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RESEARCH ARTICLE

DIVERSITY OF INSECT FAUNA IN BETELVINE ECOSYSTEM ASSOCIATED WITH SESBANIA SESBAN IN ATTUR, TUTICORIN DISTRICT

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ABSTRACT

The study aims to assess insect diversity in the betelvine ecosystem at Attur village, in Tuticorin District, Tamil Nadu, and India. Insects were collected during October 2012 to Febraury 2013 to determine their diversity, species richness and evenness. A total of 671 specimens were captured using different sampling methods e.g., netting, hand picking and trapping. Specimens belong to 26 families, 30 genera, 31 species and 10 orders of insect. Based on the data collected Lepidoptera recorded a maximum density of 150 insects with a population percentage of 22.38 % followed by Diptera with 3 species and a population percentage of 19.54 %. Based on the data collected, Homoptera with 6 species were the most diverse and abundant order (D=1.18) among collected insects. The diversity index was high in Odonata and Orthoptera due to numerical abundance of individuals. Physical factor like rainfall which was high during October and December increased the density of Lepidoptera and Diptera followed by other groups. The study may be helpful to biological management of the betelvine insect pests in the ecosystem. Further, proper timescale precaution measures like application and selection of pesticides and quantity may be predicted from the above diversity

INTRODUCTION

Biodiversity is variation of life. It refers to all species of plants, animals and micro-organisms existing and interacting within an ecosystem (Vandermeer & Perfecto, 1995). In agro ecosystems, biodiversity is generally a measure of the relative numbers of types of organisms present. When considering the effects of biodiversity on a system, two concepts are especially important to consider stability and productivity (Schowalter, 2006). Most agroecosystems tend to be highly disturbed. Common practices like tillage, planting, application of fertilizers and pesticides, irrigation, and harvest can cause temporary or longer-lasting changes in average environmental conditions that change the functioning of the ecosystem (Altieri *et al*., 2005). Stability in ecosystems is a measure of resilience, or ability of the system to recover from a disturbance, and the resistance of the system to change (Schowalter, 2006). Threats to biodiversity are global and are usually a direct result of human impact that contributes to reduction of genetic diversity through habitat loss and fragmentation as a result of increased human development (Balmford& Bond 2005). Previously no work has been done on the biodiversity of insects associated with Betelvine ecosystem in Tuticorin. So, it is the need of the time to estimate to what extent man's exploitation of natural resources has imparted adverse impact on the biodiversity of insects. The present research was conducted to estimate the biodiversity of insects associated with Betelvine ecosystem in Tuticorin.

MATERIALS AND METHODS

Study area

Survey for collection and population assessment of insect pest was carried out in Attur (Latitude 8^0 48' N 78^0 11' E Longitude) of, the taluk division of Tuticorin district in the state of Tamil Nadu, India. The main vegetation of the area are betelvine (*Piper betel*).

Sampling plan

Sampling was conducted during October 2012 to Febraury 2013, twice a month: a two hours a day sampling and one hour a night sampling. Sampling methods were non-specific according to southwood (1978): netting, beating, handpicking and trapping (pitfall and light traps). Netting was carried out with a 30 cm net swept over the topmost 20-30 cm of vegetation.

Material identification

Specimens were sorted and identified to the lowest taxonomic level possible, based on available resources and keys but at least to family level. Samples were sorted to recognizable taxonomic units, according to Oliver and Beattie (1993).

Data analysis

The diversity of insects was determined by species diversity, species richness and species evenness. Ludwig JA, Reynolds JF (1988).

Species richness

Species richness was quantified using Margalef's index (d) Margalef (1958).

$$d = (S-1) / \log N$$

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Where S is the total number of species and N is the total number of individuals.

Species diversity

This study adopted the Shannon-Wiener diversity index (H′), Clarke KR and Warwick RM (1998)

$$H' = -\sum_{i=1}^{n} p_i (\log_2 p_i),$$

Where n is the number of species and pi is the proportion of the total count arising from the *i*th species Pielou EC, 1966.

Evenness

The equitability (evenness) index used was Pielou's evenness index, J′, which expresses how evenly the individuals present are distributed among the different species. The index ranges between 0 and 1, with 1 representing even distribution. Lower values on the other hand represent dominance of individual taxa. The index is computed as follows:

$$J' = H' \text{ (observed)} / H'max$$

where H′max is the maximum possible diversity, which would be achieved if all species were equally abundant. It reduces dependence on the sample size and is simple to compute Pielou EC,(1966).

RESULTS

A total number of 671 insects belonging to 26 families, 30 genera, 31 species and 10 orders *viz.*, Odonata, Ephemeroptera, Orthoptera, Thysanoptera, Heteroptera, Homoptera,Coleoptera, Lepidoptera, Diptera and Hymenoptera were collected from October 2012 to Febraury 2013 from Betelvine ecosystem at Tuticorin District, Tamil Nadu, and South India. Table1. Shows the month wise metrological data for the study area.

Table 1 Metrological data for six months

Fortnight collection	Rainfall (mm)	Temperature (o^c)		Relative humidity (%)	Wind velocity (Kmph)
		Maximum	Minimum		
September	0.2	34.40	27.11	66.11	22.51
October	227.8	32.45	25.35	88.74	19.03
November	64.4	32.16	26.06	84.16	17.43
December	127.3	30.16	22.74	87.25	21.58
January	70	30.45	22.74	84.00	21.54
February	63	31.07	23.21	85.75	20.03

Table 2 Monthly variation in number of entamo fauna in betelvine ecosystem

Fortnight collection	Odo	Eph	Ort	Thy	Het	Hom	Col	Lep	Dip	Hem	Total
September	06	03	02	01	08	10	04	29	24	18	105
October	08	06	03	04	21	12	06	35	32	21	148
November	02	10	01	-	05	14	16	19	30	01	98
December	06	05	07	05	03	12	19	27	21	13	118
January	08	02	13	08	09	16	20	09	16	08	109
Febuary	05	03	02	10	-	05	29	31	08	-	93
Total	35	29	28	28	46	69	94	150	131	61	671

Odo- Odonata Eph- Ephemeroptera Ort- Orthoptera Thy- Thysanopter
Het- Heteroptera Hom- Homoptera Col- Coleoptera Lep- Lepidoptera
Dip- Dipter Hem- Hemiptera

The temperature was recorded maximum (34.4 ^{o}C) in the month of September and minimum (22.7 ^{o}C) in the month of December and January. Relative humidity was recorded maximum (88.7%) in October and minimum (66.7%) in September. Maximum rain fall (227.8 mm) was recorded in the month of October and minimum (0.2 mm) in the month of September. Maximum wind velocity was recorded maximum (22.5 kmph) in the month of September and minimum (19.0 kmph) in the month of October.

Table 2. Shows the variation of insect's pest in the given orders. Odonata (35), Ephemeroptera (29), Orthoptera (28), Thysanoptera (28), Heteroptera (46), Homoptera (69), Coleoptera (94), Lepidoptera (150), Diptera (131), Hymenoptera (61) were abundance in betelvine ecosystem during the collection periods (Table.2).

Table 3 Diversity parameters and species richness estimates of insect communities in the Betel vine ecosystem

Order	Richness indices	Diversity indices	Evenness indices
	D	*H′*	E
Odonata	0.28	0.16	0.23
Ephemeroptera	-	-	-
Orthoptera	0.60	0.24	0.22
Thysanoptera	-	-	-
Heteropter	0.26	0.13	0.19
Homoptera	1.18	0.18	0.10
Coleoptera	0.66	0.13	0.09
Lepidoptera	0.10	0.11	0.06
Diptera	0.41	0.09	0.08
Hymenoptera	0.49	0.15	0.14

The maximum insect population was observed in the months of October and December because there was maximum relative humidity (88.7% & 87.2% respectively) and rainfall (227.8 mm and 127.3 mm, respectively Table 3. Shows overall diversity results of insects recorded in betelvine ecosystem. Typically, the value of the index ranges from 0.09 to 0.24 (H′) and 0.06 to 0.23 (E) it indicate moderate species richness and evenness. From this results that the diversity and evenness in this site has highly disturbed habitat. The betelvine ecosystem not only has a greater number of species present, but the individuals in the community are distributed more equitably among these species.

Species Richness and Diversity

Insects belonging to the orders Homoptera (19.37 %) and Lepidoptera (19.36 %) showed higher species richness followed by those belonging to Coleoptera (12.92 %) and Orthoptera (9.68 %) (Table.3).

Members of the order Diptera showed the occurrence of species (9.68 %) followed by Hymenoptera (9.69%), Odonata (6.46 %), Heteroptera (6.46 %), Ephemeroptera (3.23 %), and Thysanoptera expected richness are very close to the observed values (3.23 %), respectively (Table 4).

Table 4 Family-wise distribution of insects showing number and occurrence of species in percentage.

Order/ Family	Genus/ Species	Species occurrence(%)	Individual occurrence(%)
Odonata			
Aeshnida (Dragonflies)	*Aeshna sp.*	01(3.23)	25(3.73)
Lestida (Damselfly)	*Lestes sp.*	01(3.23)	10(1.49)
Ephemeroptera			
Ephemerellidae (Mayfly)	*Ephemerella sp.*	01 (3.23)	29(4.33)
Orthoptera	*Locusta migratoria*		08(1.19)
Acrididae (Locust)		01 (3.23)	09 (1.34)
Tettigonidae (Grasshopper)	*Phyllophora sp.* *Phagoneura sp.*	02 (6.45)	11(1.64)
Thysanoptera			
Aelothripidae (Thrips)	*Aeolothrips fasciatus*	01(3.23)	28(4.18)
Heteroptera			
Reduviidae (Assasin bug)	*Zelus renardii*	01(3.23)	15(2.24)
Pyrrhocoridae (Red cotton pest)	*Dysdercus cingulatus*	01(3.23)	31(4.63)
Homoptera			
Aleyrodidae (Blackfly)	*Aleurocanthus sp.*	01(3.23)	13(1.94)
Aphididae (Aphids)	*Aphis gossypii*	01(3.23)	22(3.28)
Aleyrodidae (Whiteflies)	*Dialleurodes sp.*	01(3.23)	21(3.13)
Coccoidea (Scaleinsects)	*Lepidosaphescorneutes*	01(3.23)	07(1.04)
Pseudococcidae (Mealybugs) (Leaffooted bugs)	*Ferrisia virgata* *Riptortus pedestris*	02(6.45)	02(0.30)
Coleoptera	*Cheilomenes sehmaculata*	01(3.23)	38(5.67)
Coccinellidae (Ladybird beetle)	*Mesoplatys orchoptera*	01(3.23)	18(2.69)
Chrysomellidae	*Alcidodes buho*	01(3.23)	12(1.79)
Curculionidae	*Peltodytes sp.*	01(3.23)	26(3.89)
Haliplidae			
Lepidoptera	*Pierisrapiae*		24(3.58)
Pieridae		02(6.45)	
(Butterfly)	*Pieris brassicae*		24(3.58)
Noctuidae	*Achaea janata*	02(6.45)	29(4.33)
(Semilooper)	*Spodoptera litura*		37(5.52)
(Armyworm)	*Papilio demoleus*	01(3.23)	26(3.88)
Papilionidae	*Porthesia seintillaunus*	01(3.23)	10(1.49)
Lymantriidae			
Diptera			
Chamaemeyiidae (Aphid flies)	*Leucopis leteicornis*	01(3.23)	35(5.22)
Culicidae (Mosquito)	*Culex sp.* *Anopheles sp.*	02(6.45)	47(7.01) 49(7.31)
Hymenoptera			
Apidae (Honey bee)	*Apis cerana indica*	01(3.23)	26(3.88)
Mutillidae (Ant)	*Mutilla sp.*	01(3.23)	18(2.69)
Pompilidae (Spider wasp)	*Pompilus analis*	01(3.23)	16(2.39)

DISCUSSION

The study of insect biodiversity represents their adaptability to the wide range of environmental conditions. The insects' dominance has been considered the influencing structure of insects' community (Mackerrar, 1933; Water house, 1947). Insects may survive high or low temperature during certain stage of life cycle, many insects are able to survive much lower temperature in winter (0oC to 50oC). Temperature influences the development, reproduction, activity and range of expanse of insects(Glen,1954). According to Allan *et al.* (1973) the presence of insects at a particular habitat depends on a wide range of factors of which the availability of food and climatic conditions are the most important. Other than these, the abundance of larval food plants, conditions suitable for egg-laying and suitable flowers for feeding of adults, govern the distribution of insects. Further, the abundance of predators and parasitoids and the prevalence of disease also determine the abundance and density of insect populations (Pollard & Yates, 1993). Rainfall is the crucial factor for increase the insect population followed by temperature. Significant correlation was observed increasing with the rainfall and temperature and increase in insect population. Similar findings have reported by Inayat *et al.*, (2010). The effects of temperature on life history parameters of insects such as longevity and fecundity (Mbapila, 1997) have been intensively studied.

Lepidoptera is a very large order that includes the most important insect pests (Pedigo, 2002). Cartea *et al.* (2009) studied Lepidopteron pest populations that fluctuate with the change in environmental conditions. However, abundance of different insect groups did not show the same trend. Lepidopteran insects thrive well under low temperature and also limited food. While the other orders coleopteran, Odonata, Hemiptera, Hymenoptera and Orthoptera prefer high temperature and sufficient food. The Lepidoptera show many variations of the basic body structure which have evolved to gain advantages in life style and distribution. Resent estimates suggest that the order may have more species than earlier thought (Kristensen *et al.*, 2007), and is among the four most specious order, along with the Hymenoptera, Diptera and the Coleoptera (Powell *et al.*, 2009).

Diptera constitute the third most diverse order of insects, with an estimated 120,000 species, and are often the most abundant animals in temperate habitats. They are involved in various ecological functions, including decomposition, pollination and pest control (Kearns, 1992& Berebaum 1995). The biodiversity (diversity index, species richness and evenness) of insect fauna in betelvine ecosystem is mainly due to the rich vegetation in this area as vegetation plays an important role for the existence of insect fauna in a community as it provides the main source of food etc. The role of biodiversity in the dynamics and management of insect pests of croplands highlighted by Way and Heong (1994) is further substantiated by the present study.. Conservation of the natural habitats is very essential for the existence of many species of lepidopterans. The survival of a large number of endemic species in a community or habitat warrants frequent monitoring of the ecological processes besides adoption of appropriate conservation strategies in order to safeguard its rich genetic diversity (Mathew & Rahmatullah, 1993).

CONCLUSION

This study was an attempt to describe some aspects of biodiversity of insects in Betelvine ecosystem. This insect diversity study strongly supports the predictive approach of classical biological control whereby extensive pre-release studies should be conducted before the release of biological control agents in the betelvine fields. In addition, the biodiversity list provided by this study helps identify insects on the property that may be pests that are detrimental to the vegetation found on the property. Hence in the present study, we observed moderate species diversity is clearly. A lot of further research is necessary in this regard and further collections are essential for getting a detailed periodic estimate of the insect's diversity and development of standard monitoring procedures for assessing the environmental stability in this area.

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References

Allan, J.D., Barnethouse, W., Prestbye, R.A., & Strong, D.R. 1973.On foliage arthropod communities of Puerto Rican second growth vegetation. *Ecol.* **54**: 628-632.

Altieri, M., Nichols, C.I., & Fritz, M.A. 2005. Manage insects on your farm: A guide to ecological strategies. Sustainable Agriculture Network Handbook Series Book 7. American Midland Naturalist 127: 172-182.

Balmford, A. & Bond, W. 2005. Trends in the state of nature and their implications for human well-being. Ecol. Lett., 8, 1218–1234.

Berenbaum, M. R.,1995.Bugs in the system: insect and their impacton human affairs.Addison-Wesley,Reading, Massachusetts.

Cartea, M.E., Padilla, G., Vilar, M. and Valesco, P. 2009. Incidence of the major Brassica Pests in Northwestern Spain. *J. Econom. Entomol.*, 102: 767 – 773.

Clarke, K.R.,& Gorley RN., 2001 PRIMER v5: User manual/tutorial, Plymouth Marine Laboratory. Plymouth.

Clarke, K.R.,&Warwick RM. 1998. A taxonomic distinctness index and its statistical properties. J App Ecol. 35: 523-531.

Glen, Roberts. 1954. Factors that affect insect abundance. Jn.of Econ. Entomo, 47: 398–405.

Heong, K.L., G.B. Aquino and & Barrion. 1991. Arthropod community structure ofrice ecosystems in the Philippines. Bull. Ento. Res. 81:407-416.

Inayat, T.P., Rana, S.A., Khan, H.A.& Khalil-ur-Rehman.2010. Diversity of Insect fauna in croplands of district Faisalabad, *Pak. J. Agri. Sci.*, 47(3): 245-250.

Kearns, C. A. (1992). Anthophilous fly distribution across and elevation gradient.

Ludwig, J.A, & Reynolds, J.F.,1988. Statistical Ecology: A primer on methods in computing, John Wiley & Sons. New York.

Mackerrar, T. 1933. Seasonal change in the food of predatory insects. Ecology, 4: 672-673.

Mbapila, J. C., 1997. Comparative adaptation of *Cotesia flavipes* Cameron and *Cotesia sesamiae* (Cameron) (Hymenoptera: Braconidae) to *Chilo partellus* Swinhoe (Lepidoptera; Pyralidae) on the Kenya Coast. Ph.D. thesis, University of Dares - Salaam.

Oliver, I. And A.J. Beattie, 1993. A possible method for the rapid assessment of biodiversity. Conserv. Biol., 7: 562-568.

Pedigo, P.L.2002. Entomology and Pest Management, 4^{th} edition. pp. 246-247.

Pielou, E.C., 1966 .The measurement of diversity in different types of biological collections, J Theoret Biol, 13: 131-144.

Pollard, P. & Yates, T.J. 1993. Monitoring butterflies for ecology and conservation. The Study of Insects.Belment: Thomson Brooks/Cole.

R. Margalef. Temporal succession and spatial heterogeneity in phytoplankton. In: Perspectives in Marine biology. Buzzati Traverso (Eds.). Univ Calif Press. Berkeley. 1958; pp. 323-347.

Rahim, A., Asghar, A.H. & Alam, N.K., 1991. Effect of temperature and relative humidity on longevity and development of *Ooencyrtus papilionis* Ashmead (Hymenoptera: Eulophidae), a parasite of the Sugar cane pest, *Pyrilla perpusilla* Walker (Homoptera: Cicadellidae). *Environ. Entomol.,* 20: 774-775.

Southwood, T.R.E., 1978. Ecological methods with particular reference to the study of insect populations. Chapman and Hall, London, Pp: 692.

The British Butterfly Monitoring Scheme. Chapman and Hall; London,Pp: 274.

Water house, H.I. 1947.The predatory beetles.Animal ecology,38: 236-237.

Way, M.J and Heong, K.L. 1994. The role of biodiversity in the dynamics and management of insect pests on tropical irrigated rice. *Rev. Bull. Ento. Res.*, 84: 567-587.

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