Study Of The Insects Diversity Around The Wetlands Of Upper-Northern Rajasthan

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Abstract-
Insects are the most diverse group of animals on earth belongs to Phylumm Arthopoda and class Insecta. Members of the class Insecta are classified into 29 orders. This research paper investigates the insect diversity in the wetlands of upper northern Rajasthan, aiming to provide a comprehensive understanding of the various insect species present in this ecologically significant region. Through systematic field studies and taxonomic analysis, the paper explores the richness and distribution of insect populations, shedding light on their ecological roles and potential indicators of wetland health. The finding contributes to both entomological knowledge and regional conservation efforts, emphasizing the importance of preserving wetland ecosystem in northern Rajasthan.

Keywords- Insect, Diversity, Richness, Taxonomic Analysis, Entomological knowledge, Indicators, Conservation wetlands.

Introduction

Insects are the most diverse group of animals on Earth, with over one million described species, and an estimated 5 to 30 million undescribed species. They make up approximately 75% of all animal species and are found in virtually every terrestrial and freshwater ecosystem. More than any other type of life, insects capture the attention of scientists due to their enormous population size and diversity. The number of individual insects on the planet at any given time has been estimated to be one quintillion (1018) (Williams 1964), an unfathomably large number comparable to the number of copepods in the ocean (Schubel and Butman 1998) and roughly equivalent to the number of sand grains along a few kilometres of beach (Ray 1996). Similarly, the sheer quantity of insect species bankrupts the intellect. Figures have progressively climbed during the last four centuries, from 10,000 species proposed by John Ray in 1691 to as many as 80 million (Erwin 2004). The current amount of 1,004,898 described live species exceeds the 1691 estimate by more than 100 times. In May 1998, there were 1.50-1.74 million identified eukaryotic species in the world, with insects accounting for 58-67% of the total. Insect diversity plays a crucial role in maintaining the balance and functioning of ecosystems. These are some advantages of insect diversity in ecosystems or services supported to the ecosystem. Wetlands are unique and important ecosystems that occupy the transition zones between aquatic and terrestrial environments. They are characterized by the presence of water, whether it's permanently or seasonally, and support a wide variety of plant and animal species. Wetlands are dynamic and diverse ecosystems that provide numerous ecological, economic, and cultural benefits.

Objective of the Work

This research work will include the analysis of insect fauna around the different wetlands of upper-northern Rajasthan in order to understand the species composition and community structure on mathematical scale. Thus, the objectives are:

- To estimate the richness and the evenness of insect assemblages around the different wetlands of upper-northern Rajasthan.
- To formulate the catalogue of the local insects species at taxonomic scale, residing in proposed study area.
- To study biological heterogeneity of the study site, contributed by the insects, in the form of mathematical attributes.
- To analyse similarities and differences in insect assemblages among different wetlands of study area in order to find the patterns behind the formation and evolution of faunas in this semi-arid zone of Rajasthan.
- To measure and discuss the possible ecological determinants and anthropogenic factors influencing the changes in the insect assemblages.

To evaluate and judge the biodiversity models for the wetland insects, made available by Preston 1948, MacArthur 1957, Tokeshi 1996 etc. and extrapolate the best fitted model

Significance of the Work
Studying the insect diversity around wetlands is important for ecological, scientific, and practical point of view. It is meaningful for the cataloguing of local insect diversity at the taxonomic scale. This study is also pioneer for this biodiversity rich locality with the novel mathematical approach as study calculated the several biodiversity indices and tested the biodiversity models. Moreover, study is providing the ecological interpretation about local insect community, insect relation with the plant diversity and abundance, and possible ecological indicator or human induced change in vegetation structure during last few years.

Statement of the Problem
The present research will get the precise values of species richness and evenness by using the primary data and mathematical tools. So, diversity indices and distribution models are pioneer for this biodiversity rich locality to explore the natural wealth of the region and also this will help to assess the feasibility of the work and testing the tools employed.

Study Area
The study area of the insect diversity around wetlands, the Upper-Northern Rajasthan (District Sri Ganganagar and Hanumangarh) was chosen.

Sampling Sites
The study is focused on the wetlands, accordingly, the five permanent wetlands of the study area such as 13 SHPD wetland, Bhagsar Dabla wetland, Hardas Wali wetland, 5 BRP wetland, and Rangmahal wetland were taken as sampling sites.

Methodology
The current study is concerned with the insect diversity; therefore, the insect specimens were collected through specified/standard sampling method from the sampling sites (Wetlands). Experimentally, a sample consist of all the insect specimens of 1 X 1 meter plot. The research is focusing on the spatial approach of the biodiversity thus, the samples were collected only in July-August (Monsoon/Rainy season) is considered the most productive time frame of the year in the term of insect species richness.

Taxonomic Analysis
After the trap and collection of the insects' specimens, with an extra caution, morphological similar specimens were clubbed (Group of expected species/Diversity) and counted (Total representatives of an expected species/Abundance) in each sample/trap. Further diversity and abundance data of for each sample were recorded and maintained on data sheet.

Biodiversity Analysis
In connection to current research, the following selected biodiversity indices were intended. The field data were used in the formula of the particular index and consolidated value of the index was produced. Precisely, the selected biodiversity indices were calculated by the PaSt software package.

Shannon Evenness Measure (Pielou 1975)
Shannon Evenness, also known as Pielou's Evenness or simply Evenness (E), is a measure of the relative abundance or distribution of different species within a community or ecosystem. It is a component of Shannon's Diversity Index (H) and provides insights into how evenly individuals are distributed among the various species present in a given area. The formula to calculate Shannon's Evenness (E) is:

$$E = \frac{H}{H_{max}}$$

Where: E= Shannon Evenness,H= Shannon Diversity Index,Hmax= The maximum possible diversity,

Shannon Information Index (Shannon-Weaver 1949)
The Shannon Information Index, also known as Shannon's Diversity Index or Shannon- Wiener Index, is a widely used measure of biodiversity in ecological studies. It was developed by the mathematician and information theorist Claude Shannon in 1948. The Shannon Information Index is used to quantify the diversity or uncertainty of species in a community, taking into account both species richness and species evenness. It provides a measure of the amount of information or uncertainty associated with the identity of a randomly selected individual within the community. The formula to calculate Shannon's Diversity Index (H) is:
$H = 1\ P_1 \ln (P_{\&})$

Where: H- Shannon Information Index, Pi- Proportion of individuals found in the ith species.

Brillouin Index (Pielou 1969)
The Brillouin Index, also known as the Brillouin Diversity Index, is a measure of biodiversity used in ecological studies. It was proposed by French physicist Léon Brillouin in 1960. The index is similar to Shannon's Diversity Index and provides a measure of the uncertainty or diversity of species in a community, taking into account both species richness and species evenness. The formula to calculate the Brillouin Index (H) is:

$H_B = \frac{In\ N! - \Sigma\ In\ n_{\&}!}{(S-1)}$

Where: HB is the Brillouin Index,S= Total number of species in the community
ni= Number of individuals of the i^{th} species in the community N- Total number of individuals

Result and Discussion-
The study attempted to measure the insect diversity of the five prominent wetlands of the Upper Northern Rajasthan that includes the Sri Ganganagar-Hanumangarh districts. The study measured the insect diversity at spatial scale and estimated the various biodiversity indices. The systematic representation of the biodiversity of different wetlands are described below.

13 SHPD Wetland
13 SHPD Wetland is a natural wetland, and it covers the 1 Sq. Km area. The water holds the depth 1-1.5 meter, and it is being recharged by the rainwater. The periphery of the wetland contains the grasses and diminished vegetation. A significantly good number of flying and terrestrial insects was observed in the rainy season. The composition of the sample is described here and diversity indices with their values shown in table 1.

Table-1

Sampling Site-A: 13 SHPD Wetland		
S.N.	*Diversity Index*	*Value*
1	*Taxa_S*	*14*
2	*Individuals*	*61*
3	*Dominance_D*	*0.112*
4	*Simpson_1-D*	*0.888*
5	*Shannon_H*	*2.44*
6	*Evenness_e^H/S*	*0.8199*
7	*Brillouin*	*2.03*

Bhagsar Dabla Wetland Bhagsar Dabla Wetland is a natural wetland, and it also covers the 1 Sq. Km area. The water holds the depth 0.5-1 meter and interestingly it is situated under a depression of sand dune terrain. The scientific community believes that its origin occurred due to the seepage water, coming from the lateral side flowing canal. Currently it is being recharged by the rainwater and seepage water. The periphery of the wetland contains the grasses and diminished vegetation and far-peripheral area under the agriculture practices. Consequently, a significantly good number of flying and terrestrial insects was observed in the rainy season. The composition of the sample is described here and diversity indices with their values shown in table 2.

Table-2

Sampling Site-B: Bhagsar Dabla Wetland		
S.N.	*Diversity Index*	*Value*
1	*Taxa_S*	*13*
2	*Individuals*	*69*
3	*Dominance_D*	*0.1087*
4	*Simpson_1-D*	*0.8913*
5	*Shannon_H*	*2.384*
6	*Evenness_e^H/S*	*0.8347*
7	*Brillouin*	*2.034*

Hardas Wali Wetland
Hardas Wali Wetland is also a natural wetland, it covers the 1 Sq. Km area and water holds the depth 1-1.5 meter. It is situated in the countryside of the Hardas Wali village. The northern side of the wetland lined with the human settlement and other three side of the wetland covered with the vegetation. It is being recharged by the rainwater. The abundant supply of the water and vegetation ensure the food resources for other living organisms. Consequently, a significantly good number of flying and terrestrial insects was observed in the rainy season. The composition of the sample is described here and diversity indices with their values shown in table -3.

Table-3

Sampling Site-C: Hardas Wali Wetland		
S.N.	*Diversity Index*	*Value*
1	*Taxa_S*	*12*
2	*Individuals*	*56*
3	*Dominance_D*	*0.137*
4	*Simpson_1-D*	*0.863*
5	*Shannon_H*	*2.257*
6	*Evenness_e^H/S*	*0.7964*
7	*Brillouin*	*1.876*

5BRP Wetland

5 BRP Wetland is a natural wetland, and it covers the 2.5 Sq. Km area. The water holds the depth 1-2 meter and interestingly it is situated under catchment area of the Ghaggar river. The scientific community believes that its origin occurred due to the seepage water, coming from the lateral side flowing Rajasthan main canal and seasonal Ghaggar river. Currently it is being recharged by the rainwater and seepage water. It is most productive and aged wetland of the region. The periphery of the wetland contains the grasses and lush vegetation and far-peripheral area under the agriculture practices. The abundant supply of the water and vegetation ensure the food resources for other living organisms. Consequently, a significantly good number of flying and terrestrial insects was observed in the rainy season. The composition of the sample is described here and diversity indices with their values shown in table 4.

Table-4

Sampling Site-D: 5 BRP Wetland		
S.N.	*Diversity Index*	*Value*
1	*Taxa_S*	*19*
2	*Individuals*	*85*
3	*Dominance_D*	*0.08151*
4	*Simpson_1-D*	*0.9185*
5	*Shannon_H*	*2.746*
6	*Evenness_e^H/S*	*0.8201*
7	*Brillouin*	*2.331*

Rangmahal Wetland

Rangmahal Wetland is a natural wetland, and it covers the 1.5 Sq. Km area. The water holds the depth 1-2.5 meter and also interestingly it is situated under catchment area of the Ghaggar river. It is being recharged by the rainwater and Ghaggar river water. It is also most productive and aged wetland of the region. The periphery of the wetland contains the grasses and lush vegetation and far-peripheral area under the agriculture practices. The abundant supply of the water and vegetation ensure the food resources for other living organisms. Consequently, a significantly good number of flying and terrestrial insects was observed in the rainy season. The composition of the sample is described here and diversity indices with their values shown in table 5.

Table-5

Sampling Site-E: Rangmahal Wetland		
S.N.	*Diversity Index*	*Value*
1	*Taxa_S*	*21*
2	*Individuals*	*101*
3	*Dominance_D*	*0.06574*
4	*Simpson_1-D*	*0.9343*
5	*Shannon_H*	*2.885*
6	*Evenness_e^H/S*	*0.8526*
7	*Brillouin*	*2.487*

Now we discuss about presence of species with diversity, presence of Dominance with sampling site, Richness and evenness of species, Evenness between sampling site and presence of rare species within a community, which shown in Fig.1, Fig.2, Fig. 3, Fig. 4 and Fig. 5 respectively.

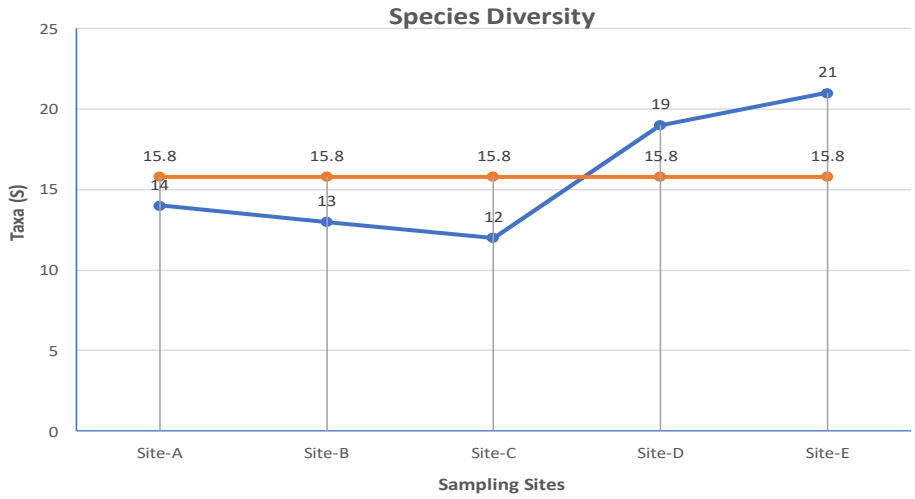

Fig: 1- Presence of Species with diversity

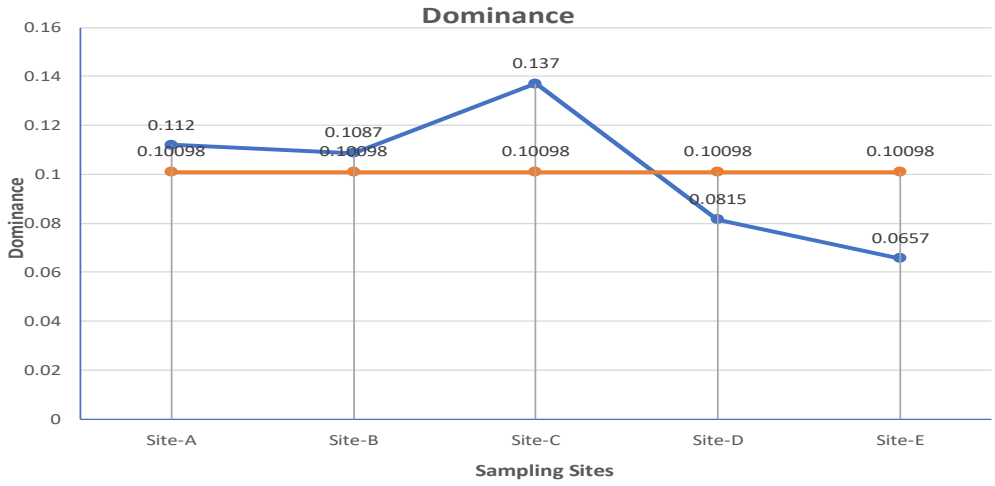

Fig: 2- Presence of Dominance with sampling site

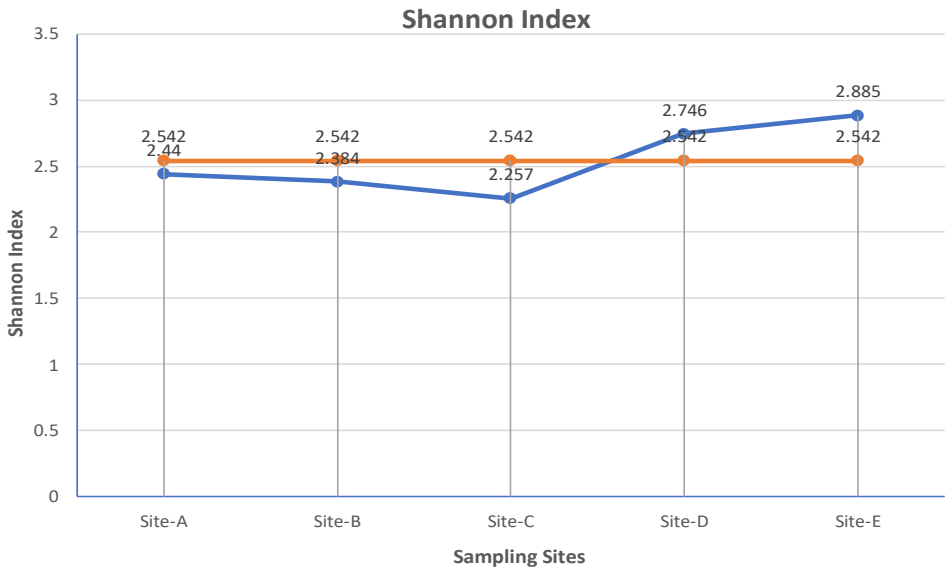

Fig:3- Richness and evenness of species

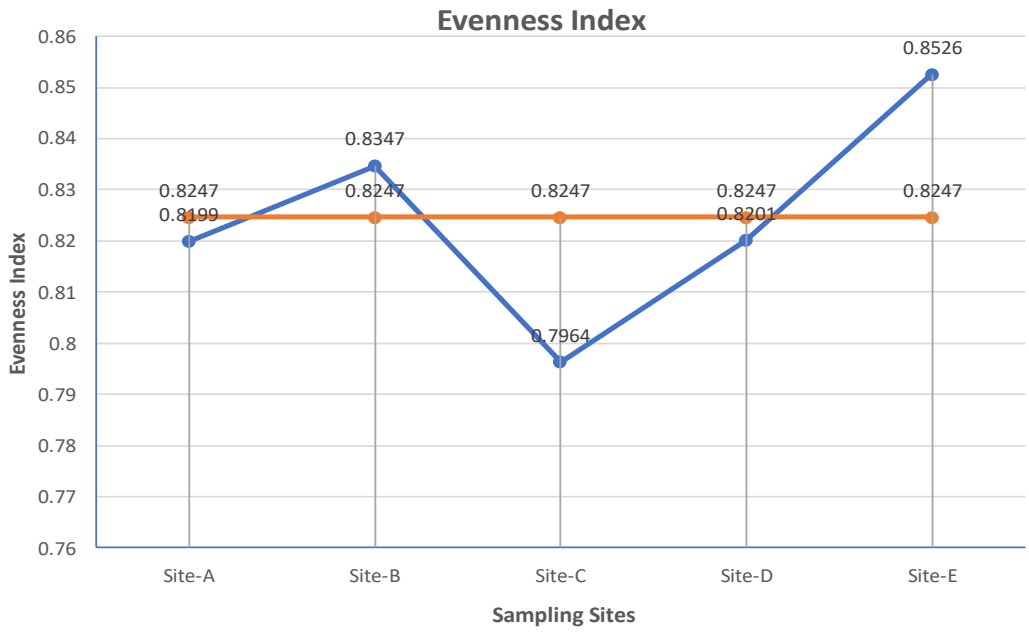

Fig:4- Evenness between sampling site

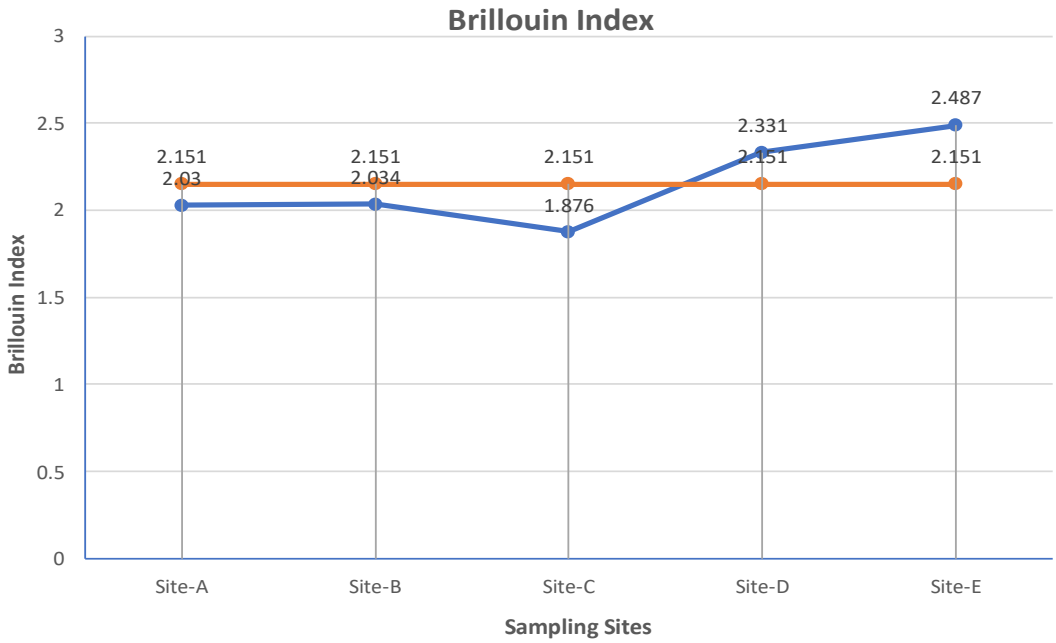

Fig:-5 Presence of rare species within a community Site-C Conclusion

- The different diversity indices suggests that sampling sites, 5 BRP Wetland and Rangmahal Wetland represent the highest biodiversity
- The different diversity indices suggests that sampling sites, Hardas Wali Wetland represents the lowest biodiversity.
- The study suggests that the sampling sites, 13 SHPD Wetland, Bhagsar Dabla Wetland, and Hardas Wali Wetland exhibit the dominance of the few insects' species or less even distribution of insect species in total assemblage.

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