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BIRD SPECIES COMPOSITION AND FEEDING GUILD STRUCTURE IN SUBURBAN HABITAT OF LOWER SHIVALIK HIMALAYAS, UTTARAKHAND, INDIA

Mohan Kukreti[1], Dinesh Bhatt[2]

[1, 2]*Avian Biodiversity and Bioacoustics Laboratory, Department of Zoology and Environmental Science, Gurukula Kangri University, Haridwar- 249404,Uttarakhand, (India)*

ABSTRACT

This study presents the suburban avian feeding guild structure adjacent of the two forest ranges of the Lansdowne forest division, Uttarakhand, India. Birds were directly observed using the binocular and video camera for the dietary guild and the foraging layer in the predefined transects used for bird census for two years (January 2010-December 2012). A total of 94 birds species which can be classified into 31 families were recorded in the suburban areas, the family Corvidae (11 species; 12%) was found dominant in the suburbs, followed by the Muscicapidae (9 species; 10%). Of the 94 bird species recorded, 60 (64%) were resident; resident altitudinal migrants 17 (18%); winter migrants 12 (13%) and summer migrants 5 (5%) species in the study area. The House Sparrow, Alexandrine Parakeet and Red-vented Bulbul were found to be the most abundant species of suburbs. Trophic guild structure showed high insectivory (47%) in the area. The foraging behavior study showed a high arboreal pattern (51%) than other foraging strategies viz., terrestrial (29%) and understory (20%). Presence of variety of feeding guild structure and foraging strategies may attribute to traditional agro-forestry system in the present study area.

Keywords: Avifauna, Bird diversity, Guild Structure, Garhwal Himalayas, Lansdowne forest division, Western Himalayas

I. INTRODUCTION

The avian community structure may be determined by the several variables such as the quality and the availability of food [1], the vegetation structure [2,3], the floristics [2,4,5], and the nest predation [6]. Measurement of the trophic structure is essential for the ecosystem resilience [7], in avian communities the balance and density of the populations are regulated by a combination of the feeding type and foraging habit, the nesting type and the sociality and also by the quality of the habitat for food, nesting, water and resting [8]. The avian biodiversity studies conducted from the state of Uttarakhand are from lower Garhwal hills [9], Corbett tiger reserve, Lansdowne forest division [10,11], Pauri Garhwal hills [12,13] and Kumaon hills [14]. There are few studies regarding avian diet and sub-feeding guilds in the Himalayan region [15]. However, in some avian community studies from other parts of India [16,17,18], the foraging of birds was discussed based on the

information given by Ali and Ripley [19]. In this study attempts have been made to understand the avian community structure and feeding guilds and sub guilds in the suburban sites adjacent to the Kotdwar and Laldhang forest ranges of the Lansdowne forest division (Pauri Garhwal district), part of the outer Shivalik hills of the western Himalayas, Uttarakhand.

II. MATERIALS AND METHODS

2.1 Study area

Lansdowne forest division (LFD) is situated between 29° 37' to 30° 2' North latitude and 78° 19' 13'' to 78° 43'0'' East longitudinally in the south west portion of district Pauri Garhwal. The forest division is situated between Rajaji national park towards its western side and Corbett tiger reserve towards its east (Fig. 1). The three suburban sites within the Lansdowne forest division are: site A Bhimsinghpur; 300-600 m ASL; 29° 47' 14.26" N-78° 27' 01" E, site B (Nisni; 600-900 m ASL; 29° 54' 55.01" N-78° 26' 21.42"E; 29° 54' 40.38" N-78° 26' 13.96" E) and site C (Mungaon; 900-1200 m ASL, 29° 54' 18.58''N-78° 26' 00.67''E).

Rabi and Kharif crops are planted throughout the year in agriculture lands close to rural households. Besides agriculture lands, people are much dependent on kitchen gardens for vegetables and herbs of daily uses. The common floral species found in kitchen garden are: *Brassica campestris*, *Brassica rugosa*, *Amaranthus cruentus*, *Allium cepa*, *Cannabis sativa*, *Hordeum vulgare*, *Chenopodium album*, and fruiting trees like *Prunus persica*, *Psidium guajva*, *Annona squamosa*, *Magnifera indica.*

2.2 Field procedure

Observation of birds in each predefined transect/route was used for bird census for two years (January 2010 to December 2012), by walking on foot once in a month using binocular and video camera. In summer bird counts undertaken only between 5:00 am and 8:00 am in the morning and 4:00 pm to 6:00 pm in the evening, while in winters predefined transects were covered from 6:30 am to 9:30 am in morning and 3 pm to 6 pm in evening only on fine days i.e., birds were not surveyed in extreme weather conditions, such as when wind or rain interfered with the audibility of bird calls, when fog or rain impaired visibility, partly cloudy sky or when cold weather limited bird activity. We maintained the same survey protocol in subsequent years. Bird field guide by Grimmett et al. [20] and Ali [21] were used for identification of birds. For nomenclature we followed Inskipp et al. [22]. We made possible affords to identify the foraging layer of the bird studied. For this, we classified forage layers in suburban habitat as: Arboreal >10 m, terrestrial, understory 0-10 m. For aerial feeders, raptors and nocturnal species, their foraging layer and feeding guilds assigned according to their ecological data present till date [19,20,23]. We also categorized each species as common (c), fairly common (f), uncommon (c) and rare (r) based on our sighting records.

III. RESULTS

3.1 Species composition

A total of 94 bird species recorded in suburban/rural areas, family Corvidae with 11 (12%) species was found to be dominant family followed by family Muscipidae with 9 (10%). Out of total 94 species recorded in the present study, residents were 60 (64%), winter migratory were 12 (13%), resident altitudinal migrant were 17 (18%) and summer migratory were 5 (5%) (Fig. 2).

The abundance category of the 94 suburban birds, based on their frequency of sightings during the field visits has been shown in Appendix 1. Out of 94, 37 (39%) were common, 16 (17%) were uncommon, 25 (27%) were fairly common and 16 (17%) were found to be rare for the suburban sites studied.

The most dominant species of suburbs was found to be House Sparrow (*Passer domesticus*) with high relative abundance (8.4) Table 1.

3.2 Feeding guild structure & foraging layer

The analysis of dominant/major dietary guild and their possible combinations revealed that the insectivores account highest dietary guild (I; 47%), followed by carnivores (C; 10%), frugivore insectivore (FI; 11%), omnivore (O; 9%), frugivore (F; 8%) while granivore (G; 5%), granivore insectivore (GI; 5%), nectivore insectivore (NI; 2%), carnivore insectivore (CI; 1%), frugivore insectivore granivore (FIG; 1%), frugivore carnivore (FC; 1%)(Fig. 3).

Results for foraging layer (Fig. 4) showed highest percentage of arboreal feeders (51%), followed by terrestrial (29%) and understory (20%) out of 94 bird species recorded. Classification of diet guild according to foraging layer of birds, accounted for 17 types of combinations (Fig. 5) showed that arboreal guild was most common followed by terrestrial and understory birds.

IV. DISCUSSIONS

4.1 Species composition

It is highly important to monitor the bird species composition and feeding guilds to understand the importance of suburbs for bird species. The recording of 94 species of birds indicated that suburban areas are attractive habitat and suitable foraging site for wide array of bird species. Presence of plentiful food resources like dragonflies, large wasps, large beetle, large homopterous etc., shelter and nutrients in agriculture fields and kitchen gardens managed by local population is one of the reason for high species richness in the area. The most dominant species of suburbs was found to be House Sparrow (*Passer domesticus*) with high relative frequency. The next dominant species was Red-vented Bulbul (*Pycnonotus cafer*), Table 1; its high abundance in all suburban sites may be due to well maintained home gardens and orchards of mango, guava, etc. in the area which they used for breeding and feeding habitats. Suburban gardens are likely to become increasingly important for conservation as the urban landscape deteriorates because of anthropogenic activities and they are arguably the main contributor to urban biodiversity in many developed countries [24,25]. In the present study area, river and small water reservoirs near agriculture fields also harbors some species like White-throated Kingfisher, Cattle Egret and White-browed Wagtail. They feed on small fishes, arthropods, small crabs etc.

In the present study it was also noted that human commensal like House Crow was found in high abundance in site A (Bhimsinghpur) which is most populated and human dominated landscape, while Large billed Crow was found in high abundance in less populated area site B (Nisni) and site C (Mungaon). This may contribute to the fact that urbanization increases biological homogenization, causing the extirpation of native species and promoting the establishment of non-native, urban-adaptable species that are becoming increasingly widespread and locally abundant [26,27,28].

An indirect finding of the present study is that the abundance of House Sparrow found to be most abundant in human dominated area (Table 1). While the studies on House Sparrow in other parts of the world suggest declining

trends [29,30]. As this decline is more than 50% in many European cities it qualifies it to categorize as a red data listed species, a bird of conservation concern [31]. Recently Bhatt et al. [32] also reported decline in the population of House Sparrow in some urbanized areas in district Haridwar of the Uttarakhand state, India.

4.2 Feeding guild structure & foraging layer

The diet of a bird species represents a fundamental aspect of its ecological niche and dietary adaptations which played an important role in understanding the ecology and evolution of communities. In the present study major dietary guilds, insectivorous (I) dietary guild showed high dominance, followed by carnivore (C), omnivore (O), frugivore (F) and granivore (G)(Fig. 3). The results are in consistent with other studies conducted in the Indian subcontinent [17,15,33]. The other dietary combinations are frugivore insectivorous (FI), granivorous insectivorous (GI), carnivorous insectivorous (CI). The dietary combination which found in least number in the area is nectivore insectivore (NI), frugivore carnivore (FC) (Fig. 3).

To ensure their survival and optimize food resources, birds show various foraging behaviors to exploit diverse food resources in suburbs are directly related to the structural adaptations of each species i.e. structure of wings, legs and feet and bill. Our results showed that arboreal foraging strategy is common followed by terrestrial and understory species (Fig. 4). If the data is pooled individually for each foraging layer, arboreal insectivore and its other dietary combination was found to be highest, followed by understory insectivore birds and its combination (Fig. 5). This can be credited to continuous supply of their predominant food substrate and suggest that spatio-temporal availability of food resources in sub tropical regions such as the present study area plays an important role in shaping the steepness of the latitude gradient and the biogeographical patterns of species richness. The important global study on dietary guild richness pattern across globe [34] showed that across latitudinal gradient, species richness was steepest increased towards the equator for arboreal/terrestrial guild and intermediate for frugivores, granivores and carnivores, and shallower for all other guilds.

The vegetation structure of the study area, deciduous forest with patches of riverine habitats appears to be responsible for year-long insects and arthropods presence in the area which may responsible for high understory insectivory among avian species. Since this study also indicates high insectivory in the area and thus needs more attention from conservation point of view as they are among the species most likely to go extinct as a result of forest fragmentation and their loss may result in insect pest outbreaks in tropical forests and surrounding agricultural areas [35]. Beissinger [36] also suggested that finding out the causes of the disappearance of understory insectivores may help in explaining the disappearance of the other small, short-lived, and specialized bird species that comprise the majority (65%) of threatened bird species in the world.

V. CONCLUSION

The results of this study highlighted that suburban areas of Shivalik hills are productive habitat and potential to attract a wide range of bird species.

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Appendix- 1

Family/ Species	Common Name	Status	Abundance	Feeding Guild
PHASIANIDAE				
Pavo cristatus	Indian Peafowl	R	c	TO
PICIDAE				
Picus xanthopygaeus	Streak-throated Woodpecker	R	r	AI
Dinopium benghalense	Black-rumped Flameback	R	c	UI
MEGALAIMIDAE				
Megalaima zeylanica	Browned-headed Barbet	R	c	AF
Megalaima asiatica	Blue-throated Barbet	R	f	AF
BUCEROTIDAE				
Ocyceros birostris	Indian Grey Hornbill	R	c	AFC
UPUPIDAE				
Upupa epops	Common Hoopoe	R	c	TI
HALCYONIDAE				
Halcyon smyrnensis	White-throated Kingfisher	R	c	UC
MEROPIDAE				
Merops orientalis	Green Bee Eater	R	c	AI
Merops leschenaultia	Chestnut-headed Bee Eater	R	f	AI
CUCULIDAE				
Clamator jacobinus	Pied Cuckoo	SM	u	UI
Eudynamys scolopacea	Asian Koel	R	c	AO
PSITTACIDAE				
Psittacula eupatria	Alexandrine Parakeet	R	f	AF
Psittacula krameri	Rose-ringed Parakeet	R	c	AF
Psittacula himalayana	Slaty-headed Parakeet	RAM	u	AF
Psittacula cyanocephala	Plum-headed Parakeet	R	c	AF

APODIDAE				
Apus affinis	House Swift	R	f	AI
STRIGIDAE				
Glaucidium cuculoides	Asian Barred Owlet	R	r	AIC
COLUMBIDAE				
Columba livia	Rock Pigeon	R	c	TG
Streptopelia chinensis	Spotted Dove	R	c	TG
Streptopelia decaocto	Eurasian Collard Dove	R	u	TG
Treron sphenura	Wedge-tailed Green Pigeon	RAM	r	AF
CHARADRIDAE				
Vanellus indicus	Red-wattled Lapwing	R	c	TI
ACCIPITRIDAE				
Elanus caeruleus	Black-shouldered Kite	R	f	AC
Milvus migrans	Black Kite	RAM	c	AC
Neophron percnopterus	Egyptian Vulture	R	u	TC
Accipiter badius	Shikra	R	f	AC
Accipiter gentilis	Northern Goshawk	WM	r	AC
FALCONIDAE				
Falco tinnunculus	Common Kestrel	WM	r	AC
ARDEIDAE				
Bubulcus ibis	Cattle Egret	R	c	TC
IRENIDAE				
Chloropsis hardwickii	Orange-bellied Leafbird	WM	r	AIF
LANIDAE				
Lanius schach	Long-tailed Shrike	R	c	AC
CORVIDAE				
Urocissa erythrorhyncha	Red-billed Blue Magpie	RAM	u	AO
Dendrocitta vagabunda	Rofous Treepie	R	c	AO
Corvus splendens	House Crow	R	c	AO
Corvus macrorhynchos	Large-billed Crow	R	c	AO

Oriolus oriolus	Eurasian Golden Oriole	SM	r	AIF
Pericrocotus roseus	Rosy Minivet	SM	r	AI
Pericrocotus ethologus	Long-tailed Minivet	RAM	f	AI
Pericrocotus flammeus	Scarlet Minivet	RAM	r	AI
Rhipidura albicollis	White-throated Fantail	R	c	UI
Dicrurus macrocercus	Black Drongo	R	c	AI
Terpsiphone paradisi	Asian Paradise-flycatcher	RAM	f	UI
MUSCICAPIDAE				
Monticola cinclorhynchus	Blue-capped Rock Thrush	SM	r	TI
Monticola solitarius	Blue Rock Thrush	WM	r	TI
Turdus boulboul	Grey-winged Blackbird	RAM	u	TI
Eumyias thalassina	Verditer Flycatcher	RAM	f	AI
Copsychus saularis	Oriental Magpie Robin	R	c	TI
Saxicoloides fulicata	Indian Robin	R	c	TI
Saxicola caprata	Pied Bushchat	R	f	TI
Saxicola ferrea	Grey Bushchat	RAM	u	TI
Cercomela fusca	Brown Rock Chat	R	c	UI
STURNIDAE				
Sturnus malabaricus	Chestnut-tailed Starling	RAM	f	AF
Sturnus pagodarum	Brahminy Starling	R	c	AIFG
Sturnus contra	Asian Pied Starling	R	c	AIF
Acridotheres tristis	Common Myna	R	c	TO
Acridotheres fuscus	Jungle Myna	R	c	TO
SITTIDAE				
Sitta castanea	Chestnut-bellied Nuthatch	R	u	AI
Sitta frontalis	Velvet-fronted Nuthatch	R	u	AI
Tichodroma muraria	Wallcreeper	WM	u	AI
CERTHIIDAE				
Certhia himalayana	Bar-tailed Treecreeper	WM	r	AI
PARIDAE				
Parus major	Great Tit	R	c	UIF
Parus xanthogenys	Black-lored Tit	R	r	UI
HIRUNDINIDAE				

Hirundo concolor	Dusky Crag Martin	R	f	AI
Hirundo daurica	Red-rumped Swallow	R	f	AI
PYCNONOTIDAE				
Pycnonotus jocosus	Red-whiskered Bulbul	R	u	AIF
Pycnonotus leucogenys	Himalayan Bulbul	R	c	AIF
Pycnonotus cafer	Red-vented Bulbul	R	c	AIF
Hypsipetes leucocephalus	Black Bulbul	RAM	f	AIF
CISTICOLIDAE				
Prinia hodgsonii	Grey-breasted Prinia	R	c	UI
Prinia socialis	Ashy Prinia	R	f	UI
ZOSTEROPIDAE				
Zosterops palpebrosus	Oriental White-eye	R	c	AI
SYLVIIDAE				
Cettia pallidipes	Pale-footed Bush Warbler	WM	u	UI
Orthotomus sutorius	Common Tailorbird	R	c	UI
Phylloscopus collybita	Common Chiffchaff	WM	f	UI
Phylloscopus inornatus	Yellow-browed Warbler	WM	r	UI
Phylloscopus trochiloides	Greenish Warbler	RAM	u	UI
Seicercus xanthoschistos	Grey-hooded Warbler	RAM	f	UI
Garrulax leucolophus	White-crested Laughingthrush	RAM	u	UI
Garrulax lineatus	Streaked Laughingthrush	R	u	UIF
Turdoides striatus	Jungle Babbler	R	c	TIG
Leiothrix lutea	Red-billed Leiothrix	RAM	f	UI
NECTARINIIDAE				
Dicaeum ignipectus	Fire-breasted Flowerpecker	WM	r	AIF
Nectarinia asiatica	Purple Sunbird	R	c	AIN
Aethopyga siparaja	Crimson Sunbird	R	f	AIN
PASSERIDAE				
Passer domesticus	House Sparrow	R	c	TIG
Petronia xanthocollis	Chestnut-shoulder Petronia	R	f	TIG
Motacilla maderaspatensis	White-browed Wagtail	R	f	TIG
Motacilla cinerea	Grey Wagtail	RAM	u	TI
Anthus rufulus	Paddyfield Pipit	SM	r	TI

Anthus hodgsoni	Olive-backed Pipit	WM	f	TI
Prunella strophiata	Rufous-breasted Accentor	WM	f	TIG
Lonchura punctulata	Scaly-breasted Munia	R	f	TG
Ploceus philippinus	Baya Weaver	R	f	TG

Abbreviations: **c**-common, **f**-fairly common, **u**-uncommon, **r**-rare, **R**-resident, **RAM**-resident altitudinal migrant, **SM**-summer migrant, **WM**-winter migrant, **A**-arboreal, **T**-terrestrial, **U**-understory, **I**-insectivore, **C**-carnivore, **F**-frugivore, **G**-granivore, **O**-omnivore, **N**-nectivore.

Table

Table 1. Showing relative abundance (RA), frequency and relative frequency (RF) of some dominant species of suburban habitat.

Common Name	Scientific Name	No. of individuals	RA & (%)
House Sparrow	*Passer domesticus*	488	8.4
Red-vented Bulbul	*Pycnonotus cafer*	467	8
Jungle Babbler	*Turdoides striatus*	475	7.01
Large-billed Crow	*Corvus macrorhynchos*	388	3.5
House Crow	*Corvus splendens*	334	3.2
Alexandrine Parakeet	*Psittacula eupatria*	295	8.1

Figures

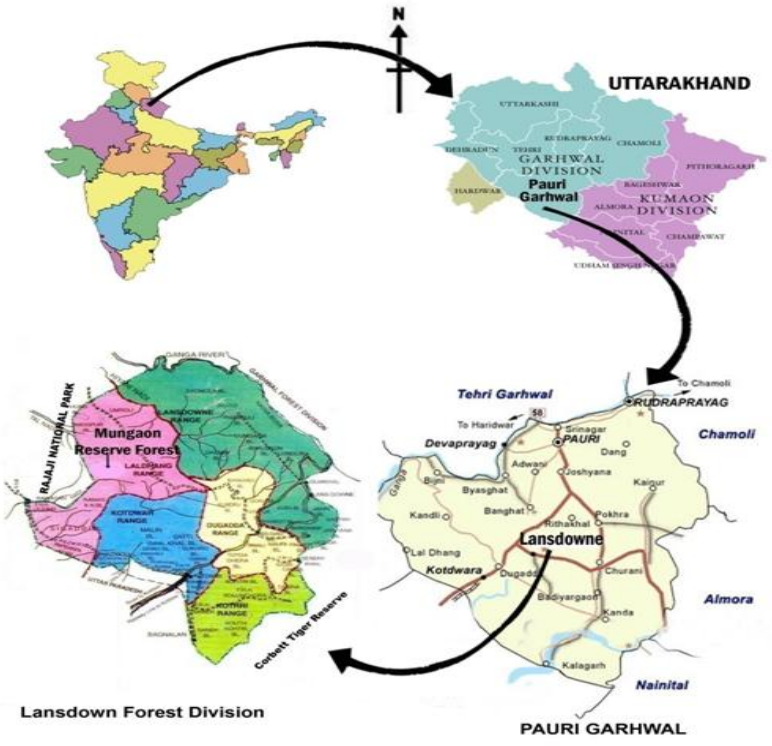

Fig. 1: Location of Lansdowne forest division in Uttarakhand.

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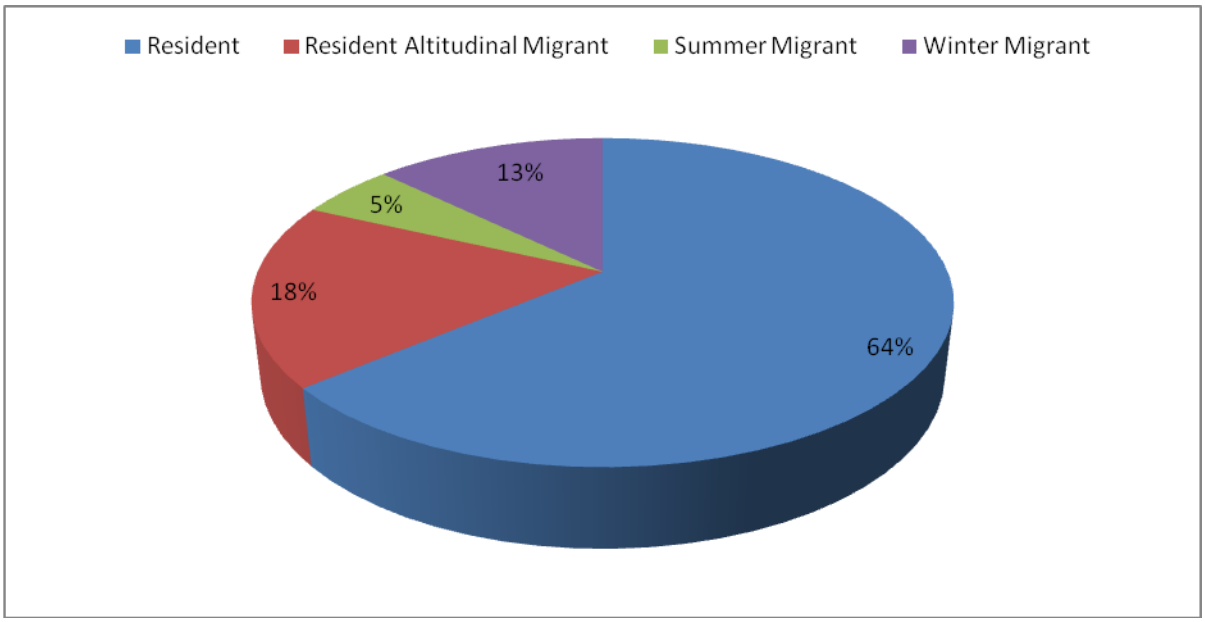
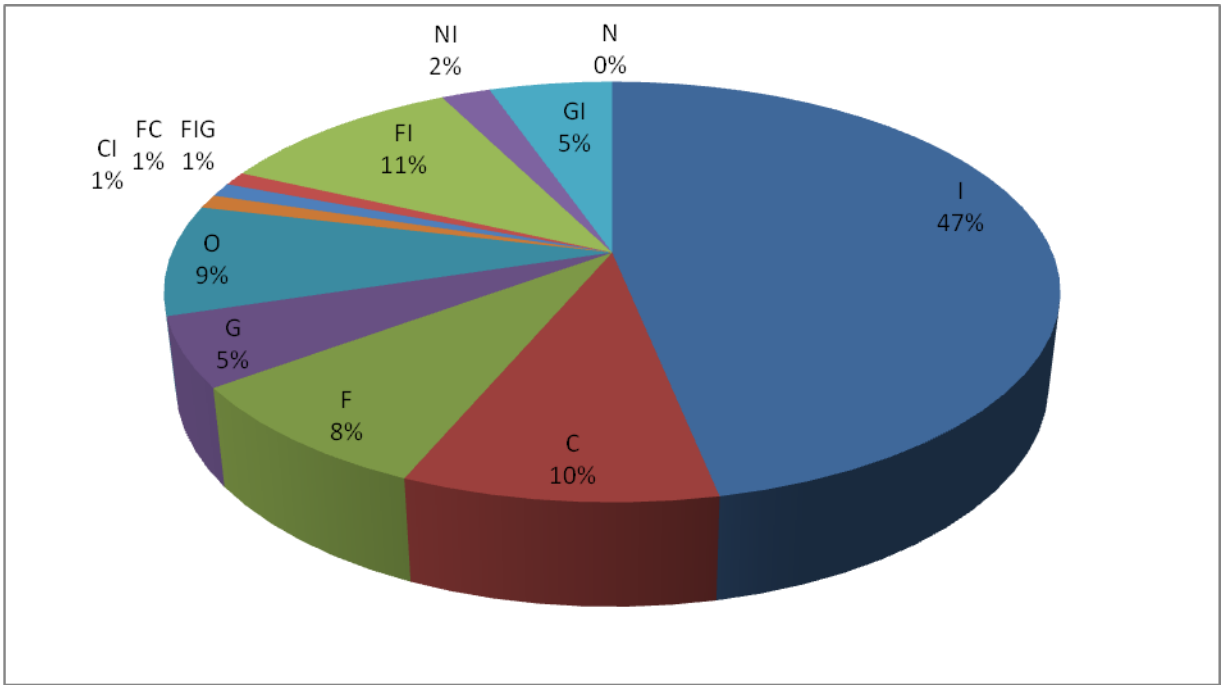
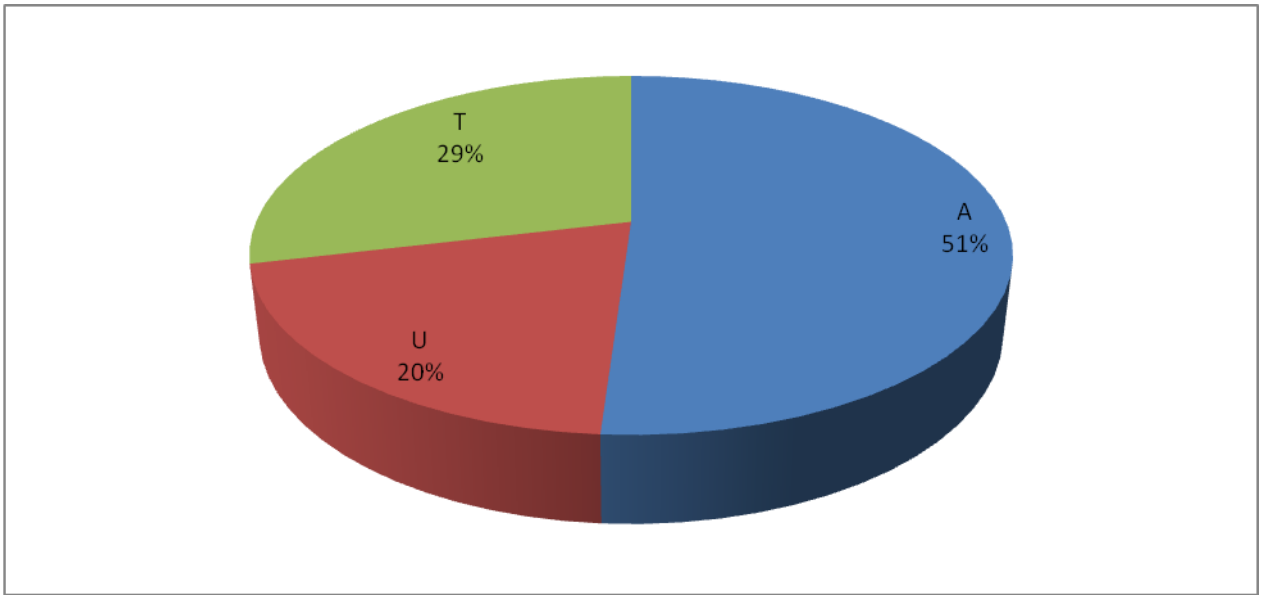


Figure 2. Pie diagram depicting the resident and migratory status of avian community in suburban habitat.



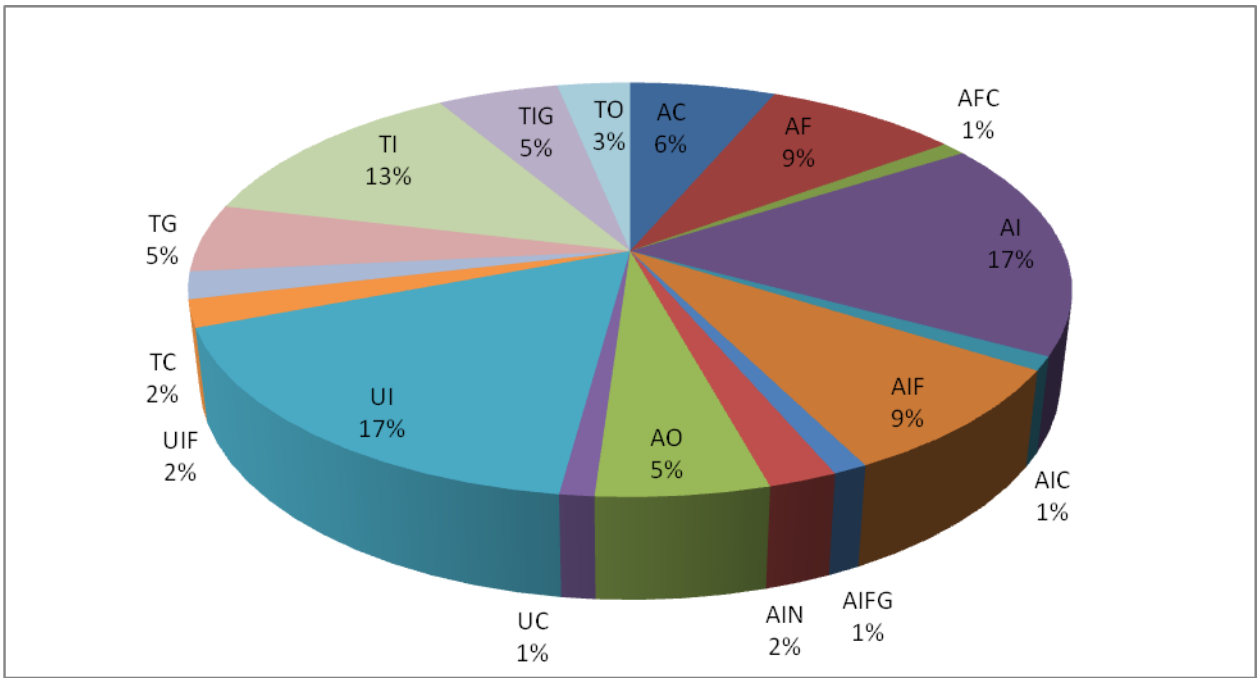
carnivores (C), frugivore insectivore (FI), frugivore (F), omnivore (O), granivore (G) carnivore insectivore (CI), nectivore insectivore (NI), frugivore carnivore (FC), frugivore insectivore granivore (FIG), insectivore (I), granivore insectivore (GI), nectivore (N)

Figure 3. Relative percentage of avian community's dietary guild structure.



Terrestrial (T), Arboreal (A), Understory (U),

Figure 4. Relative percentage of avian foraging layer.



understory insect (UI), arboreal insectivorous (AI), terrestrial insectivorous (TI), arboreal carnivore (AC), arboreal insectivore frugivore (AIF), arboreal frugivore (AF), terrestrial granivore (TG), terrestrial insectivore granivore (TIG), terrestrial carnivore (TC), Arboreal omnivore (AO), arboreal insectivore carnivore (ACI), understory insectivore frugivore (UIF), understory carnivore (UC), terrestrial omnivore (TO), arboreal insectivore nectivore (AIN), Arboreal frugivore carnivore (AFC), Arboreal insectivore frugivoregranivore (AIFG)

Figure 5. Relative percentage of feeding guild with reference to foraging layer.