FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 9 April Special Issue, 2025, pp 317 - 322
DOI: https://doi.org/10.33003/fjs-2025-09(AHBSI)-3426

BASELINE STUDY OF DIVERSITY AND INSECT SPECIES RICHNESS RECORDED IN FEDERAL UNIVERSITY DUTSIN-MA TAKE -OFF CAMPUS, KATSINA, NIGERIA

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ABSTRACT
Worldwide, University campuses are increasingly mandating ecosystem preservation and conservation into their practices. The study investigated the diversity and species richness of insects at the Take-off Campus of Federal University Dutsin-Ma, Katsina State. Two sites, the Clinic and ICT complex were chosen to reflect the level of anthropogenic disturbance. Insects were collected using the light trap methodology. Data collected was analyzed using the Shannon-Weiner diversity index, Simpson index of diversity, and Equitability Index on the PAST Program. Results showed that both locations had an identical insect species richness of 13. However, the clinic hosted a higher number of individual insects (101) compared to the ICT Complex (67). Diversity indices revealed that the ICT Complex had slightly higher values for the Simpson index (0.91) and Shannon index (2.50), indicating greater diversity and more ecosystem services. The equitability index was also higher at the ICT Complex (0.97). The findings highlighted the ecological health of the study area and underscore the importance of adopting Integrated Pest Management (IPM) strategies to manage pests while preserving beneficial insects to ensure ecological sustainability and promote a balanced campus environment.

Keywords: Diversity, Insects, Species richness, Carpenter ant, Dutsin-Ma, Nigeria

INTRODUCTION
Insects represent more than half of all described species in the animal kingdom and account for a considerable proportion of all biodiversity on the planet (Tihelka *et al*., 2021). Insects are beneficial to humans, as they produce useful substances, pollinate plants, act as scavengers, control pest insects, and serve as food for both humans and other animals (Manno *et al*., 2018). A perfect example of insects being sources of food is illustrated in the way termites and grasshoppers are considered delicacies in most parts of Nigeria, especially northern Nigeria. Despite their numerous benefits, entomofauna are considered disease vectors to man and many other organisms. For example, Halabi (2020) reported that pathogens transmitted through arthropod bites including mosquitoes and fleas increased from 27,388 cases in 2004 to over 96,000 cases in 2016. Accelerated declines in biodiversity are of major concern globally (Ceballos *et al*., 2015). Unfortunately, worldwide decline in insect populations have become alarming, attributed to habitat fragmentation, environmental factors, host plant decline and increased pesticide use (Zattara and Aizen, 2021). Sanchez-Bayo and Wyckhuys (2019) reported that a recent meta-analysis showed that nearly half of insects are declining and one third are close to extinction.
Losses in insect diversity can lead to decline in other species that feed on insects as well as decline in crop yield due to scarcity of pollinators (Seibold *et al*., 2019). In most cases, shifts in insect abundance and diversity can be used as early warning indicators of environmental change and unhealthy ecosystem. It is evident from different numerous studies that human activities, among other factors have been the primary drivers of these population decline, with a consistent correlation between human interference and reductions in the diversity and abundance of insect species in forest ecosystems, urban environment and campuses (Leteon *et al*., 2010). This decline in insect fauna is a major challenge as so many crops are dependent on insect pollinators. In some African countries, 15-40% of all calories, iron nutrient intake and protein comes from pollinator dependent crops (Teklewold *et al*., 2021).
Institutions that engage in Wildlife habitat management generally favour certain practices, especially planting indigenous species (Bosci *et al* 2018). Federal University Dutsin-Ma located in Dutsin-Ma town, Katsina State in recent times is putting increased effort towards greening and maintenance of tree species. This makes the campus a unique space to study insect diversity in a campus setting. However, there is paucity of information on insect fauna in the study area, and this study seek to fill this gap. This study is conducted to serve as baseline data for documenting the insect species in FUDMA take-off campus. The findings of this study will provide baseline information data on insect diversity and contribute to the understanding of insect diversity in the University campus ecosystem.

MATERIALS AND METHODS
Study Area
The FUDMA take-off campus in Dutsin-Ma Local Government Area of Katsina State, Nigeria, lies, between Latitude 12.47275°N and Longitudes 7.48582°E. The study area experiences moderately high relative humidity year-round, with temperatures ranging from 21°C to 35°C. The soil in the area belongs to the sandy clay loam textural class (Tukur *et al*., 2013).

Site Selection
Two sample locations were purposively selected, namely, ICT complex and the school clinic. These sites were selected

based on less human disturbance in the areas. The area surrounding the ICT Complex is dominated by a mix of Neem (*Azadirachta indica* L) and Flamboyant (*Delonix regia*) trees. The Neem trees provide dense shade with their wide canopy, while the Flamboyant trees add a vibrant touch to the landscape with their striking red flowers. The FUDMA Clinic is situated beside the Akpabio hostel, which is a female hostel. The area behind the clinic, close to the female hostel, is characterized by a similar vegetation pattern, with Neem and Flamboyant trees being predominant.

Sample Collection

Light trap was set using a light source (rechargeable bulb), Collection containers, Tissue paper, Insecticide and Camphor for preservation. The light trap consists of a simple setup where the rechargeable bulb is placed centrally to attract nocturnal insects (Plate 1).

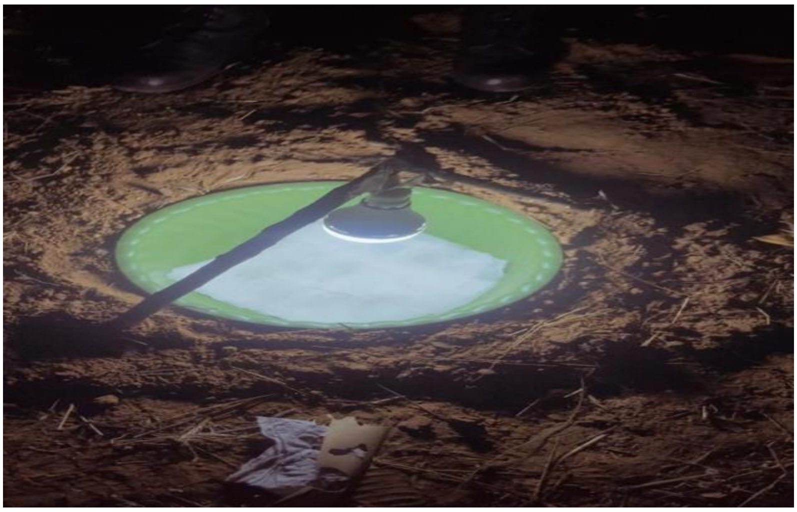

Plate 1: Light trap use for insect collection

A plastic container measuring 28.0 cm (diameter) and 12 cm (depth) was placed directly in a pit below the light source to capture the insects as they are drawn to the light. A fold of tissue paper (absorbent) was carefully lined inside the container to absorb drops of insecticide (killing agent). Rechargeable bulbs (10 Watt white) were put on from 9 pm to 6 am to attract insects (both flying and crawling). The rechargeable bulb emits light rays that attracts flying insects, which are drawn to the trap. As insects approach the light, they either fly into the container below or are captured as they land near the light source. Crawling insects may also be attracted to the light and are captured in the same manner.

Once the insects were captured, they were carefully isolated in a separate container. This container was prepared with a minimal amount of insecticide to ensure the insects are euthanized humanely. The tissue paper inside the container helps to absorb any excess insecticide, preventing the insects from becoming overly soaked, which could damage their physical structure. Camphor was placed within the container to maintain the quality of the specimens, preventing decay and ensuring that they remain in good condition for subsequent analysis.

Insects Identification

The collected insect samples were taken to the Insect Museum, Department of Crop Protection, Institute for Agricultural Research (IAR), Ahmadu Bello University Zaria for proper identification. Information about the order, class, family, genus and specie names were recorded accordingly.

Data Analysis

Data collected were analyzed using descriptive statistics such as tables, charts and percentages. Species richness and diversity were estimated using Shannon-Weiner and Simpsons Index of Diversity according to Naman *et al*. (2019).

Simpsons Index: This was calculated from the formulae below.

$$\lambda = \sum \frac{n(n-1)}{N(N-1)}$$

Where: Where ni = number of individuals or amount (e.g. biomass) of each species (the ith species) and N = total number of individuals (or amount) for the site, and ln = the natural log of the number

Shannon-Wiener Index (H') was calculated using the equation below:

$$H' = -\sum \left[\left(\frac{ni}{N}\right) * 1n\left(\frac{ni}{N}\right)\right]$$

Where ni = number of individuals or amount (e.g. biomass) of each species (the ith species) and N = total number of individuals (or amount) for the site, and ln = the natural log of the number.

Similarity Index

$$Sim = \frac{2\sum nc}{\sum n1+\sum n2}$$

Where nc = the common species between sites; n1= the species of site 1 and n2 = species of site 2

RESULTS AND DISCUSSION

The checklist of insect fauna identified in the selected sample locations is presented in Table 1. The survey recorded thirteen (13) different species, belonging to eight (8) different insect orders and ten (10) insect families. Order hymenoptera has the most species, followed by order hemiptera, coleoptera, and orthoptera, while order diptera has the least species. Out of the recorded families, Scarabacidae is the most represented.

Abundance and distribution of insect species recorded is presented Table 2. A total of 168 insect species were recorded, with the carpenter ant, *Camponotus* sp. Mayr, 1861 (Hymenoptera: Formicidae) having the highest number of 28 and a relative abundance of 16.67%, followed by Shining ground cricket, *Allonemobius allardi* Alex. & Thomas, 1959 (Orthoptera:Gryllidae) and Braconid wasp, *Phaneroroma sp* Wesmael, 1838 (Hymenoptera: Braconidae) each having a total number of 18 (10.71%) and 16 (9.52) respectively. The yellow-winged grasshopper, shield bug and sharp-winged cricket recorded the lowest number of individuals, having abundance of 5 (2.98%), 7 (4.17%) and 9 (5.36%) respectively. Out of 168 individual species, the clinic site had the highest abundance of 101 (60.12%) individual insects while the ICT site had an abundance of 67 (39.88%). Family scarabadidae and gryllidae were the most dominant while family acrididae, braconidae, nabidae, and cixiidae have low values.

Order Orthoptera was the dominant specie recorded, it had four (4) representative insect species, namely; sharp-winged cricket, decorated camel cricket, shinning ground cricket and the yellow winged grasshopper. Order hymenoptera which has the carpenter ant and braconid wasps as its representative species had the highest number of insects in both sites, having 44 individual insects at the clinic site and ICT complex, while the order diptera which has only the long-nosed flower fly had the lowest number of insects (12) at the sample sites. Order Hymenoptera is the most abundant recorded behind the clinic and ICT complex. For the clinic site, order Homoptera is the second abundant specie after hymenoptera order, while order Diptera is the next dominant one after Hymenoptera order in the ICT complex (Fig 1 and 2).

During the study, both sites recorded species richness of 13. Shannon-Weiner Diversity and Simpson Index of Diversity were higher in the ICT complex with values 2.50 and 0.91 respectively. The clinic site had diversity index of 2.43 and 0.90 for Shannon-Weiner and Simpson index respectively. Equitability indices, which measures how evenly the individuals are distributed among the species, were 0.97 for the ICT Complex and 0.95 for the clinic (Table 3).

Table 1: Checklist of insect fauna in the study area

Common name	Scientific name	Order	Family
Oriental beetle	*Anomala cuprea* Hope, 1869	Coleoptera	Scarabaeidae
Fungus weevil	*Anthribus nebulosus* Forster, 1770	Coleoptera	Anthribidae
Dung beetle	*Onitis alexis.* Klug, 1835	Coleoptera	Scarabaeidae
Long-nosed flower fly	*Rhingia campestris* Meigen, 1822	Diptera	Syrphidae
Shied bug	*Aethus sp.* DALLAS, 1851	Hemiptera	Cyanidae
Tropical spiny leaf hopper	*Destria bisignata* OMAN, 1949	Hemiptera	Cicadellidae
Yellow plant bug	*Poecilocapsus lineatus* Fabricius, 1798	Hemiptera	Miridae
Carpenter ant	*Componotus eugeniae* Mayr, 1861	Hymenoptera	Formicidae
Braconid wasp	*Phanerotoma sp* Wesmael, 1838	Hymenoptera	Braconidae
Sharp-winged cricket	*Acanthoplistus acutus* Saussure, 1877	Orthoptera	Gryllidae
Decorated camel cricket	*Ceuthophilus sp* Scudder, 1862	Orthoptera	Rhaphidophoridae
Shinning ground cricket	*Allonemobius allardi* Alex. & Thomas, 1959	Orthoptera	Gryllidae
Yellow-winged grasshopper	*Gastrimargus africanus* Saussure, 1888		Orthoptera

Source: Field survey, 2024

Table 2: Abundance and Distribution of insects in the study area

Order	Scientific name	Common name	BH	ICTC	Abundance	RA (%)
Coleoptera	*Anomala cuprea* Hope, 1869	Oriental beetle	7	3	10	5.95
Coleoptera	*Anthribus nebulosus* Forster, 1770	Fungus weevil	10	4	14	8.33
Coleoptera	*Onitis alexis* Klug, 1835	Dung beetle	7	4	11	6.55
Diptera	*Rhingia campestris* Klug, 1835	Long-nosed flower fly	5	7	12	7.30
Hemiptera	*Aethus sp.* DALLAS, 1851	Shied bug	3	4	7	4.17
Hemiptera	*Destria bisignata* OMAN, 1949	Tropical spiny leaf hopper	10	6	16	9.52
Hemiptera	*Poecilocapsus lineatus* Fabricius, 1798	Yellow plant bug	10	5	15	8.93
Hymenoptera	*Componotus eugeniae* Mayr, 1861	Carpenter ant	18	10	28	16.67
Hymenoptera	*Phanerotoma* sp Wesmael, 1838	Braconid wasp	10	6	16	9.52
Orthoptera	*Acanthoplistus acutus* Saussure, 1877	Sharp-winged cricket	4	3	7	4.24
Orthoptera	*Ceuthophilus sp* Scudder, 1862	Decorated camel cricket	5	4	9	5.36
Orthoptera	*Allonemobius allardi* Alex. & Thomas, 1959	Shinning ground cricket	10	8	18	10.71
Orthoptera	*Gastrimargus africanus* Saussure, 1888	Yellow-winged grasshopper	2	3	5	2.98
	Total		101	67	168	100

Key: BH = Behind clinic, ICTC = ICT Complex and RA = Relative Abundance

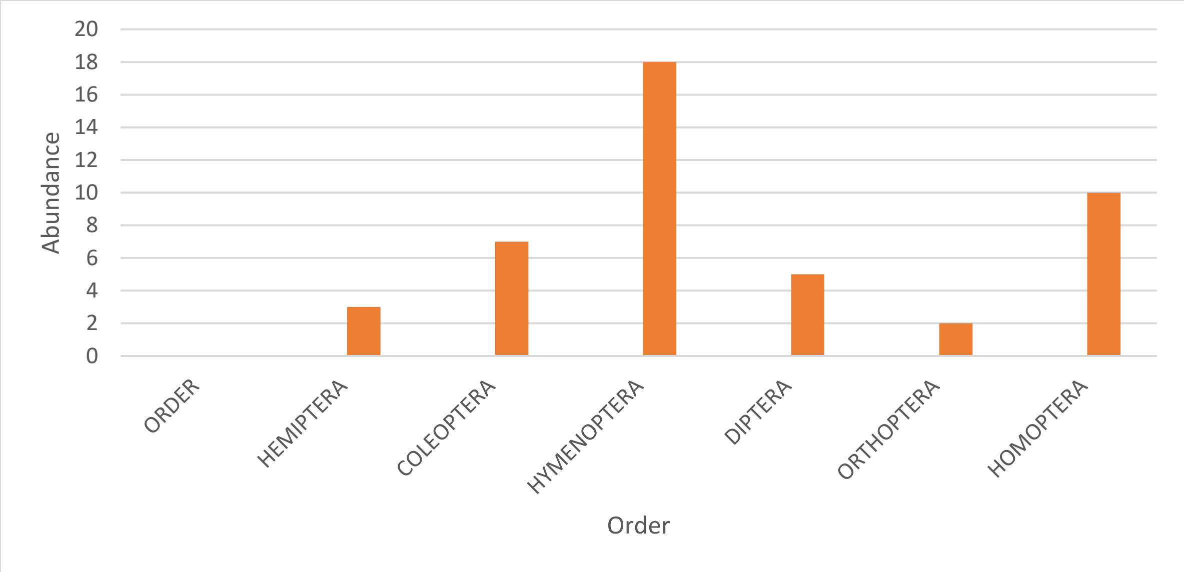

Figure 1: Distribution of insect orders behind FUDMA clinic

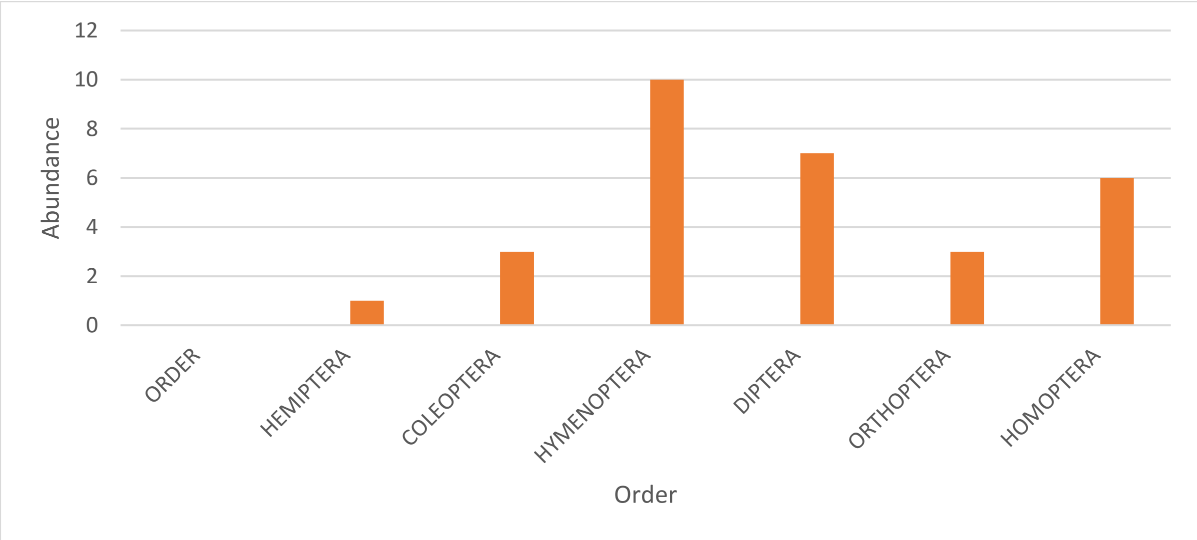

Figure 2: Distribution of insect orders behind FUDMA ICT

Table 3: Diversity indices of insect species in the study area

Variables	ICT	Clinic
Richness	13	13
Individuals	101	67
Simpson index of diversity	0.90	0.91
Shannon (H)	2.43	2.50
Equitability (EH)	0.95	0.97

Source: Field Survey, 2024

Discussion

There was difference in insect abundance between the sample locations in the study area. The difference in environmental features observed during sample collection could be the reason for the differences observed. However, there was higher insect abundance behind the clinic. The clinic site is dominated by flamboyant trees which has brightly colored flowers. The high abundance of insects here could be linked to the presence of this tree species. This is in line with Miller *et al*. (2011) who reported that floral cues such as color, size, shape and scent are the reason some insects are attracted to plants, and this is because colour makes flowers stand out against other green vegetation. The high abundance of Carpenter ants in the study area suggests that the specie has wide range of distribution and interaction with many different species, forming different types of relationship while playing significant role in its environment; and its higher abundance at the clinic site is an indication that the clinic site has better resources for its survival. This result is in conformity with the findings of Rossi and Feldhaar (2020), who reported that carpenter ants have a broad range of mutualistic interactions with plants, including seed dispersal, establishment of seedlings and pollination. The dominance in terms of abundance of order Hymenoptera, Coleoptera and Orthoptera insects' abundance in this study were in contrast with the works of Naman *et al*. (2019) and that of Alafia *et al*. (2023).

The authors reported high species abundance for order Odonata in Kaduna State University Main Campus, Kaduna state, and in certain forest areas of Lagos state, Nigeria while Ghani and Maalik (2020) recorded order Homoptera as the most dominant insect order and order Hymenoptera as the least dominant insects fauna associated with *Triticum aestivum* in district Sialkot, Pakistan. The result of this study with representative species of order Orthoptera being dominant is however in contrast with the findings of Nsabimana *et al* (2013) who reported dominance of the order Hymenoptera in Ruhande arboretum of Southern Ruwanda. These differences in abundance of insect orders in different regions could be attributed to anthropogenic activities, interaction of environmental factors, season of collection and variation in climatic conditions as reported in other works (Naman *et al*., 2019; Mhlanga *et al*., 2022; Abid *et al*., 2024). The authors reported that these factors could have adverse effect on insect fauna distributional patterns and population dynamics. Rarity of Diptera in this study contrasts Ajerrar *et al*. (2024) report of Diptera dominance in central-west Morocco. Dominance of the family scarabaeidae in the study area as opined by Brown *et al*. (2010) indicates that there is balance in the ecosystem as insects such as the dung beetle that belong to this family are known for their importance in reducing populations of pestilent flies and parasitic worms, especially in developing countries where dung beetle is important as an adjunct for improving standard hygiene.
The result of diversity indices showed that behind ICT had higher species diversity and equitability index. The area has so many trees than the clinic site. This result implies that abundance of vegetation especially trees influences the diversity of insect species. This finding conforms to that of Wenninger and Inouye (2008) who reported that in natural systems, insect diversity and abundance are often positively correlated with plant diversity; however, these relationships may be attributed to other characteristics of plant communities such as structural complexity, nutrition or productivity of plants that influence insect distributions. Both sample locations were similar in species composition, having same species richness of 13 species each, insinuating that the species are generalists, occurring in both habitats. This also means that both habitats had certain similarities in terms of habitat requirement needed for the survival of insect species.

CONCLUSION

This study showed that the Federal University Dutsin-Ma take-off Campus is a home to insect fauna, although not so many compared to other environments as seen in literatures. The present survey has for the first time documented a checklist of insect fauna in the study area. This information will be useful to ecologist and other stakeholders in proper monitoring and improvement of the environment to protect and enhance biodiversity.

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