A COMPARATIVE STUDY OF AVIAN BIODIVERSITY IN TWO SITES *VIZ.* URBAN AND SUBURBAN AND IN TWO SEASONS *VIZ.* WINTER AND SPRING

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Abstract

A comparative study of avian biodiversity in two sites *viz.* urban and suburban and in two seasons *viz.* winter and spring is a study of analyzing and comparing differences in the bird communities between the two selected sites and between the two selected seasons. In this study, avian biodiversity was determined by the avifaunal species richness in two selected sites and in two different seasons. The results showed that bird species richness and diversity was more in suburban area (Kamal Park) as compared to the urban (Jatin Das Park) area and was more in spring (breeding) season as compared to the winter season. The percent composition of each avifaunal species was also measured in two selected sites and in two different seasons respectively in this study. The results showed that Common myna was the most frequent and Spotted dove was least frequent in Jatin Das Park during winter season. Pied myna was most frequent and Spotted dove was least frequent in Jatin Das Park during spring season. Red-vented bulbul was most frequent and Lesser golden-backed woodpecker was least frequent in Kamal Park during winter season. Purple sunbird was most frequent and Yellow-footed green pigeon was least frequent in Kamal Park during spring season. So, this study revealed that bird species richness and diversity decreases with increasing urbanization and increases with greater structural complexity of vegetation. This study also revealed that spring is the typical breeding season for most bird species. This study can be used for further research work for a prolonged period of time for more information.

Keywords: Avian biodiversity, urban, suburban, winter, spring, avifaunal species richness, percent composition

Introduction

- **Biological diversity**

Biodiversity or biological diversity basically refers to the variety of different types of life found on earth and is considered at different levels of of biological organization including genes, species and ecosystems. The term "biodiversity" was coined by Walter G.Rosen in 1985. It has

a variety of definitions:-

- According to the U.S. Office of Technology Assessment (1987), Biodiversity is "the variety and variability among living organisms and the ecological complexes in which they occur".
- Biodiversity is defined as the "variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems." (CBD, 1992).
- Biological diversity (biodiversity) is the variability amongst living organisms and applies to diversity within species, between species and of ecosystems.(UNEP, 2013).

Values of biodiversity

Biodiversity has ecological value through provision of ecosystem services such as production of oxygen, reducing carbon dioxide, maintenance of biogeochemical cycles, soil moisture conservation, disposal of wastes, pest control. Some of the biological resources are food, medicinal resources, ornamental plants, wood products. Biodiversity has aesthetic value: it is important as a tourist attraction. Biodiversity is a beautiful and wonderful aspect of nature.

Importance of biodiversity

The survival of human societies and culture, maintenance of a healthy environment requires biodiversity. The importance of biodiversity can be broadly classified into two parts:-

- It provides ecological security to the country or any region within it.
- It provides livelihood security to human communities and individuals who are critically dependent on biological resources and related knowledge such as tribals, farmers, forest dwellers.

Threats to biodiversity

Every kind of land use and transformation has an effect on biodiversity; may it be urbanization, deforestation, industry or agriculture [1]. The human population is rapidly urbanizing and so urbanization is one of the greatest man- made threats to biodiversity. Human interference in ecosystem function are habitat destruction, habitat fragmentation, overexploitation and pollution. Agriculture involving drainage, intense harvesting, monocultures and chemical fertilizer use is one of the greatest drivers of biodiversity loss.Several intensification of agriculture in the second half of the 20^{th} century caused a widespread decline in farmland biodiversity across different taxa such as birds [2].

Need for conservation of biodiversity

Conservation of biodiversity is important for economic reasons such as in relation to ecosystem services, tourism, provision of raw materials, clean air and water, medication and food security [3] but also for ethical and aesthetic reasons. Ecosystem services are essential for life to thrive on the planet and declining biodiversity will negatively impact human wellbeing by reducing these services [4]. Due to rapid anthropogenic land use changes, accelerating rates of natural habitat loss, habitat fragmentation and degradation and resulting extinctions of species, there is an urgent need for understanding the state of biodiversity to aid management and conservation.

Role of birds in ecosystem

Indicators are measurable substitutes for variables in the environment such as biodiversity. Ecological indicators enable the quantifiable assessment and comparison of biodiversity benefits across space and time. Ecological indicators are species or a group of species that represent the existence of certain environmental conditions by their presence in a given area. Their condition in a particular environment or response to stresses present in that environment may be transferable to other species with similar ecological requirements [5].

Birds are some of the most prominent species of the earth's biodiversity and are sensitive to environmental changes. Birds as a group serve as excellent indicators for assessing the impacts of urbanization on biodiversity because they are conspicuous in both natural and urban settings, are of interest to people and signal the quality and availability of a number of different types of habitat [6]. Beyond their role as indicators, birds play important ecological roles that benefit human populations. They provide a diverse group of ecosystem services. Services of particular importance to human well-being are:

- Provisioning of food from both wild and domesticated bird species.
- Regulating services such as the control of agricultural pests, including insects, rodents and weeds; pollination; seed dispersal and disposal of carrion through scavenging which helps to regulate disease in animals and humans.
- Supporting services such as nutrient cycling and soil formation as birds can transport nutrients and organic matter from one location and deposit it another in their waste.
- A number of cultural services including recreational opportunities such as sport hunting and birdwatching and the utilization of birds in art and religious observances [7].

Site variation in avian biodiversity

Bird species richness, diversity decreases with increasing urbanization. Urbanization affects landscape heterogeneity, and consequently the distribution, abundance and resources upon which birds depend [8,9]. Urban area is characterized by intensive anthropogenic influences which causes avian decline. Some of the direct and indirect influences from anthropogenic disturbances are urban development, pollution (air, water or soil), traffic flows; noise from vehicles, which may reduce the habitat quality for some birds in roadside areas. Avian diversity increases with an enhanced level of vegetation. Suburban area is characterised by greater structural complexity of vegetation and less anthropogenic disturbances (traffic flows, pollution) as compared to urban

area. So we can predict that birds are suppose to be more detected in suburban area as compared to urban area.

Seasonal variation in avian biodiversity

Avian diversity in an area is not static but changes seasonally. Vegetation increases the species richness of birds and shows that season can profoundly affect such indicators. During the winter season, birds are suppose to be less detected due to lower activity and presences(migratory species).

Trees shed their leaves during winter and begin to grow again and flower in spring. The ecological definition of spring relates to biological indicators such as the blossoming of a range of plant species, the activities of birds. Many flowering plants bloom at this time of year. So spring is the typical breeding season for most bird species. Thus we can predict that birds are suppose to be more detected during the breeding (spring) season than the winter season.

This study highlights how avian biodiversity changes between two sites viz. urban and suburban and between two seasons viz. winter and spring.

Review of Literature

Birds are crucial to maintaining the balance of many ecosystems by providing various ecological services.The diversity of birds and their feeding guilds in different land-use types were investigated in different parts of India to elucidate the effect of disturbance and habitat modification on bird communities. Birds fulfill many ecological functions in their habitats. For instance, they are bioindicators of healthy ecosystems [10,11]. Birds are present in various of habitat types and are among the important groups that play a vital role in both the structure and function of ecosystems by providing numerous ecological benefits, such as seed dispersal, the facilitation of forest restoration (*et al*. 2007), the pollination of many tropical plant species, and pest control services through the consumption of insects [12] and small rodents, which can devastate hectares of agricultural products. Thus, birds are an ideal study group for the valuation of ecosystem services [13].

Due to the important role that birds play in maintaining ecosystems and supporting biodiversity, many seek their protection to manage biological threats and efficiently protect the environment [14]. In addition, insectivorous species and raptors regulate disease vectors, including mosquitoes and rodents. Scavenger birds, such as the Pied Crow (*Corvusalbus*), contribute to biomass recycling and to some degree reduce levels of disposable wastes. Frugivorous birds play an important role in seed dispersal of fleshy fruit-producing plants [14]. These ecosystem services are important for many communities, and to ensure that birds can fulfill these biological roles at an appropriate level for current and future generations, there is a pressing need to study the dynamics and socioeconomics of bird diversity outside protected areas, especially in urban areas.

Garden birds were compared between several European countries and revealed important regional differences. For example, they showed that the number of species in urban, suburban, and rural gardens was similar in countries of northern Europe but not in western and southern

Europe. Few studies have even discussed the importance of the landscape surrounding cities when it could have a strong influence on the composition and structure of urban vegetation and wildlife [15,16].Breeding birds were surveyed along a gradient of increasing urbanization in Iowa City, Iowa, during the summers of 2014 and 2015 [17]. The results of this study indicated that the varying levels of urban intensity in Iowa City were related to the bird community in a number of ways. Bird species richness, Shannon diversity and evenness were all negatively impacted by increasing urbanization. Differences in the avian community were identified at various sites and relationships among land cover characteristics were examined and the proportion of each functional guild within each community to investigate the ways in which birds respond to increasing urban intensity.

McDonnell and colleagues (1993) developed the concept of urban-rural gradient analysis by expanding on their previous study of forest areas around New York City. In an early study of urban bird communities, [18] examined the distribution and abundance of bird species over a full gradient of urbanization in order to quantify the associated changes in the structure of the avian community. Blair found that most pre-development species gradually disappeared from study sites as levels of urbanization increased. Following research conducted within three different ecoregions within the United States, Blair and Johnson (2008) compared the results of three studies focused on bird distributions along urban-rural gradients in Palo Alto, California; Oxford, Ohio; and St. Paul, Minnesota. The authors found that species richness increased initially and then declined significantly as development increased along each gradient in each gradient in each of the respective ecoregions.

Recognizing the unique opportunity presented by the complex mix of land use and land cover types found within cities, [19] examined the ways in which buildings and vegetation influence the distribution and abundance of breeding birds in riparian corridors in Cincinnati, Ohio, at multiple spatial scales. A study by Clergeau and colleagues (1998) compared the distribution of birds along urban-rural gradients in Quebec, Canada with an urban population of 650,000, and Rennes, France, a city with a population of roughly 200,000. Both cities showed a slight increase in community measures in the presence of moderate development followed by a decline with increasing levels of urbanization.An estimation of bird assemblages was done in terms of diversity, species composition, status and abundance in urban and forest habitats of Nainital district of Uttarakhand [20]. They sampled different elevational gradients to understand the effect of urbanization and season on avian community composition. The results indicated that the forest had more complex bird community structure in terms of higher species richness, higher species diversity, higher evenness and more rare species as compared to urban habitat. Bird Species Richness(BSR) varied considerably among study areas, was highest at mid elevation and decreased at high elevation. BSR and Bird Species Diversity fluctuated across seasons but not habitat type [Current Zoology 57 (3): 318-329,2011].

In a study, birds were surveyed from 200 random sites in the lowlands of South Iceland, in order to assess the importance of different habitats for biodiversity of birds [21]. Birds were surveyed in the five most common vegetated habitat classes other than agricultural land: wetland, semi-wetland, rich heathland, grassland and poor heathland. The author found that in total there were 5128 individuals of 22 avian species and 95% of them were of eight species, seven waders and Meadow Pipit. Of those eight species, five Dunlin, Snipe, Whimbrel, Black-tailed Godwit and Meadow Pipit occurred in highest density in wetland but Oystercatcher and Redshank occurred

in highest densities in grassland and Golden Plover in poor heathland. Total density of the eight species in the five habitats ranged from 274 individuals per km^2 in poor heathland to 640 individuals per km^2 in wetland. Different measures of the avifauna in South Iceland suggested that wetter habitats were of greater importance for birds than the drier ones. The wetter habitats generally had higher densities and higher mean number of bird species.A study to find out the bird diversity at the Indian Institute of Forest Management (IIFM), Bhopal, was carried out over a period of nine months from July 2012 to March 2013 [22]. A total of 106 bird species belonging to 52 families were recorded during the study covering an area of about 93 hectares. The study area was divided into three major habitat types: open scrub, dry deciduous and urbanized. Bird species were classified into eight feeding guilds: carnivore, ground insectivore, sallying insectivore, canopy and bark insectivore, nectar insectivore, general insectivore, frugivore and water birds.

Of the total 106 species observed, 27 species were recorded as winter visitors. Density analysis was done using DISTANCE software and density was found to be 32.7 birds per hectare. Rank abundance curve was used for assessing species composition in different habitats and during different seasons. In terms of both richness and evenness, open scrub scored the highest rank (72 species and most even distribution of species). Higher species richness with lower species evenness was recorded during winter season for all the habitats.A comparative study of birds was performed in Teknaf Widlife Sanctuary (TWS), Inani Reserve Forest (IRF) and the Chittagong University Campus (CUC) in 2015 [23]. A total of 249 species belonging to 50 families were recorded by the authors. 210 species from 46 families in TWS, 187 species from 45 families in IRF and 182 species from 45 families in CUC. Of these, 181 species were resident, 57 winter visitors, three summer visitors, two passage migrants and five vagrants. According to their frequency of occurrence, 73 species were very common, 66 common, 62 uncommon and 48 rare. 120 species were passerines and 129 non-passerines. Among the three areas, TWS had the greatest diversity in terms of total species, residents, non-residents, forest indicator birds and wading birds.During 1984 and 1985, winter and spring bird communities were censused in chamise, mixed chaparral and blue-oak woodland habitats at Pinnacles National Monument, California [24].They found that both species composition and relative abundance of bird species in chaparral communities were more similar between seasons and years than were those of the oak woodlands. In all seasons species richness and bird numbers were highest in the blue-oak woodland, where the proportion of seasonal residents during the winter was similar to the chaparral but increased to over 37% in the spring. The high degree of variability in the blue-oak bird communities, relative to the chaparral assemblages was probably due to greater variation in food resource availability between seasons and from year to year.In a study, thirty avian censuses were conducted over a 2 year along a wooded streamside in southcentral Washington [25]. They found that avian species diversity and richness showed temporal periodicity (summer maxima and winter minima), but evenness did not.Comparing winter censuses to spring censuses, they observed statistically significant differences in avian community structure: in winter, species diversity was correlated with evenness but not richness, while in the breeding season, diversity varied as a function of richness, not evenness. Following a model proposed by Tramer (1969), they suggested that community organization during the spring breeding season might reflect elements of resource-based interspecific competition, while winter assemblages of birds were regulated by a harsh and variable climate.

The current global biodiversity crisis requires the accurate and efficient mapping and monitoring of broad-scale patterns of biodiversity. Developing methods for effectively monitoring status and trends in biodiversity is necessary to understand pressures encountered by biodiversity, and consequent responses. Habitat models based on remotely sensed data can provide valuable information for guiding conservation strategies and the management of biodiversity. However, models built using satellite image classifications overlook within-habitat heterogeneity, which may be an important component of wildlife habitats [26].

Materials and Methods

STUDY AREAS:

1. **JATIN DAS PARK(URBAN)**

   - LOCATION: Shyama Prasad Mukherjee Road, Patuapara, Bhowanipore, West Bengal 700025.
   - POPULARITY: Well known, urban.
   - COUNTRY: India
   - CITY: Kolkata
   - COORDINATES: 22.524262°N, 88.346489°E

2. **KAMAL PARK(SUBURBAN)**

   - LOCATION: Kamal Park Lane, Birati, West Bengal 700051.
   - POPULARITY: Well known, suburban.
   - COUNTRY: India
   - CITY: Kolkata
   - COORDINATES: 22.664380°N, 88.428443°E

Figure 1. Road map of Jatin Das Park

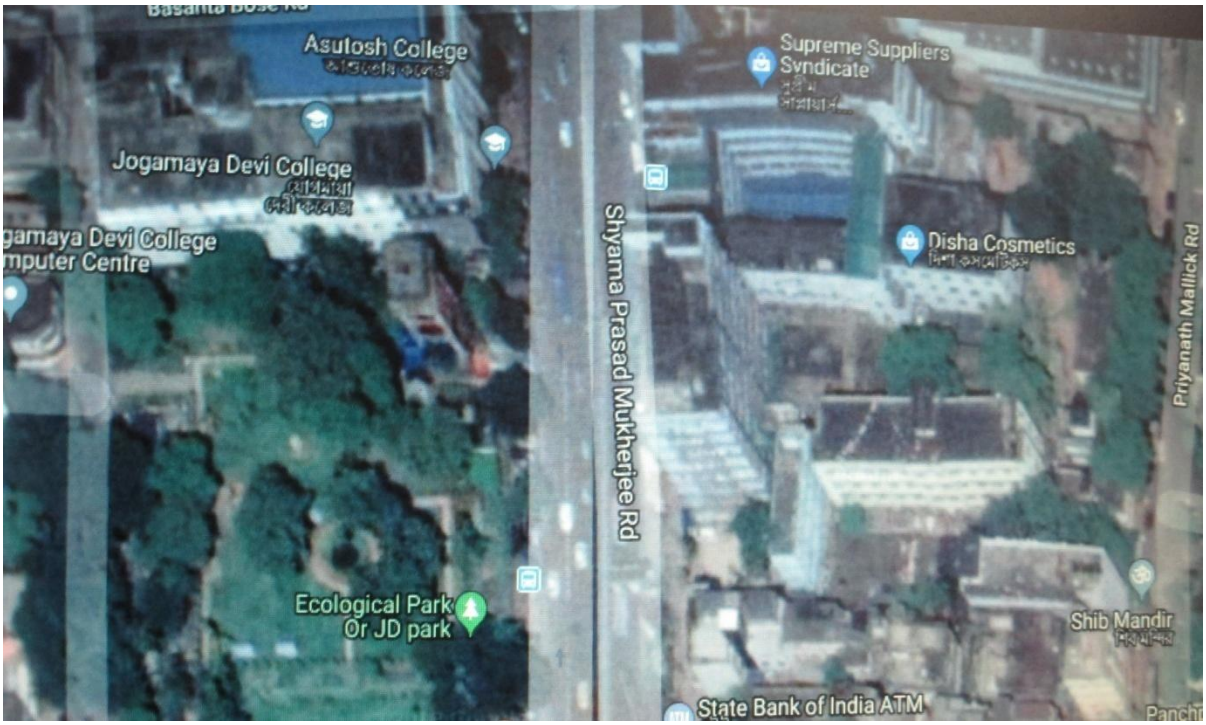


Figure 2. Satellite map of Jatin Das Park

Figure 3. Road map of Kamal Park

Figure 4. Satellite map of Kamal Park

Brief Description of the Study Areas:

1. **JATIN DAS PARK(URBAN)**

Jatin Das Park is situated on the Shyama Prasad Mukherjee Road, Bhowanipore in Kolkata. It is a densely populated area consisting of houses, buildings, roads. There is a hospital and a college in the vicinity of the park. The park consists of trees, garden, playground and it is situated adjacent to the road. So anthropogenic disturbances such as traffic flows(noise from vehicles), pollution reduces the diversity of birds in the park.

2. **KAMAL PARK(SUBURBAN)**

Kamal Park is situated on the outskirts of Kolkata. Though this a densely populated area, Kamal Park has more greenery than Jatin Das Park. So birds are able to build their nests on trees and are able to thrive here. There is a pond (Mandir Pukur) in the vicinity of the area which is a home to a great variety of aquatic birds.

MATERIALS REQUIRED:

- Camera
- Binocular
- Pen
- Record note book
- Field guide book- "The Book of Indian Birds" by Salim Ali (Oxford Publication)

METHOD OF AVIFAUNAL STUDY:

- **What to observe in a bird?**

  The morphological features that should be observed for bird watching and spotting are given below:

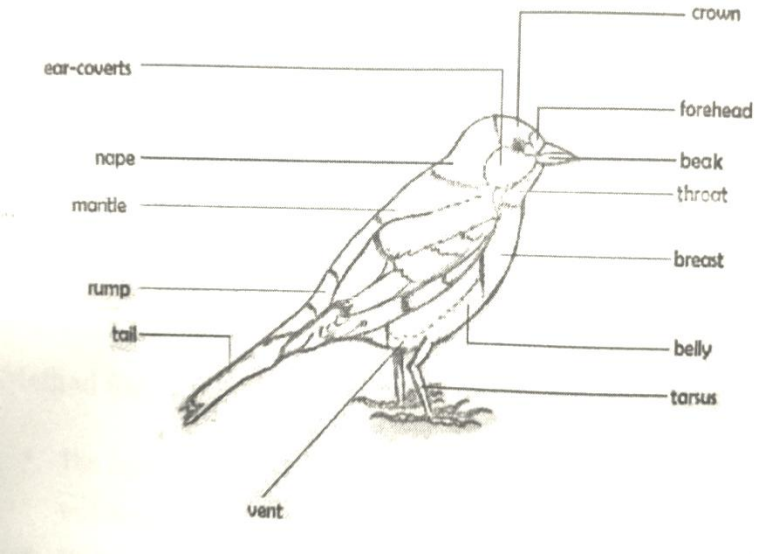


Figure 5. Descriptive Parts Of A Bird

- **Descriptive Parts Of A Bird**

  - Crown: The top or highest part of a bird's head, the peak of the head. Many birds have a crest on the crown or an otherwise distinct crown shape.

- Forehead: The part of a bird's head above the eyes and in front of the crown; the front part of the head.
- Beak: The beak or bill is an external anatomical structure of birds which is used for eating, manipulating objects, killing prey, fighting, probing for food, courtship and feeding young.
- Throat: Spans underside of lower jaw.
- Breast: Feathers continuous across front of body. Actually attached to neck.
- Belly: Actually unfeathered; covered by long feathers growing inward from flanks.
- Tarsus: The section of the vertebrate foot between the leg and the metatarsus.
- Vent: Opening at the vent is the opening of cloacae the terminal chamber of gastrointestinal and urogenital system.
- Rump: Rump is the body immediately above the tail.
- Mantle: The back of a bird together with the folded wings.
- Nape: The back of a bird's neck from the base of the skull to the upper back.
- Tail: Simply a fan that can be spread opened or folded closed.
- Ear-coverts: The ear coverts are small feathers behind the bird's eye which cover the ear opening.

Method of the Study:

The study was carried out from November 2017 to April 2018 and in two sites viz. urban and suburban. The study was conducted thrice a week in each month. The three days in a week were chosen randomly. Birds were observed in the morning (6am to 8am) and in the late afternoon (3pm to 5pm) when there is maximum bird activity. For this study, the data was separated on the basis of two seasons- winter (from November 2017- January 2018), spring (from February 2018- April 2018) and on the basis of two sites- urban (Jatin Das Park which is near to my college), suburban (Kamal Park which is my residential area).

As Jatin Das Park is very far away from my area, it was a bit difficult for me to go there and observe birds early in the morning. So some days I stayed in a relative's house which is near to Jatin Das Park and this became easier for me to observe and identify birds in Jatin Das Park.

Birds were observed and spotted with the help of binocular and their photographs were taken with the help of camera. Birds were identified mainly by their body colour and call. There were some birds which I could not identify by directly observing them. So for the identification of such birds, I took the help of the field guide book- "The Book of Indian Birds" by Salim Ali. The number of individuals of each bird species were counted and recorded in the note book for each season and for each site to find out the percent composition of each bird species.

Results

BRIEF DESCRIPTION OF OBSERVED AVIFAUNA

1. **COMMON NAME:** Black-hooded oriole

SCIENTIFIC NAME: *Oriolus xanthornus*

DESCRIPTION:

- The plumage is predominantly yellow, with jet black head, throat.
- Black also in the wings and tail centre.
- It has a bright pink bill and crimson eyes.
- It has a mixture of melodious flute-like calls and harsh calls.

2. **COMMON NAME:** Jungle babbler

SCIENTIFIC NAME: *Turdoides striata*

DESCRIPTION:

- The bird has brownish grey body, underparts are slightly darker.
- The legs and beak is yellow with mottling on throat and breast.

- It is an untidy looking bird with a longish tail.
- It is a noisy bird and lives in flocks of seven to ten or more.

So, it is popularly known as "Seven sisters" in English.

3. **COMMON NAME:** Black drongo

SCIENTIFIC NAME : *Dicrurus macrocercus*

DESCRIPTION:

- The bird is slim, fully glossy black with black beak and legs.
- It has a black long tail which is deeply forked.

4. **COMMON NAME:** Black kite

SCIENTIFIC NAME: *Milvus migrans*

DESCRIPTION:

- The bird is large, dark brown but the head and neck is pale.
- The feathers are black and have dark cross bars and are mottled at the base.
- The cere is yellow but the bill is black.
- The legs are yellow, claws are black, have a distinctive forked tail.
- It has a shrill, whistling voice "wir-r-r-r".

5. **COMMON NAME:** House crow

SCIENTIFIC NAME: *Corvus splendens*

DESCRIPTION:

- The bird is black with forehead, crown, throat are richly glossy black.
- The neck and breast are lightly grey-brown in colour.
- The beak, wings, tail, and legs are black

6. **COMMON NAME:** Rufous treepie

SCIENTIFIC NAME: *Dendrocitta vagabunda*

DESCRIPTION:

The body colour of the bird is cinnamon with a black head and the long graduated tail is bluish grey and is tipped in black.

- It has rufous brown mantle and the wing has a white patch.
- The bill is stout with a hooked tip
- The bill, legs and feet are black.

7. **COMMON NAME:** Common myna

SCIENTIFIC NAME: *Acridotheres tristis*

DESCRIPTION:

- The bird has brown body, black hooded head.
- There is a bare yellow patch behind the eye.

- The bill and legs are bright yellow.
- There is a white patch on the outer primaries and the wing lining on the underside is white.

8. **COMMON NAME:** Pied myna

SCIENTIFIC NAME: *Gracupica contra*

DESCRIPTION:

- The bird is strikingly marked in black and white.
- It has a yellowish bill with a reddish bill base.
- The bare skin around the eye is reddish.

9. **COMMON NAME:** House sparrow

SCIENTIFIC NAME: *Passer domesticus*

DESCRIPTION: It is a compact bird with a full chest and a large, rounded head. Its bill is stout and conical.

Both sexes were observed.

Male:

- The male has a dark grey crown from the top of its bill to its back and chestnut brown flanking its crown on the sides of its head.
- It has black around its bill, on its throat and on the spaces between its bill and eyes.
- They have white cheeks; wing rufous with a white wing-bar.
- Mantle is rufous-chestnut with black streaks.
- Rump and tail are greyish brown.

Female:

- The head of the female is brown with darker streaks around the mantle.
- Its underparts are pale grey-brown.
- The female's bill is brownish-grey.

10.COMMON NAME: Red-vented bulbul

SCIENTIFIC NAME: *Pycnonotus cafer*

DESCRIPTION:

- The body is dark brown with a scaly pattern.
- Its head is black with pointed black crest.
- The rump is white while the vent is red.
- The tail is black and tipped in white.

11. **COMMON NAME:** Red-whiskered bulbul

SCIENTIFIC NAME: *Pycnonotus jocosus*

DESCRIPTION:

- The body has brown upperparts, whitish underparts with a dark spur running onto the breast at shoulder level.
- It has pointed black crest, red face patch behind the eye.
- The tail long and brown with white terminal feather tips, but the vent area is red.

12. **COMMON NAME:** Oriental magpie-robin

SCIENTIFIC NAME: *Copsychus saularis*

DESCRIPTION: It is a black-and-white bird with a long tail which is held cocked upright.

Both sexes were observed.

Female:

The female is greyish black above and greyish white.

13. **COMMON NAME:** Jungle myna

SCIENTIFIC NAME: *Acridotheres fuscus*

DESCRIPTION:

- The bird has grey plumage, darker on the head and wings.
- It has white wing patches and a white tail tip.
- The head has a forehead tuft.
- The bill and legs are bright yellow and there is no bare skin around the eye.

14. COMMON NAME: Spotted dove

SCIENTIFIC NAME: *Spilopelia chinensis*

DESCRIPTION:

- The body has pinkish buff underparts with shading grey on the head and belly.
- There is a white-spotted black collar patch on the back and sides of the neck.
- The wing feathers are brown with light buff spots.
- It has a long tail, outertail feathers are tipped in white.

15. COMMON NAME: White-throated kingfisher

SCIENTIFIC NAME: *Halcyon smyrnensis*

DESCRIPTION:

- The bird has bright blue back, wings and tail.
- Its head, shoulders and lower belly are chestnut.
- The throat and breast are white.
- The long pointed bill and legs are bright red.

16. COMMON NAME : White-breasted waterhen

SCIENTIFIC NAME: *Amaurornis phoenicurus*

DESCRIPTION:

- The body has dark grey upperparts and white face, neck and breast.
- The lower belly and undertail are cinnamon coloured.

- It has a short tail which is held cocked upright, a yellow bill and legs.

17. COMMON NAME: Pond heron

SCIENTIFIC NAME: *Ardeola grayii*

DESCRIPTION:

- The bird has buff-brown back.
- It has a short neck, short bill.
- The wings are white which is prominent in flight.

18. COMMON NAME: Cattle egret

SCIENTIFIC NAME: *Bubulcus ibis*

DESCRIPTION:

- The bird is white with orange-buff plumes on the back, breast and crown.
- It has a short thick neck.
- The bill, iris are bright

19. COMMON NAME: Rock pigeon

SCIENTIFIC NAME: *Columba livia*

DESCRIPTION:

- The bird has a dark bluish-grey head, neck and chest with glossy greenish and reddish-purple lustrous effect
  along its neck and wing feathers.
- The iris is bright orange and the bare skin round the eye is bluish-grey.
- The bill is grey-black with a off-white cere.
- The feet are purplish-red.

20. COMMON NAME: Yellow-footed green pigeon

SCIENTIFIC NAME: Treron phoenicoptera

DESCRIPTION:

- The bird has yellowish olive-green body with a blue-grey crown.
- The neck and throat is dark golden olive-yellow.
- The abdomen is dull green and the lower belly is bright yellow.
- The tail is grey tinged olive basally.
- The legs are bright yellow.

21. COMMON NAME: Asian koel

SCIENTIFIC NAME: Eudynamys scolopaceus

DESCRIPTION: It is a large, long-tailed bird.

Both sexes were observed.

Male:

- The male is glossy bluish-black coloured with a pale greenish grey bill.
- The iris is crimson.
- It has grey legs and feet.
- The familiar song of the male is a repeated “koo-Ooo”.

Female:

- The female is brownish on the crown and has rufous streaks on the head.
- The back, rump and wing co dark brown with white and buff spots.
- The underparts are whitish and heavily striped.
- The call of the female is shrill "kik-kik-kik".

22. COMMON NAME: Rose-ringed parakeet

SCIENTIFIC NAME: *Psittacula krameri*

DESCRIPTION: The bird has yellow-green plumage, long graduated tail and broad, rounded and hooked pinkish-red beak.

Only female was observed, but male could not be spotted.

Female:

The female has a dull emerald-green collar and lacks the rose-pink and black collar.

23.COMMON NAME: Lesser golden-backed woodpecker.

SCIENTIFIC NAME: *Dinopium benghalense*

DESCRIPTION:

- The bird has golden yellow wing coverts.
- The rump is black.
- The underparts are white with dark chevron markings.
- The head is white with a black nape and throat.
- It has a red crown and crest.

24.COMMON NAME: Greater coucal

SCIENTIFIC NAME: *Centropus sinensis*

DESCRIPTION:

- The bird is large-sized with a long, broad, black tail.
- The head is black, upper mantle and underside are black glossed with purple.
- The back and wings are chestnut brown.
- The eyes are bright ruby red coloured.

25. COMMON NAME: Common hawk-cuckoo

SCIENTIFIC NAME: *Hierococcyx varius*

DESCRIPTION:

- The plumage is ashy grey above, whitish below, cross-barred with brown.
- The tail is broadly barred.
- It has a yellow eye ring.

26. COMMON NAME: Coppersmith barbet

SCIENTIFIC NAME: *Megalaima haemacephala*

DESCRIPTION:

- The bird is brightly green coloured.
- It has crimson forehead and crimson patch on breast.
- It has yellow throat as well as above and below eye.
- It has yellowish-green streaking on belly and red legs.
- It has short tail.

27. COMMON NAME: Blue-throated barbet

SCIENTIFIC NAME: *Megalaima asiatica*

DESCRIPTION:

- It is a green coloured, short-tailed bird.
- The forehead and crown is red with black band across the crown.
- The sides of the head, chin and throat is blue.

28. COMMON NAME: Purple sunbird

SCIENTIFIC NAME: *Cinnyris asiaticus*

DESCRIPTION: It is a small-sized bird which has a short down-curved bill. It has a short square ended tail.

Both sexes were observed.

Male:

- The male is glossy metallic bluish to purplish black on the upperparts.
- The wings are dark brown.

Female:

- The female is olive brown above and yellowish below.
- There is a darkish eye stripe.
- The throat and breast are yellow becoming pale towards the vent.

Table 1. AVIAN BIODIVERSITY IN TWO SELECTED SITES viz. URBAN AND SUBURBAN AND IN TWO DIFFERENT SEASONS viz. WINTER AND SPRING

SEASON	JATIN DAS PARK (URBAN)	KAMAL PARK (SUBURBAN)

Winter	House crow Common myna Pied myna House sparrow Red-vented bulbul Black kite Spotted dove	Black-hooded oriole Jungle babbler Black drongo Black kite House crow Rufous treepie Common myna House sparrow Red-vented bulbul Oriental magpie-robin Spotted dove White-breasted waterhen Pond heron Rock pigeon Rose-ringed parakeet Lesser golden-backed woodpecker Greater coucal

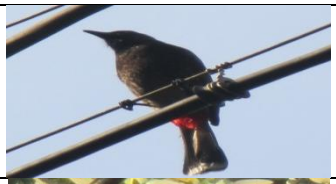
SEASON	**JATIN DAS PARK (URBAN)**	**KAMAL PARK (SUBURBAN)**

Spring	House crow Common myna Pied myna House sparrow Red-vented bulbul Black kite Spotted dove Jungle myna Coppersmith barbet	Black-hooded oriole Jungle babbler Black drongo Black kite House crow Rufous treepie Common myna House sparrow Red-vented bulbul Red-whiskered bulbul Oriental-magpie robin Spotted dove White-throated kingfisher White-breasted waterhen Pond heron Cattle egret Rock pigeon Yellow-footed green pigeon Asian koel Rose-ringed parakeet Lesser golden-backed woodpecker Greater coucal Common hawk-cuckoo Coppersmith barbet Blue-throated barbet Purple sunbird

Note:

- **No such exclusive birds were observed during winter season in both the sites.**
- **Jungle myna and Coppersmith barbet were exclusively observed during spring season in Jatin Das Park.**
- **Asian koel, Red-whiskered bulbul, White-throated kingfisher, Cattle egret, Yellow-footed green pigeon, Common hawk-cuckoo, Coppersmith barbet, Blue-throated barbet, Purple sunbird were exclusively observed during spring season in Kamal Park.**

Table 2: BIRDS OBSERVED IN BOTH SITES

SL NO.	COMMON NAME	JATIN DAS PARK	KAMAL PARK
1	House crow		
2	Common myna		
3	House sparrow		
4	Black kite		
5	Red-vented bulbul		
6	Spotted dove		
7	Coppersmith barbet		

BIRDS OBSERVED IN BOTH SEASONS

1. Black-hooded oriole
2. Jungle babbler
3. Black drongo(observed from late winter to spring)
4. Black kite(mainly observed in winter season)
5. House crow
6. Rufous treepie(observed from late winter to spring)
7. Common myna
8. Pied myna(mainly observed in spring season)
9. House sparrow
10. Red-vented bulbul
11. Oriental magpie-robin
12. Spotted dove
13. White-breasted waterhen
14. Pond heron
15. Rock pigeon
16. Rose-ringed parakeet(observed from late winter to spring)
17. Lesser golden-backed woodpecker(observed from late winter to spring)
18. Greater coucal

Species richness: It is the number of different species represented in a region.

Table 3: Avifaunal species richness in two selected sites and in two different seasons

SEASON	JATIN DAS PARK	KAMAL PARK
Winter	7	17

Spring	9	26

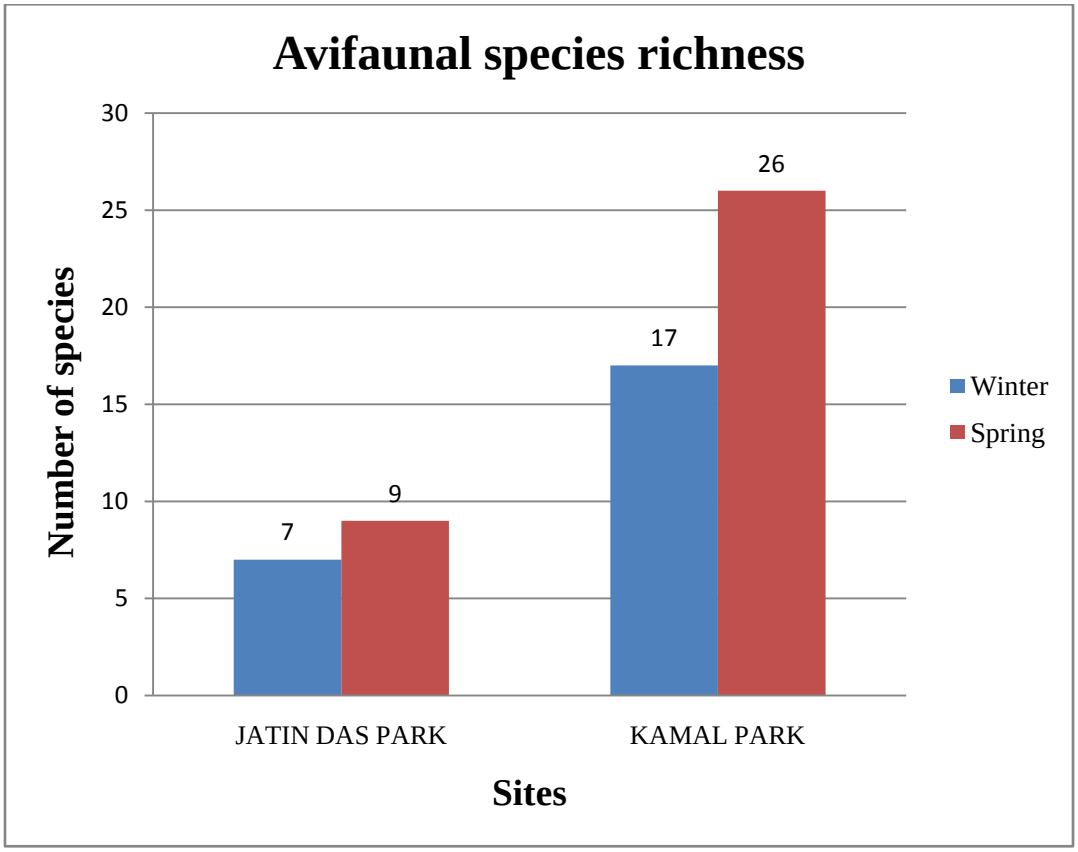


Figure 6: Graphical representation of Species richness of avifauna

Table 4: Percent composition of each avifaunal species observed during winter season in Jatin Das Park

SL NO.	COMMON NAME	NO. OF INDIVIDUALS	PERCENT COMPOSITION(%)
1	House crow	8	20
2	Common myna	12	30
3	Pied myna	5	12.5
4	House sparrow	3	7.5
5	Red-vented bulbul	6	15
6	Black kite	4	10

7	Spotted dove	2	5

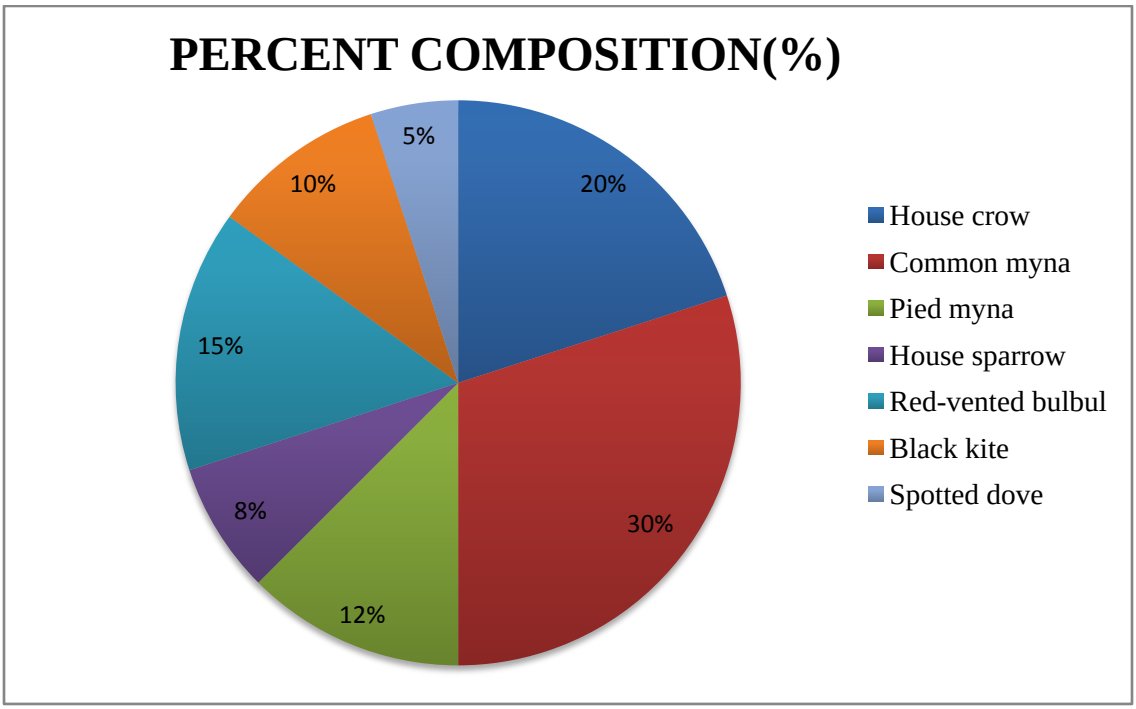


Figure 7: Graphical representation of percent composition of each avifaunal species observed during winter season in Jatin Das Park

Table 5: Percent composition of each avifaunal species observed during spring season in Jatin Das Park

SL NO.	COMMON NAME	NO. OF INDIVIDUALS	PERCENT COMPOSITION(%)
1	House crow	7	14
2	Common myna	10	20
3	Pied myna	14	28
4	House sparrow	5	10
5	Red-vented bulbul	4	8
6	Black kite	2	4
7	Spotted dove	1	2
8	Jungle myna	3	6

9	Coppersmith barbet	4	8

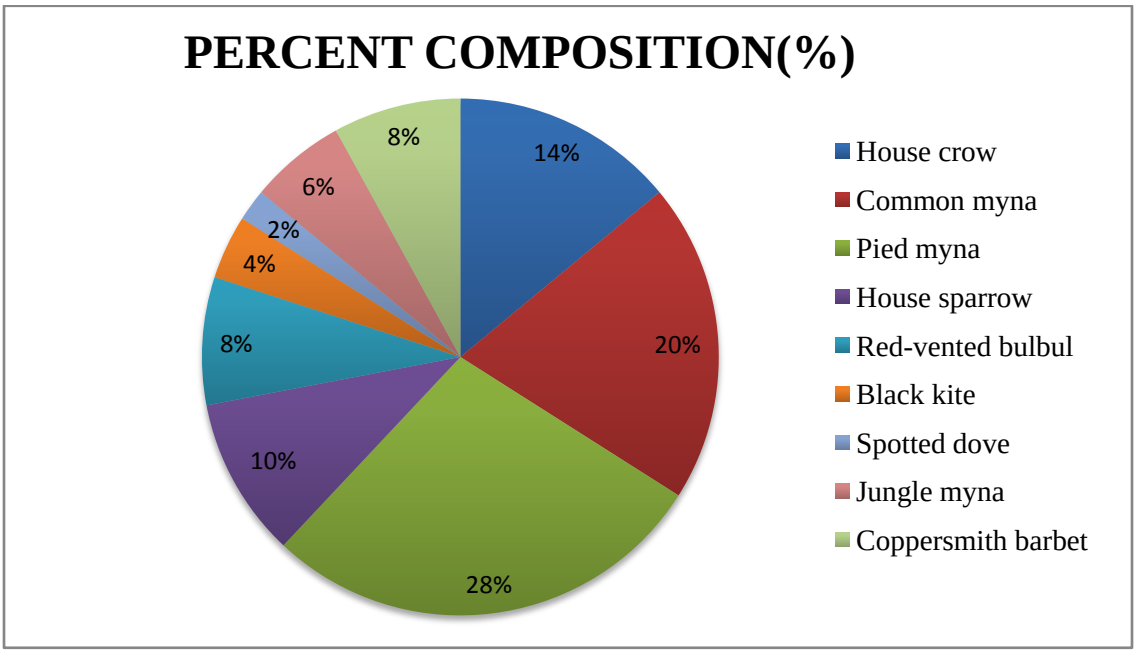


Figure 8: Graphical representation of percent composition of each avifaunal species observed during spring season in Jatin Das Park

Table 6: Percent composition of each avifaunal species observed during winter season in Kamal Park

SL NO.	COMMON NAME	NO. OF INDIVIDUALS	PERCENT COMPOSITION(%)
1	Black-hooded oriole	10	7.24
2	Jungle babbler	18	13.04
3	Black drongo	3	2.17
4	Black kite	8	5.79
5	House crow	14	10.14
6	Rufous treepie	4	2.89
7	Common myna	5	3.62
8	House sparrow	9	6.52
9	Red-vented bulbul	22	15.94
10	Oriental magpie-robin	6	4.34
11	Spotted dove	12	8.69
12	White-breasted waterhen	2	1.44
13	Pond heron	3	2.17

14	Rock pigeon	15	10.86
15	Rose-ringed parakeet	4	2.89
16	Lesser golden-backed woodpecker	1	0.72
17	Greater coucal	2	1.44

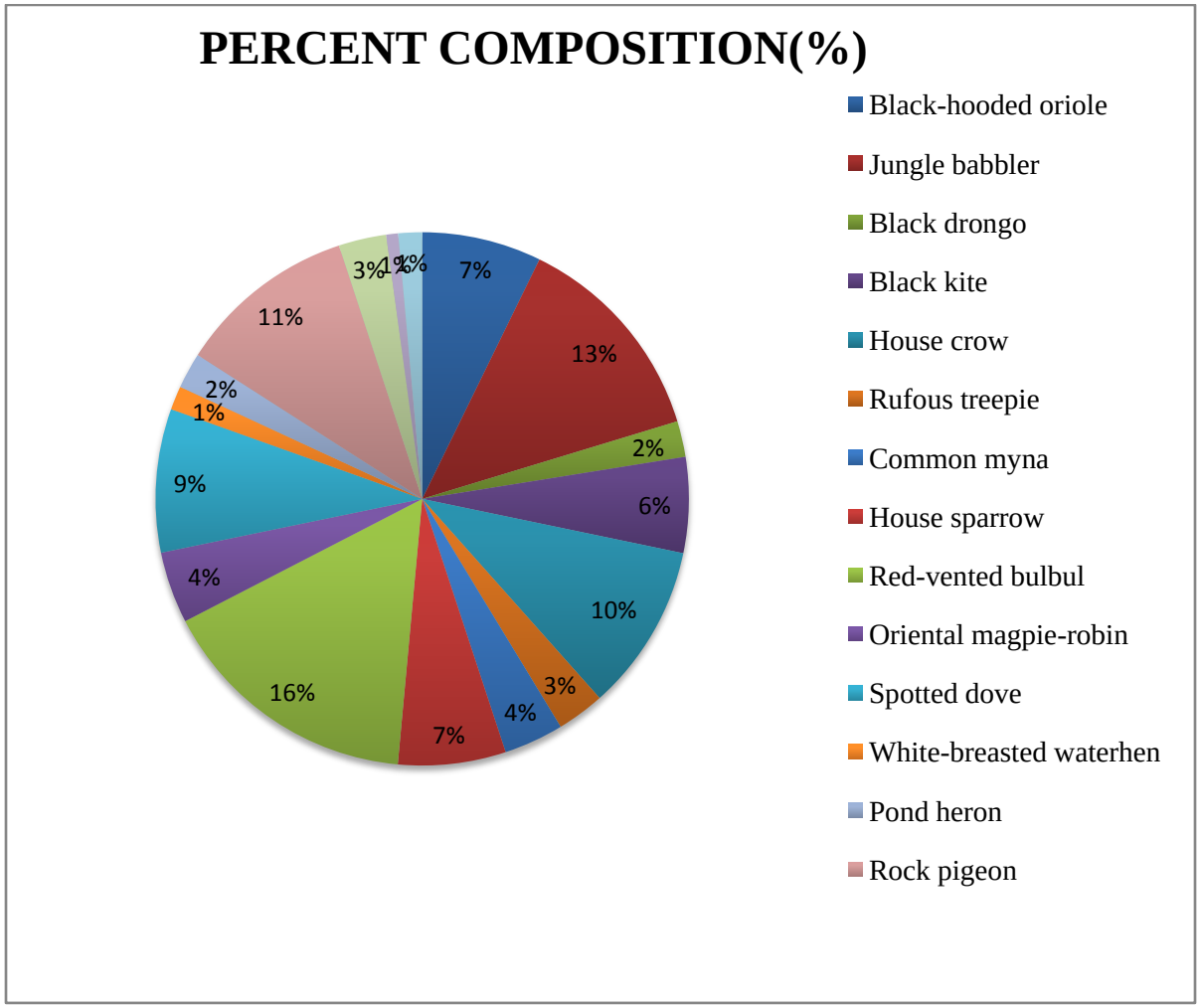


Figure 9: Graphical representation of percent composition of each avifaunal species observed during winter season in Kamal Park

Table 7: Percent composition of each avifaunal species observed during spring season in Kamal Park

SL NO.	COMMON NAME	NO. OF INDIVIDUALS	PERCENT COMPOSITION(%)
1	Black-hooded oriole	6	3.04
2	Jungle babbler	14	7.10
3	Black drongo	8	4.06
4	Black kite	3	1.52
5	House crow	15	7.61
6	Rufous treepie	9	4.56
7	Common myna	6	3.04
8	House sparrow	7	3.55
9	Red-vented bulbul	16	8.12
10	Red-whiskered bulbul	3	1.52
11	Oriental magpie-robin	4	2.03
12	Spotted dove	13	6.59
13	White-throated kingfisher	10	5.07
14	White-breasted waterhen	3	1.52
15	Pond heron	2	1.01
16	Cattle egret	12	6.09
17	Rock pigeon	13	6.59
18	Yellow-footed green pigeon	1	0.50
19	Asian koel	10	5.07
20	Rose-ringed parakeet	9	4.56
21	Lesser golden-backed woodpecker	3	1.52
22	Greater coucal	2	1.01
23	Common hawk-cuckoo	2	1.01
24	Coppersmith barbet	2	1.01
25	Blue-throated barbet	4	2.03
26	Purple sunbird	20	10.15

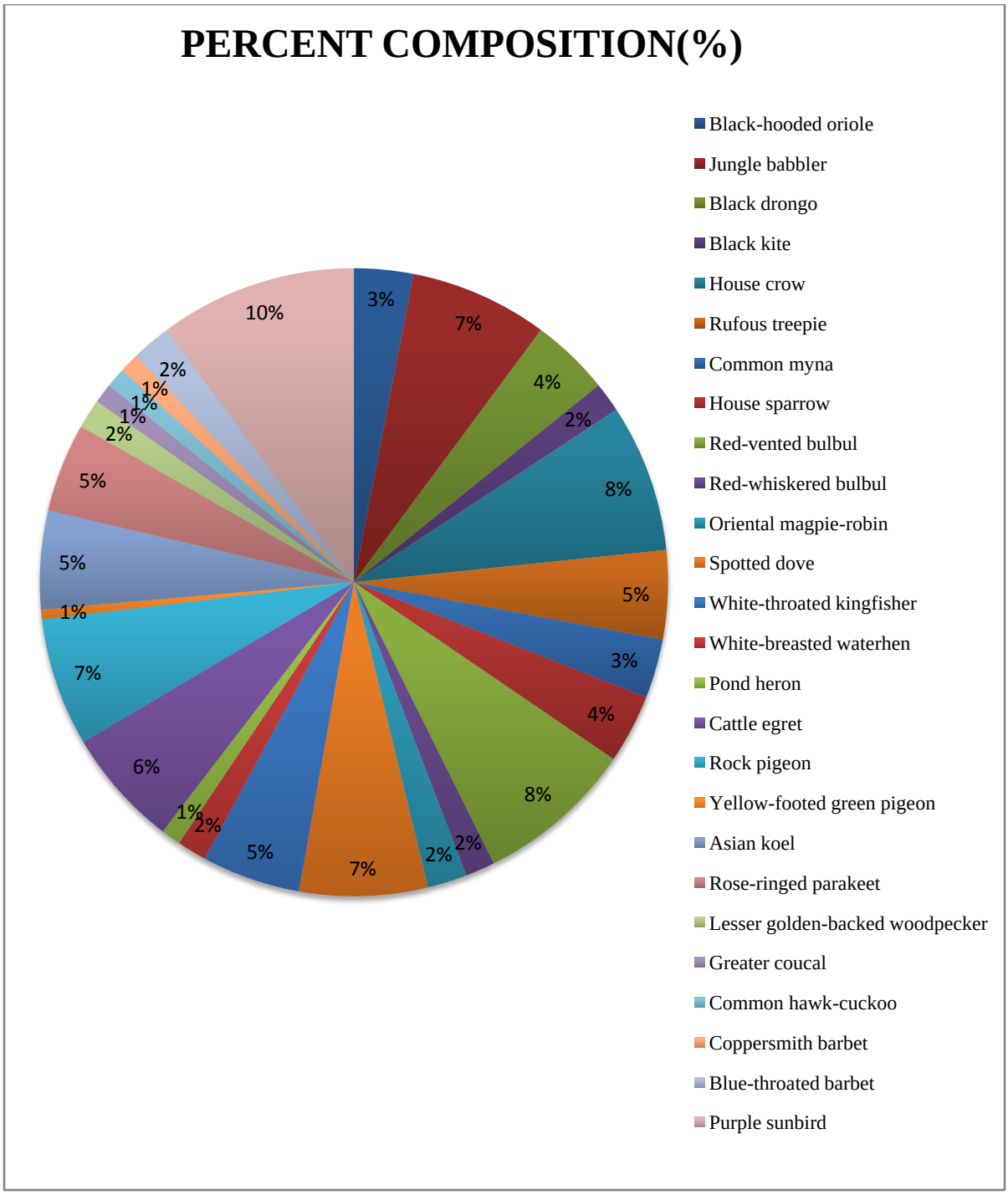


Figure 10: Graphical representation of percent composition of each avifaunal species observed during spring season in Kamal Park

Table 8: Seasonal Meteorological data of Kolkata(November 2017-April 2018)

	WINTER	SPRING
Temperature(°C)	21.9	26.9
Rainfall(mm)	18	41.6
Relative humidity(%)	67	60.6
Sunshine hours	199.3	220.8

Source: India Meteorological Department

Discussion

This study has revealed that avian biodiversity changes between two sites viz. urban and suburban and between two seasons viz. winter and spring. A total of 28 bird species were recorded during the study and each bird species were observed and identified by their body colour, beak patterns, tail, their call and many other characteristics which gives a brief description of each bird species.

Avian biodiversity is compared in two selected sites and in two different seasons [Table 1.]. The table shows that in both winter and spring season, bird diversity was highest in the suburban (Kamal Park) area and in both the sites- urban and suburban, the bird diversity was highest in the spring season. The bird species which were observed during the winter season in both the sites were also observed during the spring season in both the sites. So, no such exclusive bird species were observed during the winter season in both the sites. During the spring season, 2 exclusive bird species were observed in urban (Jatin Das Park) and 9 exclusive bird species were observed in the suburban (Kamal Park).

There were certain bird species which were observed in both the sites- Jatin Das Park and Kamal Park [Table 2.]. The table shows that bird species such as House Crow, Common myna, House sparrow, Black kite, Red-vented bulbul, Spotted dove, Coppersmith barbet have a good adaptation capability to both urban and suburban areas. It shows that they can thrive in both the environments.

Species diversity is determined by the number of different species in a region i.e. species richness. More species richness contributes to increase in biodiversity. In this study, avian biodiversity was determined by the avifaunal species richness in two selected sites and in two different seasons [Table 3, Figure 6]. The table and the figure shows that species richness was highest in the suburban (Kamal Park) in both the seasons and was highest in the spring season in both the sites. Bird species richness decreases with increasing urbanization. As urban area is characterized by intensive anthopogenic disturbances this reduces the habitat quality for some

birds in roadside areas. So, bird species richness was less in Jatin Das Park (urban) in both the seasons due to several anthropogenic disturbances.

A study on ["The effects of human development on avian diversity along an urban-rural gradient in Iowa City, Iowa by Jason D. McCurdy] showed that bird species richness decreased with increasing urbanization. Avian diversity increases with an enhanced level of vegetation. Suburban area is characterized by greater structural complexity of vegetation and less anthropogenic disturbances as compared to urban area. So bird species richness was more in Kamal Park (suburban) in both the seasons. Vegetation increases the species richness of birds and showed that season could profoundly affect such indicators. During the winter season, bird species richness was less in both the sites- Jatin Das Park and Kamal Park.

The ecological definition of spring relates to biological indicators such as the activities of birds. Many flowering plants bloom at this time of the year. So, spring is the typical breeding season for most bird species. Thus, bird species richness was more in the spring season in both the sites.

In this study, percent composition of each avifaunal species was measured in two selected sites and in two different seasons respectively. [Table 4, Figure 7] shows that Common myna was the most frequent species in Jatin Das Park during winter season. [Table 5, Figure 8] shows that Pied myna was the most frequent species in Jatin Das Park during spring season. This shows that spring was the breeding season for Pied myna. [Table 6, Figure 9] shows that Red-vented bulbul was the most frequent species in Kamal Park during winter season. [Table 7, Figure 10] shows that Purple sunbird was the most frequent species in Kamal Park during spring season. This shows that spring was the breeding season for Purple sunbird.

Conclusion

After analyzing and comparing differences in avian biodiversity between two sites-urban and suburban and between two seasons- winter and spring, it is revealed that bird species richness and diversity was more in suburban (Kamal Park) area as compared to the urban (Jatin Das Park) area and was more in spring (breeding) season as compared to the winter season. So, it can be concluded that bird species richness and diversity decreases with increasing urbanization and increases with greater structural complexity of vegetation. As more birds were detected during the spring season than the winter season, so it can be concluded that spring is the typical breeding season for most bird species.

Thus, this study suggests that suburban area exhibits greater avian biodiversity than urban area and spring season displays higher avian biodiversity than winter season.

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