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BIODIVERSITY OF INSECTS AND DISTRIBUTION PATTERN: A REVIEW

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ABSTRACT

Aquatic insects constitute over 95% of the total individual or species of macro-invertebrates in suitable fresh water biotopes. Scanning through the available literature on aquatic insects in India pertains to the distribution and abundance of mayflies. India is one of the world's twelve mega diversity countries. Insects contribute over half of all the recorded species and over three fourth of the estimated species, in the globe. However studies on other stream insects communities are fragmentary. Most streams of India have been substantially modified for irrigation and power generation, or they are impacted by pollutants including human sewage, run off from agriculture and industrial pollutants. A research lacuna of concern is the paucity of information on diversity and abundance of stream insects in the tropics.

KEYWORDS: *Biodiversity, insects, distribution and India.*

INTRODUCTION

Biodiversity is the bandwagon of this century and a lot of discussions are going on throughout the world on the conservation and sustainable use of natural resources. This is mainly due to the fear that the rapid alteration of the earth's environment may lead to a loss of stability of the ecosystems which will be detrimental to the survival of mankind in this universe (IGBP, 1990). Diversity is a fundamental property of every living system. The term biodiversity has been defined as the variety and variability among living organisms and the ecological complexes in which they occur. Thus, biological diversity includes all species of plants, animals and micro-organisms and the ecosystems of which they are part. Usually biodiversity is considered at 3 levels - genetic diversity. species diversity and ecosystem diversity. Genetic diversity covers genetic variation, life history traits, population dynamics etc.. of organisms. The amount of genetic variation within species also determines its potential for subsequent evolutionary change. As all genetic diversity utlimately arises at the molecular level and is the product of pleiotropic and epistatic interactions. it is a resource which cannot be replaced. Species and ecosystem diversity are dependant on the changes in the chemical and physical environment and human induced transformations of the earth's features (Solbrig, 1991). In addition to the compositional diversity covering genes, species and habitats as discussed above. there are also other aspects of diversity such as the functional diversity covering ecological processes (pollination, dispersal etc.) and structural diversity covering distribution of diversity in space and time (vertical stratification in tropical forests, relative abundance of species, age . structure of populations etc.). All biodiversity that we find on earth are the products of several million years of evolution. Creation and extinction are two

aspects of life. It has been stated that during the more than 3.5 billion year history of life, the average longevity of a species has ranged from less than a million years for some groups of mammals to about 10 million years for certain invertebrates and flowering plants (Wilson and Peter, 1992).

The interaction of various species among themselves and with the environment has led to an increase in the diversity of species over years. In addition to this, there are also various evolutionary pathways which produce a vast array of species and ecosystems. On the contrary, various catastrophies like drastic changes in climate brought about by continental drift, massive volcanic eruptions or asteroid impacts have caused mass extinction of life on various parts of the globe. The fossil records indicate that at least five major episodes leading to mass extinction of life have occurred during the past 450 million years ie., during Ordovician, Devonian, Permian, Triassic and late Cretaceous periods. Nearly 25-50% of biological groups were estimated to be wiped out during these periods (Raup, 1988). It is stated that the sixth period of extinction is currently underway and the cause is not due to any of the reasons discussed earlier, but due to the rapid environmental changes brought about by human beings themselves. Over one third of the world's forests, major part of freshwater lakes. rivers, seas and most of the grasslands have been either destroyed or altered affecting all life existing in these habitats.

MATERIAL AND METHODS :

The study was carried out in representative plots. At each location, eight plots were laid out at fixed intervals. The plot size was fixed at 625 m2 and the distance between plots was 25m. The plots were taken along a transect in such a way that four plots are in the disturbed zone and the remaining in the undisturbed zone. Data on vegetation and insects were collected from all the eight plots in each locality and from this, indices of diversity, dominance, evenness, species richness etc., of plants and insects were computed separately for the disturbed and undisturbed plots. The values for disturbed and undisturbed areas were pooled for deriving the overall values for each locality.

SAMPLING METHODS:

Vegetation was studied with a view to generate base line data on the floral elements to facilitate comparison of the relationship between the vegetation and insect community. For this, plants above 2 cm in diameter were enumerated in all the study,plots. The diameter of small plants was measured at about 6cm from ground. In the case of tall plants, girth at breast-height (GBH) was recorded. Based on this, the tall plants were classified into different categories viz.. mature trees (individuals with gbh more than 30.1 cm), saplings (individuals with gbh 10.1 to 30 cm). seedlings, shrubs, herbs and climbers (individuals with girth < 10 cm) (Chandrashekara and Ramakrishnan, 1994).

Sampling of insects was done using a battery operated light trap specially fitted with a switching device to facilitate self operation at specified hours (Mathew and Rahamathulla, 1995). The trap was fitted with solar panels so as to facilitate charging of battery during the day. In order to avoid the influence of lunar phase on insect catches. the trap was operated alternately between plots in the disturbed and undisturbed areas ie.. if the trap was operated initially in plot 1 in the disturbed area, the next day, it was operated in the plot 1 of the undisturbed area and then in plot 2 of the disturbed area and soon. In addition to trap catches, collections were also made during day times (8 am to 1 pm) using hand nets. At each location, collections were made for a period of one year. The insects collected were sorted out to species and the number of individuals for each species was recorded on data sheets. As it was not possible to identify all the species readily, code numbers were assigned to the various species. The insects were later identified by comparison to material available in the national collections like IARI, New Delhi and ZSI, Calcutta by the Principal Investigator himself and by referring to experts in these institutions.

DISCUSSION :

The importance of biodiversity for maintaining life support systems of the biosphere is well recognized. The recent convention on biological diversity and agenda 21 affirms conservation of biological diversity as a common concern of mankind. Over centuries in the past, human populations

have relied exclusively on biodiversity for their livelihood. Timber. extractives like dyes, gum, incense, oils. resins, various fruits, nuts, fish. honey, spices etc.. are obtained from nature. Man has also learnt to cultivate and select varieties of crops and livestock breeds to meet diverse nutritional and social needs. With current developments in technology, we have been able to produce new plant varieties and animal breeds. Much of its success is attributed to the integration of indigenous knowledge and modern technological advancements. Animal and microbial diversity are also important in the manufacture of various pharmaceutical products, as biocontrol agents against various pests and diseases, as material for advanced biological research and as indicators of environmental quality. However, much of the plant and animal genetic diversity are being lost at an alarming rate. An understanding of the flora and fauna and their interrelations is very essential for the sustainable utilization of biodiversity to the advantage of mankind (Johnson, 1995).

STUDIES ON FOREST INSECT DIVERSITY IN INDIA:

Of the 75 million ha (23% of the total land area) of forest land in India, about half (37.8 million ha) are closed forests (FSI. 1987). However, this may not hold true considering the fact that it includes monocultures and exotic species plantations, According to Mackinnen & Mackinnen (1986), India has lost 80% of its original habitats and the contained biodiversity. A discussion on forest biodiversity generally deals with various plants and large animals and birds and rarely centers round smaller organisms like litc hens, insects and microbes. This is probably a reflection of the relatively scanty information available on these groups of organisms. Although smaller in size, such organisms far outnumber all other organisms together both in biomass and in the number of species and individuals. Among these organisms, insects form the most predominant group. So far, about 67,000 species of insects have been recorded from various ecosystems in India. Of these, 16,000 species are specifically recorded from the forests (Beeson. 1941; Nair and Mathew, 1993). However, this estimate may not hold true considering the fact that many species found in other ecosystems also occur in the forests. The forests of India range from the snow-clad boreal forests of Himalayas to the wet evergreen forests of the Western Ghats. Many parts of these forests are still not explored. Attempts to study forest insect diversity were initiated in 1900 with the appointment of E.P. Stebbing as the Forest Entomologist who made a pioneering study on Umber beetles (Stebbing, 1914). Much of the early works were on the biology and ecology of important forest pests and all works upto 194 1 have been neatly summarised by Beeson (1941). Following this, the major contribution has been a comprehensive 10- volume list covering 2140 plant species and their insect associates (Bhasin and Roonwal. 1954, 1958: Mathur and Singh, 1959. 1960a. 1960b. 1960c. 1961). About 50 volumes covering various insect groups - The Fauna of British India - based on extensive surveys conducted in different parts of the 'country, is an excellent treatment of Indian faunal diversity. In addition to this, excellent treatises have been prepared on various insect groups by the Zoological Survey of India. These studies have shown that the insect fauna of India is very rich and diverse.

DENSITY:

Density was estimated for various plant categories such as trees, saplings, seedlings, shrubs, herbs and climbers in each locality for disturbed and undisturbed sites and the pooled values were also calculated separately.

DIVERSITY INDEX :

The quantification of diversity must address two statistical properties common to any mixture of different objects. The first property is the number of different classes or types of objects ie.. species, genera, families, different habitats and so on. The second property is the distribution of objects among classes such as the relative abundance of individuals of different taxa or the relative area of the habitat that falls into different habitat types. In this study only species diversity was studied. For this, the Shannon-Weiner diversity index (H) was used (Margalef. 1968):

$$H = - \Sigma_{i} Pi \log e (Pi)$$

where 'H' is the Shannon's index of species diversity and Pi is the proportion of individuals in the 'i' th species.

DISTRIBUTION MODELS:

Another way of describing diversity in a community is through species- abundance or distribution models (Fisher et al . 1943). A species- abundance model utilizes all the information gathered in a community and is the most complete mathematical description of the data (Magurran. 1988). The frequency distribution of insects per collected species was studied for all the localities separately. The data were described using truncated log-normal distribution (Pielou,1975). which will indicate whether the locality contain any rare species or not and also, the number of species which had not been possibly included in the sample collection.

EVENNESS OR EQUITABILITY INDEX :

This index which measures the evenness of species abundance is complimentary to the diversity index concept and it indicates how the individuals of various species are distributed in the community. For estimating evenness, Shannon's evenness index was calculated (Pielou, 1975). Mathematically, the evenness of frequency distribution of species abundance in a community with 's' component species, is the degree to which it approximates the uniform distribution for 's' species ie., equal abundance of all species in the sample or community (Pielou. 1977). In a collection or in a community with 's' component species, diversity will be greater if all 's' species are well represented. In this condition, there is high evenness and low dominance. On the contrary, if a few of the species, say 't' are very common and the rest (s-t) are very rare, then it is a case of low evenness and high dominance.

CONCLUSION:

The main causes of species loss in tropical forests are degradation and fragmentation of natural habitats, over exploitation of natural resources, pollution, introduction of exotics and climate change. The manner in which the rich complexity of biosphere will respond to these global environmental changes and to the rapid pace of utilization of biological resources is yet to be studied. In this context, there is an urgent need to document diversity already existing in the various habitats as a first step for conservation. Incidence of fire. the clearing of forest for agriculture. forest cutting for firewood and fodder as well as establishment of forest and agricultural plantations are the major factors that affect biodiversity in the Kerala part of Western Ghats. The present study has shown that there is a reduction in diversity in the disturbed forest patches compared to the undisturbed areas. An examination of data on the vegetational aspects of Silent Valley indicates that shrubs, herbs and climbers were relatively more in number, both in terms of species and individuals, in the disturbed area. There was also an increase in the number of tree seedlings and saplings indicating a flourishing forest stand.

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