Khata Corridor

Evenness is a measure of the relative abundance of the different species making up an area/ habitat richer.

The relative abundance of each species was estimated using McKinnon list. Index of relative abundance was estimated based on the frequency of occurrence. The relative abundance measure for each species is the proportion of lists it occurs in (McKinnon and Phillip 1993). Species occurrence was categorized into five different categories according to Index of relative abundance.

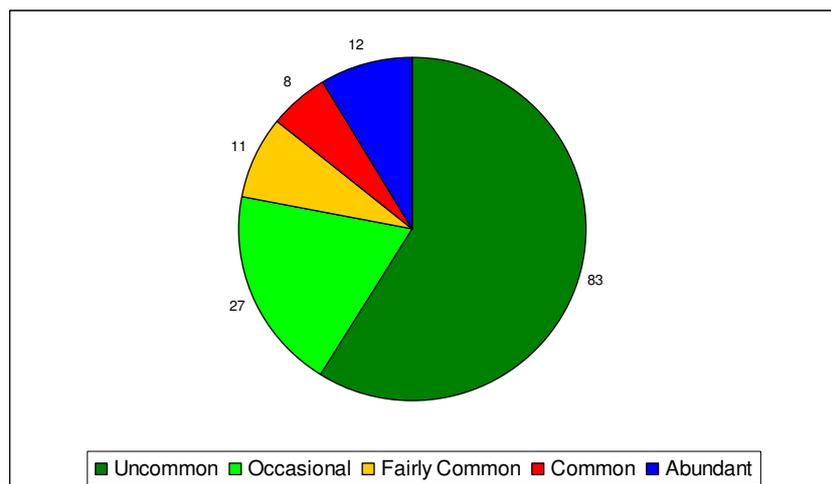


Figure 3: Abundance ratings of birds in Khata Corridor forest (May- June 2007)

Shannon's Diversity Index

Shannon- Weiner's Index or Shannon Diversity Index (H) ¹ was used to quantify the species diversity of birds for this season in the intensive study area and of different habitat within intensive study area.

The observed species richness of birds of the KCF for the summer season was 141. The Shannon's diversity index of the KCF thus produced in summer season was reckoned as (H = 3.11486) with evenness of (J = 0.629422).

Further, species diversity of birds was reckoned to each habitat type.

The species richness of the birds of the Riverine cum Sissoo-Khair Forest was found to be 82. The Shannon's diversity index of this habitat in summer season was reckoned as (H = 3.72393) with an evenness of (J = 0.845057).

The species richness of the birds of the Moist Mixed Forest was found to have 63. The Shannon's diversity index of this habitat in summer season was reckoned as (H = 3.691668722) with an evenness of (J = 0.891033).

The species richness of birds of the Riverine Grassland was found to have 79. The Shannon's diversity index of this habitat in summer season was reckoned as (H = 1.90092) with an evenness of (J = 0.43632).

Threatened and Near-threatened Birds of KCF

The corridor forest is home to many threatened and near-threatened birds as well. The corridor area represents the significant number of threatened as well as near threatened globally and nationally.

The corridor forest supports one of the near-threatened species, Oriental Darter (*Anhinga melanogaster*) with two individuals of estimated population.

Table 1: Birds listed in CITES found in Khata corridor forest

S.N.	English Name	Scientific Name	Status	Estimated Population
1.	Great Hornbill	<i>Buceros bicornis</i>	Appendix I	observed by individual (very short time visitor)
2.	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Appendix II	36
3.	Oriental Pied-Hornbill	<i>Anthracoceros albirostris</i>	Appendix II	1
4.	Indian Pitta	<i>Pitta brachyura</i>	Appendix II	3
5.	Cattle Egret	<i>Bubulcus ibis</i>	Appendix III	6
6.	Little Egret	<i>Egretta garzetta</i>	Appendix III	3

Source: IUCN-Nepal 1995

Table 2: Nationally threatened birds found in Khata corridor forest

S.N.	English Name	Scientific Name	Status	Population
1	Asian Openbill	<i>Anastomum oscitans</i>	Vu	3
2	Painted Stork	<i>Mycteria leucocephala</i>	Vu	observed by individual
3	Oriental Darter	<i>Anhinga melanogaster</i>	Vu	2
4	Yellow-wattled Lapwing	<i>Vanellus malarbaricus</i>	Vu	3
5	Red Junglefowl	<i>Gallus gallus</i>	Vu	11
6	Striated Grassbird	<i>Megalurus palustris</i>	En	1

Vu: Vulnerable, En: Endangered

Source: Baral and Inskipp 2004

Only two individuals of Oriental Darter (*Anhinga melanogaster*) were encountered in the intensive study area. The X-Y coordinates and elevation of the Oriental Darter was recorded in the field with the help of Garmin -12 channel GPS and fed to the Cartalinx 1.1 and exported to ArcView 3.2a, and thus final layout map of Oriental Darter was produced.

Distribution Map of Globally Near- Threatened species

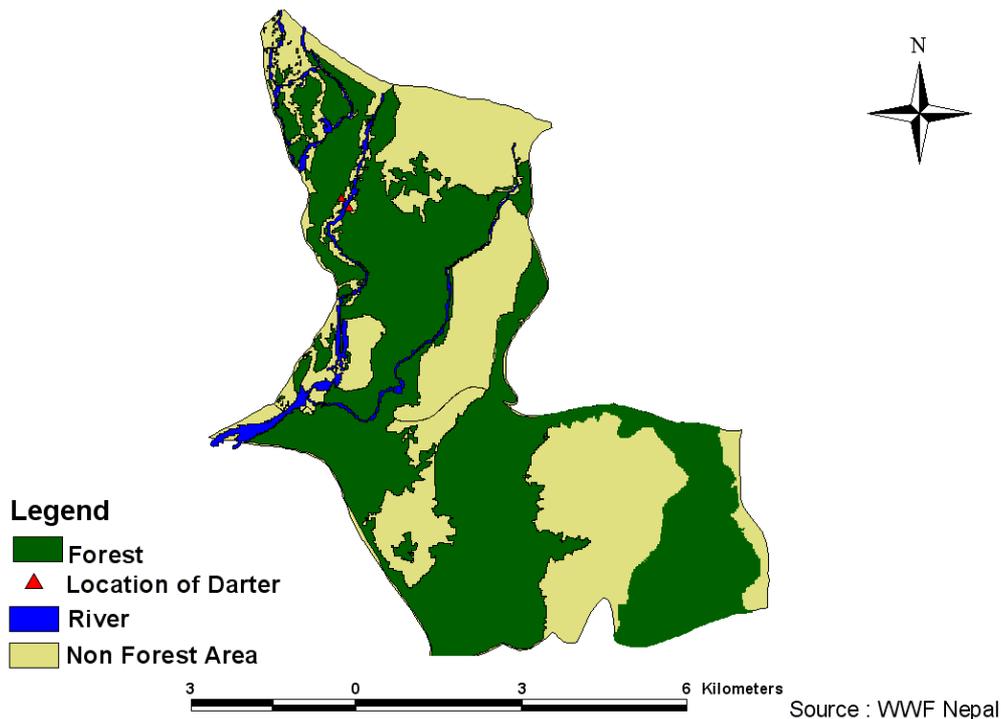


Figure 4: Distribution map of Globally Near-threatened species

There were only two individuals of Oriental Darter encountered; one is on the middle of the Khauraha river (branch of Geruwa-Karnali) on dead log and another is just a little far from the first on the bank of the river on dead Khair (*Acacia catechu*) tree.

Habitat Association

Subjective and Descriptive Approach of Association

Among 141 species of eleven orders and 43 families, 14 species were associated only with Riverine cum Sissoo-Khair Forest, 16 species were associated only with Moist-mixed Forest. 42 species were associated only with Riverine Grassland. 33 species were associated with Riverine cum Sissoo-Khair Forest and Moist-mixed Forest, 21 species were associated with Riverine cum Sissoo-Khair Forest and Riverine Grassland, and there were only 2 species which were associated with Moist-mixed Forest and Riverine Grassland. Only 13 species were associated with all the habitat types.

Statistical Approach of Association

There is a very weak correlation ($r= 0.2879$) between the species and individuals in each species of Riverine Cum Sissoo-Khair forest and Moist-mixed forest at 0.05 level of significance. There is because high canopy loving and frugivores were found only in Moist Mixed forests which were not found in Riverine cum Sissoo-Khair forest, and another reason may be due to fruiting season of *Ficus* species.

There is strong correlation ($r = 0.9014$) between the species and individuals in each species of Riverine cum Sissoo-Khair forest and Riverine grassland at 0.05 level of significance. This is because most of the species shares both habitat or the species found in Riverine cum Sissoo-Khair forest and Riverine grassland were mostly same.

There is very weak correlation ($r = 0.0720$) between the species and individuals in each species of Moist-mixed forest and Riverine grassland at 0.05 level of significance. This is because the dense canopy loving birds were found only in Moist-mixed forest not on grassland where as aquatic and grassland loving birds were found only in Riverine grassland.

Conclusion and Recommendations

Khata Corridor Forest harbours a very diverse avifauna which is yet to be fully explored for the remaining season. KCF is home for a number of avian species.

Shannon–Weiner’s Diversity Index indicates that the KCF is rich in avifaunal diversity. Shannon’s diversity index for birds of the Riverine cum Sissoo-Khair Forest is highest among all the habitat type. KCF represents different habitat type which supports different group of birds. Higher numbers of birds were observed in Riverine cum Sissoo-Khair Forest than other habitat because this habitat type covers large portion of the KCF. But higher numbers of bird species were observed in Riverine Grassland. Frugivores were more concentrated in Moist Mixed Forest because of the fruiting season of trees and understory vegetation that bear fruits. Shore and wader birds were found to share swallow water and floodplain grassland along the river with highest species number.

KCF is home for many nationally as well as globally threatened avifauna. Khauraha River is an important habitat for Oriental Darter - a globally near-threatened species as well as for other water birds. Riverine grassland/bushes and Moist Mixed Forest are crucial habitat for other nationally threatened species as well.

Riverine cum Sissoo-Khair Forest, Moist Mixed Forest and Riverine Grassland were the three main habitat types of KCF. Old alluvium deposits with dry soil, riverine tree species *Dalbergia sissoo*, *Acacia catechu*, *Bombax ceiba*, *Trewia nudiflora* and other riverine understory vegetation such as *Mallotus philippensis*, *Murraya koenigii*, *Zizyphus mauritiana* etc. are the key parameters to characterize habitat type as Riverine

cum Sissoo-Khair Forest. Wet soil with dominant tree species *Ficus glomerata*, *Schleichera oleosa*, *Syzigium cumini* and other understorey vegetation such as *Calamus tenuis*, *Acacia rugata* are the parameters to characterize the habitat as Moist Mixed Forest. The another important parameter to characterize that the habitat is Moist Mixed Forest is the presence of *Teliacora* species, a species of liana found in almost all type of moist forest in Nepal. Since the proximity of water was not more than 600 meter away from the habitat type, this parameter is also taken to determine that the sampled habitat falls under Moist Mixed Forest. Riverine Grassland was characterized by visual observation. Riverine floodplain and open grassland with dominant grass species *Imperata cylindrica*, *Saccharum spontaneum*, *Demostachya bipinnata* are considered as important parameters to characterize the habitat as Riverine Grassland.

Bird-habitat relation based on presence/absence data or the subjective method of association between bird and habitat is found to be more powerful than other methods. There are very few species which were found to share all types of habitat, it is because the instinct of birds which distinguishes with other birds. Some are found in all habitats which are also called generalist but some are confined to only in particular habitat or called specialist.

Birds are good indicators of the health of an environment, the statement is found to be very proper and reasonable in this study. There were only five species recorded from Orai River system where as altogether 78 species were recorded from the Khauraha and Geruwa-Karnali river system; and also they were not new to the later sites. This is because over fishing, poisoning and blasting were more common on Orai River where as there was no any evidence of such activities in Khauraha and Geruwa-Karnali river system.

Species discovery curve is still not in a level of asymptote, therefore, it is highly recommended for more monitoring until the curve attains horizontal line with the x-axis. Two species of globally near-threatened, Great Hornbill (*Buceros bicornis*) and Painted Stork (*Mycteria leucocephala*) are found in the corridor habitat and regular monitoring of these two species is desired. Although every bird has equal importance in an ecosystem we suggest that nationally threatened birds be monitored as they put more significance than other common species. Over spreading of invasive *Lantana camara* plant should be controlled. The biodiversity value of the corridor forest has not been revealed yet, so research focused on biodiversity and biodiversity value of corridor should be initiated. Bird conservation oriented awareness program is essential among the inhabitants of Orai River as the Orai River ecosystem has considerably less number of birds as compared with Khauraha River ecosystem. Over fishing and poisoning should immediately be stopped on the Orai River through functional local institutional mechanism.

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