International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 08-01-2023, Accepted: 25-01-2023, Published: 10-02-2023
Volume 8, Issue 2, 2023, Page No. 49-59

A study on the diversity and abundance of aquatic insects in the Manjalar Dam, Theni district, Tamil Nadu, India

Subalakshmi V[1], Delphine Rose M R[2*]

[1] Research Scholar, PG and Research Centre of Zoology, Jayaraj Annapackiam College for Women, Affiliated to Mother Teresa Women's University, Periyakulam, Theni, Tamil Nadu, India

[2] Associate Professor, PG and Research Centre of Zoology, Jayaraj Annapackiam College for Women, Affiliated to Mother Teresa Women's University, Periyakulam, Theni, Tamil Nadu, India

Abstract

The understanding of biology and ecological significance would contribute to future use of some orders of aquatic insect organisms. In the current investigation, the maximum and minimum populations of 536 and 423 individuals, respectively, were seen in the months of November and February and 369 and 267, respectively, in the months of August and May in the years 2020 to 2021. In the years 2020 to 2021, the months of November and February saw the highest diversity indices of 1.999 and 1.978 and the lowest diversity indices of 1.925 and 1.950. The maximum species richness of 1.115 & 1.255 was observed in the month of November & May and the minimum species richness of 1.185 & 1.159 were recorded in the month of August & February in 2020 to 2021. The maximum species richness of 0.855 & 0.85 was observed in the month of November & February and the minimum species richness of 0.8384 & 1.841 were recorded in the month of August & May in 2020 to 2021. The maximum species evenness of 0.9205 & 0.9006 was observed in the month of November & February and the minimum species evenness of 0.859 & 1.8796 were recorded in the month of August & May. The diversity profile curve for the November (536) & February (423) months was lying at the top indicating higher diversity and curve for the October (483), September (435) and August (369) & March (369), April (299) and May (267) was lying at the bottom indicating lower diversity insect biodiversity at Season I and II. The histogram graph clearly showed that the curve for the months of November, February, and March was at the top, signifying higher diversity, and the curve for the months of October, September, and August was at the bottom, signifying lower diversity insect biodiversity at Seasons I and II. The most numerous species (Coleoptera, Diptera, Orthoptera, and Hemiptera) were clearly separated by the PCA study's results with positive scores on axis X (horizontal). The most numerous (Coleoptera and Diptera) species were clearly indicated (positive line) by the current findings of this PCO study on positive axis X (0.4). According to the current findings, CCA analysis was more prevalent in November, October, and February and March of every season from 2020 to March 2021. In the current studies, paired group links were used in cluster analysis to examine the grouping of the major insect groups with high similarity, which included October and November, August and September, April and May, and February and March. In the current study, aquatic insects were employed in various studies to evaluate the biological integrity of the river ecosystem.

Keywords: aquatic insects, diversity, PCA, PCO, CCA analysis

Introduction

The measurement of insect biodiversity is a key objective of ecology. This measurement is difficult to "capture" in a single number. Several "facets" of biodiversity have already been measured using various taxonomic, phylogenetic and richness diversity indices. However, whether a proposed statistic allows for meaningful inquiries about ecosystem functioning or environmental factors is more crucial than whether it satisfies some theoretical criterion. The key is no longer considered to be species diversity per se, but rather functional diversity, which is the value and range of functional traits of the organisms present in a given ecosystem. Because it is simple to estimate and is thought to be a good estimator for functional biodiversity, species richness is almost always used as an explanatory variable for ecosystem function.

Though theoretical research by Belamkar and Jadesh (2014) [1] demonstrated that species richness (species number per se) will only be a sufficient proxy for functional diversity if there is a linear increase in niche space coverage as insect species richness increases. According to Rafael (2009) [2], species traits could only be equally complementary if functional diversity and richness dominance were strongly related. Different insect assemblages that contain more or less functionally redundant or similar species serve as a summary of these two underlying hypotheses. Functional diversity does not increase at the same rate as richness when species with similar functions are introduced into an ecosystem. In fact, a lot of authors contend that functional diversity, not species richness, determines how well an ecosystem functions and must be estimated by Jana(2009) [3].

Aquatic insects are effective indicators of how humans have affected the ecosystem in freshwater. According to Khan and Ghosh (2001) [4], insects are excellent biological indicators of the water quality, pollution, and ecological health of lakes, rivers, dams, and other bodies of water. Their levels of threat and environmental disturbance tolerance vary. While some aquatic insects can survive in disturbed, highly polluted freshwaters, others are less sensitive to it.

Since aquatic insects have a long history of water quality monitoring, they are suitable for use in environmental impact assessment (EIA) research and serve as trustworthy indicators. The diversity of aquatic insects in Manjalar Dam, Theni District, Tamilnadu, India, is documented in the current study because aquatic insects are generally underappreciated in current estimates of Indian biodiversity.

Materials and methods

Sampling and gathering

The majority of the insect species were collected in the current work twice per year, from February 2020 to May 2021 for season II and from August 2020 to November 2021 for season I. Each visit lasted at least two to three hours. Additionally, the prevalence of various species was noted. The majority of the insects used in this study were gathered in the Manjalar Dam region during seasons I and II. The following Pielou (1966) [5] formula was used to calculate the evenness index equitability (J') after the data were analyzed for diversity index (H' log2) using the Shannon - Wiener's formula (1949) [6]. Species richness (S) was calculated using two formulas provided by Margalef (1958) [7] and Simpson (1949) [8]. The identities of the component species as well as their relative importance in terms of abundance or biomass were used to compare communities using CollMultivariate methods of classification and ordination. In contrast to classification analysis, which aims to categorize entities into groups, ordination analysis aims to ordinate these spatially so that similar and dissimilar entities are close to one another. Diversity profiles, histogram graphs, Principal Coordinate Analysis (PCO), Principal Component Analysis (PCA), Canonical Correspondence Analysis (CCA), and cluster analysis are a few examples of ordination techniques. In the current study, PAST, SPSS, SIMPER, and ANOSIM were also used to access the data.

Results

Indices of diversity

The diversity index values for Seasons I and II (August to November for Season I and February to May for Season II) from 2020 to March 2021 are shown in Tables 1 and 2.

Table 1: Insect diversity indices for Season I from 2020 to 21

Diversity Index	Aug	Sep	Oct	Nov
Taxa S	8	8	8	8
Individuals	369	435	483	536
Dominance_D	0.1616	0.1584	0.1494	0.145
Simpson_1-D	0.8384	0.8416	0.8506	0.855
Shannon_H	1.925	1.936	1.977	1.999
Evenness_e^H/S	0.859	0.8668	0.9029	0.9205
Brillouin	1.878	1.893	1.937	1.96
Menhinick	0.4176	0.3836	0.364	0.3462
Margalef	1.185	1.152	1.133	1.115
Equitability_J	0.9269	0.9312	0.9509	0.9602
Fisher_alpha	1.443	1.392	1.362	1.335
Berger-Parker	0.2371	0.2253	0.2174	0.2154
Chao-1	8	8	8	8

Table 2: Insect diversity indices for Season II from 2020 to 21

Diversity Index	Feb	Mar	Apr	May
Taxa_S	8	8	8	8
Individuals	423	369	299	267
Dominance_D	0.15	0.1522	0.1566	0.159
Simpson_1-D	0.85	0.8478	0.8434	0.841
Shannon_H	1.978	1.966	1.955	1.950
Evenness_e^H/S	0.9006	0.8924	0.8829	0.8796
Brillouin	1.93	1.916	1.896	1.886
Menhinick	0.3904	0.4165	0.4627	0.4914
Margalef	1.159	1.184	1.228	1.255
Equitability_J	0.9497	0.9453	0.9401	0.9383
Fisher_alpha	1.402	1.442	1.512	1.555
Berger-Parker	0.2048	0.2033	0.2375	0.2566
Chao-1	8	8	8	8

Univariate methods

a. Number of Individuals

Figure 1 depicts the monthly distribution of individuals from August 2020 to November 2021, during season I. The highest number of individuals 536 was noted in the month of November, and the lowest number 369 was noted in the month of August.

The monthly frequency of people from February 2020 to May 2021 at season II is depicted in (Fig. 1, 2). The highest number of individuals, 423, was seen in the month of February, and the lowest number, 267, was noted in the month of May.

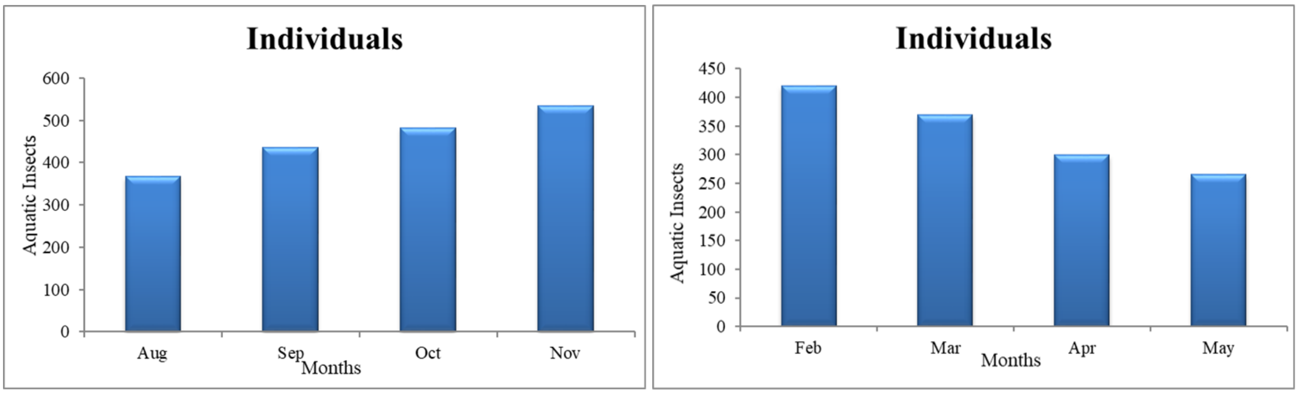


Fig 1, 2: Month wise individuals recorded from 2020 to 2021 at Season I & II

b. Shannon – Wiener Diversity Index (H')

Fig.3 displays the diversity index's monthly frequency from August 2020 to November 2021, during season I. The month of November saw the diversity index reach its highest value of 1.999, and the month of August saw its lowest value of 1.925.

In season II, from February 2020 to May 2021, the diversity index's monthly occurrence is depicted in (Fig. 4). The month of February saw the highest diversity index, 1.978, while the month of May saw the lowest diversity index, 1.950.

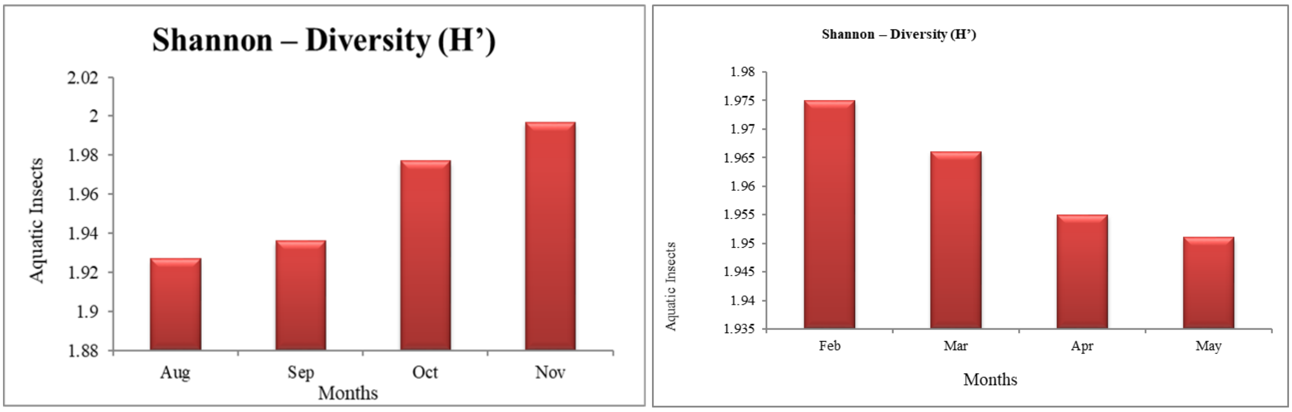


Fig 3, 4: Month wise Shannon diversity (H') recorded from 2020 to 2021 at Season I &II

1. Species Richness: Margalef Index (d)

The month-by-month distribution of species richness from August 2020 to November 2021 at season I is depicted in (Fig. 5). The maximum and minimum species richness's were 1.115 and 1.185 in the months of November and August, respectively.

Season II's species richness distribution by month from February 2020 to May 2021 is depicted in Figure 6. The maximum and minimum species richness's were 1.255 and 1.159 respectively, in the months of May and February.

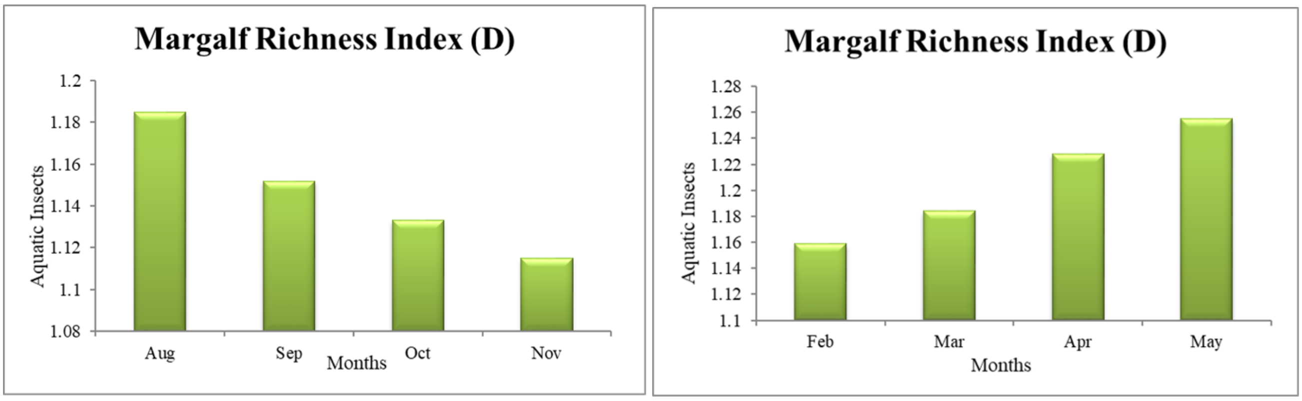


Fig 5, 6: Month wise Margalef index (d) recorded from 2020 to 2021 at Season I & II

2. Species Richness: - Simpson Index (D)

The month-by-month distribution of species richness from August 2020 to November 2021 at season I is depicted in (Fig. 7). The month of November recorde the highest species richness of 0.855, and the month of August had the lowest species richness of 0.8384.

Season II's species richness distribution by month from February 2020 to May March 2021 is depicted in Figure 8. The month of May had the lowest species richness (1.841) and the month of February had the highest species richness (0.85).

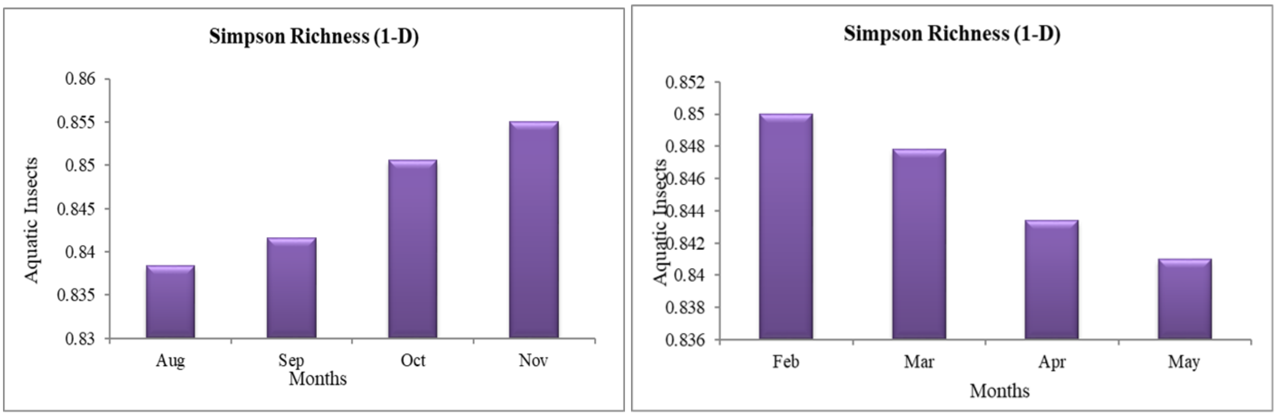
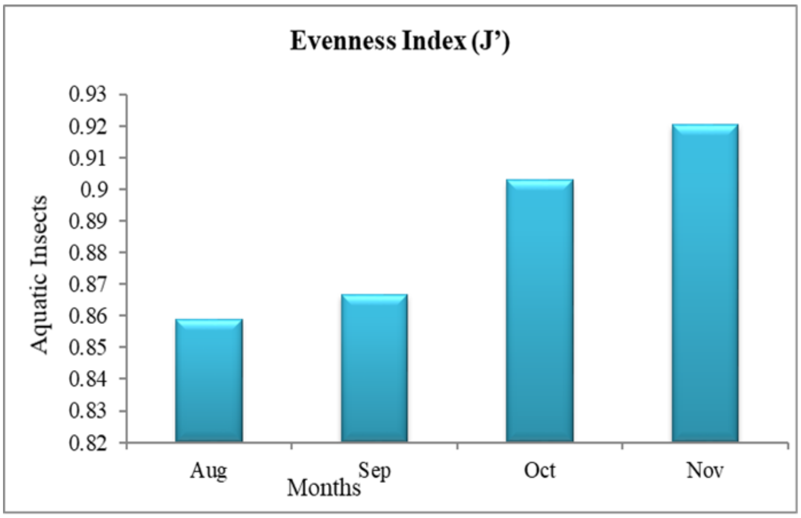


Fig 7, 8: Month wise Simpson richness (1-Lambda) recorded from 2020 to 2021 at Season I & II

c. Index of Pielou's Evenness

Figure 9 displays the monthly distribution of species evenness from August 2020 to November 2021 during season I. The maximum and minimum species evenness values, respectively, were 0.9205 and 0.859, respectively, in the months of November and August, respectively.

Figure 10 displays the monthly occurrence of species evenness from February 2020 to May 2021 at season II. The maximum species evenness was recorded in the month of February at 0.9006, and the lowest species even ess was noted in the month of May at 1.8796.



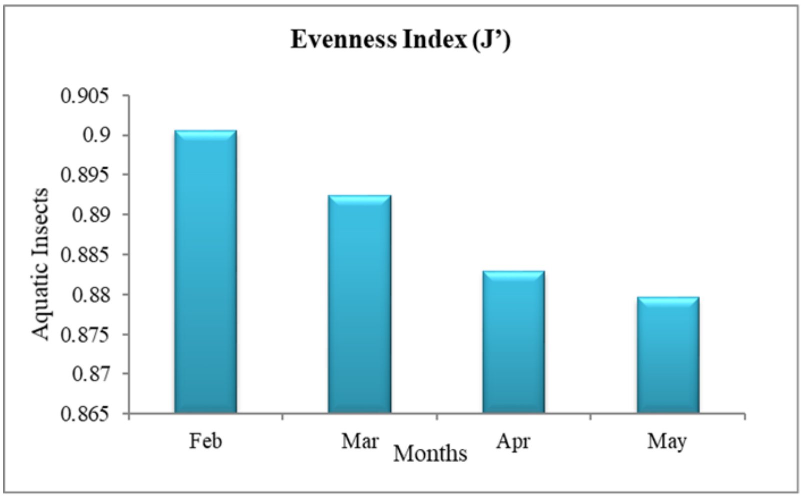
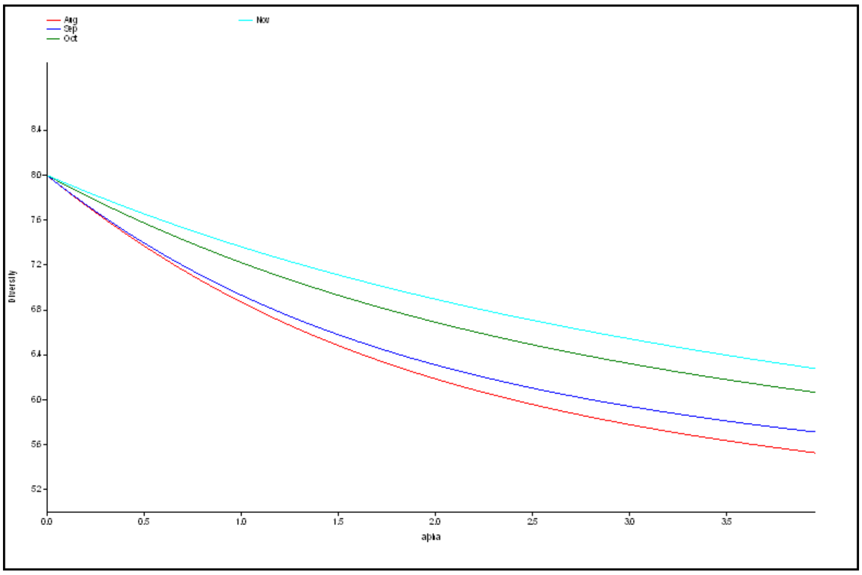


Fig 9, 10: Month wise evenness index J recorded from 2020 to 2021 at Season I & II

Profile of Diversity

The diversity profiles created for the current investigation's four-month period from August 2020 to November 2021 during season I clearly showed the diversity of insect models (Fig. 11). In Season I, the curve for the month of November (536) was at the top, indicating higher diversity, and the curve for the months of October (483), September (435), and August (369) was at the bottom, indicating lower diversity.

The diversity profiles created in the four-month period from February 2020 to May March 2021 at season II clearly showed the diversity of the insect model (Fig. 12). In season II, the curve for the month of February (423) was at the top, indicating higher diversity, and the curve for the months of March (369), April (299), and May (267) was at the bottom, indicating lower diversity.



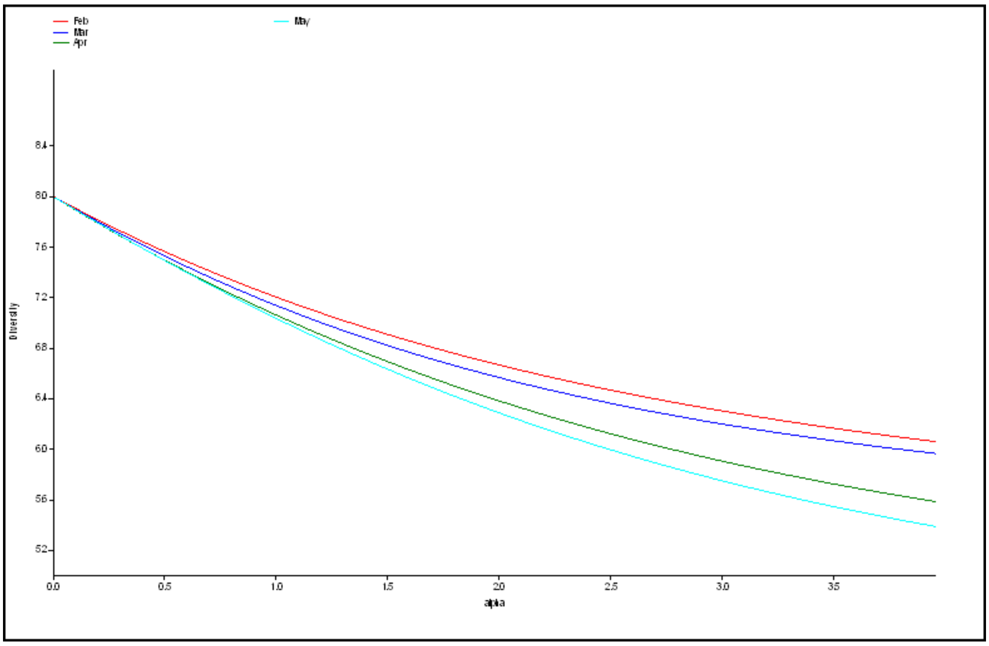
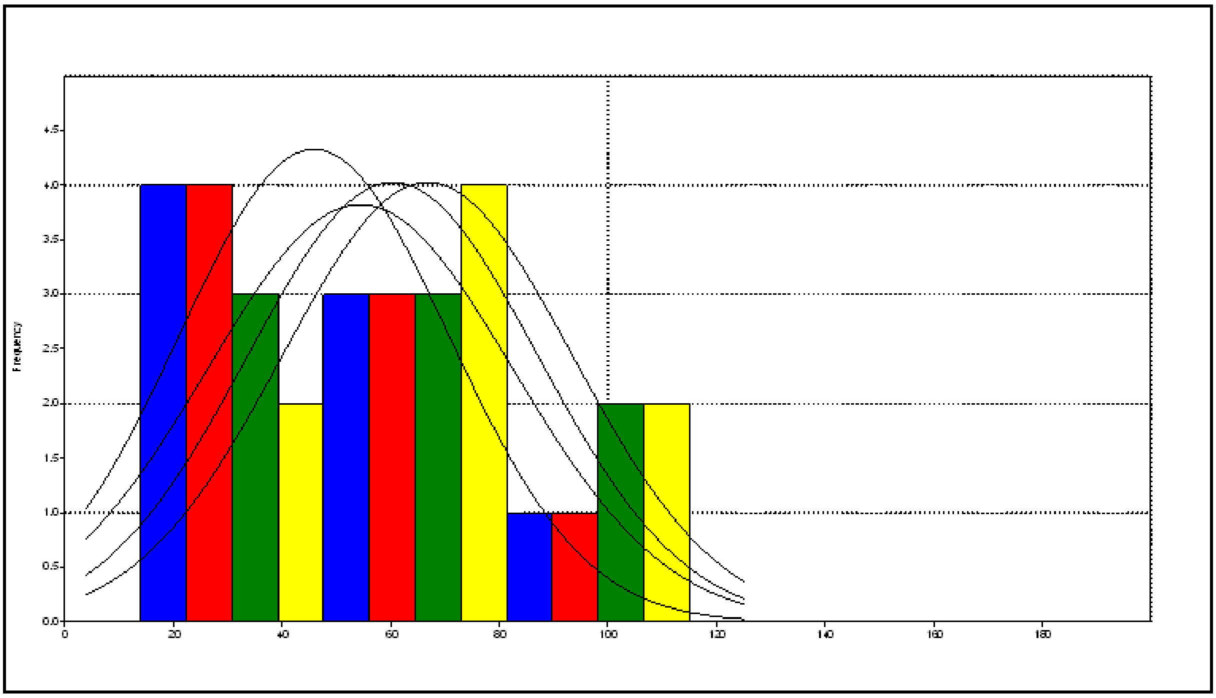


Fig 11, 12: Month wise diversity profiles recorded from 2020 to 2021 at Season I & II

Histogram

The histogram graph used in the current investigation (Fig. 13) made clear the variety of insect models in the four months from August 2020 to November 2021 during the first season. In Season I, the curve for the month of November was at the top, indicating higher diversity, and the curve for the months of October, September, and August was at the bottom, indicating lower diversity.

The insect model diversity in the four months from February 2020 to May 2021 during season II was clearly shown by the histogram graph (Fig. 14). Indicating greater diversity, the curve for the months of February and March was at the top of the chart, and the curve for the months of April and May was at the bottom.



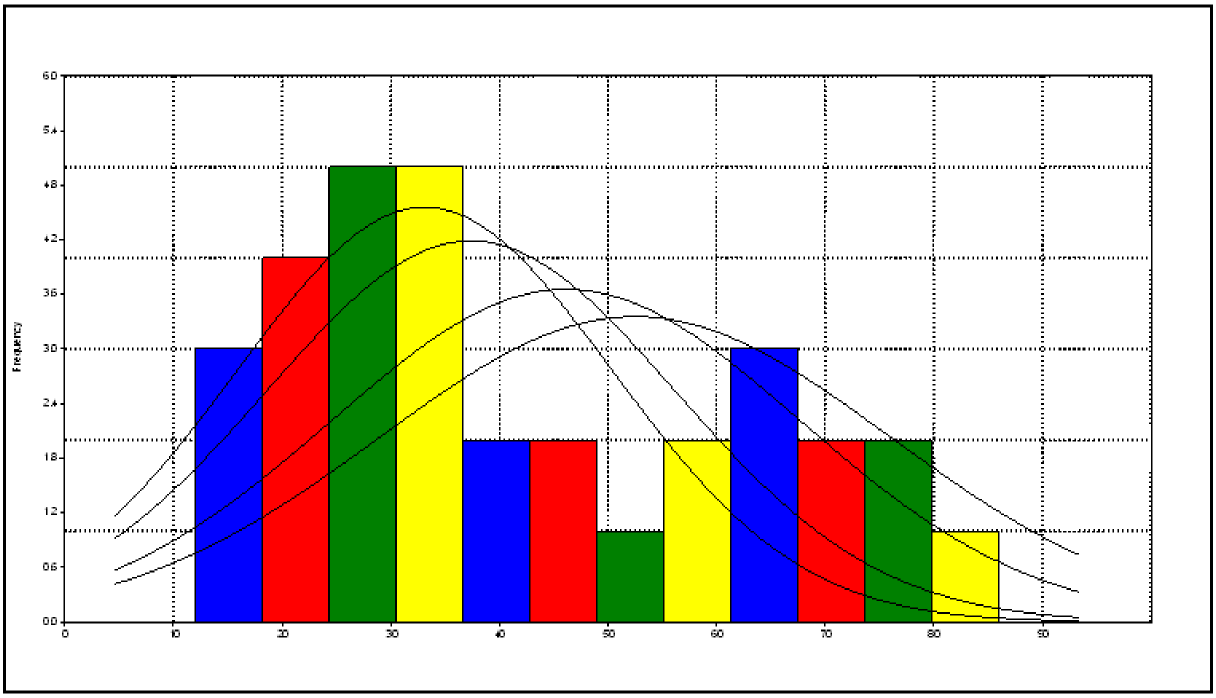


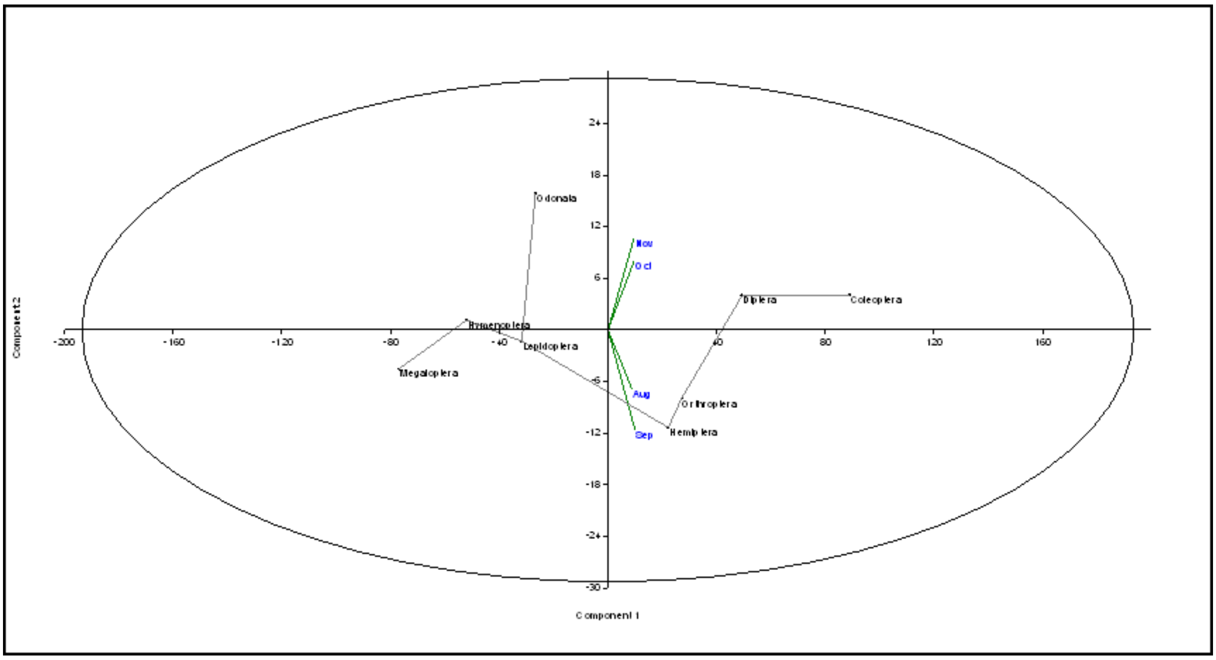
Fig 13 14: Month wise histogram recorded from 2020 to 2021 at Season I & II

Scatter Diagram for PCA

From August 2020 to November 2021, during season I, four sampling months were used in the PCA sampling process. Coleoptera (405), Diptera (326), Orthoptera (282) and Hemiptera (271) had the highest Principal Component Analysis (PCA) values, while Megaloptera (74) had the lowest values during season I (Fig. 15).

From February 2020 to May 2021, during season II, four sampling months were used in the PCA sampling process. The Principal Component Analysis (PCA) increased to be the highest and the least was recorded for Megaloptera (58) in season II for the graph axes of the insect (orders) Diptera (298), Coleoptera (274), Hemiptera and (200).

The results of this PCA study also showed that some insect species can adjust to their environment and a variety of environmental parameters (variables 5 intervals within species 96.6, 2.2, and 1.1). The most numerous species (Coleoptera, Diptera, Orthoptera, and Hemiptera) were clearly distinguished by the scores on the positive axis X (horizontal).



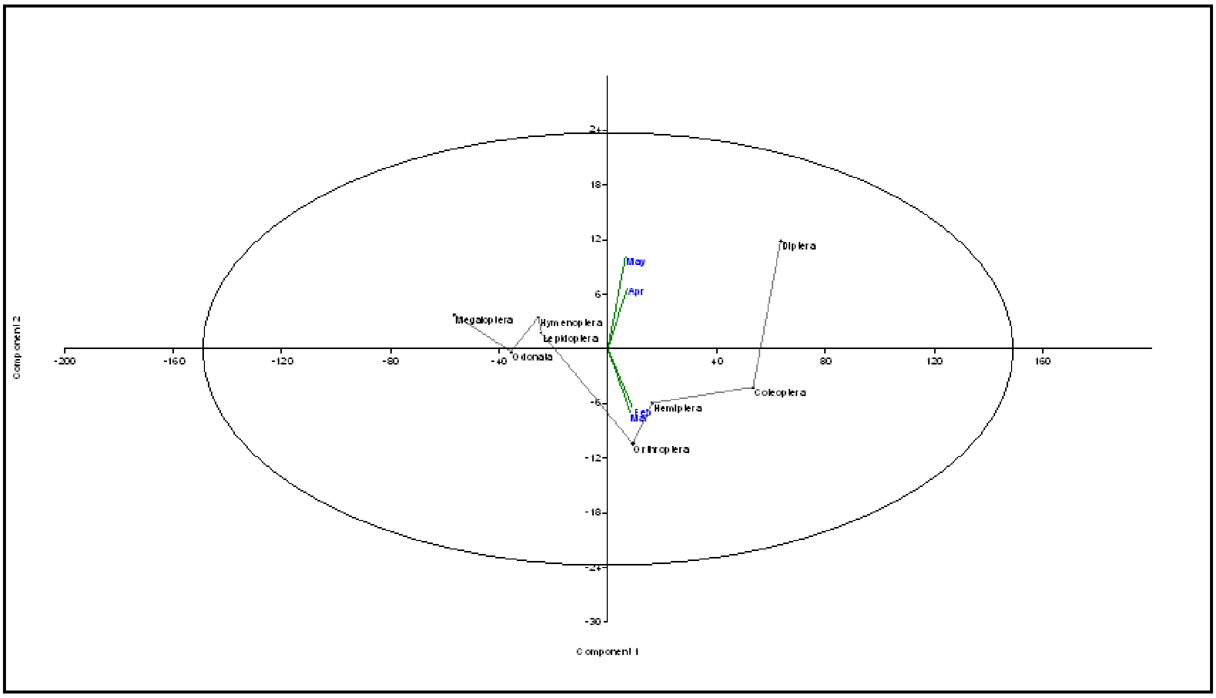
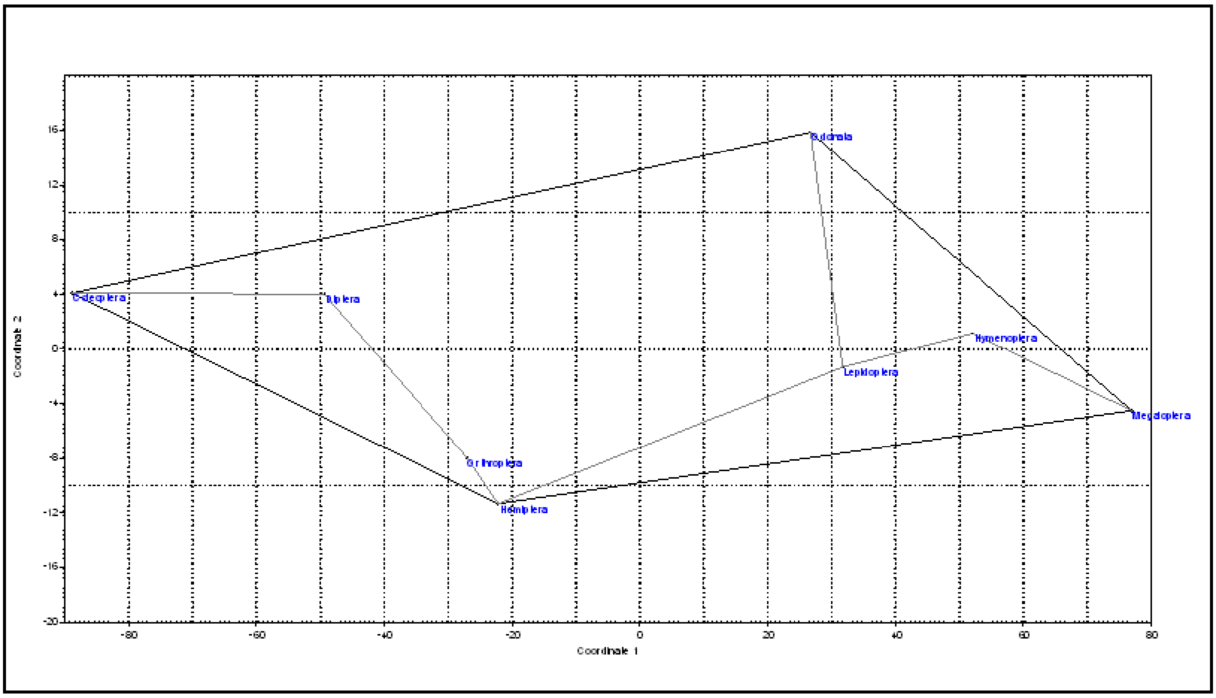


Fig 15, 16: Month wise PCA recorded from 2020 to 2021 at Season I & II

A scatter gram for a PCO

At season I, the PCO sampling process was carried out for four sampling months, from August 2020 to November 2021. In season I, Megaloptera had the lowest PCO and Coleoptera and Diptera had the highest PCO for the graph axes of the insect orders (Fig. 17).

Season II saw the PCO sampling process take place over four sampling months, from February 2020 to May 2021. In season II, Megaloptera had the lowest PCO (Fig. 18) and Diptera and Coleoptera had the highest PCO for the graph axes of the insect orders. The most numerous (Coleoptera and Diptera) species were clearly indicated (positive line) by the current findings of this PCO study on positive axis X (0.4).



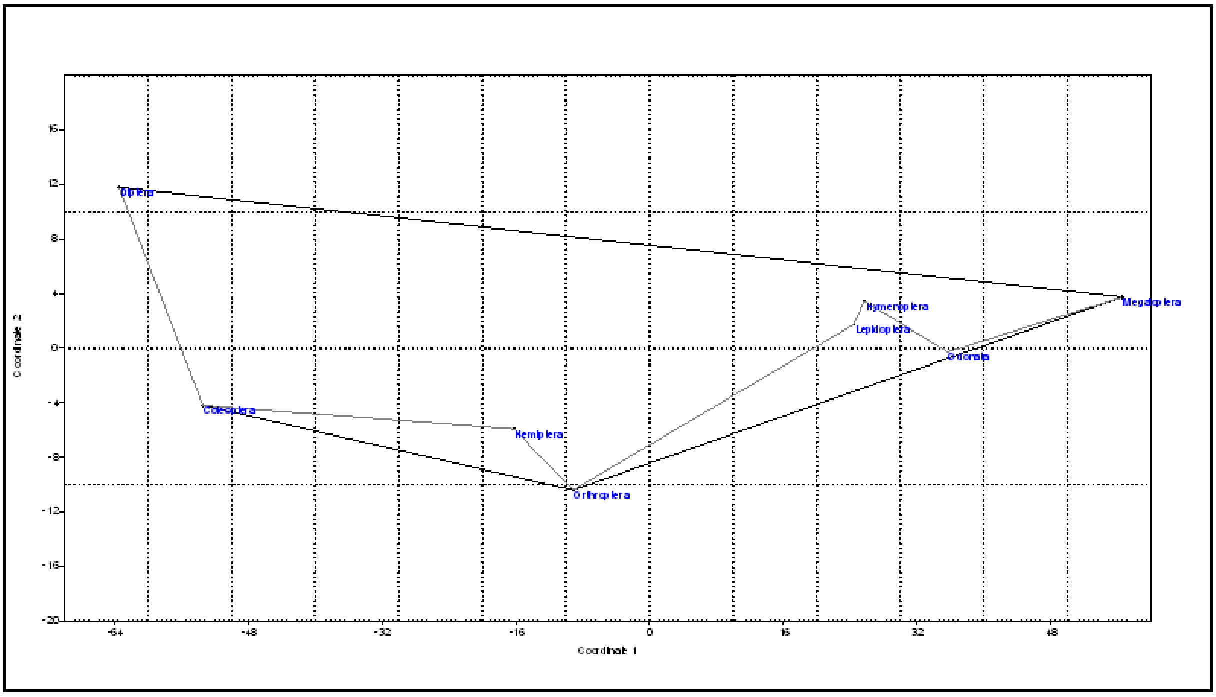


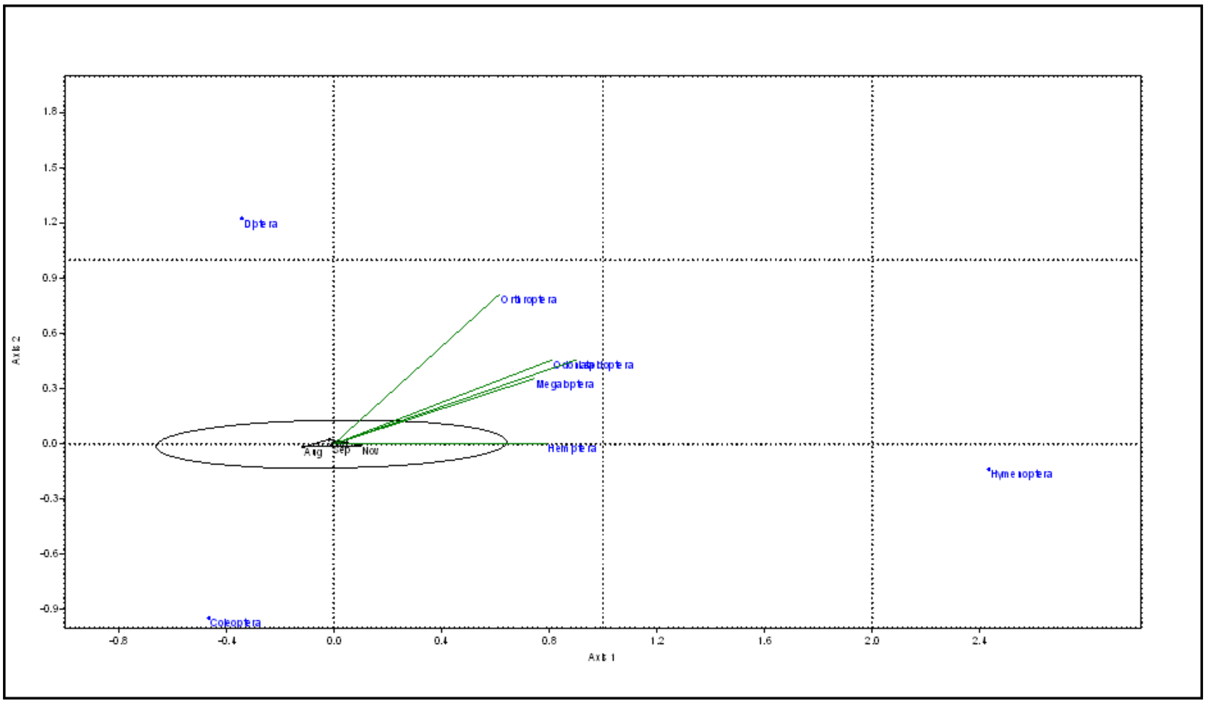
Fig 17, 18: Month wise PCO recorded from 2020 to 2021 at Season I & II

CCA

Throughout the study period, there are variations in the variety and abundance of insect species. Their distribution remained constant from one monthly sampling date to the next. Between August 2020 and November 2021 in Season I, the abundance of the insect shows as the highest positive CCA graph x axis and y axis line in November, October, and September (Fig. 19).

Insect distribution was lowest in August according to the negatively skewed line graph. The CCA graph's x axis and y axis line during February and March of Season II, which runs from February 2020 to May 2021, show the highest positive insect abundance (Fig. 20). Insect distribution was at its lowest in March, according to the negatively skewed line graph.

According to the current findings, CCA analysis was more prevalent in November, October, and February and March of every season from 2020 to March 2021. This demonstrated how picky these orders are about their habitats. This demonstrates the abundance and diversity of the insect population in the research area.



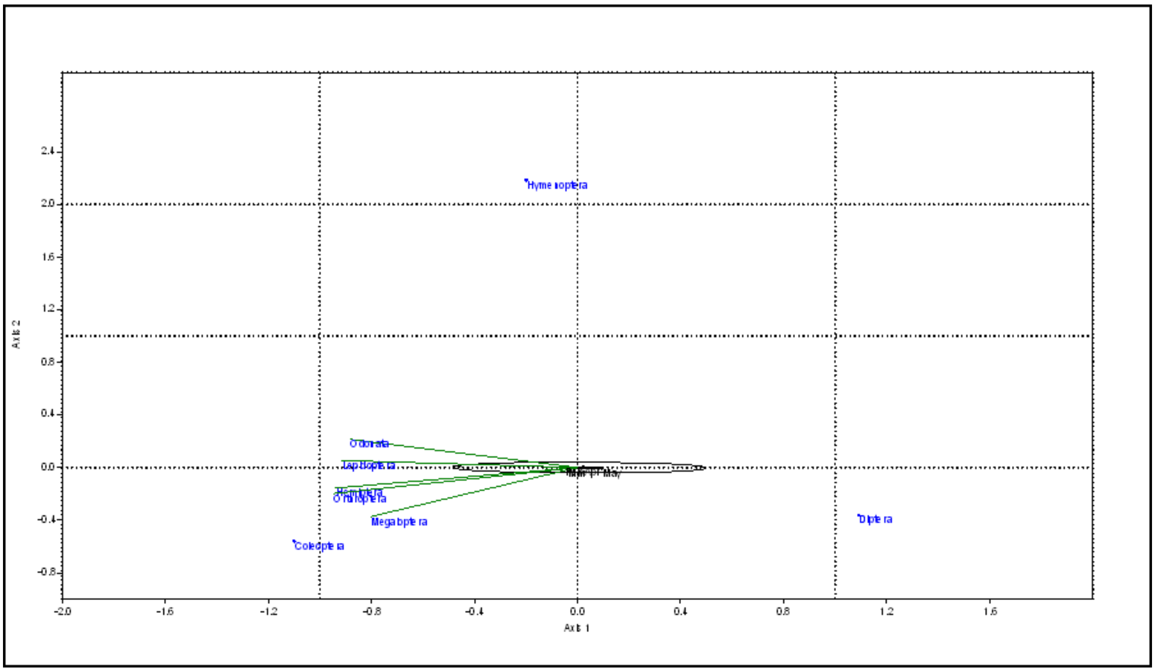
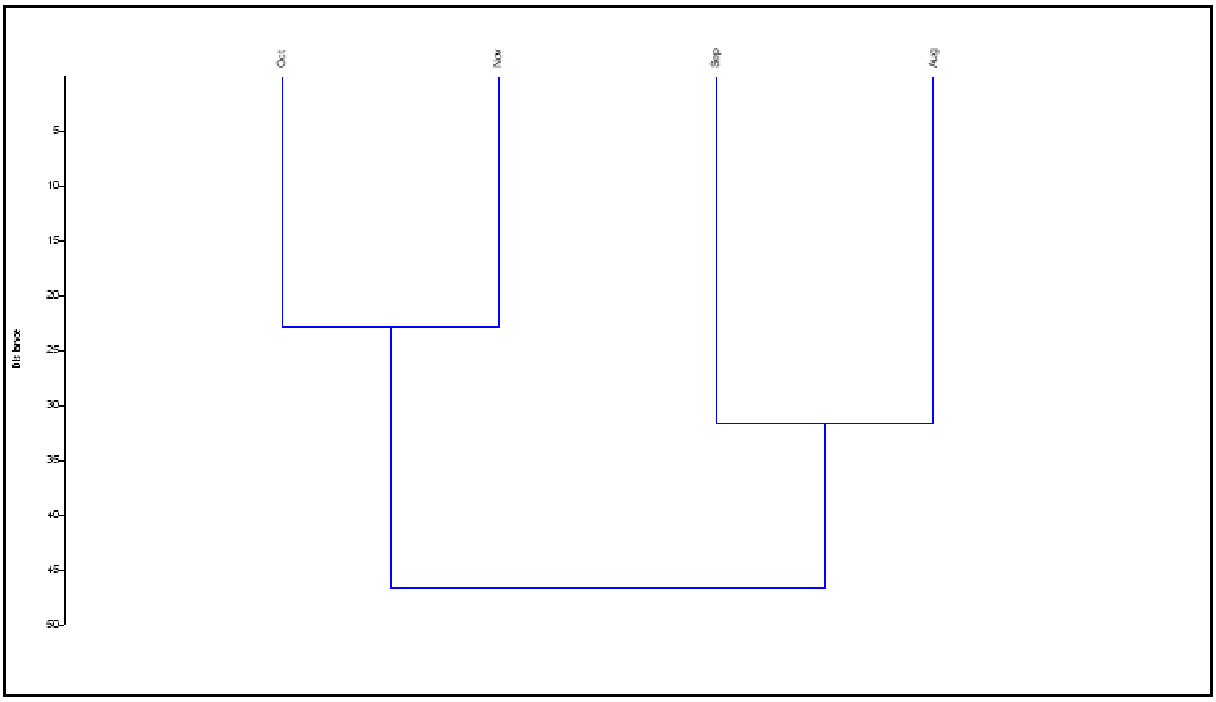


Fig 19, 20: Month wise CCA recorded from 2020 to 2021 at Season I & II

Clustering Analysis

The grouping of the various in four months at season I from August 2020 to November 2021 was studied in the current studies using paired group links and cluster analysis (Fig. 21). The dendrogram displayed groups 1 and 2. Insects from August and September and October and November shared a lot in common with the other major groups.

The grouping of the various variables in four months during season II, from February 2020 to May 2021, was studied in the current studies using cluster analysis with paired group links (Fig. 22). The dendrogram displayed groups 1 and 2. April and May insects and February and March insects shared a lot in common with the major groups.



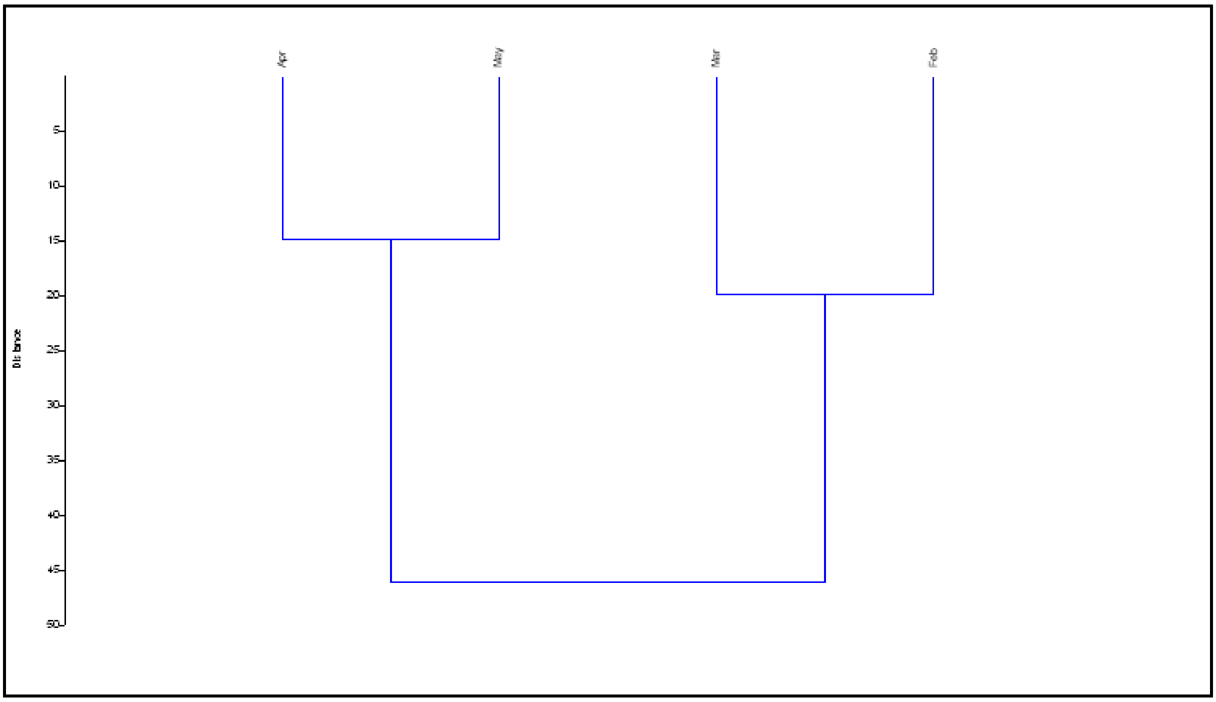


Fig 21, 22: Dendrogram shows in month wise insects from 2020 to 2021 at season I & II

Discussion

The abundance of aquatic invertebrate diversity is enriched by the aquatic vegetation, which offers habitat, food sources, and protection from predators, and structure for mating and emergence of aquatic insects. In freshwater ecosystems, different functional groups of aquatic insects occupy various trophic levels of the food chain and food web. Aquatic macrophytes frequently have an impact on the diversity, distribution, and abundance of aquatic insects by Khan and Ghosh (2001) [4].

In the months of November and February, respectively, and August and May, respectively, in the years 2020 to 2021, the maximum and minimum numbers of individuals were 534 and 423, respectively, and 369 and 267, respectively. In the years 2020 to 2021, the months of November and February saw the highest diversity indices of 1.999 and 1.978 and the lowest diversity indices of 1.925 and 1.950. In the years 2020 to 2021, the months of November and May had the highest and lowest species richness, respectively, of 1.115 and 1.255, and 1.185 and 1.159 respectively.

In the years 2020 to 2021, the months of November and February saw the highest and lowest species richness values, respectively, of 0.855 and 0.85, and 0.8384 and 1.841 respectively. The months of November and February recorded the highest and lowest species evenness values, respectively, of 0.9205 and 0.9006, and 0.859 and 1.8796 in August and May. According to a previous study by Joydeb Majumder (2013) [9], aquatic insects have the highest diversity (H = 3.03), lowest dominance (D = 0.06), and highest s s s dominance (D = 0.06). Shannon index is 0.4, Simphon's diversity index is 0.93, and evenness index is 0.1, according to Grampurohit and Karkhanis (2013) [10] study of biodiversity. The index of species richness is 1.94. According to Innifa Hasan (2016) [11], the Simpson (1949)[8]. Diversity Index for richness and evenness shows that the Jor pukhuri (0.906), Dighalipukhuri (0.9), and Silpukhuri (0.82) have the highest scores. A crucial first step in any research project, management strategy, and river ecosystem conservation is the documentation of biological diversity and the diversity of a biological insect organism in the preset result.

The diversity profile curve for the months of November (536) and February (423) was at the top, indicating higher diversity, while the curve for the months of October (483), September (435), and August (369) and for the months of March (369), April (299), and May (267) was at the bottom, indicating lower insect biodiversity at Seasons I and II. The histogram graph clearly showed that the curve for the months of November, February, and March was at the top, signifying higher diversity, and the curve for the months of October, September, and August was at the bottom, signifying lower diversity insect biodiversity at Seasons I and II.

According to the current findings, CCA analysis was more prevalent in November, October, and February and March of every season from 2020 to March 2021. In the current studies, paired group links were used in cluster analysis to examine the grouping of the major insect groups with high similarity, which included October and November, August and September, April and May, and February and March. The abundance and distribution of aquatic insect species in the current study vary from one month to the next in terms of histogram, CCA, and cluster analysis. The most numerous species (Coleoptera, Diptera, Orthoptera, and Hemiptera) were clearly separated by the PCA study's results with positive scores on axis X (horizontal). The most numerous (Coleoptera and Diptera) species were clearly indicated (positive line) by the current findings of this PCO study on positive axis X (0.4).

Conclusion

In the present results indicates the various diverse group of aquatic insects orders in the study area. In the present investigation the abundance, dominance and species richness of aquatic insect and primary importance to the functioning river ecosystem services that nature provides free of charge to human society.

References

1. Belamkar NV, Jadesh M. A Preliminary Study on Abundance and Diversity of Insect Fauna in Gulbarga District, Karnataka, India. International Journal of Science and Research (IJSR), 2014, 2319-7064.
2. Rafael JA, Aguiar AP, Amorim DDS. Knowledge of Insect Diversity in Brazil: Challenges and Advances. Neotropical Entomology,2009:38(5):565-570.
3. Jana S, Pahari PR, Dutta TK, Bhattacharya T. Diversity and Community of aquatic insects in a pond in Midnapore town, Pachimbanga, India. J. Environ. Bio,2009:30(2):283-287.
4. Khan RA, Ghosh LK. Faunal diversity of aquatic insects in freshwater wetlands of South Eastern West Bengal. Zool. Surv. Ind., Kolkata, 2001, 104.
5. Pielou EC. The measurement of diversity in different types of biological collections. J. Theoret. Biol. 13:144.
6. Shannon C.E and W. Wiener, 1949. The mathematical theory of communication. Univ. of Illinois Press, Urbana, 1966.
7. Margalef R. Information theory in ecology. Gen Syst,1958:3:36-71.
8. Simpson EH. Measurement of Diversity. Nature,1949:163:688. DOI: 10.1038/163688a0.
9. Joydeb Majumder, Rajib K Das, Prasanta Majumder, Ghosh D, Agarwala BK . Aquatic Insect Fauna and Diversity in Urban Fresh Water Lakes of Tripura, Northeast India. Middle-East Journal of Scientific Research,2013:13(1):25-32.
10. Grampurohit B. Karkhanis H. Insect Biodiversity At Mangrove Ecosystem. National Conference on Biodiversity : Status and Challenges in Conservation - _FAVEO, 2013.
11. Innifa Hasan, Dip Jyoti Haloi, Suraj Chetri, Sehnaz Begum. Biodiversity of aquatic insect population in three permanent ponds of Guwahati, Assam, India. International Journal of Fisheries and Aquatic Studies,2016:4(6): 271-275.