International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

IJFBS International Journal of Fauna And Biological Studies

ISSN 2347-2677
IJFBS 2017; 4(4): 78-85
Received: 01-05-2017
Accepted: 02-06-2017

Rathod Jagruti
Gujarat Ecology Society, 3rd floor Synergy House, Subhanpura, Vadodara, Gujarat, India

Padate Geeta
Division of Avian Biology; Department of Zoology; Faculty of Science, the Maharaja Sayajirao University of Baroda. Vadodara, Gujarat, India

Correspondence
Rathod Jagruti
Gujarat Ecology Society, 3rd floor Synergy House, Subhanpura, Vadodara, Gujarat, India

Feeding Guilds of urban birds of Vadodara city

Rathod Jagruti and Padate Geeta

Abstract
Food and shelter are the two basic necessities for all the living organisms. Urbanization modifies the habitat with change in its vegetation structure and availability of unpredictable anthropogenic food. Several species of birds adapt to these modified habitats while others leave the habitat and become extinct. Birds were surveyed in and around 12 different habitats in Vadodara city in the semi-arid zone of Gujarat, India for two years (2005-2007). Graminivorous birds (48.9 %) were recorded in highest density this could be due to Rock Pigeon (*Columba livia*). Followed by omnivorous (25.3%), carnivorous (10.4 %), insectivorous (6.7%) and frugivorous (5.8 %) and birds of prey (0.64 %) and nectirivourous (0.62 %) birds are very less. All these could be due to availability of food, less nesting sites for nectirivorous and frugivorous birds. Gramnivores and omnivore feeding guilds are habituated with the urban conditions but the insectivores, frugivores and nectarivores are probably adversely affected by the human disturbances and urban development in this region.

Keywords: Feeding guild, urban conditions, Birds, Graminivorous

Introduction
Food and shelter are the two basic necessities for all the living organisms which they get from their habitats. It is a long established fact that availability of food affects the population size (Perrins and Birkhead, 1983 [14]; Krebs, 1985 [10]; Welty and Baptista, 1988) [19]. Andrewartha and Birch (1954) [2] have discussed that animal's chances for survival and to multiply depend on four components of the environment such as the weather, availability of food, predators and secured shelter. For many species, food is the most important ultimate factor while for some species other resources like breeding sites, nesting materials, rain, day length *etc*. play important role for survival and breeding (Lake, 1968 [11]; Immelmann, 1971) [7].
In developing world, increase in human population has led to the fragmentation of habitat and decrease in the availability of natural resources. As the human pressure increases it modifies the habitat with change in its vegetation structure and availability of unpredictable anthropogenic food. These changes are reported to influence the urban bird communities (Mills *et al*., 1989) [13]. Several species of birds adapt to these modified habitats while others leave the habitat and become extinct in that area. It is also reported that the vegetation structure is highly developed and diversified at the edges of urban areas influencing the bird diversity (Smith and Schaefer, 1992) [18]. Birds are the biological indicators that are studied extensively to find out influence of habitat change. The changes in the bird communities occur across the gradients of urbanization (Clergeau *et. al*., 1998) [4]. According to the difference in feeding habits, different species of birds are expected to respond in different ways. The immediate response of birds to any changes in environment can be due to their specific type of feeding, nesting and roosting habits. As they are able to fly away from any adverse condition, their presence in a particular area can be associated with their dietary guilds, their type of habitat as well as human disturbances.
The relation between human and bird communities is easy to study (Cody, 1985) [5]. Reynaud and Thioulouse (2000) [17] have stated that the bird data can reflect habitat changes and the data analysis can identify the most important factors that cause changes in the bird population and bird species or it can also identified the guilds that are more suitable to represent these changes. The analysis of the avian response to guilds indicates those species that are most sensitive to habitat perturbations and species that are benefited or at least are not affected by environmental disturbances.
In the present paper, birds observed in 12 different areas- *i.e*. nine terrestrial habitats [Disturb areas (DA), Moderately Disturb areas (MD) and Undisturbed areas (UD,)] along with three ponds [Lal baugh Pond (LP), Gorti Pond (GP) and Harni Pond (HP)].

Birds are divided in to 7 different categories on the basis of their feeding guilds as described by Ali (1996) [1]. These categories are Graminivores: The species that feed on seeds as well as grass. Omnivores: species eating insects and small animals as well as fruits and seeds. Carnivores: Generally feeding on fish, frog, snake, insects and worms. Insectivores: exclusively depending on insects. Frugivores: feeding exclusively on fruits. Birds of prey: the hunters feeding on animal matters and Nectarivores: nectar feeders. Their density and abundance in 12 different study areas are analyzed to understand.

The second important factor that gets modified due to urban development is shelter. In urban area the native vegetation is replaced by ornamental vegetation or concrete jungle. Many of these use concrete structure or modified vegetation as their roosts besides others use these habitats for nesting. Several species of birds especially urban exploiter roost in large colonies in Vadodara. Hence, the densities of birds at some of the roosts in the city needed evaluation.

Materials and methods

As mentioned earlier depending on the feeding habits, birds were categorized in to seven different guilds: Graminivores, Omnivores, Insectivores, Frugivores, Carnivores, Birds of prey and Nectarivores depending on the description given by Ali (1996) [1]. There are total 216 visits were done. Further, the number of species with their densities in each group was pooled to find out densities of each group in the city. To find out their abundance (%) (Krebs, 1985) [10], the data for 12 sites was pooled for each group every month. These monthly data of % abundance of each group was used to find out annual total monthly density and further analyzed using ANOVA or t-test for different study areas as DA, MD and UD with the help of Graph-pad Prism-3 and Excel.

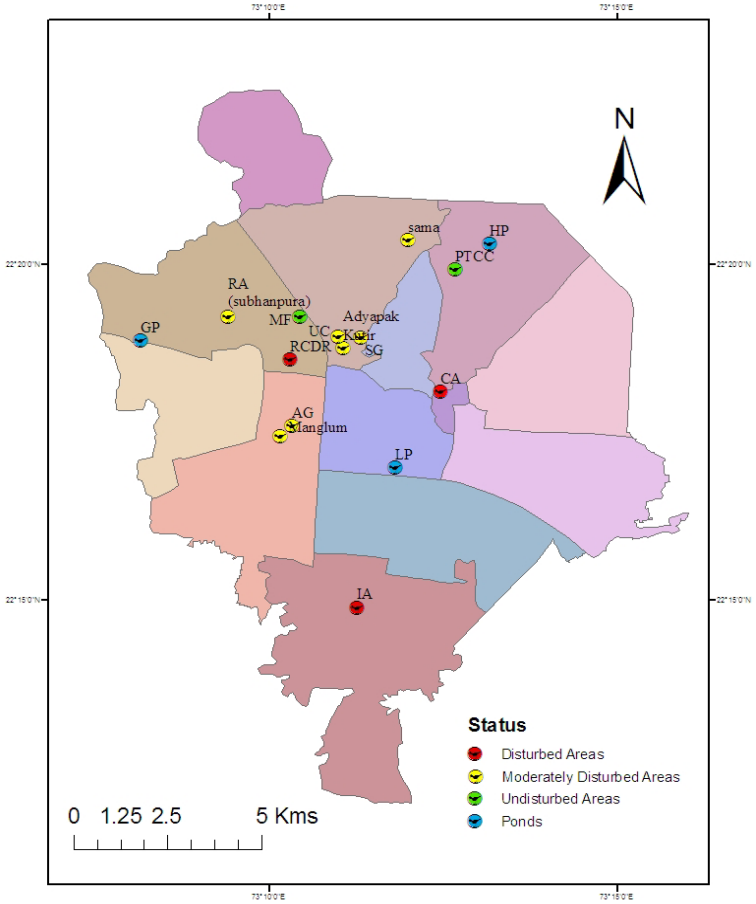
Statistical analysis

The p value for ANOVA and t-test is non-significant if $P>0.05$ (ns), significant if $P<0.05$ (*), significantly significant (**) if P is < 0.001 and highly significant (***) if $p<0.0001$. The positive and negative impacts of urban pressures on avifauna are discussed.

Study area

Location map of 12 Study areas of Vadodara city

I disturbed areas (DA) (a) R. C. Dutt Road (RCDR) (b) City area (CA) and (c) Industrial area (IA). II Moderately disturbed areas (MD) (d) Sayaji Garden (Kamatibaug) (SG), (e) University Campus (UC), (f) Akota Garden (AG) and Residential area (RA). III Undistributed areas (UD) (h) Model farm (MF) and (i) PTC campus (PTCC). IV. Ponds (PS) (a) Lal baugh Pond (LP), (b) Gotri Pond (GP) (c) Harni Pond (HP)



Results and Discussions

It is well known that food and roosting as well as nesting sites are the basic requirements for survival and continuation of a species of bird (Welty and Baptista, 1988) [19]. As a result of urbanization, a new ecosystem urban ecosystem has developed that is a modified ecosystem with moderate to heavy concrete jungle. Certain birds adapt to these modifications very well but many leave the site. Total 105

species of birds were recorded in different at areas of Vadodara city. Urban environments with concrete jungles and recreational parks, privet premises provide nesting habitat and additional food supply (Rathod *et al*, 2017) [14]. Graminivorous birds were recorded in highest density this could be due to Rock Pigeon (*Columba livia*). In the present study, it is noted that Vadodara mainly offers the graminivorous guild to birds. Maximum number of granivores, the Blue Rock Pigeon (*Columba livia*) are found in the city. The birds like pigeons, usually congregate around temples, mosques and other large buildings including railway stations (Ali and Ripley, 1969) where they are fed with grains. Highest density of graminivores was noted at RCDR (9714 birds/Km^2) followed that is Disturb area. This could be due to presence of house and most of the people feed them so they got sufficient amount of food and place for shelter. Freely available supplementary foods which are exploited by urban dwelling species have several readily predictable outcomes (Boal and Mannan 1999) [3]. Most important and significant of this is advancement of breeding dates by seasonally breeding birds as they may rear additional brood when food is unusually abundant (Perrins and Birkhead 1983) [14]. In Vadodara, extended breeding period for pigeon has been reported by Kotak (1979) [9].

The differences were highly significant among each group, DA ($P<0.0001$, $F_{2, 69}$ 63.10), moderately disturb areas (MD) ($P<0.0001$, $F_{3, 92}$ 41.80), Undisturbed areas (UD) ($P<0.0001$) and Ponds (PS) ($P<0.0001$, $F_{2, 69}$ 30.42)

The next major group was of omnivore species that include 32 species observed in 12 areas**.** The highest density of omnivorous birds were noted at GP (2822 $\pm$ 197.2 birds/Km^2) and lowest at Model Farm (MF) (189.4 $\pm$ 14.05 birds/Km2. Edges of all the three ponds have large trees further, LP has garden also which proved food and roost of the other birds. Further, Gotri ponds (GP) have trees for roosting or garbage dump which provide food for the species like Large-billed Crow and Common Mynas. This shows that Omnivorous species have adapted to the urban environment and its particular food resources such as garbage as is also reported by Clergeau *et al*. (1998) [4]. The sub-urban lawns have higher net productivity and food utilization by birds than other grassland habitats and they act as areas of concentrated food supply capable of supporting high densities of birds (Falk, 1976) [6]. The densities of Crows and Common Myna directly affected the abundance of the omnivorous guild. This indicates that omnivorous birds are abundant in the areas that have water resources. These species are more tolerant towards human disturbances because omnivorous species do exploit anthropogenic food resources effectively (Jokimaki and Suhonen, 1998) [8].

Highly significant differences were noted among DA ($P<0.0001$, $F_{2, 69}$ 59.11), MD ($P<0.0001$, $F_{3, 92}$ 96.09) and PS ($P<0.0001$, $F_{2, 69}$ 40.23).

Next in abundance were carnivores species. This includes 17 species of birds feeding on animal matter. The highest density was noted at HP (1683 $\pm$ 206.8 birds/Km^2). Carnivorous guilds that mainly supply aquatic food like fish, molluscs, amphibians, *etc*. available in pond water. Therefore, the density of carnivores was higher at these three ponds. Further, in India and especially in Gujarat most of the people are vegetarian so other areas of Vadodara city have no food for carnivorous birds. Highly significant differences were noted among the MD ($P<0.0001$, $F_{3, 92}$ 27.81).

The third highest guild was insectivorous guild. Total 28 species of insectivorous birds were noted in 12 study areas with 6.67 $\pm$ 0.96 % total abundance and 291.8 $\pm$ 46.37 birds/Km^2 total density. The highest density of insectivorous birds was 1598 $\pm$ 531.2 birds/Km^2 at CA, this could be due to presence of House Swifts (*Apus nipalensis*) which use the old heritage type of buildings for their nest formations and garbage dump provide food. According to Lim and Sodhi (2004), the richness of insectivores and carnivores increase with increasing natural vegetation and declines with increasing percentage of built up area and human population. However, compared to graminivorous birds, the abundance of the insectivorous birds was low in Vadodara, as Insectivores are reported to be more sensitive to the quality of the environment (Clergeau *et al*., 1998) [4].

Significantly significant differences were noted among DA ($P<0.001$, $F_{2, 69}$ 7.579), highly significant among MD ($P<0.0001$, $F_{3, 92}$ 14.92).

Further, three species of Frugivorous birds were observed in Vadodara during the study period with 5.88 $\pm$ 0.32 % abundance and 248.1 $\pm$ 13.19 birds/Km^2 density The density of frugivores was highest at SG (564.8 $\pm$ 52.14 birds/Km^2). Moreover, the frugivorous guild was available in moderately disturbed areas (UC, SG, AG, RA) as well as pond (LP) with the garden where large flowering and fruiting trees are present. The residential areas with backyard vegetation and the gardens or parks with large trees are favoured by the frugivorous birds (Reynaud and Thioulouse 2000) [17]. Further, the frugivorous guild appeared mainly at low-density housing development of residential areas (Lim and Sodhi 2004).

Highly significant differences were noted among MD ($P<0.0001$, $F_{3, 92}$ 8.990) and PS ($P<0.0001$, $F_{2, 69}$ 38.10) and insignificant among DA ($P>0.05$, $F_{2, 69}$ 1.004) and UD ($P>0.05$).

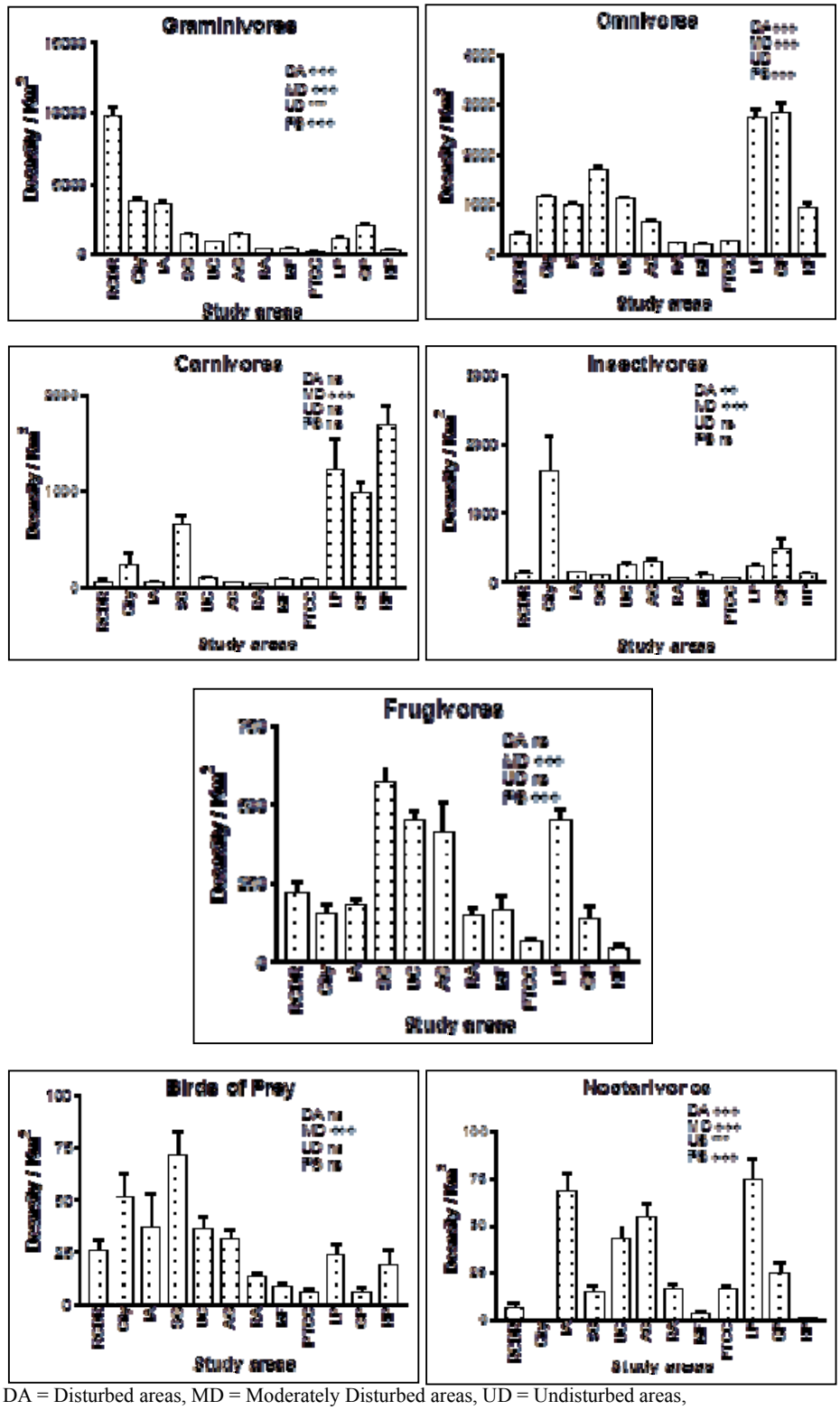
Moreover, only 2 species of diurnal Birds of prey were observed during study period. These are Black Kite (*Milvus migrans*) and Shikra (*Accipiter badius*). The total density of birds of prey was 27.10 $\pm$ 2.318 birds/Km^2 and the abundance only 0.64 $\pm$ 0.05 % (Fig 2, Table 2). The highest density of birds of prey was 70.95 $\pm$ 11.99 birds/Km^2 at SG. This could be due to presence of nesting sight of egrets, river, and large trees and roost of Black kite at SG. Large roosts of kites are present showing annual fluctuations (Rathod and Padate, 2004) [16]. The density of raptors was due to the large number of Black Kite present in the city. Their high density was noted at SG, CA, UC and IA, the areas nearer to water either Vishwamitry River or Sursagar Lake. Further, less disturbed areas are reported to provide rodents, chickens or reptiles to the raptors (Reynaud and Thioulouse 2000) [17]. In a preliminary study Kites have been reported to feed on poultry left over, mainly skin with feathers in Vadodara (Rathod and Padate, 2004) [16].

Statistically significant differences were noted among MD ($P<0.0001$, $F_{3, 92}$ 11.83) and insignificant among DA ($P>0.05$, $F_{2, 69}$ 1.075), UD ($P>0.05$) and PS ($P>0.05$, $F_{2, 69}$ 2.447).

Though several species feed on nectar, only 2 purely nectarivorous species Purple- rumped Sunbird (*Nectarinia zeylonica*) and Purple Sunbird (*Nectarinia asiatica*) were observed in Vadodara. Nectarivorous guild was the smallest guild during present study period. Their abundance was 0.62 $\pm$ 0.06% and the total density 26.77 $\pm$ 2.70 birds/km^2 (Fig 2, Table 2). The highest density of nectarivorous birds was noted

at LP and IA and higher at UC and AG this indicated that these four areas have several flowering plants. Vadodara is having several areas with green patches. Nectarivores often use suburban gardens (Young *et al*., 2007) [20]. Urban avifauna use street trees and the species of tree strongly influence its use by birds (Young *et al*., 2007) [20].

Highly significant differences were noted among areas of each group DA ($P<0.0001$, $F_{2, 69}$ 35.01), MD ($P<0.0001$, $F_{3, 92}$ 13.93), UD ($P<0.0001$) and PS ($P<0.0001$, $F_{2, 69}$ 26.46).



DA = Disturbed areas, MD = Moderately Disturbed areas, UD = Undisturbed areas,
PS = Ponds
*/ + P< 0.05, ** /++ P< 0.001, *** / +++ P<0.0001, ns = insignificant
*For T-test, + For ANOVA

Fig 1: Distribution of Density of birds according to their different feeding habits at different study areas of Vadodara City.

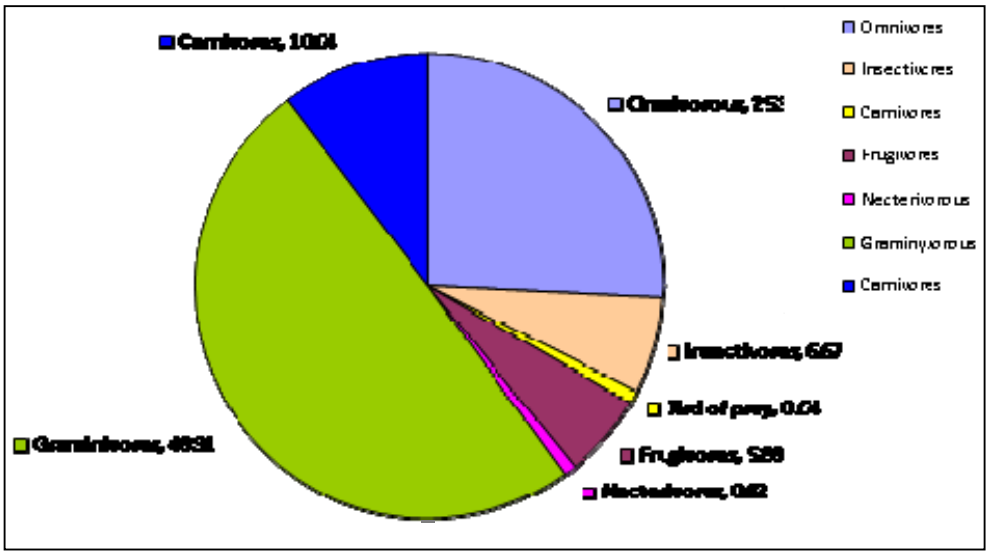


Fig 2: Percentage distribution of birds according to their feeding habits in Vadodara city.

Table 1: Characteristics of site locations for bird diversity assessments and tree as well as building cover.

Study areas	Site locations	Site characteristics	% cover (Approximate)	
Disturbed areas (DA)			**Buildings**	**Vegetation**
RCDR (R.C. Dutt Road)	22° 18' 35 N 73° 10' 17 E	Highly populated	75%	25%
CA (City area)	22° 18' 06 N 73° 12' 27 E	highly populated	95%	5%
IA (Industiral area)	22° 14' 53 N 73° 11' 14 E	Industrial buildings	50%	50%
Moderately Disturbed areas (MD)				
SG (Sayaji Garden)	22° 18. 53' N 73° 11 20' E	least human disturbances	5%	95%
UC (University Campus)	22° 18. 46' N 73° 11 07' E	Moderate human disturbances	40%	60%
AG (Akota Garden)	22° 17' 36" N 73° 10' 19" E	least human disturbances	5%	95%
RA (Residential areas)	22° 20' 22" N 73° 11' 58" E	moderately populated	40%	60%
Undisturbed areas (UD)				
MF (Model Farm)	22^0 17' 13" N 73^0 10'25" E	very less human distrubances	5%	95%
PTCC (PTC campus)	22^0 19' 55" N 73^0 12' 40" E	very less human distrubances	5%	95%

Table 2: Total number of Species, percentile distribution and density of birds according to their feeding habits in Vadodara city.

Feeding Guilds	Total number of species	Species abundance (%)	Density/Km^2
Graminivores	6	48.91 ± 1.02	2080 ± 65.23
Omnivores	32	25.30 ± 0.69	1072 ± 33.63
Carnivores	17	10.04 ± 0.73	429.1 ± 34.25
Insectivores	28	6.67 ± 0.96	291.8 ± 46.3
Frugivores	3	5.88 ± 0.32	248.1 ± 13.19
Birds of Prey	2	0.64 ± 0.05	27.10 ± 2.318
Nectarivores	2	0.62 ± 0.06	26.77 ± 2.70

Appendix: Check-list of birds and their feeding guilds during study period														
Nu.	**Name of the Species of the Birds**	**Disturbed area**			**Moderately disturbed area**				**Undisturbed area**		**Ponds**			**Food**
		RCDR	**CA**	**IA**	**SG**	**UC**	**AG**	**RA**	**MF**	**PTC**	**LP**	**GP**	**HP**	
I	Podicipedidae													
1	Little Grebe (*Tachybaptus ruficollis*)					*								C
II	Phalacrocoracidae													
2	Indian Shag (*Phalacrocorax fuscicollis*)												*	C
3	Little Cormorant (*Phalacrocorax niger*)	*	*	*	*	*		*	*	*	*	*	*	C
III	Ardeidae													
4	Cattle Egret (*Bubulcus ibis*)	*	*	*	*	*	*	*	*	*	*	*	*	C
5	Large Egret (*Casmerodius albus*)				*									C
6	Median Egret (*Mesophoyx intermedia*)				*	*		*		*	*		*	C
7	Little Egret (*Egretta garzetta*)	*		*	*	*	*	*	*	*		*	*	C
8	Black-crowned Night-Heron (*Nycticorax nycticorax*)				*			*			*			C
9	Pond Heron (Ardeola grayii)				*	*		*	*	*	*	*	*	C
IV	Ciconiidae													
10	Painted Stork (*Mycteria leucocephala*)				*									C
11	Asian Openbill-Stork (*Anastomus oscitans*)										*		*	C

V	Threskiornithidae													
12	Oriental White Ibis (*Threskiornis melanocephalus*)		*		*		*	*		*	*			C
13	Black Ibis (*Pseudibis papillosa*)				*							*		C
14	Glossy Ibis (*Plegadis falcinellu*)				*					*	*		*	C
VI	Anatidae													
15	Lesser Whistling-Duck (*Dendrocygna javanica*)									*	*		*	O
16	Garganey (*Anas querquedula*)												*	Aq
17	Cotton Teal (*Nettapus coromandelianus*)												*	O
18	Comb Duck (*Sarkidiornis melanotos*)	*			*					*	*		*	G
VII	Accipitridae													
19	Black winged Kite (Elanus caeruleus)	*	*	*	*	*	*	*	*	*	*	*	*	B
20	Shikra (Accipiter badius)			*	*	*	*	*	*	*	*			B
VII	Falconidae													
21	Red-headed Falcon (*Falco chicquera*)													B
VIII	Phasianidae													
22	Grey Francolin (*Francolinus pondicerianus*)								*	*		*	*	O
IX	Rallidae													
23	White-breasted Waterhen (*Amaurornis phoenicurus*)				*	*			*	*	*	*	*	O
24	Common Moorhen (*Gallinula chloropus*)										*		*	O
25	Purple Moorhen (*Porphyrio porphyrio*)										*		*	O
26	Common Coot (*Fulica atra*)												*	O
	Jacanidae													
27	Pheasant-tailed Jacana (*Hydrophasianus chirurgus*)												*	O
28	Bronze-winged Jacana (*Metopidius indicus*)										*	*	*	O
X	Charadriidae													
29	Red-wattled Lapwing (*Vanellus indicus*)			*	*	*	*	*			*	*	*	O
30	Yellow-wattled Lapwing (*Vanellus malabaricus*)								*					O
31	Common Ringed Plover (*Charadrius hiaticula*)										*	*		O
XI	Scolopacidae													
32	Marsh Sandpiper (*Tringa stagnatilis*)											*		C
33	Common Greenshank (*Tringa nebularia*)											*		C
34	Wood Sandpiper (*Tringa glareola*)											*	*	C
35	Common Sandpiper (*Actitis hypoleucos*)				*					*		*	*	C
36	Painted Snipe (*Gallinago stenura*)												*	C
XII	Recurvirostridae													
37	Black-winged Stilt (*Himantopus himantopus*)				*						*	*		C
XIII	Laridae													
38	Gull-billed Tern (*Gelochelidon nilotica*)											*		C
39	Little Tern (*Sterna albifrons*)												*	C
XIV	Columbidae													
40	Yellow legged Green Pigeon (*Treron phoenicoptera*)				*	*		*	*	*				F
41	Blue Rock Pigeon (*Columba livia)*	*	*	*	*	*	*	*	*	*	*	*	*	G
42	Eurasian collared Dove *(Streptopelia decaocto)*													G
43	Spotted Dove *(Streptopelia chinensis)*			*	*	*	*	*	*		*			G
44	Little Brown Dove *(Streptopelia senegalensis)*	*	*	*	*	*	*	*	*	*	*	*	*	G
XV	Psittacidae													
45	Roseringed Parakeet *(Psittacula krameri)*	*	*	*	*	*	*	*	*	*	*	*	*	F
XVI	Cuculidae													
46	Asian Koel *(Eudynamys scolopacea)*	*	*	*	*	*	*	*	*	*	*	*		O
47	Greater coucal *(Centropus sinensis)*	*		*	*	*	*	*	*	*		*		O
XVII	Tytonidae													
48	Barn Owl (*Tyto alba*)													
XVIII	Strigidae													
49	Oriental Scops-Owl (*Otus sunia*)													
50	Eurasian Eagle-Owl (*Bubo bubo*)													
51	Spotted Owlet *(Athene brama)*					*								
XIX	Apodidae													
52	House Swift *(Apus affinis)*	*	*	*	*	*	*	*	*	*	*	*	*	I
XX	Alcedinidae													
53	Lesser Pied Kingfisher *(Ceryle rudis)*												*	C
54	Small Blue Kingfisher *(Alcedo atthis)*											*		C
55	Whitebreasted Kingfisher *(Halcyon smyrnensis)*				*	*			*	*	*	*	*	C
XXI	Meropidae													
56	Small Bee-eater *(Merops orientalis)*			*	*	*	*	*	*	*	*	*	*	I
XXII	Coraciidae													

57	Indian Roller *(Coracias benghalensis)*								*	*				C
XXIII	Upupidae													
58	Common Hoopoe *(Upupa epops)*									*				O
XXIV	Capitonidae													
59	Crimsonbreasted Barbet *(Megalaima haemacephala)*	*		*	*	*	*	*	*	*	*	*		F
XXV	Picidae													
60	Lesser Flamebacked woodpecker*(Dinopium benghalense)*				*	*		*	*	*				I
XXVI	Eurylaimidae													
61	Indian Pitta (*Pitta brachyura*)													
XXVII	Hirundinidae													
62	Dusky Crag Martin *(Hirundo concolor)*								*	*				I
63	Common Swallow *(Hirundo rustica)*								*			*	*	I
64	Wiretailed Swallow *(Hirundo smithii)*								*			*		I
65	Streak-throated Swallow (*Hirundo fluvicola*)												*	I
66	Redrumped Swallow *(Hirundo daurica)*								*			*	*	I
XXVIII	Laniidae													
67	Rufousbacked Shrike *(Lanius schach)*									*				O
XXIX	Oriolidae													
68	Eurasian Golden Oriole (*Oriolus oriolus*)													O
XXX	Dicruridae				*	*		*						
69	Black Drongo *(Dicrurus macrocercus)*			*	*	*	*	*	*	*	*		*	I
XXXI	Sturnidae													
70	Brahminy Starling (Sturnus pagodarum)			*	*	*	*	*		*	*			O
71	Rosy Starling *(Sturnus roseus)*				*	*				*	*	*		O
72	Common Myna *(Acridotheres tristis)*	*	*	*	*	*	*	*	*	*	*	*	*	O
73	Bank Myna *(Acridotheres ginginianus)*	*	*			*	*				*	*		O
XXXII	Corvidae													
74	Indian Tree Pie *(Dendrocitta vagabunda)*			*	*	*	*	*	*	*	*	*		O
75	House Crow *(Corvus splendens)*	*	*	*	*	*	*	*	*	*	*	*	*	O
76	Large-billed Crow *(Corvus macrorhynchos)*	*	*	*	*	*	*	*	*	*	*	*	*	O
XXXIII	Campephagidae													
77	Large Cuckoo-Shrike (*Coracina macei*)					*		*						O
XXXIV	Irenidae													
78	Common Iora (*Aegithina tiphia)*					*		*	*	*				I
79	Marshall's Iora (*Aegithina nigrolutea*)				*	*	*	*	*	*				I
XXXV	Pycnonotidae													
80	Red Vented Bulbul *(Pycnonotus cafer)*	*	*	*	*	*	*	*	*	*	*	*		O
81	White-browed Bulbul (*Pycnonotus luteolus)*					*								O
XXXVI	Timaliinae													
82	Common Babbler *(Turdoides caudatus)*											*		O
83	Large Grey Babbler *(Turdoides malcolmi)*						*			*				O
84	Jungle Babbler *(Turdoides striatus)*	*		*	*	*	*	*	*	*	*			O
XXXVII	Sylviinae													
85	Red-throated Flycatcher (*Ficedula superciliaris*)						*		*	*				I
86	Grey- headed Flycatcher (*Culicicapa ceylonensis*)								*					I
XXXVIII	Rhipidurinae													
87	White- browed Fantail Flycatcher *(Rhipidura aureola)*			*	*	*	*	*	*	*				I
88	White-throated Fantail-Flycatcher (*Rhipidura albicollis)*				*	*	*	*	*		*			I
XXXIX	Monarchinae													
89	Plain Prinia (*Prinia inornata*)								*					I
90	Ashy Prinia (*Prinia socialis)*					*	*	*	*	*	*			I
91	Common Tailorbird *(Orthotomus sutorius)*			*	*	*	*	*		*	*			I
92	Oriental Magpie Robin *(Copsychus saularis)*			*	*	*	*	*	*	*	*	*		O
93	Indian Robin *(Saxicoloides fulicata)*			*	*	*	*	*	*	*	*			I
XXXX	Motacillidae													
94	Paddyfield Pipit *(Anthus rufulus)*									*				I
95	Yellow Wagtail *(Motacilla flava)*				*	*	*		*	*	*	*	*	I
96	Citrine Wagtail (*Motacilla citreola*)					*								I
97	Pied or White Wagtail *(Motacilla alba)*			*	*	*	*		*	*	*	*	*	I
98	Grey wagtail (*Motacilla cinerea*)								*	*		*	*	I
XXXXI	Dicaeidae													
99	Tickell's Flowepecker (*Dicaeum erythrorhynchos*)					*			*	*				I
XXXXII	Nectariniidae													
100	Purple Sunbird *(Nectarinia asiatica)*	*		*	*	*	*	*	*	*	*	*		N

101	Purple - rumped sunbird (*Nectarinia zeylonica)*				*			*		*	*			N
XXXXIII	Zosteropidae													
102	Oriental White-eye *(Zosterops palpebrosa)*			*		*		*		*	*			O
XXXXIV	Ploceidae													
103	House Sparrow *(Passer domesticus)*		*	*	*			*		*	*	*	*	O
104	White-throated munia (*Lonchura malabarica*)							*						I
105	Scaly-Breasted Munia (*Lonchura punctulata*)					*					*			I

G = Graminivore, O = Omnivore, C = Carnivore, B= Bird of Prey, I = Insectivore, F = Frugivore, N = Nectarivorous

Conclusion

The urban ecosystem in semi-arid zone of Gujarat, India supports mainly graminivorous guild followed by omnivorous guild whereas ponds provide the good habitat for the carnivorous birds. The insectivores, frugivores and nectarivores are probably adversely affected by the human disturbances and urban development in this region.

References

1. Ali S. The book of Indian Birds.11th ed. Bombay Natural Society, Bombay, 1996.
2. Andrewartha HG, Birch LC. The Distribution and Abundance of Animals, Chap. 14. University of Chicago Press, Chicago. 1954.
3. Boal CW, Mannan RW. Comparative breeding ecology of Cooper's hawks in urban and exurban areas of southeastern Arizona. J. Wildl. Manage. 1999; 63:77-84.
4. Clergeau P, Savard LJP, Mennechez, G. Falardeau G. Bird Abundance and Diversity along an Urban-Rural Gradient: A Comparative Study between Two Cities on Different Continents. The Condor, 1998; 100(3):413-425.
5. Cody ML, An introduction to habitat selection in birds. In Habitat Selection in Birds. Ed. Cody M. L. Orlando, FL: Academic Press. 1985, 4-56.
6. Falk JH. Energetics of a suburban lawn ecosystem. *Ecology*, 1976; 57:141-150.
7. Immelmann K. Ecological aspects of periodical aspects of reproduction. In: *Avian,* Vol I, Eds. Farner, D. S. and King, J. R. Academic press, New York, London, 1971.
8. Jokimaki J, Suhonen J. Distribution and habitat selection of wintering birds in urban environments. Landscape Urban plan, 1998; 39:253-263.
9. Kotak VC. Certain histoenzymological observations on the reproductive cycle of Indian Feral Blue Rock Pigeon *Columba livia* (Gmelin): Ph. D Thesis submitted to the M. S. Univerisity of Baroda. India, 1979.
10. Krebs CJ. Ecology: the experimental analysis of distribution and abundance. Third edition, Harper and Row Publishers, New York, 1985.
11. Lake D. Ecological Adaptations for Breeding in Birds. Edward Grey Institute of Field Ornithology, Oxford. Methuen and Co Ltd. London, 1968.
12. Lim HC, Sodhi NS. Responses of avian guilds to urbanisation in a tropical city. Landscape and Urban Planning, 2004; 66:199-215.
13. Mills GS, Dunning JB, Bates JM. Effects of urbanization on breeding bird community structure in southwestern desert habitats. *Condor,* 1989; 91:416-429.
14. Perrins CM, Birkhead TR. *Avian Ecology*. Blackie. Glasgow and London. New York, 1983.
15. Rathod Jagruti, Deshkar Sonal and Padate Geeta. Diversity of avifauna in urban city, Vadodara, Gujarat. *Biolife*, 2017; 5(2):224-231.
16. Rathod JY, Padate GS. Feeding Habits of Pariah Kite *Milvus migrans* in Urban Areas" International Conference on Bird and Environment, Organized by Department of Zoology and Environmental Science Gurukula Kangri University, Haridwar, India from, 2004.
17. Reynaud PA, Thioulouse J. Identification of birds as biological markers along a neotropical urban-rural gradient (Cayenne, French Guiana), using co-inertia analysis. Journal of Environmental Management, 2000; 59:121-140.
18. Smith RJ, Schaefer JM. Avian Characteristics of an urban riparian strip corridor. *Wilson Bulletin*, 1992; 104:732-738.
19. Welty JC, Baptista L. In: The life of birds, fourth edition. Saunders College Publishing. New York, Chicago, San Francisco, Philadelphia, Montreal, Toronto, London, Sydney, Tokyo, 1988.
20. Young KM, Daniels CB, Johnston G. Species of street tree is important for Southern hemisphere bird trophic guilds. *Austral Ecology*, 2007; 32:541-550.