

Home Point Study of Birds and Mammals Diversity Allied to Humans in Lockdown of COVID-19 at Bharatpur, Chitwan, Nepal

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Abstract

The birds and mammals are nature gifted gene banks which differ greatly with variation in altitudes, climates, landscapes, vegetation and availability of food and water. The altitudinal variation in Nepal is 60 m to 8,848 m which affects climatic conditions and habitat types within short distance that influence species diversity of wild animals. Therefore, the objectives of this study were to reveal species richness, behaviors and luring factors for birds and mammals to attract to an urban area of Bharatpur Metropolitan City, the South-central lowland of Nepal. The methods applied to record species diversity of birds and mammals were made from a home point (a point of study made at the North-west corner of verandah in first floor of my home) located in Bharatpur-9, Saradpur, Sitalpath, in the coordinates of 27°39'55"N and 84°26'08"E. The animal species were observed thrice daily (at 7 AM, 10 AM and 2 PM) for 2 months beginning from 24 March to 23 May 2020 during the period of lockdown of COVID-19 and were listed in "Observation Data Sheet". The photographs and/or videos were taken except one of the species of bats (*i.e.* *Myotis formosus*) and six species of birds which were flying swiftly over the sky in 70 m in diameter (*i.e.* 7,436 square meters or 22 kattha in area) of the home point. The results obtained from my study were; 83 species, 53 genera and 37 families of wild birds; and 6 species, 5 genera and 3 families of wild mammals. Among birds, *Dicrurus* and *Ploceus* were recorded the highest 7.54% (4/53); followed by *Acridotheres*, *Megalaima*, *Merops*, *Oriolus*, *Psittacula* and *Streptopelia* with 5.66% (3/53), and remaining twelve genera were found 3.77% (2/53), and thirty three genera were 1.88% (1/53). Similarly, 33.33% (2/6) of *Herpestes*; and 16.66% (1/6) of each *Canis*, *Vulpes*, *Pipistrellus* and *Myotis* were recorded among mammals. Conclusively, I found that the species of birds and mammals were lured to human settlement area due to availability of food (*i.e.* small invertebrates, kitchen garbage etc.);

crops (*i.e.* maize, sesame etc.); vegetables (*i.e.* bean); fruits (litchi, mango, berries etc.); nesting places and healthy environment. However, there is great chance of transmission of viral (rabies, foot-mouth disease etc.), bacterial (tuberculosis) and parasitic zoonoses (echinococcosis, toxoplasmosis, helminthiasis etc.) to humans and domesticated animals through feces and saliva droppings in addition to the poultry raiding, biting to people and damage of fruits, vegetables and crops creating conflicts.

Keywords

Conflicts, COVID-19, Garbage, Predators, Zoonotic Diseases

1. Introduction

The birds and mammals are natural gene pools which differ greatly with variation in topography, and the environmental factors like altitudes, landscapes, climates, vegetation, availability of food and water, etc. The altitudinal variation in Nepal is 60 m to 8,848 m which affects climatic conditions and habitat types within short distance that influence species diversity of wild birds [1] [2] and wild mammals [3]. The temperature ranges from 7 degree Celsius in winter (January) to 34 degree Celsius in summer (May) in Bharatpur with annual rain fall 1,993 mm in average [4] which affects in growth of plants [5] and crop production [6] increasing insect population [7] [8] as well as livestock infestation [9] that influence microhabitat or local ecosystem [10]. The temperature and human density also affect population of mollusks like giant African snail (*Achatina fulica*) [11] which is one of the prime food of greater coucal bird (*Centropus sinensis*).

There are 18,043 living wild bird species [12] and 6,495 living wild mammal species [13] in the world. Nepal carries 4.91% ($n = 886$) of the bird species [14] and 3.46% ($n = 225$) of the mammals species of the world [15]. Total 543 species of birds and 68 species of mammals were reported from Chitwan National Park (CNP) and adjoining community forests of buffer zone areas [16]. In addition to these, 244 species of birds and 28 species of mammals were recorded from urban area (*ex-situ* habitat) of Bharatpur Metropolitan City (BMC) [17] [18]. The fragmented greenery, gardens, bushes and agricultural crops are important to attract wildlife to urban areas [7] [19] [20].

Several researches were accomplished to reveal species diversity and wildlife conflicts [21] [22] in Protected Areas (PAs) like National Parks and buffer zones of Terai. The PAs occupy 17.32% (1.03 million hectares) of the total forests whereas 82.68% (4.93 million hectares) are outside of Protected Areas [23]. Altogether, 27 Important Bird Areas (IBAs) were reported including forests, grasslands and fresh water ecosystems [24]. However, the IBAs from urban localities are yet to declare. The studies performed in PAs are mainly concerned with species diversity with little information to disclose behaviors and conflicts of wild

mammals with people [22] [25] [26].

The premier study was carried out to enlist diversity of urban birds and mammals from *ex-situ* habitat of Bharatpur Metropolitan City [17] [18]. Yet, there is need of behavior research of wild birds and mammals associated with human population and interacting one or other way to adapt in highly populated area in spite of dreadful threats created by conflicts. Therefore, in-depth study of animal population influenced by microclimates [27] of an urban area in BMC can open fields for new researchers to learn their adaptive behaviors, abundance, public importance (economy and diseases) and conflicts with human in micro-habitat.

Significances of the Study

This study has great importance mainly in two ways. The first and the most precious importance is: Reveal of species diversity of wild birds and mammals and their behaviors such as indicators of environment (*i.e.* commencement of pre-monsoon and monsoon, free of pesticides and other pollutions etc.), fixing of territory, feeding, courtship and nesting, parental care, aggression and defense, inter and/or intra-species interactions, and conflicts posed by socio-economic (plant pollination, crop damage, disease in domestic animals etc.) and/or socio-health problems (animal bite, transfer of zoonotic diseases etc.) in human population of the urban ecosystem. Secondly: The study discloses the increased behavior of wild animals in human settlement area in absence of vigorous human activities at the period of lock down of COVID-19.

2. Materials and Methods

2.1. Materials

The normal camera-Nikon COOLPIX S6400 (with 12X zoom) was used to take photographs or videos or both of the birds and mammals. The “Observation Data Sheets” were used to list the species diversity and behaviors. The pen and pencils were used to write on data sheet and erasers were used to erase when needed.

2.2. Methods

2.2.1. Study Site

The study area is located in about 250 meters (m) of air distance from the Bharatpur Central Bus Park in Bharatpur Metropolitan City at ward number-9 (Saradpur, Sitalpath), Chitwan, Nepal and comprised around 70 m in diameter and 7,436 square meters (*i.e.* 22 kattha) in area from “a home point” (a point of study made in a corner of verandah of first floor of my house) located in the coordinates of 27°39'55"N and 84°26'08"E and 194 m above sea level (a.s.l.). The diameter was taken in three directions (*i.e.* North, East and West) from the home point because the South direction was blocked by wall of the house (**Figure 1**).

Bharatpur Metropolitan City consists of 29 wards with 433 square kilometers that represents 19.34% area of Chitwan District (*i.e.* 2,238.39 kilometers) and



Figure 1. Micro-ecosystem with rapid changes: Plowed field seen after rain (a), Chinese Berry with cut branch (b), grown crops and vegetables (c), Ashy Drongo in front of resting bee (d), kitchen garbage eating Small Asian Mongoose and Greater Coucal in cleared field (e), and the researcher sitting at “a home point” to record data in “Observation Data Sheet” (f).

locates in the South-central lowland area of Nepal in the coordinates of 27°34'N to 27°45'N and 84°19'E to 84°29'E with altitudinal variation of 181 to 271 m a.s.l. [28]. The temperature rises up to 34 degree Celsius in the summer (May) and decreases to 7 degree Celsius in the winter (January) with 1,993 mm average annual rain fall [4]. The temperature of the study site varied from 13 to 29 degree Celsius in March (*i.e.* warm climate), 18 to 33 degree Celsius in April and

21 to 34 degree Celsius in May (*i.e.* warmest climate). Total precipitation was 35 mm (1.4 inch) in single day of March, 83 mm (3.3 inch) in 2 days of April and 188 mm (7.4 inch) in 4 days of the month May. Therefore, the fluctuations in temperature and rain fall affect in vegetations, fruiting plants, cultivating crops [5] [27] [29] [30] [31] and in/vertebrate animal species [8] [32] [33] [34].

The lack of use of pesticides and dumping of kitchen garbage (organic wastes) in the field also increase insect populations which attract wild birds and mammals. The fruiting trees, bushes and vegetables like java plum, china berry, litchi, mango, jack fruits, guava, papaya, pumpkins, bitter guard etc., planted near the edge of crop fields and adjoining houses create suitable environment to get foods and tin roofs provide safety hiding places during heavy rain and falling of hail-stones. The cemented poles and extended electric wires also provide roosting place for birds and bushes provide hiding place for mammals. The fallowing of soil exposes plenty of invertebrates and provides food temporarily for birds like crow, cattle egret, myna, starling, drongo, dove, pigeon etc. Yet, it creates sudden and very unstable environment during cultivation and harvesting.

2.2.2. Data Collection and Analysis

The identification of species diversity of birds and mammals, their behaviors and public and/or environmental importance were recorded from a home point. The animal species were observed and listed in "Observation Data Sheet" thrice daily (*i.e.* continuous sitting of 1-2 hours at 7 and 11 AM, and 2 PM) for 2 months beginning from 24 March to 23 May 2020 in the period of lockdown of COVID-19. The photographs and/or videos were taken except one of the species of bats (*i.e.* *Myotis formosus*) and six species of Birds (*i.e.* *Aegithina tiphia*, *Tadorna ferruginea*, *Ixobrychus cinnamomeus*, *Coracina macei*, *Delichon nipalense* and *Turdoides earlei*) which were flying swiftly over the sky in 70 m in diameter of the home point. The species of these birds and mammals were identified with photographic comparisons and using peculiar characteristics as given in [35] [36] [37] [38] [39] for birds and [3] [40] [41] [42] [43] [44] for mammals. The free search from Wikipedia and Animal Diversity Web (ADW) was performed to confirm taxonomic categories. The range of recorded number of a species was listed in each time. The types of behaviors like feeding, courtship and nesting, aggression and defense, parental care, conflicts and their public (*i.e.* carrier of zoonotic diseases, crop damage, pollination etc.) and environmental importance (*i.e.* indicator of pollution free environment, as scavenger etc.) were recorded to analyze using MS-Excel. The impact of daily weather such as temperature, rain and daylight was also considered to influence in regular activities of birds and mammals as the animals appeared infrequently in raining and dusky days.

3. Results

3.1. Species Diversity and National Status

From my study, total 83 species, 53 genera and 37 families of wild birds and 6 species, 5 genera and 3 families of wild mammals were reported (Tables 1-3).

Table 1. Checklists of birds with families, genera, species, common and Nepali names with national status.

SN	Code	Family	Genus	Species	Common name	Local name	National Status [24] [35]	Observed number at a time
1	21	Accipitridae	<i>Accipiter</i>	<i>badius</i>	Shikra	Sikra	LC	1 to 10
2	22	Accipitridae	<i>Circus</i>	<i>cyaneus</i>	Hen Harrier	Challa-chor Bhuichil	CR	1 to 10
3	69	Aegithinidae	<i>Aegithina</i>	<i>tiphia</i>	Common Lora	Suseli Chari	LC	1 to 10
4	34	Alcedinidae	<i>Megaceryle</i>	<i>lugubris</i>	Crested Kingfisher	Thulo-chhirbire Matikor	LC	1 to 10
5	35	Alcedinidae	<i>Halcyon</i>	<i>pileata</i>	Black-caped Kingfisher	Kalo-tauke Matikor	LC	1 to 10
6	33	Anatidae	<i>Tadorna</i>	<i>ferruginea</i>	Ruddy Shelduck	Chakhewa Chakhewi	NT	1 to 10
7	67	Apodidae	<i>Apus</i>	<i>affinis</i>	House Swift	Phirphire Gauthali	LC	1 to 10
8	46	Ardeidae	<i>Bubulcus</i>	<i>ibis</i>	Cattle Egret	Bastu Bakulla	LC	1 to 10
9	47	Ardeidae	<i>Ixobrychus</i>	<i>cinnamomeus</i>	Cinnamom Bittern	Rato Junbakulla	LC	1 to 10
10	41	Campephagidae	<i>Coracina</i>	<i>macei</i>	Large Cuckooshrike	Latushak Birahichari	LC	1 to 10
11	43	Chloropseidae	<i>Chloropsis</i>	<i>hardwickii</i>	Orange-billed Leafbird	Swornodar Haritchari	LC	1 to 10
12	32	Ciconidae	<i>Leptoptilos</i>	<i>javanicus</i>	Lesser Adjutant	Bhudifor Garud	VU	1 to 10
13	48	Ciconidae	<i>Anastomus</i>	<i>ascitans</i>	Asian Openbill	Ghungifor Garud	LC	1 to 10
14	54	Cisticolidae	<i>Orthotomus</i>	<i>sutorius</i>	Common Tailorbird	Paat-siune Fisto	LC	1 to 10
15	7	Columbidae	<i>Stigmatopelia</i>	<i>senegalensis</i>	Laughig Dove	Dhusar Dhukur	LC	1 to 10
16	16	Columbidae	<i>Streptopelia</i>	<i>orientalis</i>	Oriental Turtle Dove	Tame Dhukur	LC	1 to 10
17	17	Columbidae	<i>Streptopelia</i>	<i>decaocto</i>	Eurasian-collared Dove	Kanthe Dhukur	LC	1 to 10
18	18	Columbidae	<i>Stigmatopelia</i>	<i>chinensis</i>	Spotted Dove	Kurle Dhukur	LC	1 to 10
19	44	Columbidae	<i>Streptopelia</i>	<i>tranquebarica</i>	Red-collared Dove	Sanotame Dhukur	LC	1 to 10
20	77	Columbidae	<i>Columba</i>	<i>livia</i>	Common Pigeon	Parewa	LC	1 to 10
21	78	Columbidae	<i>Treron</i>	<i>phoenicoptera</i>	Yellow-footed Green Pigeon	Halesho	LC	1 to 10
22	15	Coraciidae	<i>Coracias</i>	<i>benghalensis</i>	Indian Roller	Theuwa	LC	1 to 10
23	11	Corvidae	<i>Corvus</i>	<i>macrorhynchus</i>	Black Crow	Kalo Kaag	LC	1 to 10
24	12	Corvidae	<i>Corvus</i>	<i>splendens</i>	House Crow	Ghar Kaag	LC	1 to 10
25	29	Corvidae	<i>Dendrocitta</i>	<i>vagabunda</i>	Rufous Treepie	Kokale	LC	1 to 10
26	58	Corvidae	<i>Dendrocitta</i>	<i>formosae</i>	Grey Treepie	Pahadi Kokale	LC	1 to 10
27	9	Cuculidae	<i>Centropus</i>	<i>sinensis</i>	Greater Coucal	Thode Gokul	LC	1 to 10
28	10	Cuculidae	<i>Eudynamis</i>	<i>scolopaceus</i>	Asian Koel	Koili	LC	1 to 10
29	63	Cuculidae	<i>Centropus</i>	<i>bengalensis</i>	Lesser Coucal	Sano Caucal	LC	1 to 10
30	49	Dicaeidae	<i>Dicaeum</i>	<i>erythrorhynchus</i>	Pale-billed Flowerpecker	Rato-thude Puspakokil	LC	1 to 10
31	13	Dicruridae	<i>Dicrurus</i>	<i>macrocerus</i>	Black Drongo	Kalochibe	LC	1 to 10
32	14	Dicruridae	<i>Dicrurus</i>	<i>leucophaeus</i>	Ashy Drongo	Dhwase Chibe	LC	1 to 10
33	55	Dicruridae	<i>Dicrurus</i>	<i>aeneus</i>	Bronzed Drongo	Sano Chibe	LC	1 to 10
34	56	Dicruridae	<i>Dicrurus</i>	<i>caerulescens</i>	White-bellied Drongo	Seto-pete Chibe	LC	1 to 10
35	53	Estrildidae	<i>Amandava</i>	<i>amandava</i>	Red Avadavat	Rato Munia	NT	1 to 10

Continued

36	52	Estrildidae	<i>Lonchura</i>	<i>punctulata</i>	Scaly-breasted Munia	Katero Munia	LC	1 to 10
37	79	Estrildidae	<i>Lonchura</i>	<i>striata</i>	White-rumped Munia	Seto-dshade Munia	LC	1 to 10
38	71	Fringillidae	<i>Carpodacus</i>	<i>erythrinus</i>	Common Rosefinch	Amonga Titu	LC	1 to 10
39	24	Hirundinidae	<i>Delichon</i>	<i>nipalense</i>	Nepal House-martin	Ghar Gauthali	LC	1 to 10
40	30	Lanidae	<i>Lanius</i>	<i>schach</i>	Long-tailed Shrike	Bhadrai	LC	1 to 10
41	31	Lanidae	<i>Lanius</i>	<i>vittatus</i>	Bay-backed Shrike	Chitrak Bhadrarai	LC	1 to 10
42	36	Megalaimidae	<i>Megalaima</i>	<i>haemacephala</i>	Coppersmith Barbet	Mil Chara	LC	1 to 10
43	37	Megalaimidae	<i>Megalaima</i>	<i>asiatica</i>	Blue-throated Barbet	Kuthurke	LC	1 to 10
44	68	Megalaimidae	<i>Megalaima</i>	<i>zeylanica</i>	Brown-headed Barbet	Kum-chhirke Kuthurke	LC	1 to 10
45	80	Meropidae	<i>Merops</i>	<i>orientalis</i>	Green Bee-eater	Murali Chara	LC	1 to 10
46	81	Meropidae	<i>Merops</i>	<i>philippinus</i>	Blue-tailed Bee-eater	Nilpuchhre Muralichara	LC	1 to 10
47	82	Meropidae	<i>Merops</i>	<i>leschenaulti</i>	Chestnut-headed Bee-eater	Katus-tauke Muralichara	LC	1 to 10
48	26	Monarchidae	<i>Terpsiphone</i>	<i>paradisi</i>	Asian-paradise Flycatcher	Dhage Chara	LC	1 to 10
49	27	Muscicapidae	<i>Copsychus</i>	<i>sauralis</i>	Oriental Magpie Robin	Dhobini Chari	LC	1 to 10
50	28	Muscicapidae	<i>Copsychus</i>	<i>malabaricus</i>	White-rumped Shama	Syama	LC	1 to 10
51	50	Muscicapidae	<i>Hodgsonius</i>	<i>phoenicuroides</i>	White-bellied Redstart	Seto-pete Khanjari	LC	1 to 10
52	57	Muscicapidae	<i>Saxicoloides</i>	<i>fulicatus</i>	Indian Robin	Debi Syama	LC	1 to 10
53	39	Nectariniidae	<i>Aethopyga</i>	<i>siparaja</i>	Crimson Sunbird	Sipraja Bungecharo	LC	1 to 10
54	1	Oriolidae	<i>Oriolous</i>	<i>xanthornus</i>	Black-hooded Oriole	Kalotauke Sunchari	LC	1 to 10
55	40	Oriolidae	<i>Oriolous</i>	<i>tenuirostris</i>	Sleder-billed Oriole	Tikhothude Sunchari	LC	1 to 10
56	74	Oriolidae	<i>Oriolous</i>	<i>oriolus</i>	Eurasian Golden Oriole	Gajale Sunchari	LC	1 to 10
57	51	Passeridae	<i>Passer</i>	<i>domesticus</i>	House Sparrow	Ghar Bhangera	LC	1 to 200
58	70	Passeridae	<i>Passer</i>	<i>montanus</i>	Eurassian Tree Sparrow	Rukh Bhangera	LC	1 to 200
59	19	Ploceidae	<i>Ploceus</i>	<i>bengalensis</i>	Black-breasted Weaver	Chhati-kale Topchara	VU	1 to 20
60	59	Ploceidae	<i>Ploceus</i>	<i>manyar</i>	Streaked Weaver	Dharke Topchara	LC	1 to 20
61	72	Ploceidae	<i>Ploceus</i>	<i>philippinus</i>	Baya Weaver	Baya Topchara	NT	1 to 20
62	75	Ploceidae	<i>Ploceus</i>	<i>megarhynchus</i>	Finn's Weaver	Sunaolo Topchara	CR	1 to 20
63	4	Psittasidae	<i>Psittacula</i>	<i>krameri</i>	Rose-ringed Parakeet	Kanthe Suga	LC	1 to 20
64	20	Psittasidae	<i>Psittacula</i>	<i>cycanocephala</i>	Plum-headed Parakeet	Tuisi Suga	LC	1 to 20
65	83	Psittasidae	<i>Psittacula</i>	<i>roseata</i>	Blossom-headed Parakeet	Gulafi-tauke Suga	NT	1 to 20
66	5	Pycnonotidae	<i>Pycnonotus</i>	<i>cafer</i>	Red-vented Bulbul	Jureli	LC	1 to 10
67	6	Pycnonotidae	<i>Pycnonotus</i>	<i>jocosus</i>	Red-whiskered Bulbul	Swet-wakshak Jureli	LC	1 to 10
68	65	Pycnonotidae	<i>Hypsipetes</i>	<i>leucocephalus</i>	Black Bulbul	Bakhre Jureli	LC	1 to 10
69	64	Sittidae	<i>Trichodroma</i>	<i>muraria</i>	Wallcreeper	Murari Putalichara	LC	1 to 10
70	2	Sturnidae	<i>Acridotheres</i>	<i>tristis</i>	Common Myna	Dangre Rupri	LC	1 to 20
71	3	Sturnidae	<i>Sturnia</i>	<i>pagodarum</i>	Brahminy Starling	Jure Sarau	LC	1 to 10
72	8	Sturnidae	<i>Sturnus</i>	<i>contra</i>	Asian Pied Starling	Dangre Sarau	LC	1 to 10

Continued

73	25	Sturnidae	<i>Acridotheres</i>	<i>fuscus</i>	Jungle Myna	Ban Rupi	LC	1 to 10
74	42	Sturnidae	<i>Gracula</i>	<i>religiosa</i>	Common Hill Myna	Myna	LC	1 to 10
75	61	Sturnidae	<i>Acridotheres</i>	<i>ginginianus</i>	Bank Myna	Bhid Rupi	LC	1 to 10
76	66	Sturnidae	<i>Sturnus</i>	<i>malabaricus</i>	Chestnut-tailed Starling	Fushro-tauke Sarau	LC	1 to 10
77	76	Sylviidae	<i>Sylvia</i>	<i>curruca</i>	Lesser Whitethroat	Swet-kantha Fisto	LC	1 to 10
78	23	Threskiornithidae	<i>Pseudibis</i>	<i>papillosa</i>	Black Ibis	Karraa Sawari	LC	1 to 10
79	60	Timalidae	<i>Turdoides</i>	<i>striata</i>	Jungle Babbler	Bagale Bhyakur	LC	1 to 10
80	62	Timalidae	<i>Turdoides</i>	<i>earlei</i>	Striated Babbler	Khar Bhyakur	LC	1 to 10
81	45	Tytonidae	<i>Tyto</i>	<i>capensis</i>	Grass Owl	Ghanse Latokosero	LC	1 to 10
82	73	Tytonidae	<i>Tyto</i>	<i>alba</i>	Barn Owl	Gothe Latokosero	VU	1 to 10
83	38	Upupidae	<i>Upupa</i>	<i>epops</i>	Common Hoopoe	Kapre Chara	LC	1 to 10
Total		37	53	83				

Table 2. Checklists of mammals with families, genera, species, common and Nepali names with National status.

SN	Code	Family	Genera	Species	Common Name	Nepali Name	National Status [3] [40]	Observed number at a time
1	1	Canidae	<i>Canis</i>	<i>aureus</i>	Golden Jackal	Shyal	LC	1 to 8
2	2	Canidae	<i>Vulpus</i>	<i>bengalensis</i>	Bengal fox	Phyauro	VU	1 to 2
3	3	Herpestidae	<i>Herpestes</i>	<i>edwardsii</i>	Grey Mongoose	Khairo Nyauri Musa	LC	1 to 4
4	4	Herpestidae	<i>Herpestes</i>	<i>javanicus</i>	Small Asian Mongoose	Sano Nyauri Musa	LC	1 to 4
5	5	Vespertilionidae	<i>Pipistrellus</i>	<i>tenuis</i>	Least Pipistrelle	Sano Chamero	LC	1 to 5
6	6	Vespertilionidae	<i>Myotis</i>	<i>formosus</i>	Hodgson's bat	Hodgson ko Chamero	LC	1 to 10
Total		3	5	6				

Table 3. Total families, genera and species of birds and mammals with their National status.

SN	Animals	Family	Genus	Species	National status [3] [24] [35] [40]				Total
					CR	NT	VU	LC	
1	Birds	37	53	83	2	4	3	74	83
2	Percentage				2.41	4.82	3.61	89.16	100
3	Mammals	3	5	6	0	0	1	5	6
4	Percentage				0	0	16.67	83.33	100.00
	Total	40	58	89	2	4	4	79	89

Among the genera of birds, *Dicrurus* and *Ploceus* were recorded the highest 7.54% (4/53); followed by *Acridotheres*, *Megalaima*, *Merops*, *Oriolus*, *Psittacula* and *Streptopelia* with 5.66% (3/53), and remaining twelve genera *i.e.* *Centropus*, *Copsychus*, *Corvus*, *Dendrocitta*, *Lanius*, *Lonchura*, *Passer*, *Pycnonotus*, *Stig-*

matopelia, *Sturnus*, *Tyto* and *Turdoides*; were recorded 3.77% (2/53). Similarly, thirty three genera i.e. *Accipiter*, *Aegithina*, *Aethopyga*, *Amandava*, *Anastomus*, *Apus*, *Bubulcus*, *Carpodacus*, *Chloropsis*, *Circus*, *Columba*, *Coracias*, *Coracina*, *Delichon*, *Dicaeum*, *Eudynamys*, *Gracula*, *Halcyon*, *Hodgsonius*, *Hypsipetes*, *Ixobrychus*, *Leptoptilos*, *Megaceryle*, *Orthotomus*, *Pseudibis*, *Saxicoloides*, *Sturnia*, *Sylvia*, *Tadorna*, *Terpsiphone*, *Treron*, *Trichodroma* and *Upupa* were recorded 1.88% (1/53). Likewise, 33.33% (2/6) of *Herpestes* spp.; and 16.66% (1/6) of each *Canis aureus*, *Vulpes bengalensis*, *Pipistrellus tenuis* and *Myotis formosus* were recorded among mammals. The number of birds observed at a time were in the range of 1-200 (sparrows); 1-20 (common myna, weaver birds and parakeets); and remaining 1-10 (**Table 1**); and 1-4 (*Herpestes* spp.); 1-2 (*Vulpes bengalensis*); 1-8 (*Canis aureus*); 1-5 (*Pipistrellus tenuis*); and 1-10 (*Myotis formosus*) were among mammals (**Table 2**). Similarly, the reported birds were CR 2.41% (2/83), NT 4.82% (4/83), VU 3.61% (3/83), and LC 89.16% (74/83) of National status [24] [35] and in mammals only two categories of National status [3] [40] VU 16.67% (1/6) and LC 83.33% (5/6) were reported (**Table 3**).

3.2. Behaviors Observed

Well specialized behaviors of birds and mammals were recorded such as feeding and territory (**Figures 1-3**), courtship and mating (**Figure 4**), nesting and parental care (**Figure 5**), aggression, defense and conflict behaviors (**Figure 6**). These animals were also reported as environmental indicators (presence of swallows, bee-eater and weaver birds indicated pre-monsoon and monsoon), pollinators (humming birds, sunbirds, weaver birds, bats etc.) [15] and carrier or host of zoonotic diseases (e.g. jackals, foxes, mongoose, bats etc.) like skin disease, parasitic (protozoan, toxocariasis, helminthiasis etc.), bacterial and viral infections (e.g. rabies, foot and mouth disease etc.) [30] [45] [46] [47]. Yet, the animal behaviors were affected by diverse factors such as sudden change in crop fields and micro-ecosystem due to cultivation and harvesting, temperature fluctuations and rain fall, growth of fruiting plants and vegetables as well as human activities.

3.2.1. Feeding and Territorial Behaviors

Both birds and mammals were established territory for feeding and forages (**Figures 1-3**) shaping with their experience, health and body size. The rubbing of snouts and urination in the plant stocks and walls as well as markings on the ground were made to fix the territory. The birds like coppersmith, coucal, drongo, crow, dove, humming bird, weaver bird, bee-eaters, shrike, bulbul and jungle babblers etc., produced diverse sounds to grab opportunity for feeding and to keep space. Similarly, natural behavior patterns were observed in small and medium sized mammals like bengal fox, golden jackals, bats etc., to establish feeding and foraging space. These animals were more active after rain, at morning (after 7 AM), at noon (after 11 AM) and early evening (after 2 PM). The birds were observed feeding even at 6.45 PM (e.g. coppersmith), at 7:20 PM (e.g. barn



Figure 2. Feeding behavior of birds: Inter species interactions for feeding among Blossom-headed Parakeet (a), Jungle babbler (b) and Streaked weaver (c). Blossom-headed parakeets eating Sesame oil seeds as alternative food just 6 m down to “a home point” (d), Asian Pied Myna (coprophagous) eating Jackal feces (e) and Greater Coucal (f) eating Giant African Snail (*i.e.* an exotic crop pest).

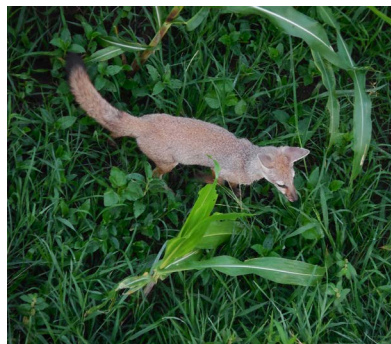




(c)



(d)



(e)



(f)

Figure 3. Feeding behavior of mammals: Golden Jackal (a) and Grey mongoose (b) eating kitchen garbage, baby Grey Mongoose testing food (c), Small Asian Mongoose eating a mouse (d) a crop pest, Bengal Fox (e) eating small in/vertebrates and Least Pipistrelle bat (f) on rest.



(a)



(b)



(c)



(d)



(e)



(f)

Figure 4. Courtship display and mating behaviors: Jungle Babblers (a), Red-vented Bulbuls (b), Red-whiskered Bulbuls (c) and Scaly-breasted Munia (d) among birds and Golden Jackals (e) among mammals are in courtship display where as Grey Mongooses are mating (f).



(a)



(b)



(c)



(d)



(e)



(f)

Figure 5. Nesting behaviors and parental care: House sparrows (a) and Jungle Myna (b) collecting nesting grasses, Common Myna (c) and Red-vented Bulbul (d) built nests under tin roofs, Asian Pied-starling feeding to its juvenile (e) and Grey Mongooses with parental care (f).



***Note:** The Golden Jackal tied in iron chain (d) was rescued and released by the researcher.

Figure 6. Aggression, defense and conflict behaviors: Living holes of Bengal Fox (a) under furniture, Small Asian Mongoose (b) and Golden Jackal (c) with skin diseases, Golden Jackal (d) tied in iron chain, killed Grey Mongoose (e) and Least Pipistrelle bats (f).

owl) and at 8:25 PM (e.g. grass owl). The jackals and foxes were observed repeatedly after rain (at noon, *i.e.* 12 PM) and in the evening (*i.e.* 9 PM). However, mongooses were more active in the morning (after 7 AM), at midday (11 AM to 12 noon) and in the early evening (after 2 PM).

3.2.2. Courtship and Mating Behaviors

Birds produced varieties of sounds to communicate sexual partners for mating. For examples, the male coucals, bulbuls, coppersmith, humming birds, drongo, koels etc., produced high pitched sound to attract females in early morning or in

the dusky day and rubbed wings or heads and pecked gently to make females ready for frequent mating. In streaked weaver birds, scaly-breasted munia, and jungle babblers, the male often rubbed heads and beaks with female partners for mating.. The jackals and foxes hauled infrequently at evening and night with short choppy sound. Similarly, the mongooses and jackals rubbed their snout with their partners to show closeness and preparedness for mating. The male jackal was riding on the female's body and biting mouth to mouth softly to make involved in sexual activities. Similarly, the mongooses were mating in the peaceful midday with careful gestures holding female by male with fore limbs coinciding genitalia from back side and remained in this posture for 5 minutes (**Figure 4**).

3.2.3. Nesting and Parental Care

The favorable season for nesting of birds was recorded in the first week of April for brahminy starlings, common myna, jungle myna and Asian pied myna, bulbuls, orioles, weaver birds, drongo and crows. The brahminy starling made nest in the electric meter box, common myna made nest under the tin roof, the bulbuls made nest with iron pipe under tin roof, Asian pied myna made nest in the cemented electric pillar, weaver birds made nest in the nut and palm tree leaves, and the other birds made nest in the fruiting and tall trees. The second batches were also begun in the third week of June in the same nest of brahminy starling, common myna and Asian pied myna. However, bulbuls, orioles, drongo, and crows nested for single batch. The mongooses and foxes made holes under the furniture or bushes to give birth of babies and Least Pipistrelle bats gave birth in the iron pipes, dark crevices and under tin roofs of the houses. The birds cared babies for more than three weeks where as mammals showed advanced social care until babies develop survival capacity (**Figure 5**).

3.2.4. Aggression, Defense and Conflicting Behaviors

Aggression is an innate behavior of birds and mammals used for shaping hierarchy among members and fixing territory mainly at feeding and sexual activities where as defense is ultimate way of protection. The birds such as drongo, brahminy starlings, crows and shrikes were more aggressive than others to protect babies from predator birds like shikra and hen harrier. These birds had strong pecking and chasing strategy to prevent invaders (*i.e.* suspected birds and carnivore mammals). The mongooses had three step protection strategies like Stand erect, See and Proceed (SSP). The foxes had elusive strategy and jackals were fearless to gnaw. The anomalous behaviors of jackals to raid poultry and sharing of feeding on organic garbage with different animals like mongooses, foxes, domestic cats, dogs and birds increased chances of transmitting viral, bacterial and parasitic zoonoses. The Asian pied myna was recorded feeding on feces of jackals (**Figure 2**) that can create socio-economic or health problems in humans through contamination of ripen fruits. The mongooses were recorded killed in the accidents in the streets and least pipistrelle bats were harshly killed in large population (*i.e.* 6 in number) at once by the people due to nuisance be-

havior of fecal droppings in the room (**Figure 6**), as the droppings were laid 1 m South to my “home point” of study, yet we did not disturb.

3.3. Factors Affecting Animal Behaviors

The behaviors of birds and mammals were affected by local environments of the study site. For examples the vegetations, temperatures, rain, pollutions and human activities had a direct impact in animal behaviors. The birds, mongooses, foxes and jackals were active in low temperature of the day (*i.e.* morning at 7 AM and in the early evening after 2 PM), after rain or in the dusky day and during reduced human activities. The visit of birds and mammals was increased at the time of maturation of crops or vegetables and fruiting trees like litchi, mango, java plum, china berry, guava, papaya etc. The fast grown plants due to frequent rain (up to 4 times precipitation in May) and tin roofs that were used as hiding places as well as the kitchen garbage (organic matters) kept in the mud pit lured these animals to fulfill hunger in crisis and lack of pollution or pesticides in this area were prime factors to attract wild animals to the city.

4. Discussion

This study reveals 83 species of birds (**Table 1** and **Table 3**) which represents 34.01% (83/244) of urban bird species of Bharatpur [17], 15.28% (83/543) of birds of Chitwan National Park (CNP) and 9.36% (83/886) of birds of Nepal [48]. Likewise, 6 species of mammals reported from this study, represent 21.42% (6/28) of urban mammals of Bharatpur [18], 8.82% (6/68) mammals of CNP and 2.66% (6/225) mammals of Nepal [48]. The fragmented gardens, bushes, agricultural lands free from pesticides, suitable microhabitat for insects and presence of hiding places in urban houses under tin roofs with availability of organic kitchen wastes of soil pit attracted wild birds and mammals in the urban area [17] [18] [20] [49] [50] [51]. The birds of CR (2.41%), NT (4.82%), VU (3.61%), and a species of mammal (Bengal fox) of the National status VU (16.67%) (**Table 3, Figure 3**) were reported in the densely populated city of human which signified great ecological values. Therefore, the urban area is a home for nesting and foraging birds, and temporarily or permanently living mammals.

The animals performed different types of behaviors to handle the situation in their own favors. Courtship and nesting, proper feeding and parental care, aggression and defense, intra-species or inter-species interactions etc., were maintained to balance micro-ecosystem of the locality. For instances, the spathe of maize cobs was removed by parakeets to expose seeds and hence jungle babblers, streaked weaver birds, common myna etc., were fed as an intra-species harmony (**Figure 2**). The parent birds like drongo, common myna, brahminy starlings, bulbuls, crows, sparrows and shrikes were more aggressive to protect babies with predators like shikra, hen harriers, mongooses, civets and cats. These birds also produced intense sound to warn other species to hide and were furiously chasing predators from their territory. The wild birds and mammals were also shifting

their behavior to adapt in the same urban areas due to opportunity of food selection. The habitat and food overlaps were also reported among species of jackals, and between foxes and jackals as reported by [52] [53]. Ten species of birds (*i.e.* bulbul, common myna, Asian pied starling, brahminy starling, house sparrow, crow, dove, pigeon, Eurasian golden oriole, and weaver birds) made nests near or at the human houses, in the cemented pillars or in electric meter box etc. (Figure 5) that indicated favorable environment in terms of getting nesting materials and foods (*i.e.* crops, fruits, grasses, in/vertebrates etc.) for their babies mainly in rainy season (April to July). Three species of mammals (*i.e.* a species of Bengal fox and two species of mongooses) also made den and/or holes under the tin roofs or furniture of human settlement area. Hence, the mesopredators were adapted in the city to be safe from large predators like leopards; tigers etc., of the PAs, and the urban people were gradually accepting wildlife presence in human habitat for their protection in sympatric association.

The birds and mammals were useful in control of in/vertebrate pests as biodiversity effects on function of ecosystem [54]. For examples the coucal birds were found eating on Giant African snail (*Achatina fulica*) which are exotic mollusk pests of crops, fruiting trees and vegetables. The shrikes, drongo, bee-eaters, common myna, oriental magpie robins, brahmini starlings etc., controlled grasshoppers, locusts, and other insects (pollinators) that increased agricultural production [55]. The martins, weavers and bee-eater birds were also useful to indicate commencement of pre-monsoon and monsoon. The granivorous (weavers, house sparrow etc.), frugivorous (parakeets, coucal etc.), and nectivorous (sunbirds, bulbuls etc.) birds were spreading seeds and pollinating plants (*i.e.* papaya, guava, maize, sesame etc.) as bats and humming birds pollinate flowering and fruiting plants [56] [57]. Hence, birds and mammals are major agents of pollination [58]. The small (e.g. mongoose) to medium sized mammals (e.g. foxes, jackals) and birds (e.g. coucal, crows, shikra, hen harriers etc.) were controlling crop pests like insects and rodents due to selection habit of diets and foods [59] and also were controlling pollutants like kitchen garbage (Figure 1 and Figure 3).

The presence of migratory or residential birds (Asian pied myna, coucal, bee-eater, weavers, shikra, etc.); and mammals (bats, foxes, jackals etc.); in the human locality [18] [60] alarms for zoonotic diseases like viral (H5N1 virus, rabies, foot and mouth disease etc.) [30] [45], bacterial (tuberculosis), and parasitic diseases (helminthiasis, skin disease etc.) due to overlap of habitat and diets [40] that can transmit to people through their stools and droppings of saliva in raw edible vegetables and ripen fruits like papaya, guava etc. The birds (*i.e.* coucal, crow, sparrow etc.) and mammals harbor different protozoan and helminthes parasites [45] [46], and their modes of transmission in the community people is yet to verify.

5. Conclusion

The existence of significant number of wild birds and mammals in a small hu-

man settlement area of Bharatpur Metropolitan City in lock down of COVID-19, indicates sympatric association of animals with humans although their innate behaviors were not sufficient to endure frequent and unpredicted challenges to save life. These animals were adapted to build nests or dens in or near human houses, feeding on anthropogenic plant productions (e.g. fruits, crops, vegetables etc.), kitchen garbage, poultry and small invertebrates. Therefore, the coprophagous (**Figure 2**) and other birds and mammals were connected in different aspects of human life to act as pollen vectors, monsoon and pesticide indicators, scavengers, local ecosystem regulator, and as carrier or host of viral, bacterial or parasitic zoonoses in addition to their own safety from human conflicts and large predators.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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