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Urban green spaces for sustainable urban development and ecological integrity

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Abstract:

Urbanization involves various human activities such as infrastructure development, pollution, habitat destruction and introduction of invasive species. These factors can have profound effects on animal populations, including changes in abundance, behavior and even local fauna/flora extinctions. Therefore, conducting extensive studies on such issues is crucial to gain deeper insights into the dynamics of urban biodiversity. During the study period, a comprehensive assessment of the flora and fauna was conducted, resulting in the identification of 67 species of fauna belonging to 7 classes, 24 orders, and 47 families. The avian community, represented by 41 species (61.19%), was the most dominant biotic group, followed by mollusks with only a single species (1.49%). Additionally, 47 species of flora were identified, including prominent plants such as the *Ficus benghalensis, Ficus religiosa, Tamarindus indica, Eucalyptus lanceolatus,* and *Alstonia scholaris*. The herpetofauna community was represented by several species, including the *Hoplobatrachus tigrinus, Calotes versicolor, Sphenomorphus dussumieri,* and *Eryx whitakeri*. The Simpson index, which measures species dominance, yielded a maximum value of 2.15, indicating a diverse distribution of species within the studied area. The Shannon index, which considers species richness with evenness and was found to be 1.25. Overall, this study provides valuable insights into the composition and distribution of fauna and flora species within the study area and assessing the impacts of anthropogenic pressure which is crucial for informed urban planning and biodiversity conservation. By expanding our understanding of urban biodiversity dynamics, we can develop strategies and policies that strike a balance between urban development and the preservation of ecological integrity.

Keywords: Urban green spaces (U.G.S); Simpson index; Shannon index; Biodiversity; ecological integrity

1.Introduction:

Urban cities are rising day by day and biodiversity is at a verge of declining due to new competition with predatory or exotic species, increasing human habitation or urbanization, climate change, habitat loss with ecosystem degradation (Caragh *et al.,* 2017). The Urbanization is a global trend with significant implications for the future and the world's population living in urban areas has been steadily increasing in last three decades and moreover, according to the United Nations survey, approximately 55% of the global population lived in urban areas, and this number is projected to reach 68% by 2035 (UN World Urbanization Prospects 2018). This urbanization causes a decrease in per capita space and thereby a loss of per capita urban green space (UGS), which furthermore causes a decrease in daily exposure to more natural environments. Urban green spaces refer to areas within cities that are covered with grass, trees, and other vegetation. These spaces can come in the form of parks, community gardens, green roofs, and other types of open spaces. The UGSs are important for mitigating the effects of pollution and reducing the heat effect. In addition, many studies have confirmed that urban green space plays a key role in improving human well-being, such as relieving stress and fatigue, reducing noise pollution, and reducing disease occurrence and they have great potential to improve the living quality of residents and their physical and mental health (Caragh *et al.,* 2017). Scholars have also widely discussed the ecosystem function of UGS based-biodiversity and USG areas have been linked to a positive effect to increase urban biodiversity (De la Barrera, 2016; Correa, 2021; Sangwan *et al.,* 2022; Zhao *et al.,* 2022). These areas are considered to enhance the total biodiversity of that particular region but local development, urbanization, and population explosion impose serious threats to the flora and fauna (Mortberg and Wallentinus, 2000).

In this particular context of USG, local administrators should encourage the provision of UGS in small city or city with congested population. Additionally, city governments are planting vegetation in streets, parks, gardens, and on roofs to help offset the negative impacts of increased urban density. However, providing more UGS is a challenging task for finding suitable UGS in densely populated cities particularly in metropolitan cities like Delhi and Gurugram. This environmental injustice has become a planning priority, leading to parkland acquisition programs and diverse strategies to deploy underutilized urban land wherever possible for additional green space. So, when we talk about big and congested city, the day by day increasing population and pollution along with air quality degradation has become a serious issue in concern to the loss of large, native trees and declines in habitat complexity have a negative impact on urban bird communities, but little is known about the impacts on other taxa. So, we need more information on how to better manage vegetation to retain complex habitats particularly in congested city. As successful biodiversity conservation strategies we require to evaluate potential interventions for UGS, such as adaptive reuse of infrastructure, and sustainable development of India, so the present study was planned to assess the impact of rapid urbanization on local flora and fauna and evaluate the success of efforts to expand inner-city green spaces in Gurugram city particularly. Such research can provide valuable insights into the ecological consequences of urbanization and the effectiveness of measures taken to mitigate its impacts. However, aggregate community measures such as species richness may not adequately account for species-specific responses to vegetation quality. Here, we use multi-species site occupancy-detection models to provide a more nuanced understanding of urban biodiversity patterns by accommodating both taxa-level and species-specific responses. We use this approach to identify beneficial management actions to support a wide range of taxonomically and functionally diverse native biodiversity.

1. SURVEY METHODS

1.1 Study area

Metropolitan City Gurugram (28°46' N latitude and 77°02' E longitudes) lies in the near world's most populated city in India (Fig. 1). It has experienced dramatic population and spatial growth in the last 20 years: the population was doubled in last decade's 2011 and the built-up area increased from 24.6 km^2 in 1949 to more than 190 km^2 in 2003 (Indian Institute of Human Settlements, 2011). The area examined in this study includes a UGS (area of Dronacharya college) situated on new railway road in the hub of the concrete jungle of overpopulated city which covers an area of approximately 50 hec. (Fig.1).

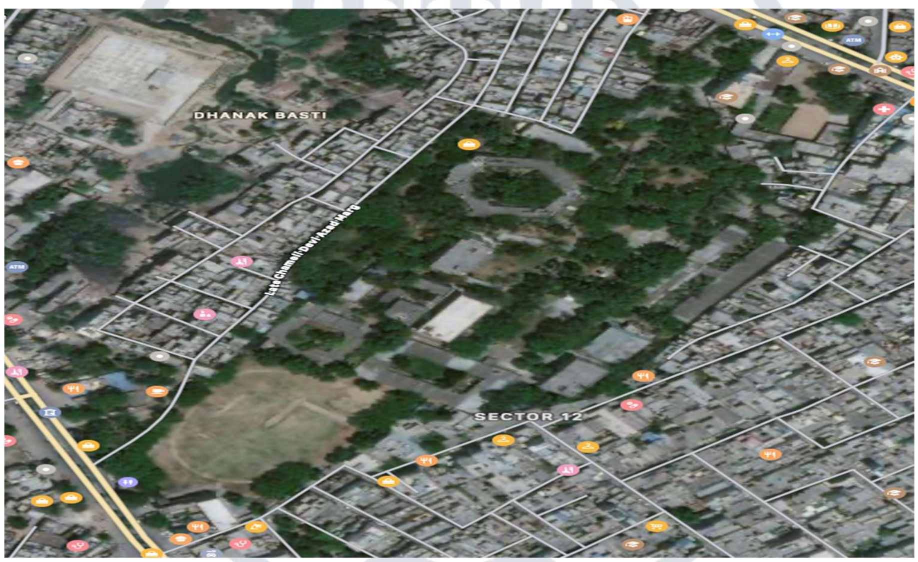

Fig.1 - Map (dotted line) showing study area.

2.2 Urban green space vegetation

Within our green spaces, we randomly established green space plots to measure vegetation variables. To characterize the vegetation within each green space plot, we measured by (i) the density of all trees; (ii) the diversity of vegetation, and (iii) vegetation composition (native and exotic). Vegetation composition, we identified all plants to species wherever possible. We then calculated the proportion of plant species (including trees) native to a foreigner.

2.3 Fauna biodiversity

To observe the fauna of this urban green space of Dronacharya Govt. College was regularly monitored during morning hours and evening hours following the fixed path as described by Sale and Berkmuller, (1988), along with the point count method and call count method of Blondel *et al.,* (1981). Binoculars (Nikon 7×50 CF) were used to locate/identify the distant biodiversity. The digital camera Nikon L-120 model was used to take photographs of the fauna diversity encountered. Later, the observed flora and fauna were identified with the help of different field guides and standard references (Grimmett *et al.,* 1998; Inskipp *et al.,* 1999).

We sampled five fauna taxa (Aves, Insects, Reptiles, Mammals, and Mollusks) as they represent broad taxonomic and functional groups. The spatial scale at which we sampled a taxonomic group varied to account for differences in the way each uses the landscape, and their mobility. A summary of the techniques used can be observed by formula 1, with additional detail below. We have also accounted for different levels of detection between species and between taxonomic groups by including detection in our analyses. The numbers of species in each class were further calculated to assess the percentage of occurrence using a formula.

Percentage occurrence = $\frac{\text{No. of species in each group/class}}{\text{Total number of different species observed}}$ x100

and Shannon index (H) defined as

$$H = -\Sigma\ Pi\ ln\ Pi$$

Where the *Pi* stands for the proportion for individuals of species.

Simpson index, $D = 1/\Sigma P_i^2$

(Shannon and Weaver, 1949; Simpson, 1949 and Rather *et al.,* 2022)

2. RESULTS AND DISCUSSION:

Our findings suggest that there are opportunities to enhance biodiversity in urban green areas through accessible activities, despite the diverse management systems in place. The impact of these activities can benefit a wide range of fauna species, including sedentary invertebrates and highly mobile vertebrates. To further promote biodiversity in urban green spaces which are managed by governmental institutes particularly, we suggest implementing top-down policies that prioritize green space management strategies focused on increasing the planting of native vegetation. The majority of the fauna species we looked at, from sedentary invertebrates to highly mobile vertebrate species, will be strongly impacted by top-down policies that support green space management that increase planting of native vegetation. Our findings are consistent with those of other recent research (Shwartz *et al.,* 2013), which indicate that these management techniques may be beneficial at the site scale (e.g., for a single park, garden, or golf course). The flora and fauna of the region gave the characteristics of that particular ecosystem, although DGC is located in the skyline building of the city, however the interior of the college provides an ambient ecosystem for both animals and plants.

In the research region, numerous animal and plant species were observed, and a scientific categorization was created, yielding a total of 67 animal species and 47 plant species, primarily angiosperms like trees, herbs, shrubs etc. (Tables -1 &2). Additionally, the species richness and diversity index were calculated for observed faunal diversity (Table-3). The level of community organization can be assessed by the diversity pattern and degree of species interactions such as predation, competition, and availability of suitable niches (Rather *et al.,* 2022). The Shannon index was found to be 1.25, while the Simpson diversity index had a maximum value of 2.15 (Table-3). According to Padoa *et al.* (2006) the diversity index considers community structure, species interactions, and health of habitat and in context to the current study, only a few species were found to interact at parching grounds made especially for pigeons, parrots, and squirrels which indicate coexistence of multiple species at a particular site. This suggests that these particular areas facilitated species interactions and provided suitable niches for these animals.

The opportunity to preserve natural biodiversity in cities is provided by urban green spaces. However, native vegetation and complex understory habitat are mainly absent from metropolitan areas, where vegetation is still being simplified (Le Roux *et al.,* 2014). Our findings imply that these characteristics of urban green areas` vegetation have a significant impact on how suitable their habitat is for a range of taxa. We observed a diverse canopy with big trees such as *Ficus benghalensis, Ficus religiose, Tamarindus indica, Azadirachta indica*, *Eucalyptus lanceolatus*, *Alstonia scholaris, etc.* (Table. 2) which support various animals altogether. Surprisingly, we found that the presence of plenty of big native trees had an influence on the presence of animal taxa such as horned owl and kite population, which were found in the current study area frequently. This presents great potential for urban green space managers, when native plant species were used more frequently and giant trees are already present in the landscape which eventually benefits the faunal biodiversity in such small-scale, urban green spaces.

The fauna in the study area was represented by several taxonomically and functionally diverse animal groups. The major biotic communities observed were Aves (birds) with 41 species, followed by Insects with 11 species, Reptiles with 5 species, and Mollusks with a single species (Table-1). These animal taxa were distributed across 7 classes, 24 orders, and 47 families. The findings indicate that the presence and abundance of vegetation within UGS influenced the diversity and distribution of fauna. The low levels of natural flora and undergrowth may have limited suitable habitats and resources for a variety of animal taxa, resulting in reduced occupancy. It suggests that a more diverse and dense vegetation cover could potentially support a wider range of animal species (Fig. 2).

By the analysis of Table-3, we could reveal that Mollusca (1.49%) and Amphibians (2.98%) were less in the percentage of occurrence whereas the major percentage occurrences were of Aves (61.19%). Various herpetofauna diversity publications indicated that there is a huge decline in the population of herpetofauna due to annual increase in global temperature and destruction of species-specific habitation due to human intervention (Bhandarkar *et al.,* 2012; Bawaskar and Bawaskar, 2016; Khate and Bawaskar, 2020). However, during the current study, few instances have been recorded when Skink, *Sphenomorphus dussumieri* and Sand boa, *Eryx whitakeri* were observed. Undoubtedly, these urban green spaces of Dronacharya Govt. College provide a potential habitat to these herpetofauna. The study also revealed that the dense canopy of this USG provides good feeding, nesting, and roosting sites for aves particularly small birds such as *Prinia socialis, Copsychus saularis*, *Cinnyris asiaticus*, *Zosterops palpebrosus* etc. According to Chopra *et al.,* (2013) Passeriformes order is considered to be the most diversified among the aves due to various types of beak modification to garb the various kind of food available in the form nectar, small insects, foliage of the trees, fruits etc. Our study showed that the majority of species (60%) responded positively to the vegetation trait. Diverse habitats involving complex vegetation which allow many species to obtain the diverse resources they need during their life cycle. Similar to other studies (White *et al.,* 2005; Threlfall *et al.,* 2017), we found a high correlation between undergrowth vegetation and insectivorous bird species. The analysis of flora revealed that UGS has a variety of flowers such as *Jasminum, Hibscus, rosa, Argemon, lily, Datura, Euphorbia* etc. which attract the fauna particularly aves in addition to the butterfly, particularly Common Mormon, *Papilio polytes* and Common Tiger Butterfly*, Danaus genutia.* The butterflies and birds are considered an indicator of a good ecosystem (Padoa *et al.,* 2006; Chopra *et al.,* 2012; Sharma and Sharma, 2017; Salahuddin *et al.,* 2021) and during the present survey, it was observed that Mormon butterfly along with some rare species of aves such as Barn owl, *Tyto alba;* Oriental White-eye, *Zosterops palpebrosus;* Coppersmith Barbet, *Psilopogon haemacephalus* were encountered in good number. It is pertinent to mention that the infrastructure of a multistory building along with its flora provides shelter to the fauna such as *Columba livia*, *Passer domesticus*, *Hemidactylus frenatus*, *Athene brama* etc. The congested population around the UGS, creates well-known anthropogenic pressures such as noise pollution, a decrease in the green area due to commercialization and overcrowding, and depletion of water resources particularly in summers and in this situation these UGS managed by governmental institutes are the only natural shelter for the suffering fauna particularly. Due to these alarming anthropogenic influences, the DGC's flora and fauna diversity has all the conditions to thrive, and undoubtedly serve as good perching, resting, and feeding grounds for the diverse flora and fauna. Urban landscape managers may easily alter these vegetational characteristics, which have a significant impact on habitat quality. There is evidence to support the idea that preserving vegetation at the urban scale can boost the diversity of many taxa, but few researchers have examined the specific elements of vegetation that encourage this response. Here, we show how to effectively manage urban vegetation to promote habitat for a wide range of species. This includes showing the mix of vegetation features necessary to maximize benefits to bat, bird, bee, beetle, and insect communities in a network of urban green spaces. The presence of some unique flora such as *Tamarindus indica* and *Moringa oleifera* clearly indicates that this site has good potential to support the rare fauna viz., Black Rumped Flameback; Barn owl and Black Kite etc. Urban planning and conservation efforts should prioritize the creation, accessibility, and preservation of green spaces to ensure that cities are inclusive, healthy, and sustainable for all residents.

Conclusion:

The authors propose conducting more comprehensive studies that focus on the assemblage of faunal species in highly congested urban areas to better understand the impacts of anthropogenic pressure. These studies would aim to assess how urban development and human activities influence the composition and abundance of fauna species in these areas.

Furthermore, the development of a green space network that considers ecological factors and addresses anthropogenic pressure should be a key objective of future research. This involves studying the connectivity and configuration of green spaces to create a more cohesive and effective network for promoting biodiversity conservation. In terms of vegetation management, the authors recommend implementing strategies that ensure the presence of higher native plant diversity. Maintaining a diverse and structurally complex vegetation community is essential for supporting a wider range of fauna species and enhancing overall biodiversity within urban green spaces. In any case, local governments must make sure that management plans for urban green spaces incorporate conservation measures. These strategies might be crucial for preserving urban biodiversity. Furthermore, future studies will focus particularly on landscape conditions and types of green space to assess the effectiveness of these efforts in densely populated urban and semi-urban areas for biodiversity management operations. This research can contribute to the development of evidence-based strategies and policies that effectively balance urban development with ecological conservation goals. This study hopes to provide a reference for future research on urban green space biodiversity and promote the sustainable development of urban green space.

Table -1: Checklist of representative fauna of Dronacharya Govt. College.

S.N	Class /Phylum	Order	Family	Common name	Scientific name
1.	Annelida	Opisthopora	Megascolecidae	Earth Worm	*Pheretima posthuma* (Kinberg, 1867)
2				Earth Worm	*Eutyphoeus aborianus* (Stephenson, 1914)
3	Mollusca	Stylommatophora	Helicidae	Garden Snail	*Cornu aspersum* (Muller, 1774)
4	Insecta	lepidoptra	Nymphalidae	Common Tiger Butterfly	*Danaus genutia* (Cramer, 1779)
5			Papilionidae	Common Mormon	*Papilio polytes* (Linnaeus,1758)
6		Orthopetra	Acrididae	Grasshopper	*Phlaeobain fumata* Brunner von (Wattenwyl, 1893)
7		Odonata	Libellulidae	Coral-tailed cloud wing Dragon fly	*Tholymis tillarga* (Fabricius, 1798)
8		Diptera	Muscidae	House fly	*Musca domestica* (Linnaeus,1758)
9			Culicidae	Culex Mosquito	*Clulex pipiens* (Linnaeus, 1758)
10		Hymenoptera	Apidae	Honey Bee	*Apis mellifera* (Linnaeus,1758)
11				Red Ant	*Lepisiota frauenfeldi* (Mayr, 1855)
12				Weaver ant	*Oecophylla smaragdina* (Fabricius,1775)
13		Coleptra	Scarabaeidae	Dung Beetle	*Onitis virens* (Lansberg, 1875)
14		Araneidae	Arachnida	Signature Spider	*Argiope aemula* (Walckenaer, 1841)
15	Amphibians	Phaneroglossa	Ranidae	Bull frog	*Hoplobatrachus tigrinus*

					(Daudin, 1802)
16			Bufonidae	Indian Toad	*Duttaphrynus melanostictus* (Schneider, 1799)
17	Reptilia	Squamata	Lacertidae	Wall Lizard	*Hemidactylus frenatus* (Schlegel,1836)
18				Garden Lizard	*Calotes versicolor* (Daudin, 1802)
19			Ophidia	Rat Snake	*Ptyas mucosa* (Linnaeus, 1758)
20			Scincidae	Skink	*Sphenomorphus dussumieri* (Dumeril & Bibron, 1839)
21			Boidae	Sand Boa	*Eryx whitakeri* (Das 1991),
22	Aves	Passeriformes	Muscicapidae	Common Stone Chat	*Saxicola torquata* (Pallas,1773)
23				Ashy Prinia	*Prinia socialis (*Sykes, 1832)
24				Graceful Prinia	*Prinia gracilis* (Lichtenstein, 1823)
25				Indian magpie robin	*Copsychus saularis* (Linnaeus,1758)
26				Large Grey Babbler	*Turdoides malcolmi* (Sykes, 1832)
27			Motacillidae	White Wagtail	*Motacilla alba (*Linnaeus,1758)
28			Sturnidae	Common Myna	*Acridotheres tristis* (Linnaeus,1766)
29				Bank Myna	*Acridotheres ginginianus* (Latham,1790)
30			Cisticolidae	Common Tailorbird	*Orthotomus sutorius* (Pennant,1769)
31			Passeridae	House Sparrow	*Passer domesticus* (Linnaeus,1758)
32				Oriental White eye	*Zosterops palpebrosus (Timminck,1824)*
33			Corvidae	House Crow	*Corvus splendens* (Vieillot,1817)
34				Jungle crow	*Corvus macrorhynchos* (Sykes,1832)
35				Rufous Treepie	*Dendrocitta vagunbunda* (Latham,1790)
36			Dicruridae	Black Drongo	*Dicrurus paradiseus* (Linnaeus,1758)
37			Pycnonotidae	Red vented Bulbul	*Pycnonotus cafer* (Linnaeus,1766)
38			Nectariniidae	Purple Sunbird	*Cinnyris asiaticus* (Latham, 1790)
39		Coraciformis	Upupidae	Common Hoopoe	*Upupa epops* (Linnaeus, 1758)
40			Ardeidae	Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)
41			Meropidae	Green Bee-eater	*Merops orientalis* (Latham,1801)
42			Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)
43		Falconiformes	Accipitridae	Black Kite	*Milvus migrans* (Boddaert, 1783)
44				Shikra	*Accipiter badius* (Gmelin, 1788)
45		Columbiformes	Columbidae	Blue Rock Pigeon	*Columba livia*. (Gmelin, 1789)
46				Yellow footed Green Pigeon	*Treron Phoenicoptera* (Latham,1790)
47				Spotted Dove	*Streptopelia chinensis* (Scopoli,1786)
48				Eurasian Collared Dove	*Streptopelia decaocto* (Frivaldszky,1838)
49				Laughing Dove	*Streptopelia senegalensis* (Linnaeus,1766)
50		Charadriformes	Charadriidae	Red- wattled Lapwing	*Vanellus indicus* (Boddaert,1783)
51			Recurvirostridae	Black-winged Stilt	*Himantopus himantopus* (Linnaeus,1758)
52		Piciformes	Megalaimidae	Brown -headed Barbet	*Psilopogon zeylanica* (Gmelin,1758)
53			Ramphastidae	Coppersmith Barbet	*Psilopogon haemacephalus* (Statius Muller, 1776)

54		Cuculiformes	Cuculidae	Asian Koel	*Eudynamys scolopaceus* (Linnaeus,1758)
55				Greater Coucal	*Centropus sinensis* (Stephens1815)
56		Psittaciformes	Psittaculidae	Rose -ringed Parakeet	*Psittacula krameri* (Scopoli, 1769)
57				Alexandrine Parakeet	*Psittacula eupatria* (Linnaeus,1766)
58		Coraciformis	Picidae	Black Rumped Flameback	*Dinopium benghalense* (Linnaeus,1758)
59			Bucerotidae	Indian Grey Hornbill	*Ocyceros birostris* (Scopoli, 1786)
60		Galliformes	Phasianidae	Indian Peafowl	*Pavo cristatus* (Linnaeus,1758)
61		Strigiformes	Strigidae	Spotted Owlet	*Athene brama* (Temminck,1821)
62				Barn Owl	*Tyto alba* (Scopoli,1769)
63	Mammalia	Rodentia	Muridae	Mouse	*Mus musculus* (Linnaeus, 1758)
64			Sciuridae	Northern Palm Squirrel	*Funambulus pennanti* (Wroughton, 1905)
65		Carnivora	Herpestidae	Mongoose	*Urva edwardsii* (Bonaparte, 1845)
66			Felidae	Cat	*Felis catus* (Linnaeus, 1758)
67			Canidae	Dog	*Canis familiaris* (Linnaeus,1758)

Table-2 Checklist of recorded flora of Dronacharya Govt. College.

S.N.	Botanical Name	Local Name of the Plants	Family
1	*Azadirachta indica*	Neem	Meliaceae
2	*Ailanthus excels*	Uloo neem	Simaroubaceae
3	*Albizia lebbeck*	Siris	Fabaceae
4	*Albizia lebbeck*	Amaltas	Fabaceae
5	*Dalbergia sissoo*	Sisham	Fabaceae
6	*Eucalyptus lanceolatus*	Safeda	Myrtaceae
7	*Eugenia jambolana*	Jamun	Myrtaceae
8	*Ficus benghaltnsis*	Bargad	Moraceae
9	*Ficus racemosa*	Cluester fig tree (Gular)	Moraceae
10	*Ficus religiosa*	Pipal	Moraceae
11	*Moringa oleifera*	Saijna	Moringaceae
12	*Morus alba*	Shahtoot	Moraceae
13	*Phyllanthus emblica*	Indian Gooseberry	Phyllanthaceae
14	*Acacia nilotica*	Kikar	Fabaceae
15	*Aegle marmelos*	Belpatra	Rutaceae
16	*Saraca asoca*	Ashoka tree	Fabaceae
17	*Grevillea robusta*	Silveroak	Proteaceae
18	*Bambusa bulgaris*	Bamboo	Poaceae
19	*Psidium guajava*	Guava	Myrtaceae
20	*Elaeis guineensis*	Africian oil palm	Arecaceae
21	*Delonix regia*	Gulmohar	Fabaceae
22	*Alstonia scholaris*	Devil tree	Apocynaceae
23	*Nerium oleander*	Kaner	Apocynaceae
24	*Plumeria obtuse*	Champa	Apocynaceae
25	*Callistmemon*	Bottle brush	Myrtaceae
26	*Tamarindus indica,*	Imli	Fabaceae
Plants (Shrubs & Herbs)			
1	*Ocimum sanctum*	Tulsi	Lamiaceae

2	*Jasminum*	Chameli	Oleaceae
3	*Bougainvillea glabra*	Four O Clock	Nytanginaceae
4	*Hibiscus rosa sinensis*	China rose	Malvaceae
5	*Punica granatu*	Pomegranate	Punicaceae
6	*Codiaeum variegatum*	Croton	Euphorbiaceae
7	*Amaranthus (linn.)*	Jangli chauli	Amaranthaceae
8	*Achyranthes aspera*	Prickly chaff flower	Amaranthaceae
9	*Rosa*	Rose	Rosaceae
10	*Calotropis procera*	Aak	Asclepiadaceae
11	*Cannabis sativa*	Bhang	Callabaceae
12	*Cynodon dactylon*	Dub	Poaceae
13	*Datura stramonium*	Datura	Solanaceae
14	*Argemone*	Prickly poppy	Papaveraceae
15	*Tinospora cordifolia*	Giloy	Menispermaceae
16	*Pteris vittata*	Fern	Pteridaceae
17	*Euphorbia pulchrima*	poinsettia	Euphorbiaceae
18	*Catharanthus roseus*	Sadabahar	Apocynaceae
19	*Tagetes minuta*	Marigold	Asteraceae
20	*Lilium*	Lily	Liliaceae
21	*Euphorbia milli*	Crown of throns	Euphorbiaceae

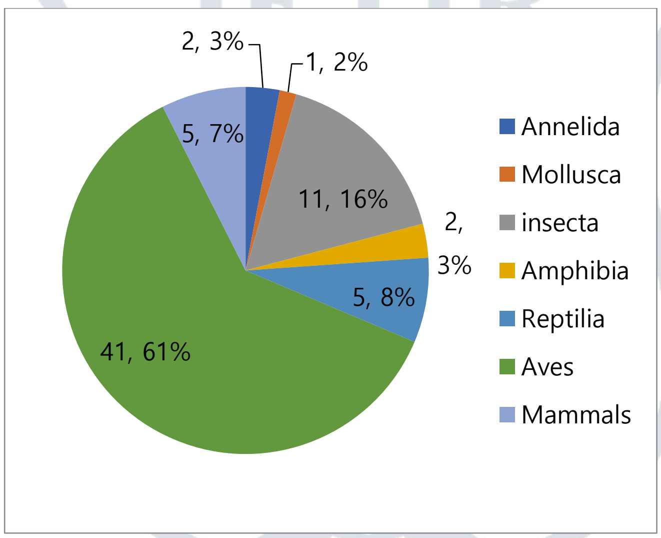

Fig.2: Pie chart showing percentage of representative classes of observed faunal diversity.

<table>
<tr><td>Classes</td><td>Percent Occurrence</td><td rowspan="8">Shannon index(H) 1.25</td><td rowspan="8">Simpson index(D) 2.15</td></tr>
<tr><td>Annelida</td><td>2.98%</td></tr>
<tr><td>Mollusca</td><td>1.49%</td></tr>
<tr><td>Insecta</td><td>16.42%</td></tr>
<tr><td>Amphibia</td><td>2.98%</td></tr>
<tr><td>Reptilia</td><td>7.46%</td></tr>
<tr><td>Aves</td><td>61.19%</td></tr>
<tr><td>Mammals</td><td>7.46%</td></tr>
</table>

Table-3 Percent occurrence and diversity index of observed fauna

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