EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 11
Issue: 4
434-442
Year: 2024

INSECT EXPLORERS: PRELIMINARY INSIGHTS INTO THE DIVERSE INSECT COMMUNITY OF KATTUPUTHUR, TRICHY DISTRICT

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Article Received on 21/02/2024 **Article Revised on 13/03/2024** **Article Accepted on 03/04/2024**

ABSTRACT
The main objectives of the study were to determine the insect diversity and relative abundance of insect species in the study area of Kattuputhur and its surrounding. The study was conducted from June 2020 to November 2020, using basic manual collection methods that resulted in the collection of 713 individual insects, belonging to seven orders and 24 families. Diversity was assessed using various indices, including Dominance Index D, Shannon Index H, Margalef's Richness Index R, and Evenness (Buzas and Gibson's Evenness) E2. The results revealed that Coleoptera (20.00) was the most dominant order, followed by Orthoptera (18.15), Diptera (16.79), Hymenoptera (14.66), Lepidoptera (12.42), and Odonata (7.57), respectively. Coleoptera and Orthoptera showed higher dominance compared to other orders, indicating a higher species richness in the area. Insects play various important roles in nature. They have served as a food source for humans for thousands of years (entomophagy). Insects, including honeybees, native bees, butterflies, moths, beetles, and flies, act as pollinators for plants. Insects that feed on carrion, such as beetles, flies, wasps, and ants, contribute to the recycling of organic matter and decomposition processes. Additionally, insects help in nutrient cycling, pollination of plants, seed dispersal, soil formation, and controlling populations of other organisms. However, it should be noted that some non-native insect species introduced into new ecosystems can become major pests in agriculture due to the absence of natural biological control agents.

KEYWORDS: Insect diversity, Coleopteran, Orthoptera, Diptera, Odonata.

INTRODUCTION
The preliminary findings of this study can serve as a foundation for further research and conservation efforts in the region. Understanding the insect community and their ecological roles is essential for effective ecosystem management, biodiversity conservation, and sustainable development. Factors such as foliage cover, climate, and territory disturbance level have a significant impact on insect populations due to their rapid reproductive cycles and numerous interspecies relationships. Insects exhibit an incredibly high level of diversity, with an estimated 30 million species of tropical arthropods alone.[1] They make up around 90% of all species on Earth,[2] and their abundance and variability often shape the structure of ecosystems they inhabit.[3] Insects fulfill crucial roles in their ecosystems, including soil turning and aeration, dung burial, pest control, pollination, and wildlife nutrition.[1]

Approximately two-thirds of all plant species rely on insects for pollination, with bees, beetles, butterflies, and flies being the most important pollinators.[4] Habitat destruction has a negative impact on insect pollinators as it results in the loss of food sources, nesting sites, oviposition sites, resting areas, and mating sites.[5] Human activities that disrupt natural ecosystems, such as habitat fragmentation, are the primary cause of habitat destruction. This process involves breaking up natural landscapes into smaller, isolated habitat patches surrounded by human-altered areas. As a result, habitat areas become smaller and biodiversity decreases.[2,6] The loss of biodiversity in agricultural areas not only affects the plants and animals that inhabit those areas but also has implications for humans. In agriculture, insects play crucial roles in providing ecosystem services such as pollination, soil nutrient cycling, and pest control.[7, 8] Insects serve as an excellent model for studying patterns of diversity, particularly within urban landscapes.[8-10]

Insects are highly abundant, diverse, and play important ecological roles, showcasing a wide range of life-history strategies.[11] They also serve as a valuable tool for promoting community awareness of nature and science through citizen-science projects and scientific education.[12-14] However, the understanding of how insects respond to site-level characteristics and urban gradients is often overlooked but is likely crucial for predicting local community structure.[5,6] Agricultural land use, being an artificial ecosystem, attracts a variety of insects for nesting, resting, food sources, and other biological activities.[15-17] Insects play a vital role in the success of agroecosystems. The focus on biodiversity has increased in recent years, particularly in understanding how it influences ecosystems and ecological processes.[18,19] A significant majority of experimental studies, around 95%, support a positive relationship between diversity and ecosystem functioning.[20,21] Kattuputhur is a region located in Trichy District, known for its diverse ecosystems, including agricultural fields, forests, and residential areas. The area provides a unique opportunity to study the insect community and understand their ecological significance. By gaining insights into the insect diversity and their ecological significance, the study aims to contribute to the broader understanding of biodiversity in the Kattuputhur area and promote the importance of insect conservation in maintaining healthy ecosystems. Thus, In the present study, our aim is to investigate the biodiversity richness in Kattuputhur, Trichy district.

MATERIALS AND METHODS

Study area

The present study was conducted in and around the area of Kattuputhur, located in Trichy district, Tamil Nadu. Kattuputhur is situated at coordinates 10.9961° N and 78.2163° E. It is a vast rural land area, located 30 km north of Namakkal city. Kattuputhur serves as the entry point to the Trichy Rockfort on the eastern side and is also a central hub for the Thalaimalai hills in the northern region. The study involved field visits to the entire area in and around Kattuputhur.

Observation of insect diversity

Observations were conducted between June 2020 and September 2020, from 7 am to 6 pm. The study encompassed various areas, including cultivated areas, wild areas, and suburban areas, featuring a range of vegetation such as large trees, shrubs, herbs, and grasses. Sample collection followed a standard protocol of experimental design, with collections taken every ten days once a month.

Insect Collection and Preservation

In the study, various methods were employed to collect insects, including hand picking, shaking or beating. To aid in the collection process, tools such as a hair brush, forceps, stick, handnet, and killing bottle were used. The killing bottle was made using a cylindrical glass jar, into which a cotton piece soaked with chloroform was inserted to ensure the insects were killed. After collection, the dead insects were transferred to boxes for temporary storage. To prevent fungal attacks, naphthalene balls were placed inside the insect boxes. The collected insects were then carefully pinned using steel pins and allowed to dry. Proper labeling and identification of the insects were carried out, with families assigned serial numbers and catalogued in a collection data book for subsequent analysis.

Identification and Statistical

The collected insects were identified using reference literature and by comparing them with specimens in museum collections. To ensure accuracy, the identifications were also confirmed by consulting entomological experts.

Statistical analysis

For this study, appropriate statistical methods were used to analyze various aspects of diversity. The relative dominance, which refers to the proportion of individuals belonging to a particular species, the number of individuals per species, the number of species, and family per order were calculated. The absolute number of species (S) and individuals (N) were calculated for each month of sampling.

Alpha diversity measures across months

Alpha diversity is the diversity of species within a community or habitat. The following alpha diversity measures were calculated.

Dominance Index D $D = \sum ((n_i/n)^2)$

Where, *n* is number of individuals of particular species.

Shannon index *H* $H = \sum ((n_i/n)\mathrm{In}(n_i/n))$

Where, *ni* is number of individuals of taxon *i*.

Margalef's richness index *R* $R = (S-1)/\mathrm{In}\ (n)$

Where, *S* is the number of taxa, and *n* is the number of individuals.

Eveneness (Buzas and Gibson's evenness) *E2* $E2 = e^{H/S}$

Where, *S* is the number of taxa and *H* is the Shannon Index.

To determine if there was a significant difference in the diversity, dominance, evenness, and richness index values between data collected from transects inside swamps and outside swamps, a paired t-test was used.

Relative Dominance = ni x100/N

Where ni = no. of insects in the 'i' the order, and N = the total number of insects in all the orders collected during the study period.

RESULT AND DISCUSSION

Diversity of insects

During the 4-month study period from June 2020 to September 2020, a total of 1050 individual insects belonging to 7 orders and 32 families, and 103 species were identified in the Kattuputhur area. The prevalent insect orders observed in the study area were Coleoptera, Orthoptera, Diptera, Hymenoptera, Lepidoptera, Hemiptera, and Odonata, as shown in Table-1.

Table 1: Shows: Inventory of insects found in the kattuputhur area.

Order	Family	(No. of Species) (S)	(No.of Individuals) (NI)
Coleoptera	*Coclinellidae*	5	46
	Chrysomelidae	3	40
	Scarabidae	4	39
	Elateridae	3	20
	Paussidae	4	25
	Meloidae	3	36
Orthoptera	*Gryllidae*	4	45
	Acrididae	5	35
	Pyrgororphidae	6	50
	Gryllotalpidae	3	32
	Tetrigidae	3	25
Diptera	*Muscidae*	4	55
	Culicidae	3	38
	Sarcophagidae	5	45
	Tipulidae	4	35
Hymenoptera	*Apidae*	5	45
	Farmicidae	4	40
	Sphecidae	4	38
	Ichneomonoidae	3	28
Lepidoptera	*Papilionidae*	2	42
	Geometridae	3	30
	Noctuidae	2	21
	Lycaenidae	1	35
Hemiptera	*Pentato midae*	3	30
	Rhopalidae	2	20
	Pyrrhocoridae	4	35
	Lygaeidae	2	22
Odonata	*Libellulidae*	2	15
	Petaluridae	3	28
	Corduliidae	1	15
	Aeshnidae	1	12
	Neopetaliidae	1	8

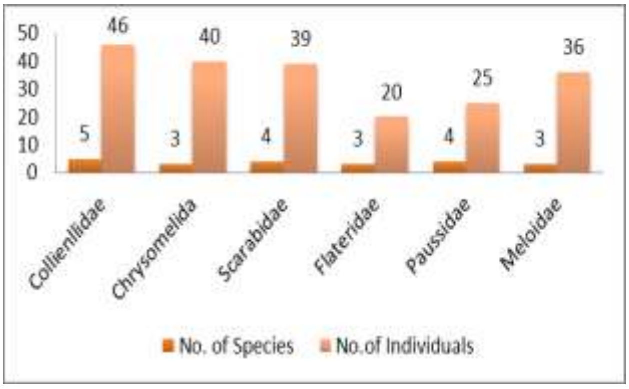

Fig. 1: Order: Coleoptera.

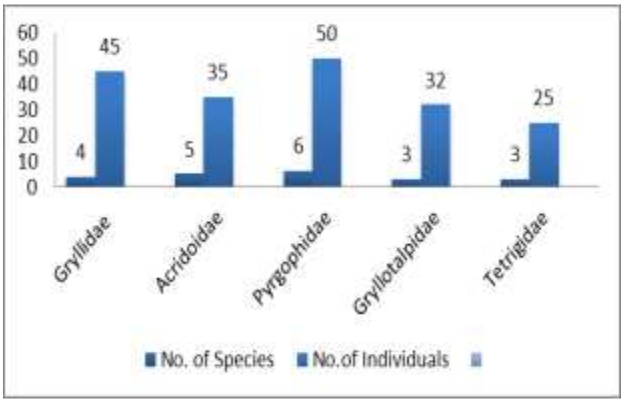

Fig. 2: Order: Orthoptera.

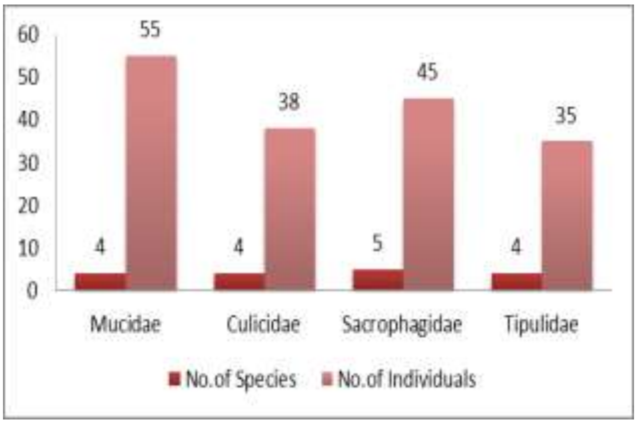

Fig. 3: Order: Diptera.

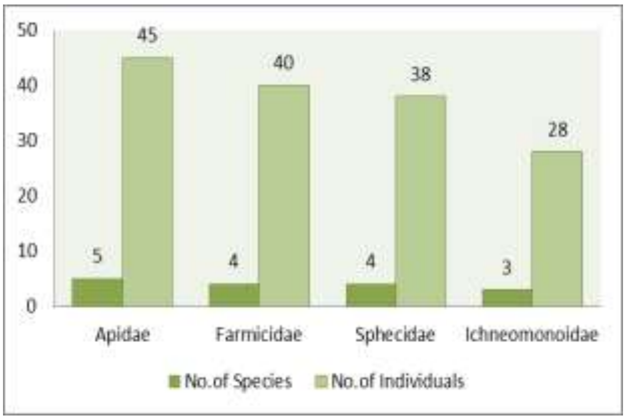

Fig. 4: Order: Hymenoptera.

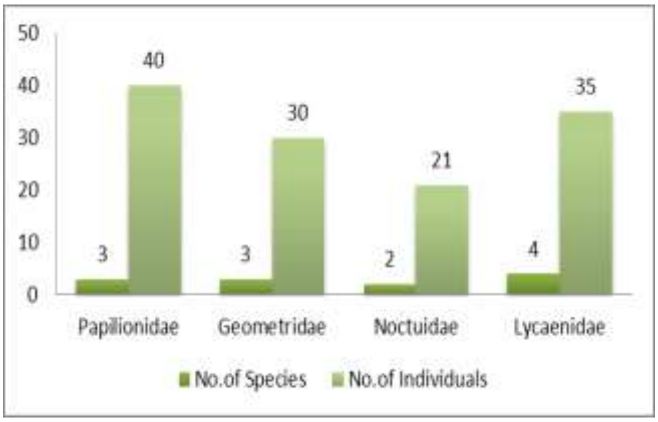

Fig. 5: Order: Lepidoptera.

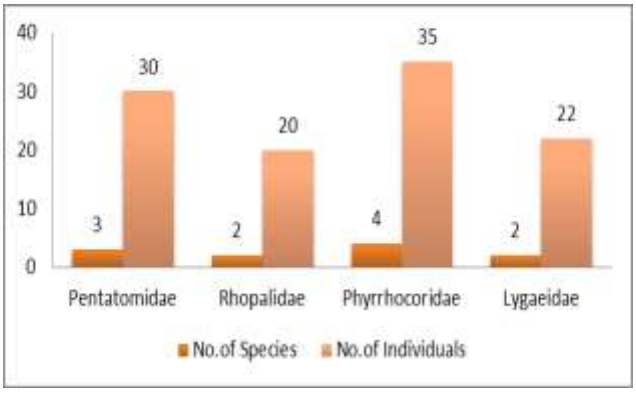

Fig. 6: Order: Hemiptera.

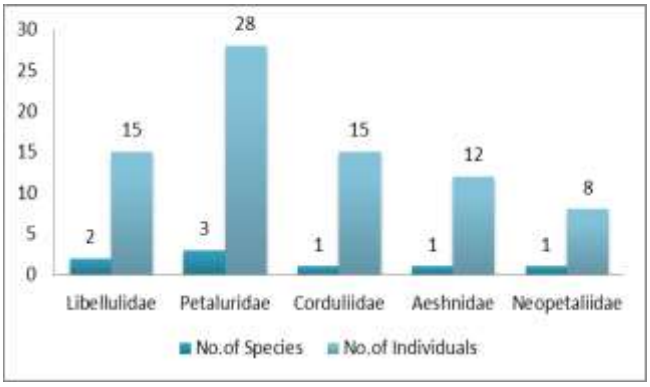

Fig. 7: Order: Odonata.

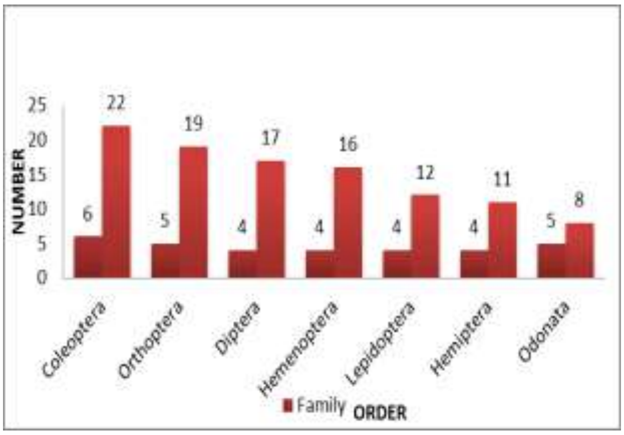

Fig. 8: Family and Species diversity of insect orders in the study in Kattuputhur.

Dominance in insect orders

The dominant insect orders in the Kattuputhur area based on the number of individuals were Coleoptera and Orthoptera, while the least dominant order was Odonata. In terms of the number of species, the most dominant order was Coleoptera with 20.00 species, followed by Orthoptera (18.15), Diptera (16.79), and Hymenoptera (14.66). The least dominant order with respect to the number of species was Odonata with only 7.57 species, as shown in Table-2.

Table 2: Relative Dominance of different insects I the Kattuputhur area.

Order	Relative Dominance
Coleoptera	20.00
Orthoptera	18.15
Diptera	16.79
Hymenoptera	14.66
Lepidoptera	12.42
Hemiptera	10.38
Odonata	7.57

Table-3 and Figure 9 present a comparative graphical representation of the number of insect species and the number of individual insects observed during the study period in the Kattuputhur area. The maximum number of species and individuals were observed in June, while the minimum values were observed in September. There was a sudden increase in both the number of species and individuals in June compared to September, followed by a steady decline in the values. No change was observed in the host plants of the insects or the general ambience, except for changes in rainfall and associated climatic factors. The rains started gently in June, which may have made the conditions more suitable for insect growth and reproduction. However, the same rains were not heavy enough to push the insects into sheltered areas or impede observation.

From July 2020, heavy and constant rains may have impeded the number of observed insects, as most insects may have sheltered in nooks and crannies inaccessible to human sight. A similar observation was reported by Raheem in 2019.[8] This could be due to the fact that some insects appear in a few months each year, and their life cycle is regulated by diapause, based on day length and humidity. Studies have shown that seasonal peaks of insect abundance are more commonly found in tropical regions, and similar results were obtained in a study conducted to estimate the species composition and seasonal abundance of carbide in a forest partly surrounded by paddy fields.[5,7,11,22] The reason for such variations could be several, including changes in weather, floral structures, and other factors.

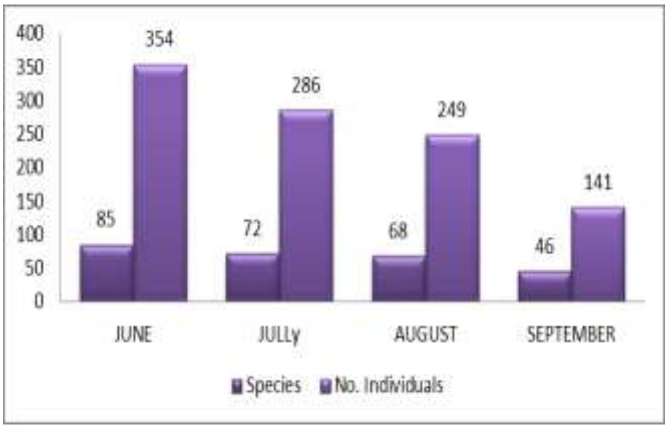

Fig. 9: Month wise Distribution of Insect population in the study in Kattuputhur.

Table 3: Diversity Indices calculated for different months.

	JUNE	JULY	AUG	SEP
Dominance D	0.11	0.07	0.05	0.01
Shannon H	2.979	2.693	2.688	2.251
Eveness_e^H/s	1.4356	1.448	1.462	1.509
Margalef	14.311	12.553	12.143	9.0931

The dominance index is a measure of the dominance of any one species or guild in a community. If a species or guild is found to be exponentially abundant compared to others, it can be considered dominant, and the community may have a high dominance index (close to 1). However, in this study, all the months showed dominance index values less than 0.1, indicating that no single species or guild exhibited significant dominance. The month of June had a relatively higher dominance index compared to September, as reported in a similar study.[11] The Shannon Index of Diversity is considered the most comprehensive measure of diversity as it considers both the number of species and the abundance of each species. In this study, the Shannon index of diversity ranged from 2.251 in September to 2.979 in June, which is consistent with the observations of the number of species (S) and individuals (N). A similar finding was reported in a study by Raja et al in 2018.[23]

Buzas's Evenness, which considers the distribution of species and their numbers across gradients, returned high values ranging from 1.43 to 1.50 (with the highest value being 1) in this study. This suggests that no species was dominant in terms of abundance or resource use. A similar finding was reported by Raja et al in 2018.[23] The Evenness index is reciprocal in value to the Dominance index, and this relationship was also observed in this study. Margalef's Richness returned high values ranging from 9.09 (in September) to 14.31 (in June), indicating the species richness per month. A similar observation was reported by Banu et al. 2023.[3]

The most dominant orders in terms of species (S) and individuals (N) were Coleoptera and Hymenoptera. Diversity indices such as Shannon index (H), Dominance index (D), Evenness index (eH/S), and Menhinick's species richness index were calculated and compared across different months. There was not much variation in species composition on a month-wise gradient, but the month of June stood out with the highest values. The diversity of species is influenced by various environmental factors, as reported by Logeswari et al. 2021.[24] There is often a correlation between the structural complexity of habitats and species diversity, as mentioned by Latharaja and Banu in 2022.[25] Higher diversity is usually observed in regions where a variety of habitats are available, as noted by Viajayapriya et al. in 2019.[1]

Beetle diversity is typically higher on structurally complex shrubs, as reported by Murugesan et al. in 2020.[26] The order Coleoptera has a high species richness in the family Coccinellidae, which are predators of Hemipteran pests like aphids, mealybugs, and scale insects. This family has received considerable research attention due to its potential as biocontrol agents, as noted by Rajaseka Pandian et al. in 2007.[27] In the order Hymenoptera, the dominant family was Apidae, which includes bees that collect pollen and nectar from flowers as food resources, as reported by Ganesan and Xu in 2017.[28] Ground beetles are generally considered opportunistic feeders that primarily find their food through random searches, although some species hunt using sight or special hair-like appendages on their antennae, as mentioned by Kumar et al. 2008.[29] Additionally, many species are known to have a seasonal diet shift based on food availability, moving back and forth between insect prey and weed seeds, allowing the predators to exploit different resources throughout the year, as noted by Kumar et al. in 2007,[30] Ganesan et al. in 2023[31] and Pandian et al. in 2006.[32]

Insects have been found to have a significant impact on seed set and agricultural soil improvement. For example, a variety of insect taxa have been linked to increasing seed set, as mentioned by Zhang et al in 2022[33] and Ganesan and Xu in 2017.[34] Insects, such as dung beetles, play a crucial role in improving agricultural soil. Their activities in the soil lead to increased levels of nitrogen, phosphorous, potassium, calcium, magnesium, and total proteins, which significantly enhance the yield of wheat plants compared to chemical fertilizers.[35-38] Muscid flies, which belong to the diverse family Muscidae of Diptera, are distributed worldwide. These flies also play a key role in pollination, particularly in alpine and arctic areas where they have been identified as the most common flower visitors.[39-42] The abundance of butterflies in ecosystems is directly proportional to the type and abundance of plant growth in the area.[43-46] Hemipterans, a diverse group of insects, have adapted to various habitats and utilize a range of food sources. Some members, such as aphids and planthoppers, have become notorious agricultural pests, while the evolutionary history of the group has been characterized by numerous shifts between predation and plant feeding.

CONCLUSION

In conclusion, the study found that the community had high diversity, with no single species or guild exhibiting significant dominance. The month of June had the highest diversity, as indicated by the Shannon index. Coleoptera and Hymenoptera were the most dominant orders in terms of species and individuals. Beetles, particularly the family Coccinellidae, were found to have high species richness and potential as biocontrol agents against Hemipteran pests. Bees, specifically the family Apidae, played a key role in pollination by collecting pollen and nectar from flowers. Ground beetles were opportunistic feeders and their diet often shifted seasonally based on food availability. Insects were found to have positive effects on seed set and agricultural soil improvement, such as dung beetles increasing nutrient content in the soil and muscid flies contributing to pollination. Lastly, the abundance of butterflies in ecosystems was found to be influenced by the type and abundance of plant growth in the area. Overall, the study highlights the importance of various insect taxa in contributing to the diversity and functioning of the community, as well as their ecological roles in pest control, pollination, and soil improvement.

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