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Arthropods Biodiversity In And Around Ramtek Region, Maharashtra, India

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Abstract

Ramtek is situated in the Nagpur district of Vidarbha, Maharashtra, on the northern edge of the Deccan Plateau. This region is characterized by a wide variety of bioclimatic and geographical variables. The region is characterized by a mosaic of diverse ecosystems encompassing deciduous forests, scrublands, agricultural fields, and freshwater bodies, which harbor a rich variety of insect life for ecological and conservation research. Ramtek is situated in the Nagpur district of Vidarbha, Maharashtra, on the northern edge of the Deccan Plateau.
The present study was carried out in and around Ramtek region of Maharashtra India. Total five spots were identified and study was undertaken in forest area, lake side area, agricultural farm, college campus and open land area of various vegetation. The study was conducted from January to April 2025 period. The collected insects were identified and maintain the record in tabulated form for analysis. Results shown that lepidopteran species were dominant followed by Odonata, Hymenoptera, Diptera, Orthoptera, Coleoptera, Isoptera etc. The objective of this study is to evaluate the dominance and abundance of various arthropods population in different region of Ramtek.

Key word
Ramtek, ecosystems, conservation, lepidopteran, Hymenoptera

Introduction

Biodiversity, defined as the variety of life at the genetic, species, and ecosystem levels, is fundamental to global ecological stability and human well-being. The ongoing and accelerating loss of biodiversity, however, constitutes a major global crisis driven by anthropogenic activity, including habitat destruction, overexploitation, pollution and urbanization. The intrinsic value of biodiversity, as well as the ecosystem services it provides—such as provisioning (food, medicine), regulating (climate regulation, water purification), and cultural services—are significantly threatened. This necessitates a deeper understanding of the drivers of biodiversity change and the effectiveness of current conservation efforts. Insects, recognized as keystone components of terrestrial ecosystems, play pivotal roles in essential ecological processes, such as pollination, nutrient cycling, and decomposition, directly influencing plant reproduction and soil fertility (Mukherjee *et al.,*., 2014).

Furthermore, insects serve as a crucial food source for a myriad of other animal species, underpinning intricate food web dynamics and contributing to the overall stability of the ecosystem (Burner *et al.,*., 2020). Understanding the intricate relationships between insect communities and their environment is crucial for developing effective conservation strategies (Samways *et al.,*., 2020).

Human activities, including urbanization, agricultural intensification, and deforestation, pose significant threats to insect populations and their habitats worldwide. These anthropogenic pressures can lead to habitat loss and fragmentation, pollution, and the introduction of invasive species, all of which can negatively impact insect

diversity and abundance (Schläppi *et al.,*. 2021). Considering the vital ecosystem services provided by insects, including pollination, pest control, and decomposition, the decline in insect populations could have cascading effects on agriculture, forestry, and human livelihood (Ameixa *et al.,*., 2018).
The presence of insects in a habitat is considered a reliable indicator of a healthy ecosystem. They possess a wider range of species than other invertebrates and serve an important role as prey for birds, bats, and other insectivorous animals in the food chain. Because insects are affected by habitat loss and climate change, their consequences are frequently studied by ecologists, with insects being used as model animals.
Litter organism assemblages in Ramtek, notably in the Khindsi lakeside region and residential areas, are dominated by functional guilds adapted to wet or moist litter environments. The occurrence of litter creatures from closely related taxonomic groups is promoted by these wet ecological circumstances, resulting in significant heterogeneity in taxonomic distribution. Hence, this study was conducted on arthropod biodiversity and their population in five different regions of Ramtek.

Materials and Methods:

In the present study, we considered Ramtek city as the place of investigation. The data on insect biodiversity were recorded from January to April 2025, once investigated in the morning time starting from 6.30 am to 9 am. During the investigation, total Five sites have been investigated namely Site 1 Nagarjuna forest. The second site was considered agricultural land (Pindakapar farm area). The third site was a lake site (Khindsi Lake). The fourth lake is located in the college area (TGMR college campus) and the last site is considered as open land (Manapur land area). The survey was conducted on a regular and random basis, and the spotted insects were photographed and identified.

Comparative analysis of biodiversity in terms of genus, species, and order

Once the data of insects were recorded across the five sites, as mentioned above. Careful identification was carried out using photography and identification keys. With the help of zoologists, its identity was confirmed and photos were submitted in Zoology Department. Here, we defined structural features and reported the identity and its % prevalence with respect to overall biodiversity also been showcased. In addition, we reported the common prevalence of insects at all five sites investigated.
In the further course of investigation, we recorded the dominance-based insect reporting in each site as well as in Ramtek, and its location-based relation has been put forward once related with earlier references.

Result and Discussion

Insect diversity in Nagarjuna Forest

According to the survey, the insects belonging to order Lepidoptera, Hymenoptera, Orthoptera, Odonata, Diptera, Araneida, Isoptera, and Blattodea was observed (Table 1).

Insect diversity on agricultural farms

Similarly, in Pindakapar farm, insects' orders of Lepidoptera, Hymenoptera, Orthoptera, Coleoptera, Diptera, Isoptera and Hemiptera was observed (Table 1).

Insect diversity in Khindsi lake

In khindsi lake orders of Lepidoptera, Hymenoptera, Orthoptera, Odonata, Coleoptera, Diptera, and Blattodea was observed (Table 1).

Insect diversity in TGMR College Campus

In College campus Lepidoptera, Hymenoptera, Orthoptera, Odonata, Diptera, Araneida, Dictyoptera, and Isoptera were abundance (Table 1).

Insect diversity in the Manapur land area

In the present study, open land was also found to be positive with profound diversity, as we recorded the dominance of Lepidoptera, Hymenoptera, Orthoptera, Coleoptera, Diptera, Isoptera, and Plasmatodea (Table 1).

Percent dominance as per site of Insect order

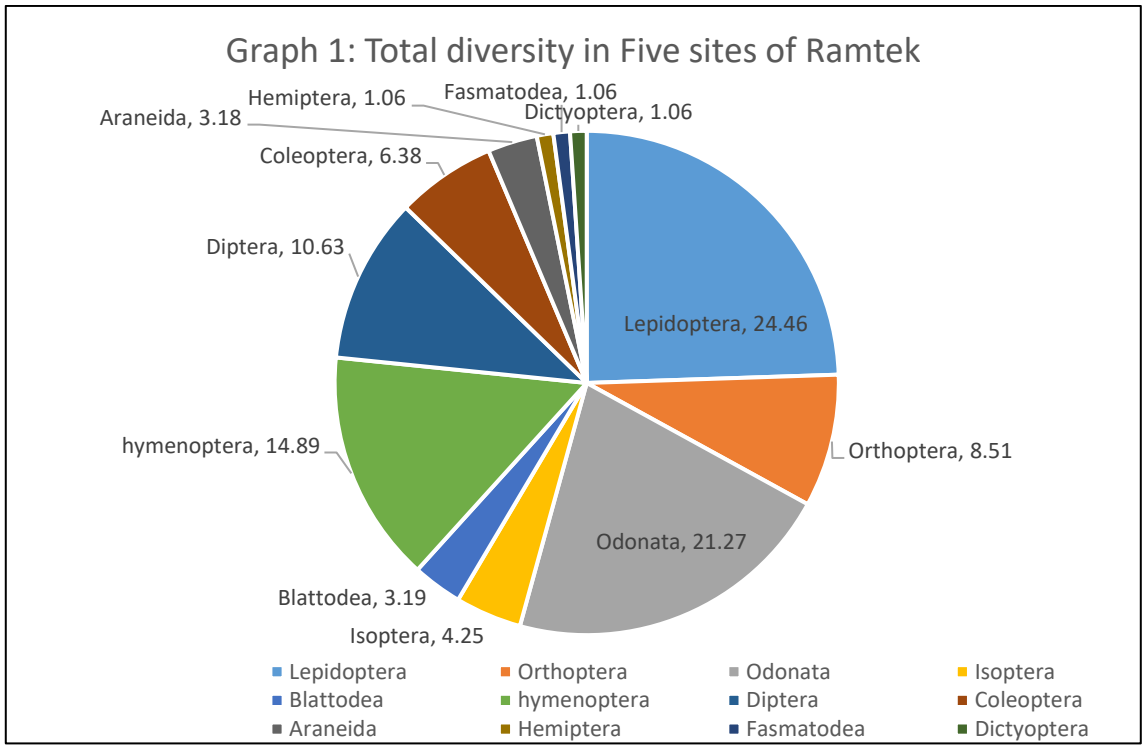
Based on the overall data, we recorded the percent dominance of every site for insect orders. Here in the Nagarjuna Forest area, the decreasing dominance of insect orders was recorded as Hymenoptera (23.07%), Lepidoptera (15.38%), Blattodea (15.38%), Odonata (15.38%), and Orthoptera, Isoptera, Diptera, and Araneida, each with 7.69% (Table 1).

Table: 1: Percent diversity showcased as per site (in row sum) and also the order wise percentage share of insects recorded in all sites of Ramtek once recorded as column sum

Name of Sites	Lepidoptera	Orthoptera	Odonata	Isoptera	Blattodea	Hymenoptera	Diptera	Coleoptera	Araneida	Hemiptera	Fasmatodea	Dictyoptera	
Site 1- (Nagarjuna forest)	2(15.38%)	1(7.69%)	2(15.38%)	1(7.69%)	2(15.38%)	3(23.07%)	1(7.69%)	0	1(7.69%)	0		0	99.97%
Site 2- (Pindakapar Farm Area)	4(23.5%)	1(5.8%)	2(11.7%)	1(5.8%)	0	3(17.6%)	3(17.6%)	1(5.8%)	1(5.8%)	1(5.8%)		0	99.40%
Site 3- (Khindsi Lake)	3(18.75%)	1(6.25%)	5(31.25%)		1(6.25%)	1(6.25%)	2(12.5%)	3(18.75%)		0		0	100%
Site 4- (Tai Golwalkar Mahavidyalaya)	8(30.76%)	3(11.53%)	5(19.23%)	1(3.84%)	0	4(15.38%)	3(11.53%)	0	1(3.84%)	0		1(3.84%)	96.11%
Site 5- (Manapur land area)	6(27.27%)	2(9.09%)	6(27.27%)	1(4.54%)	0	3(13.63%)	1(4.54%)	2(9.09%)	0	0	1(4.54%)	0	99.97%
Total sum	23(24.46%)	8(8.51%)	20(21.27%)	4(4.25%)	3(3.19%)	14(14.89%)	10(10.63%)	6(6.38%)	3(3.18%)	1(1.06%)	1(1.06%)	1(1.06%)	99.94%
Dominance in Ramtek by rank for all sites	1	5	2	7	8	3	4	6	9	10	10	10	

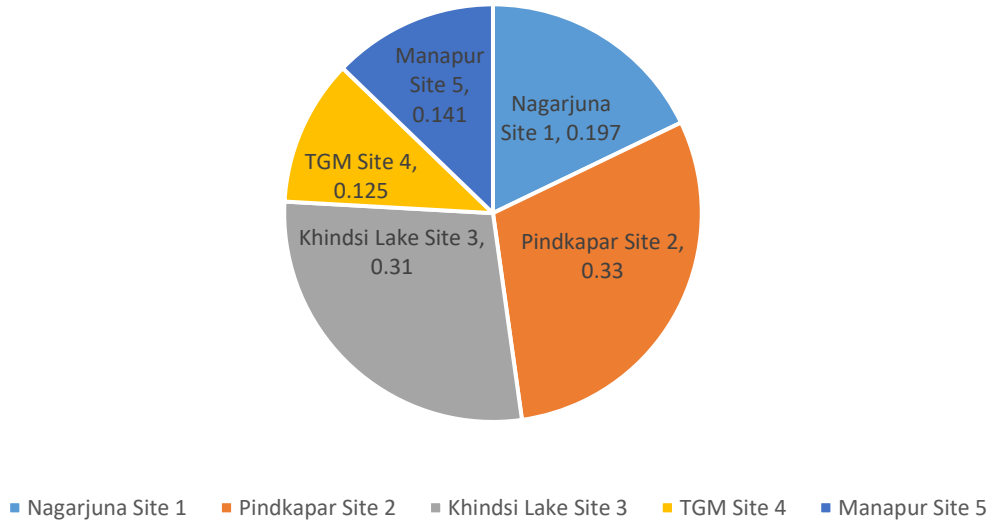
In the case of site 2 of the Pindakapar farm area, we recorded a decreasing trend in insect orders such as Lepidoptera (23.5%), Hymenoptera and Diptera (17.6% each), Odonata (11.7%), Orthoptera, Isoptera, Coleoptera, Araneida, and Hemiptera, which showed 5.8% dominance each (Table 1).
In the case of site 3 of Khindsi Lake, a decreasing trend of insect orders was recorded as Odonata (31.25%), Lepidoptera (18.75%), Coleoptera (18.75%), and Diptera (12.5%), with the least being Orthoptera, Blattodea, and Hymenoptera, each showing 6.25%, as shown in Table 1.
In the case of site 4 (Tai Golwalkar Mahavidyalaya), we recorded a decreasing trend in insectsect orders of Lepidoptera (30.76%), Odonata (19.23%), Hymenoptera (15.38%), Diptera, Orthoptera (11.53%), and Isoptera (3.84%) (Table 1).
In the case of site 5 (Manapur land area), that is, the open land area, the decreasing order of insect 'order' is Lepidoptera (27.27%), Odonata (27.27%), Coleoptera (9.09%), Isoptera (4.54%), Diptera (4.54%), and Fasmatodea (4.54%) (Table 1).

Overall dominance of Insects in Ramtek sites
In the overall study, we combined insect biodiversity at all five sites. Here, we recorded a high percentage of Lepidoptera at all sites, with overall insect biodiversity reaching 24.46%, followed by Odonata (21.27%), Hymenoptera (14.89%), Diptera (10.63%), Orthoptera (8.51%), Coleoptera (6.38%), Isoptera (4.25%), Blattodea (3.19%), Araneida (3.18%), and least by Hemiptera, Phasmatodea, and Dictyoptera (1.06%) (Graph 1).



The Shannon diversity index (H') were analyzed and found variable range from (0.197) at Site 1, (0.33) at site 2, (0.31) at site 3, (0.125) at site 4 and (0.141) at site 5 (Graph 2).

Graph 2: Shannon Diversity Index



Global entomofauna are currently facing declines in both abundance and diversity, raising concerns about the potential consequences for ecosystem services and food security (Schläppi *et al.,*., 2021). Understanding the intricate relationships between insect communities and their habitats is crucial for developing effective conservation strategies and mitigating the impacts of anthropogenic activities on these essential creatures (Ameixa *et al.,*., 2018). Total arthropods diversity found at college site was 26as college campus was maintained in harsh summer also hence greenery was maintained and insects were found. On other side water logging part of khindsi lake and Nagarjuna part of forest was dried and no vegetation was found during survey time hence insects' population was less.

The diversity of insect communities is significantly influenced by habitat type, with each environment supporting a unique assemblage of species adapted to specific conditions. Lakes, as lentic ecosystems, harbor specialized aquatic insect fauna that contribute to nutrient cycling and serve as vital food sources for fish and other aquatic predators (Ward, 1992). These aquatic insects, which spend a portion of their life cycle in water, include species from the orders Ephemeroptera, Odonata, and Trichoptera, and are frequently used as bioindicators because of their sensitivity to water quality (Dijkstra *et al.,*., 2013; Sharma *et al.,*., 2020). No. of odonates were more near Khindsi lake and manapur site as these sites are near water bodies as compared to other studied sites. Dragonfly's diversity decreased with the increasing degree of land use intensification, but increased with the length of water bodies (Nagy *et. al*., 2019).

Agricultural landscapes, although often characterized by reduced biodiversity owing to intensive farming practices, can still support a variety of insect species, including pollinators, herbivores, and natural enemies of crop pests. Orthoptera, Hemiptera, and Coleoptera are commonly found in agricultural settings and play complex roles in crop production and ecosystem services. Urban environments, such as college campuses, present a mosaic of habitats, including managed lawns, gardens, and remnant natural areas that can support surprisingly diverse insect communities. These areas are often home to species from the orders Hymenoptera, Diptera, and Lepidoptera, which contribute to pollination and decomposition processes. Open lands, such as grasslands and meadows, are characterized by herbaceous vegetation and are home to a diverse array of insects, including Orthoptera, Hemiptera, and Lepidoptera, which play critical roles in plant pollination and nutrient cycling. Forest ecosystems, with their complex vertical structures and diverse plant communities, support the highest levels of insect diversity. (Burner *et al.,*., 2020)

Lepidoptera, which includes butterflies and moths, are highly sensitive to habitat alterations, and their presence and abundance often reflect the overall health of the ecosystem. Orthoptera, including grasshoppers and crickets, are commonly found in grasslands, agricultural fields, and open woodlands, where they feed on plant material and contribute to nutrient cycling (Karanja *et al.,*. 2010). Odonata, such as dragonflies and damselflies,

are predaceous insects that inhabit aquatic environments as both larvae and adults, playing a crucial role in regulating aquatic insect populations. Isoptera, commonly known as termites, are social insects that play a vital role in decomposition and nutrient cycling, particularly in tropical and subtropical ecosystems. The insect orders Hymenoptera, Isoptera, Thysanura, and Orthoptera dominated the litter arthropod abundance and contributed 73% of the total litter arthropods collected from all four tropical dry regions of Nagpur, India (Raut *et al.,*., 2022).

Conclusion

In the present study, Ramtek was investigated as a popular place for its greenery and biodiversity of insects in the forest, lake, farm, college, and open land areas. We recorded the insect orders as Lepidoptera, Orthoptera, Odonata, Isoptera, Blattodea, Hymenoptera, Diptera, Coleoptera, Araneida, Hemiptera, Fasmatodea, and Dictyoptera.

Here, we recorded that insect diversity remained site-specific for many insect orders, but the majority of insect orders were universally present at all sites, especially Orthoptera, Lepidoptera, Odonata, Hymenoptera, and Diptera, while some insect orders remained site-specific, such as Isoptera, Blattodea, Araneida, Hemiptera, Coleoptera, Fasmatodea, and Dictyoptera. Thus, study has given a clear glance how insect diversity remained in Ramtek city for year 2024-2025 as per short study carried out.

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