

A Preliminary Study on Avifaunal Species Diversity of Maharaja Bir Bikram College Campus, Tripura, North East India

Animesh Dey¹, Dipankar Deb², Sujitraj Das Chaudhuri² and P.S. Chaudhuri^{2*}

¹Maharaja Bir Bikram College, Department of Zoology, Agartala – 799004, Tripura, India.

²Tripura University, Department of Zoology, Suryamaninagar – 799022, Tripura, India.

Abstract

Maharaja Bir Bikram College campus, Tripura is having a very good biodiversity having a different type of flora and fauna. The two big lakes and different types of flowering and fruit plants present in the campus provide grounds for feeding, breeding and nesting for avian fauna. The field survey was made to assess the campus avian faunal diversity by conducting weekly observations. Seventy six species of birds belonging to 42 families and 14 orders were recorded. Order Passeriformes contribute to about 42% of the total bird species richness. Of the total diversity, 51% birds are common, 22% are rare and 26% are abundant. Among the foraging groups, insectivores dominated the bird community.

Keywords: Avifauna, avian diversity, species richness, educational campus, M.B.B. College

INTRODUCTION

Bird communities have been studied fairly well both in tropical and temperate forests [1-11]. As far as bird diversity is concerned, India is a blessed country, having more than 1300 species which is over 13% of the world bird species [12]. But unfortunately India is the third among the countries having the largest number of threatened and rare species followed by Brazil and Indonesia [13]. However, there is insufficient knowledge available regarding the bird communities and their dynamics in India [14, 15].

The eastern Himalaya, including NE India is a global hotspot of biodiversity and an Endemic Bird Area [16-18]. Continued degradation of forests, habitat loss, urbanisation are the major threats for avian biodiversity in North-east India [19], which has remained poorly explored and much of its biodiversity has been lost without any record [20]. However, some important studies have been made regarding avian biodiversity of NE India [21-24].

Urban biodiversity has received very little attention from conservation biologists as compared to natural and protected ecosystems [25, 26]. According to Jain *et al.* [27], educational and defense premises are the hotspots for urban biodiversity. Although educational premises occupy less than 5% of the total urban area, such areas may harbour up to half the biodiversity of the urban biota [27].

Maharaja Bir Bikram College (M. B. B. College) (23°49'38"N,

91°17'56"E) is situated in the capital city of Agartala in Tripura state (Figure 1). The sprawling college campus is spread over an area of

234 acres with lush green fields bordered with native and exotic varieties of plants and two very big lakes. The river Howrah flows along its South-East periphery. The area experiences a temperature which ranges between 10°C - 35°C from winter to summer respectively, and an average annual rain fall of 2000 mm [28].

The distribution and occurrence of avifauna correlate well with the vegetations patterns of the area, which is of great significance [27]. The vegetation found in this area mainly consists of naturally grown herbs and shrubs. The study area supports a number of native as well as exotic floral species. Different species of grown up trees like *Ficus benghalensis*, *Ficus religiosa*, *Eucalyptus* sp., *Mangifera indica*, *Delbergia Sisso*, *Tamarindus indica*, *Corchorus olitorius*, *Caesalpinia pulcherrima*, *Guazoma ulmifolia*, etc. and a variety of shrubs like *Lantana camara*, *Melastoma malabathricum*, etc. and grasses support and provide nesting sites for many species of resident bird species as well as migratory birds which visit here every year. A large number of tall trees and a large number of fruiting trees occur in this area which attracts many birds [29]. Two large lakes used for fishery and the surrounding area with a lot of trees, shrubs and grasses add to the diversity of bird habitat in the campus.

The present study is focused not only on preparing the checklist of birds, but also to find out their occurrence, status as well as to create awareness for their conservation. In addition, the study aims at providing the basic information of the avifauna for further studies related to campus biodiversity. It also provides a baseline data regarding bird diversity of the state since there is no satisfactory report on this respect till date. M. B. B. College campus is the only large green spot in the city where the birds can get cover. Hence the area should be wisely used without disturbing the activity of the birds and instead encouraging more number of species in the area.

MATERIALS AND METHODS

This report is based on the observations made from January 2012 to December 2012. The birds are observed and recorded at various locations of the campus like garden, park, water bodies and adjacent areas, wasteland area of the old university campus. Sightings were carried out for two days a week during all the months

Received: Sep., 2013.; Revised: Oct, 2013 ; Accepted: Dec, 2013

*Corresponding Author

P.S. Chaudhuri
 Tripura University, Department of Zoology,
 Suryamaninagar – 799022, Tripura, India
 Email: lpriya_1956@rediffmail.com

of the year to encounter maximum birds in the area. Studies were made twice a day, at morning and afternoon for two to three hours. Birds were observed by binoculars, photographed whenever possible

by using compact super zoom digital cameras. Identification was done by using field guides [12, 30-32] and after confirmation of identity, those species are reported in this paper.

Table 1. Bird species recorded in Maharaja Bir Bikram College campus, Tripura, north east India

Taxa	Common Name	Abundance	Status	Food Habit
Order: Passeriformes				
Family: Alaudidae				
<i>Mirafa assamica</i> Horsfield, 1840	Bengal bush lark	C	R	IN, GR
Family: Artamidae				
<i>Artamus fuscus</i> Vieillot, 1817	Ashy wood swallow	C	RM (R, SM)	IN, NE
Family: Hirundinidae				
<i>Hirundo rustica</i> Linnaeus, 1758	Barn swallow	C	WM	IN
Family: Laniidae				
<i>Lanius tephronotus</i> (Vigors, 1831)	Grey-backed shrike	RA	WM	CU
<i>Lanius schach</i> Linnaeus, 1758	Long-tailed shrike	C	WM	CU
<i>Lanius cristatus</i> Linnaeus, 1758	Brown shrike	A	WM	CU
Family: Oriolidae				
<i>Oriolus xanthornus</i> (Linnaeus, 1758)	Black-hooded oriole	C	R	FR, IN
Family: Dicruridae				
<i>Dicrurus macrocercus</i> (Vieillot, 1817)	Black drongo	A	R	IN
<i>Dicrurus bracteatus</i> (Gould, 1842)	Spangled drongo	RA	RM (R, LC)	IN
<i>Dicrurus leucophaeus</i> Vieillot, 1817	Ashy drongo	C	R	IN
Family: Sturnidae				
<i>Acridotheres tristis</i> (Linnaeus, 1766)	Common myna	A	R	OM
<i>Acridotheres fuscus</i> (Wagler, 1827)	Jungle myna	A	R	OM
<i>Sturnus contra</i> (Linnaeus, 1758)	Asian pied starling	A	R	OM
<i>Sturnus malabaricus</i> (Gmelin, 1789)	Chestnut-tailed starling	A	RM (R, LM)	FR
Family: Corvidae				
<i>Corvus splendens</i> Vieillot, 1817	House crow	C	R	OM
<i>Corvus macrorhynchos</i> Wagler, 1827	Jungle crow	A	R	OM, CA
<i>Dendrocitta vagabunda</i> (Latham, 1790)	Rufous treepie	C	R	OM
Family: Irenidae				
<i>Aegithina tiphia</i> (Linnaeus, 1758)	Common iora	C	RM (R, LM)	IN
Family: Pycnonotidae				
<i>Pycnonotus cafer</i> (Linnaeus, 1766)	Red-vented bulbul	A	R	FR, GR
<i>Pycnonotus jocosus</i> (Linnaeus, 1758)	Red-whiskered bulbul	C	RM (R, LM)	FR, IN
Family: Muscipidae				
<i>Ficedula albicilla</i> (Pallas, 1811)	Taiga flycatcher	A	WM	IN
Family: Phylloscopidae				
<i>Phylloscopus inornatus</i> (Blyth, 1842)	Yellow-browed warbler	RA	WM	IN
Family: Sylviidae				
<i>Orthotomus sutorius</i> (Pennant, 1769)	Common Tailor bird	A	R	IN
Family: Turdinae				
<i>Copsychus saularis</i> (Linnaeus, 1758)	Oriental magpie robin	A	R	IN
Family: Paridae				
<i>Parus major</i> Linnaeus, 1758	Great tit	A	R	IN

Family: Motacillidae

Motacilla alba Linnaeus, 1758 White wagtail C WM IN

Family: Dicaeidae

Dicaeum erythrorhynchos (Latham, 1790) Pale-billed flower pecker C R FR

Family: Nectarinidae

Nectarinia asiatica Latham, 1790 Purple sunbird C R NE

Family: Ploceidae

Ploceus philippinus (Linnaeus, 1766) Baya weaver C RM (R,SM) IN, GR

Lonchura punctulata (Linnaeus, 1758) Scaly-breasted munia C R GR

Passer domesticus (Linnaeus, 1758) House sparrow A R IN, GR

Family: Turnidae

Monticola solitarius (Linnaeus, 1758) Blue rock-thrush RA WM OM

Order: Coraciiformes**Family: Alcedinidae**

Alcedo atthis (Linnaeus, 1758) Common kingfisher C R FE

Halcyon smymensis (Linnaeus, 1758) White-throated kingfisher A R FE, IN

Halcyon capensis (Linnaeus, 1766) Stork-billed kingfisher RA R FE

Ceryle rudis (Linnaeus, 1758) Pied kingfisher C R FE

Family: Meropidae

Merops philippinus Linnaeus, 1766 Blue-tailed bee-eater RA SM/LM IN

Merops orientalis Latham, 1802 Green bee-eater C RM (R, LM) IN

Family: Upupidae

Upupa epops Linnaeus, 1758 Hoopoe RA WM IN

Order: Charadriiformes**Family: Charadriidae**

Vanellus indicus (Boddaert, 1783) Red-wattled lapwing C RM (R, LM) IN

Family: Rostratulidae

Rostratula benghalensis ((Linnaeus, 1758)) Greater Painted Snipe RA R IN

Family: Scolopacidae

Gallinago gallinago (Linnaeus, 1758) Common Snipe C WM IN

Order: Piciformes**Family: Picidae**

Dinopium benghalense (Linnaeus, 1758) Black-rumped flameback A R IN

Dendrocopos macei (Vieillot, 1818) Fulvous-breasted woodpecker C R IN

Celeus brachyurus (Vieillot, 1818) Rufous woodpecker RA R IN

Family: Capitonidae

Megalaima lineate (Vieillot, 1816) Lineated barbet C R FR

Megalaima haemacephala Muller, 1776 Coppermith barbet C R FR

Order: Falconiformes**Family: Accipitridae**

Milvus migrans (Boddaert, 1783) Black kite A R CU, CA

Haliastur indus Boddaert, 1783 Brahminy kite C R CU

Accipiter badius Gmelin, 1788 Shikra RA R CU

Pernis ptilorhynchus Temminck, 1821 Oriental honey buzzard RA WM IN

Family: Falconidae

Falco peregrinus Tunstall, 1771 Peregrine falcon RA WM CU

Order: Stringiformes**Family: Strigidae**

<i>Athene brama</i> (Temminck, 1821)	Spotted owl	C	R	IN
<i>Glaucidium cuculoides</i> (Vigors, 1831)	Asian barred owl	C	R	CU
<i>Ninox scutulata</i> Raffles, 1822	Brown hawk owl	RA	R	IN, CU
<i>Otus bakkamoena</i> Hodgson, 1836	Collared scops owl	RA	R	IN

Family: Tytonidae

<i>Tyto alba</i> (Scopoli, 1769)	Barn owl	RA	R	CU
----------------------------------	----------	----	---	----

Order: Ciconiformes**Family: Ardeidae**

<i>Ardeola grayii</i> (Sykes, 1832)	Indian pond heron	A	R	FE
<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	Black-crowned night heron	RA	RM (R, LM)	FE
<i>Ardea alba</i> Linnaeus, 1758	Great egret	C	RM (R, SM)	FE
<i>Egretta garzetta</i> (Linnaeus, 1766)	Little egret	C	RM (R, SM)	FE
<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle egret	C	RM (R, SM)	FE, IN

Family: Ciconidae

<i>Anastomus oscitans</i> Boddaert, 1783	Asian open-billed stork	C	RM (R, SM)	CU
--	-------------------------	---	------------	----

Order: Cuculiformes**Family: Cuculidae**

<i>Eudynamis scolopacea</i> (Linnaeus, 1758)	Asian koel	C	RM (R, SM)	FR
--	------------	---	------------	----

Family: Centropidae

<i>Centropus sinensis</i> (Stephens, 1815)	Greater coucal	C	R	CU
--	----------------	---	---	----

Order: Suliformes**Family: Phalacrocoracidae**

<i>Phalacrocorax niger</i> Vieillot, 1817	Little cormorant	C	RM (R, SM)	FE
---	------------------	---	------------	----

Order: Anseriformes**Family: Anatidae**

<i>Dendrocygna javanica</i> (Horsfield, 1821)	Lesser whistling duck	C	RM (R, SM)	FE, IN, GR
---	-----------------------	---	------------	------------

Order: Gruiformes**Family: Rallidae**

<i>Amauromis phoenicurus</i> Pennant, 1769	White-breasted water hen	C	R	IN
--	--------------------------	---	---	----

Order: Columbiformes**Family: Columbidae**

<i>Columba livia</i> Gmelin, 1789	Blue rock pigeon	A	R	GR
<i>Streptopelia chinensis</i> (Scopoli, 1768)	Spotted dove	A	R	GR
<i>Streptopelia tranquebarica</i> (Hermann, 1804)	Red-collared dove	RA	RM (R, LM)	GR
<i>Teron phoenicoptera</i> (Jerdon, 1840)	Yellow-footed green pigeon	C	RM (R, LM)	FR

Order: Psittaciformes**Family: Psittacidae**

<i>Psittacula alexandri</i> (Linnaeus, 1758)	Red-breasted parakeet	C	RM (R, LM)	FR, GR
<i>Psittacula krameri</i> (Scopoli, 1769)	Rose-ringed parakeet	C	R	FR, GR

Order: Apodiformes**Family: Apodidae**

<i>Cypsiurus balasinensis</i> Gray, 1829	Asian palm swift	C	R	IN
<i>Apus affinis</i> (J E Gray, 1830)	House swift	A	R	IN

Key: C - Common, A - Abundant, RA-Rare, R-Resident, UC - Uncommon, S - Seasonal, WM - Winter migrant, SM - Seasonal migrant, RM - Resident Migrant, FE - Fish eating, CU - Carnivore, OM - Omnivore, CA - Carrion, IN - Insectivore, GR - Granivore, FR - Frugivore, NE - Nectivore

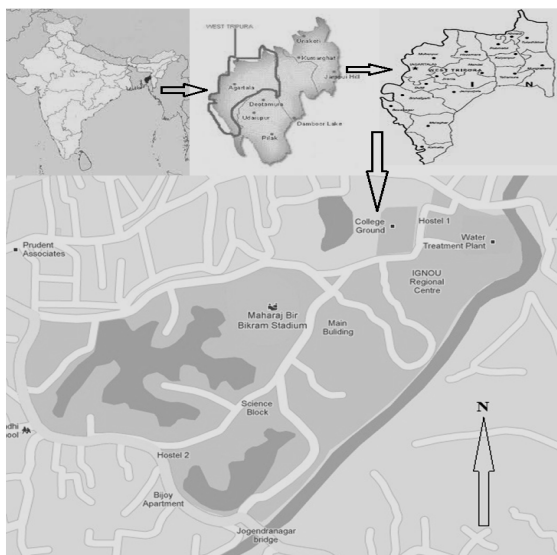


Fig 1. Location map of Maharaja Bir Bikram College campus

- Suliformes
- Gruiformes
- Cuculiformes
- Piciformes
- Ciconiformes
- Charadriiformes
- Stringiformes
- Passeriformes
- Anseriformes
- Columbiformes
- Apodiformes
- Falconiformes
- Psittaciformes
- Coraciformes

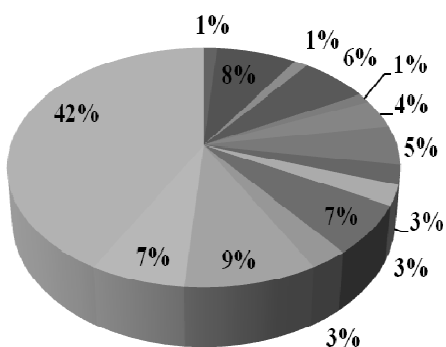


Fig 2. Showing the different percentages of avifaunal species represented by 14 orders

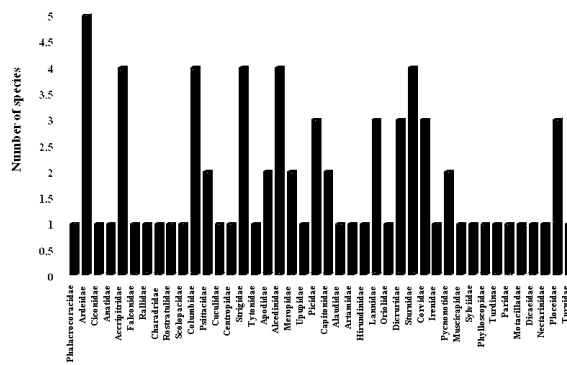


Fig 3. Number of species represented different families of birds

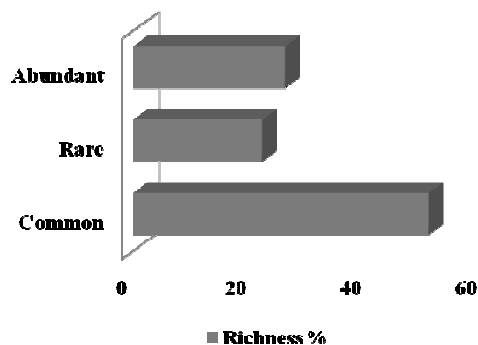


Fig 4. Showing the variation in percentage of bird species having different relative abundance

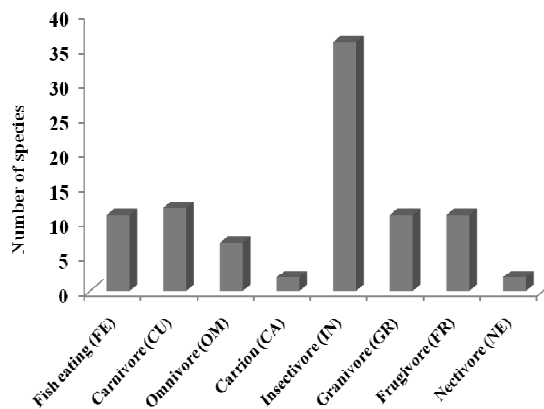


Fig 5. Number of bird species represented by different foraging groups

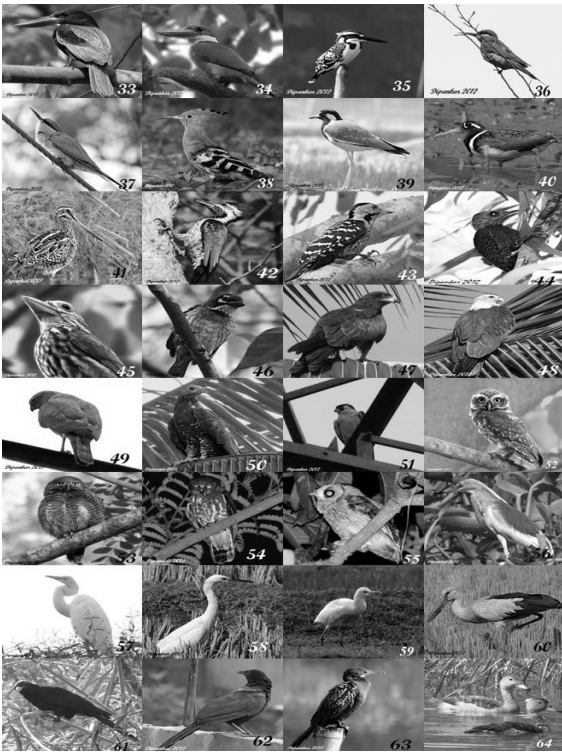


Photo plate: 1. Bengal Bush lark 2. Ashy Wood swallow 3. Barn Swallow 4. Grey-backed Shrike 5. Long-tailed Shrike 6. Brown Shrike 7. Black-hooded Oriole 8. Black Drongo 9. Spangled Drongo 10. Ashy Drongo 11. Common Myna 12. Jungle Myna 13. Asian Pied Starling 14. Chestnut-tailed Starling 15. Large-billed Crow 16. Rufous Treepie 17. Common Iora 18. Red-vented Bulbul 19. Red-whiskered Bulbul 20. Taiga Flycatcher 21. Yellow-browed Warbler 22. Common Tailorbird 23. Oriental Magpie Robin 24. Great Tit 25. White Wagtail 26. Pale-billed Flowerpecker 27. Purple Sunbird 28. Baya Weaver 29. Scaly-breasted Munia 30. House Sparrow 31. Blue Rock Thrush 32. Common Kingfisher 33. White-throated Kingfisher 34. Stork-billed Kingfisher 35. Pied Kingfisher 36. Blue-tailed Bee-eater 37. Green Bee-eater 38. Common Hoopoe 39. Red-wattled Lapwing 40. Greater Painted-snipe 41. Common Snipe 42. Black-rumped Flameback 43. Fulvous-breasted Woodpecker 44. Rufous Woodpecker 45. Lineated Barbet 46. Coppersmith Barbet 47. Black Kite 48. Brahminy Kite 49. Shikra 50. Oriental Honey-buzzard 51. Peregrine Falcon 52. Spotted owl 53. Asian Barred Owl 54. Brown Hawk Owl 55. Collared Scops Owl 56. Pond Heron 57. Great Egret 58. Little Egret 59. Cattle Egret 60. Asian Openbill 61. Asian Koel 62. Greater Coucal 63. Little Cormorant 64. Lesser Whistling-duck 65. White-breasted Water hen 66. Blue Rock Pigeon 67. Spotted Dove 68. Red Collared Dove 69. Yellow-footed Green Pigeon 70. Red-breasted Parakeet 71. Rose-ringed Parakeet 72. House Swift

RESULTS

The present study of bird's community structure of M. B. B. College campus of West Tripura district revealed the presence of 76 species of birds belonging to 14 orders and 42 families (Table 1). Order Passeriformes represented by 32 species belonging to 20 families contribute to about 42% of the total avifaunal species richness (Figure 2). Among the non-passerines, maximum richness was represented by the order Coraciformes (3 families, 7 species) and order Charadriiformes (3 families, 3 species) (Table 1).

The Ardeidae family shows the highest species richness (5 species) within the campus (Fig. 3) followed by Sturnidae, Alcedinidae, Acciptridae, Strigidae and Columbidae (4 species of each) (Table 1; Figure 3).

Of the total diversity, 51.32% (39 species) are common, 22.36% (17 species) are rare and 26.32% (20 species) are abundant on the basis of relative abundance (Figure 4). Further analysis of residential status indicates that of the 76 bird species, 44 were residents, 19 were resident migrants, 12 were winter migrants and 1 was seasonal or local migrant. Further categorisation of resident migrants revealed that out of 19 birds, 10 were resident local and 9 were resident seasonal migrants (Table 1).

Among the foraging groups, insectivores (47.37%) dominated the bird community, followed by carnivores, granivores, frugivores, fish-eating and omnivores (Figure 5). Carrion-eaters and nectivores were least represented in the avian community of M. B. B. College campus. A distinct seasonal variation in avian species richness was observed with a peak during the wet season.

DISCUSSION

Present study shows that M. B. B. College campus supports a high avifaunal diversity. Recent reports revealed the presence of

277 bird species [33] in the state of Tripura with a total area of 10,491 sq. km [34]. The MBB College campus represents only 0.01% of the total geographical area but harbors 27% of the total avifaunal richness of the state which includes 11 migratory species. Presence of large number of bird species in the campus indicates that the area is able to provide ecological security to these bird species by providing ample quantities of food and shelter [24, 35]. Most of the observed species are breeding residents mainly due to occurrence of various types of microhabitats within the campus, nearby river and large lakes. This shows that mosaic habitats comprising of diversified vegetations, water bodies and river beds are crucial for conservation of birds of the campus [23].

The domination of the bird community by insectivores is a common trend and observed in other studies in the Himalayan and the North-east region [14, 23, 36]. Due to their specialized diet and low availability of preferable food resources, carnivores, granivores, frugivores and others are generally less represented [2, 3].

Seasonal changes in species richness were observed which is mainly due to changes in weather conditions or fluctuations in food productivity and habitat quality [23, 35, 37, 38]. Species richness of the birds in the campus becomes maximum during the wet season due to greater availability of insects and favourable weather conditions.

The study site is rich in avifauna but problems have arisen recently as the habitats of these birds are threatened due to unplanned activities being carried out in favour of human development. Birds are sensitive to local landscape and changes in vegetation patterns can affect the bird population in their area [27, 39, 40]. Such a rare green spot should be managed well to attract more bird species and make the premises favourable for various birds.

REFERENCES

- [1] MacArthur, R.H. and J.W. MacArthur. 1961. On bird species diversity. *Journal of Ecology* 42: 594-598.
- [2] Perrins, C.M. and T.R. Birkhead. 1983. *Avian Ecology*. Blackie, New York. 221 p.
- [3] Wiens, J.A. 1989. *Ecology of Bird Communities*. Vols. I and II. Cambridge University Press, Cambridge. 879 p.
- [4] Keast, A. 1990. *Biogeography and Ecology of Forest Bird Communities*. SPB Publishing bv, The Netherlands. 410 p.
- [5] Terborgh, J., S.K. Robinson, T.A. Parker, C.A. Munn and N. Pierpont. 1990. Structure and organisation of an Amazonian forest bird community. *Ecological Monographs* 60: 213-238.
- [6] Thiollay, J.M. 1994. Structure, density and rarity in an Amazonian rain forest bird community. *Journal of Tropical Ecology* 10: 449-481.
- [7] Willson, M.F. and T.A. Comet. 1996a. Bird communities of northern forests: patterns of diversity and abundance. *Condor* 98: 337-349.
- [8] Willson, M.F. and T.A. Comet. 1996b. Bird communities of northern forests: ecological correlates of diversity and abundance in the understory. *Condor* 98: 350-362.
- [9] Robinson, W.D., J.D. Brawn and S.K. Robinson. 2000. Forest bird community structure in central Panama: Influence of spatial scale and biogeography. *Ecological Monographs* 70: 209-235.
- [10] Latta, S.C., C.C. Rimmer and K.P. Mcfarland. 2003. Winter bird communities in four habitats along an elevational gradient on Hispaniola. *Condor* 105: 179-197.
- [11] Blake, J.G. 2007. Neo-tropical forest bird communities: a comparison of species richness and composition at local and regional scales. *Condor* 109: 237-255.
- [12] Grimmett, R., C. Inskipp and T. Inskipp. 1999. *Birds of Indian Subcontinent*. New Delhi: Oxford University Press. 384 p.
- [13] Dandapat, A., D. Banerjee and D. Chakraborty. 2010. The case of the Disappearing House Sparrow (*Passer domesticus indicus*). *Veterinary World* 3(2): 97-100.
- [14] Khan, J.A., D.N. Khan and A. Ahmed. 1993. Preliminary Investigation o bird community structure at Aligarh, India. *Tropical Ecology* 34: 217-225.
- [15] Safiq, T., S. Javed, and J.A. Khan. 1997. Bird community structure of middle altitude oak forest in kumaon Himalayas, India: a preliminary investigation. *International Journal of Ecology and Environmental Sciences* 23: 389-400.
- [16] Stattersfield, A.J., M.J. Crosby, A.J. Long and D.C. Wege. 1998. *Endemic Bird Areas of the World: Priorities for biodiversity Conservation*. Cambridge, UK: Birdlife International. (Birdlife Conservation Series No. 7). 815 p.
- [17] Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.
- [18] Mittermeier, R.A., P.R. Gill, M. Hoffman, J. Pilgrim, T. Brooks, C.G. Mittermeier, J. Lamoreux and G.A.B. da Fonseca. 2005. *Hotspots Revisited: Earth's Biologically Richest and most Endangered Terrestrial Ecoregions*. Mexico, Cemex. 390 p.
- [19] Pandit, M.K., S. Sodhi, L.P. Kob, A. Bhaskar and B.N. Brook. 2007. Unreported yet massive deforestation during loss of biodiversity in Indian Himalaya. *Biodiversity Conservation* 16: 153-163.
- [20] Singh, S., A. Borkotoki and C.K. Sarmah. 2012. Species distribution of Spiders in Barpeta district of Assam: A diversity measure. *E-International Scientific Research Journal* IV (1): 47-57.
- [21] Raman, T.R.S., G.S. Rawat and A.J.T. Johnsingh. 1998. Recovery of tropical rainforest avifauna in relation to vegetation succession following shifting cultivation in Mizoram, Northeast India. *Journal of Applied Ecology* 35: 214-231.
- [22] Chettri, N., R. Jackson and E. Sharma. 2005. Birds of Khecheopalri and Yuksom-Dzongri trekking corridor West Sikkim. *Journal of Hill Research* 18: 16-25.
- [23] Acharya, B.K., L. Vijayan and B. Chettri. 2010. The bird community of Shingba Rhododendron wildlife sanctuary, Sikkim, Eastern Himalaya, India. *Tropical Ecology* 51 (2): 149-159.
- [24] Dutta, N.N., D. Baruah and S. Borah. 2011. Avifaunal diversity in an IBA site north east India and their conservation. *Annals of Biological Research* 2 (5): 374-384.
- [25] Jules, E.S. 1997. Danger in dividing conservation biology and agro ecology. *Conservation Biology* 11: 1272-1273.
- [26] Vandermeer, J. 1997. The Agro Economics System. A need for the conservation-biologist's lens. *Conservation Biology* 11: 591-592.
- [27] Jain, N.K., S.N. Patel and M.V. Patel. 2005. Birds of Gujarat University Campus, Ahmedabad. *Zoos' Print Journal* 20 (12): 2111-2113.
- [28] Dey, A. and P.S. Chaudhuri. 2013. Ecological studies on earthworm communities of pineapple (*Ananas comosus*)

- plantations in West Tripura (India). *International Journal of Advanced Bioscience* 1(2): 17-23.
- [29] Wadatkar, J.S. 2001. Checklist of birds from Amaravati University Campus, Maharashtra. *Zoos' Print Journal* 16 (5): 497-499.
- [30] Kazmierczak, K. 2000. *A Field Guide to the Birds of India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and the Maldives*. Om Book Service, New Delhi. 352 p.
- [31] Ali, S. and L. Fatehali. 2003. *Bharatiya Pakshi*. India: National Book Trust. 126 p.
- [32] Tiwari, V.M. 2005. *Joy of Bird Watching*. India: National Book Trust. 291 p.
- [33] Choudhury, A. 2010. Recent ornithological records from Tripura, north-eastern India, with an annotated checklist. *Indian Birds* 6 (3): 66-74.
- [34] Dey, A. and P.S. Chaudhuri. 2012. Community Characteristics of Earthworms in Different Age Groups of Pineapple Plantations (*Ananus comosus*) in West Tripura, India. *The Asian and Australasian Journal of Plant Science and Biotechnology* 6 (Special issue 1): 67-75.
- [35] Verma, S.K. 2011. A preliminary survey on the avian community of Dalma Wildlife Sanctuary, Jharkhand, India. *Journal of Threatened Taxa* 3(5): 1764-1770.
- [36] Sultana, A., M.S. Hussain and J.A. Khan. 2007. Bird communities of the proposed Naina and Pindari wildlife sanctuaries in the Kumaon Himalaya, Uttarakhand, India. *Journal of Bombay Natural History Society* 104: 19-29.
- [37] Loiselle, B.K. and J.G. Blake. 1991. Temporal variation in birds and fruits along an elevational gradient in Costa Rica. *Ecology* 72: 180-193.
- [38] Norris, D.R. and P.P. Marra. 2007. Seasonal interactions, habitat quality, and population dynamics in migratory birds. *Condor* 109: 535-547.
- [39] Sauvot, R.M., M. Buechner, D.A. Kamradt and C.M. Schonewald. 1998. Patterns of human disturbances and response by small mammals and birds, in chapparal near urban development. *Urban Ecosystem* 2: 279-297.
- [40] Savard, L.J., P. Clergeau and G. Mennechez. 2000. Biodiversity concept and urban ecosystem. *Landscape and Urban Planning* 48 (3-4): 131-142.