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Estimation of Arthropod Faunal Diversity Inhabiting *Calotropis procera* (W. T. Aiton) in Industrial and Non-industrial Areas of West Bengal, India

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ABSTRACT The present paper explored the species richness, 5 bootstrap diversity estimates, 4 evenness measures, 6 similarity coefficients, two parametric analyses of diversity (lognormal distribution and logarithmic series) of arthropods from four insect orders (namely, Coleoptera Hemiptera, Orthoptera, and Hymenoptera,) and one arachnid order Araneae inhabiting *Calotropis procera*. The investigation was conducted in 15 study sites, 10 of which are around the Falta Export Processing Zone (FEPZ) and 5 from non-industrial expanses in South 24 Parganas district, West Bengal, India. The overall mean abundance value of all the arthropod fauna of FEPZ is 69.1 percent to that of 83.0 percent from non-industrial areas, which indicates a reduction in 13.9 percent fauna in FEPZ. Impact of industrialization on species richness is observed in Coleoptera, Hymenoptera, Orthoptera and Lepidoptera. However, both Hemiptera and Araneae virtually show no impact from industrialisation. Results indicate that industrialisation affected the harmonic distribution of the insect community inhabiting *Calotropis procera.*

INTRODUCTION

Diversity estimation is a measure that combines richness and evenness across species. Arthropods, mainly insects, are significant participants for their diversity, ecology, and effect on agriculture, human health and hygiene, and natural resources. Destroying biodiversity is likely to eliminate the subsistence base of many communities (Santra 2014). Insects are considered as one of the major components and indicators of terrestrial biodiversity of environmental conditions, and this can be used to conserve and restore biodiversity (Ashfaq et al. 2018). Arthropods live in particular ecological niches, inhabited by common and generalist species. Sankarganesh (2017) provided an estimation that nearly 63,760 species of insects are present in India of which about 21,166 species are endemic. According to him the species diversity is greater in north-eastern states, the Western Ghats, and the Andaman and Nicobar Islands and most of the species of these areas are endemic. Sánchez-Bayo and Wyckhuys (2019) while reviewing the worldwide decline in entomofauna, revealed that in terrestrial ecosystems, Hymenoptera, Lepidoptera, and dung beetles Coleoptera seem to be the most affected taxa, while Odonata, Trichoptera, Plecoptera, and Ephemeroptera have now lost a significant part of species richness.

Biodiversity plays a prominent role in modulating ecosystem function and stability (Sanyal and Hazra 2014). The effect of industrial set up on the arthropod communities belonging to five orders namely, Coleoptera, Hemiptera, Hymenoptera, Orthoptera, and Araneae and their host-plant relationship in the Falta Export Processing Zone (FEPZ) and in non-industrial expanse was earlier reported by Mukherjee et al. (2014). The study was sustained by conferring comparative distribution of insects among host plant species depending on their trophic relationship while Araneae maintains a housing relationship with the inhabiting plants (Mukherjee et al. 2017). Change in host plant preference in some hymenopteran species and the quality of environment in relation to the bioindicators study was reported by Jana et al. (2005). From the result of comparison of multivariate analysis in relation to species richness from eight study sites, Jana et al. (2006) reported

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the change in diversity pattern of species richness under the influence of industries. The alpha and beta diversity pattern of fauna of five insect orders in the Haldia industrial area and adjoining non-industrial areas was further reported and noted that some of the species can be considered as bioindicators (Jana et al. 2006). A report of the beta diversity analysis of quantitative estimation on insect diversity is available on the biodiversity of some insect population inhabiting Akanda (local name) plant (*Calotropis procera)* in the Haldia industrial zone and non-industrial areas of East Medinipur (erstwhile Midnapore) district (Jana et al. 2012), where species diversity is found to be affected by more than one factor.

Balakrishnan et al. (2014) recorded 929 insects belonging to 23 families and 6 orders (Lepidoptera, Coleoptera, Hemiptera, Diptera, Hymenoptera, and Heteroptera) from the coastal environment of Tamil Nadu, India. However, the list of the host plants is not mentioned. Bishnoi and Dang (2019) studied the diversity of hymenopteran insects from Kota, Rajasthan, India and recorded 17 species belonging to 5 families. Saikia et al. (2015) recorded association of 9 insect species belonging to 5 different families (Coleoptera, Hemiptera, Homoptera, and Orthoptera) associated with *Calotropis gigantea* plant from different localities of the Guwahati city area, Assam, India.

The present study considers a number of diversity studies, mean abundance data, relative abundance, Bootstrap estimation, comparison of evenness measures, and similarity measures were investigated along with lognormal distribution and logarithmic series. The aims of the present study were:

1. Quantitative estimation and comparison of the faunal diversity of five arthropod orders (namely, Coleoptera, Hemiptera, Hymenoptera, Orthoptera, and Araneae) occupying a medicinal plant, *Calotropis procera,* in industrial and non-industrial expanses.
2. Assessment of the effect of industrialisation on the diversity of these arthropod orders.
3. Elucidation of efficacy of various analytical measures used in studies of ecological diversity.

The hypothesis of the present work is that a single plant species (*Calotropis procera*) would show substantial alterations in diversity pattern between industrial and non-industrial zones, that is, the effect of industrialisation is unavoidable, even in a single host plant species.

METHODOLOGY

Fifteen study sites were considered for the present work and ten of them are in the industrial area very close to the Falta Industrial Zone. Five sites were selected from non-industrial adjacent areas. The locations and distances of the study sites are shown in Table 1 (*cf.* Fig.1, Mukherjee et al. 2017). The macroclimate of this part of the country is tropical, with an average rainfall of above 1400 mm per annum, relative humidity 50 percent to 90 percent, ground water level 0.9 meters to 2.25 metres, and an annual temperature range 15 ºC to 35 ºC. Predominant south and south-east wind speed is not exceeding 40 kilometres an hour. Entisols or deep fine loamy soil and Inceptisols or deep fine clayey soil with moderate or strong salinity is the characteristic feature (*Source:* National Bureau of Soil Survey and Land Use Planning).

The small wild shrub, Akanda, *Calotropis procera* R. Br. (Asclepiadaceae) was selected for quantitative analysis of five arthropod orders in all the study sites. *Calotropis procera* is easily accessible in every season and is a quite manageable shrub for such a study. Hence, the normal insect infestation is expected in this shrub. Younger plants are specially selected, in accordance with the plant phonological age hypothesis (Karban 1990), which states that herbivore arthropods favour and perform better on younger plants than older plants because the nutritional value of plant material declines with the oldness of the plant (Jana et al. 2012). Indeed, nutrient levels decrease while the non-nutrient substances and toughness of the leaves increase with the age of the plant species (Scheirs et al. 2002).

Sampling Procedure

Arthropod fauna was collected as mentioned in Mukherjee et al. (2017). Sweeping net is used only to collect insects on the wing, beating method is applied for under leaf fauna, beside this handpicking method is also applied in some instances. Other than spiders, all insect groups are dry preserved and pinned according to guidelines of ZSI manual (Ghosh and Sengupta 1982). Hymenoptera, arachnid and coleopteran specimens

Table 1: Location of study sites in and around Falta Export Processing Zone (FEPZ)

Study sites	*Geographical coordinates*		*Distance from Falta industrial area*
	Industrial Study Sites		
1. Falta (FAL)	22º17'45"(N)	88º06'30"(E)	0 km
2. Falta PS1 (FALPS1)	22º18'00"(N)	88º06'30"(E)	2 km away to north
3. Burul (BUR)	22º21'30"(N)	88º06'45"(E)	5 km away to north
4. Dongaria (DON)	22º24'00"(N)	88º10'60"(E)	10 km away to north
5. Falta PS2 (FALPS2)	22º18'00"(N)	88º06'00"(E)	2 km away to east
6. Sahararhat (SAR)	22º17'10"(N)	88º09'30"(E)	5 km away to east
7. Dighirpar (DIG)	22º17'30"(N)	88º12'30"(E)	10 km away to east
8. Inspection Bunglow (IB)	22º17'00"(N)	88º06'30"(E)	2 km away to south
9. Nainan (NAI)	22º16'00"(N)	88º05'55"(E)	5 km away to south
10. Nurpur (NUR)	22º12'30"(N)	88º05'00"(E)	10 km away to south
	Non-industrial Study Sites		
11. Vidyanagar (VID)	21º30" (N)	88º16'45"(E)	20 km away from Falta to north
12. Khangabaria (KHA)	22º23'30"(N)	88º15'30" (E)	22 km away from Falta to north
13. Kanyanagar (KAN)	22º23' (N)	88º14'45"(E)	24 km away from Falta to north
14. Vasa (VASA)	22º24'30" (N)	88º16'30"(E)	32 km away from Falta to north
15. Bibirhat (BIB)	22º23'00"(N)	88º14'00"(E)	27 km away from Falta to west

kept in ampoules with 70 percent alcohol, small specimens were killed and preserved.

Four to five young plants of similar bushy nature were selected in each site for insect collection during three consecutive years of study (2002-2004). Quantification was done by extrapolating the counts to the occurrence of the arthropod fauna as the number of individuals per 100 leaves (which is a quadrat).

Insects limited to particular plants or trees, leaves, or other parts of trees were thoroughly scrutinised, and the number of individuals of each

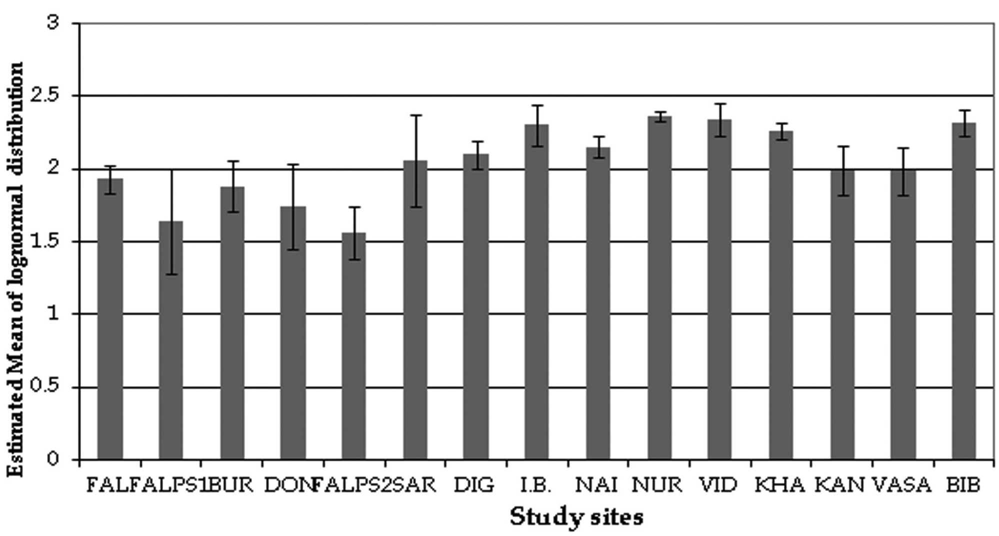

Fig. 1. Lognormal distribution of arthropod assemblage on *C. procera* in and around Falta

species in each sample was counted and analysed for biodiversity (Satchell and Mountform 1962). When abundant insects were being counted, the sampling unit was as small as possible (Shands et al. 1954). The collected arthropod samples were appropriately preserved and were identified by the Zoological Survey of India, Kolkata.

Statistical Analysis

Dominant index of a species was calculated from relative abundance data according to Skubala (1999). Species with relative abundance exceeding 10.0 percent were regarded as 'eudominant', those between 5.1 and 10.0 percent as 'dominant', between 2.1 and 5.0 percent as 'subdominant', between 1.1 and 2.0 percent as 'recedent', and less than 1.0 percent as 'subrecedent'.

Multivariate statistical analysis of the present study involves estimation of the species composition of the insects, spiders and host plants. Various measures of similarity indices like Sørensen's similarity index (Sørensen 1948), similarity coefficient by Bray-Curtis Measure (Bray and Curtis 1957), Canberra similarity coefficient (Lance and Williams 1967), Morisita similarity coefficient (Morisita 1959), Horn's similarity index (Horn 1966), and Euclidean distance and percent similarity (Renkonen 1938) were estimated. Pearson correlation including *p*-value of the abundance data was also assessed. The present study also includes estimation of abundance of species, diversity measures like Simpson diversity measure (1-D) (Simpson 1949), reciprocal of Simpson diversity measure (1-D) (Williams 1964; MacArthur 1972), Shannon-Weiner Diversity (H′) (Margalef 1958), number of equally common species [N(1)] (Buzas and Gibson 1969), and Brillouin Diversity (H) (Margalef 1958). Evenness measures were done using following methods of Simpson's evenness measure, Camergo's index of evenness, Smith and Wilson's index of evenness and modified Nee et al. index of evenness (Krebs 1999).

Bootstrap technique was also followed to evaluate species richness after Smith and Van Belle (1984). Heterogeneity procedures were calculated for lognormal distribution (Cohen 1961), and logarithmic series (Fisher et al. 1943). Variance of the diversity index, α, of logarithmic series was given following Anscombe (1950).

RESULTS

Quantitative Analysis of Insects in *Calotropis procera*

Altogether 25 species of arthropod assemblage covering 5 orders (namely, Coleoptera, Hemiptera, Orthoptera, Hymenoptera, and Araneae) were collected form *C. procera* encompassing 15 study sites of the Falta industrial and non-industrial expanses. There were 7 species of Hemiptera, 9 species of Coleoptera and 3 species each of Hymenoptera, Orthoptera and Araneae. The mean abundance data of these insects and arachnids (Table 2) revealed occurrence of 23 species from FAL followed by KAN (20), BUR (18) and so on. One species of Coleoptera, *Platycorynus* sp. and all the three species of Hymenoptera, *Comptonotus paira*, *C. compressus* and *Polistes stigma* were collected from *Calotropis procera* in all the 15 study sites. Out of 7 species of Hemiptera, 6 were recorded from FAL and KAN. All the 9 species of Coleoptera were registered from FALPS1 and KHA. Three species of Hymenoptera were noted from all the 15 sites, while 2 out of 3 species of Orthoptera were recorded form FAL and BUR. Three species of Araneae were found from FAL only (Table 2). The relative abundance and the dominant status are presented in Table 3. Jackknife estimate of species richness yielded no result, as there are no unique species detected in 15 study sites. Monthly species richness index (Margalef), diversity index (Shannon-Weiner), and evenness index (Pielou 1969) are also studied and indicate monthly as well as seasonal variation of these indices.

Bootstrap diversity estimate of arthropods collected from *C. procera* in the 15 study sites shows that maximum diversity index was in FAL for all the indices namely, Simpson diversity (1-D), Reciprocal of Simpson diversity (1/D), Shannon-Weiner diversity (H') and Brillouin diversity (H). Minimum value for all these indices was in SAR (Table 4). Four evenness measures of arthropods of 15 sites were done and presented in Table 5. Simpson (1/D), Camargo (E'), and modified Nee et al. (1992) E (Q) measures show maximum evenness in BIB, whereas NUR exhibits maximum value in Smith and Wilson (E_{var}) measures. The minimum value is found in FALPS2 for both 1/D and E', FALPS1 for E_{var}, and DON for E (Q) measures.

Table 2: Mean abundance data of arthropods in *Calotropis procera* in 15 study sites collected during three years

Insect		*Industrial*											*Non-industrial*			
Order	*Species*	*FAL*	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
Hemiptera	*Chrysocoris stollii*	392.44	0.00	10.11	0.00	0.00	0.00	196.44	0.00	0.00	217.44	0.00	256.33	257.00	178.78	285.33
	Leptocorysa acuta	131.11	0.00	26.44	0.00	5.78	154.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.44	0.00
	Riptortus fuscus	91.78	0.00	39.78	52.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.78	0.00	34.44
	Clovia conifer	59.33	0.00	0.00	0.00	62.89	0.00	0.00	142.00	0.00	0.00	0.00	238.00	101.78	0.00	134.00
	Physopelta schlanbuschi	22.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Urolabida histrionica	47.78	0.00	0.00	21.89	0.00	0.00	60.89	0.00	0.00	0.00	0.00	0.00	52.33	0.00	0.00
	Spilostithus hospes	0.00	148.56	0.00	129.00	53.67	0.00	239.89	0.00	301.33	0.00	367.00	0.00	327.56	209.11	288.89
Coleoptera	*Calasposomasp.*	86.44	62.22	77.56	0.00	24.89	76.67	0.00	250.11	0.00	0.00	0.00	143.78	178.22	75.78	0.00
	Platycorynus sp.	62.89	51.44	141.44	77.56	34.44	152.67	137.44	174.22	94.22	152.78	147.78	274.00	160.22	148.89	224.22
	Aulacophora sp.	124.22	208.56	280.33	152.00	11.78	42.00	394.11	257.89	82.67	337.33	384.44	271.56	330.11	171.33	0.00
	Coccinilla transversalis	36.00	22.44	28.44	23.67	0.00	0.00	62.89	0.00	0.00	0.00	0.00	56.00	170.44	142.89	248.78
	Scymnus pyrocheilus	25.33	68.67	0.00	1.56	20.44	0.00	86.00	0.00	0.00	0.00	0.00	136.89	66.89	18.00	0.00
	Cathersius molossus	81.11	7.67	35.67	0.00	39.11	0.00	60.44	0.00	0.00	0.00	0.00	139.78	42.22	0.00	0.00
	Astycus lateralis	124.89	17.67	18.44	28.00	38.22	0.00	0.00	125.78	105.11	0.00	76.44	120.44	0.00	0.00	0.00
	Apogonia sp.	61.33	1.67	34.67	27.33	0.00	0.00	0.00	0.00	48.89	0.00	0.00	92.67	39.33	30.00	0.00
	Hoplasoma uni-color	0.00	19.44	133.11	123.78	46.22	0.00	44.00	0.00	148.33	165.00	419.33	541.67	0.00	150.44	206.44
Hymenoptera	*Camponotus paira*	306.44	147.89	377.00	238.11	150.67	449.56	348.44	844.89	372.11	434.56	334.00	263.56	370.44	215.78	351.11
	Camponotus com-pressus	308.22	105.44	343.67	207.56	300.67	552.89	231.78	607.33	202.00	288.89	611.78	307.00	366.67	192.89	355.78
	Polistes stigma	151.00	163.56	233.67	71.33	16.44	13.56	99.56	96.00	197.22	140.78	241.56	130.89	150.44	177.11	264.22
Orthoptera	*Oxya fuscovittata*	44.89	0.00	46.89	0.00	0.00	0.00	0.00	0.00	116.67	0.00	0.00	0.00	64.00	0.00	0.00
	Oxya hyla hyla	67.56	0.00	80.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.33	0.00	0.00
	Atractomorpha crenulata	61.11	0.00	25.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68.22	0.00	0.00	0.00	0.00
Araneae	*Marpissa sp.*	99.56	0.00	0.00	74.67	0.00	0.00	109.33	0.00	0.00	0.00	116.22	0.00	55.11	0.00	0.00
	Theriodion sp.	91.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.00	0.00	0.00
	Castianeiria sp.	81.78	0.00	0.00	0.00	0.00	0.00	0.00	55.11	0.00	0.00	0.00	0.00	0.00	78.00	0.00
Species richness		**23**	**13**	**18**	**14**	**14**	**7**	**13**	**9**	**10**	**7**	**10**	**15**	**20**	**14**	**10**

Table 3: Relative abundance of arthropods inhabiting *Calotropis procera* in 15 study sites collected during three years

Insect		*Industrial*											*Non-industrial*			
Order	*Species*	*FAL*	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
Hemiptera	*Chrysocoris stollii*	0.153	0.000	0.048	0.000	0.000	0.000	0.095	0.000	0.000	0.125	0.000	0.081	0.090	0.099	0.119
	Leptocorysa acuta	0.051	0.000	0.013	0.000	0.007	0.107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.000
	Riptortus fuscus	0.036	0.000	0.019	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.000	0.014
	Clovia conifer	0.023	0.000	0.000	0.000	0.075	0.000	0.000	0.056	0.000	0.000	0.000	0.076	0.036	0.000	0.056
	Physopelta schlanbuschi	0.009	0.000	0.041	0.000	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.006	0.000	0.000
	Urolabida histrionica	0.019	0.000	0.000	0.018	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.018	0.000	0.000
	Spilostithus hospes	0.000	0.145	0.000	0.105	0.064	0.000	0.116	0.000	0.181	0.000	0.133	0.000	0.114	0.116	0.121
Coleoptera	*Calasposoma* sp.	0.034	0.061	0.037	0.000	0.030	0.053	0.000	0.098	0.000	0.000	0.000	0.046	0.062	0.042	0.000
	Platycorynus sp.	0.025	0.050	0.067	0.063	0.041	0.106	0.066	0.068	0.056	0.088	0.053	0.087	0.056	0.083	0.094
	Aulacophora sp.	0.049	0.203	0.133	0.124	0.014	0.029	0.190	0.101	0.050	0.194	0.139	0.086	0.115	0.095	0.000
	Coccinilla transversalis	0.014	0.022	0.013	0.019	0.000	0.000	0.030	0.000	0.000	0.000	0.000	0.018	0.060	0.079	0.104
	Scymnus pyrocheilus	0.010	0.067	0.000	0.001	0.024	0.000	0.042	0.000	0.000	0.000	0.000	0.043	0.023	0.010	0.000
	Cathersius molossus	0.032	0.007	0.017	0.000	0.047	0.000	0.029	0.000	0.000	0.000	0.000	0.044	0.015	0.000	0.000
	Astycus lateralis	0.049	0.017	0.009	0.023	0.045	0.000	0.000	0.049	0.063	0.000	0.028	0.038	0.000	0.000	0.000
	Apogonia sp.	0.024	0.002	0.016	0.022	0.000	0.000	0.000	0.000	0.029	0.000	0.000	0.029	0.014	0.017	0.000
	Hoplasoma unicolor	0.000	0.019	0.063	0.101	0.055	0.000	0.021	0.000	0.089	0.095	0.152	0.172	0.000	0.083	0.086
Hymenoptera	*Camponotus paira*	0.120	0.144	0.179	0.194	0.179	0.312	0.168	0.331	0.223	0.250	0.121	0.084	0.129	0.120	0.147
	Camponotus compressus	0.120	0.103	0.163	0.169	0.358	0.384	0.112	0.237	0.121	0.166	0.221	0.097	0.128	0.107	0.149
	Polistes stigma	0.059	0.160	0.111	0.058	0.020	0.009	0.048	0.038	0.118	0.081	0.087	0.042	0.053	0.098	0.110
Orthoptera	*Oxya fuscovittata*	0.018	0.000	0.022	0.000	0.000	0.000	0.000	0.000	0.070	0.000	0.000	0.000	0.022	0.000	0.000
	Oxya hyla hyla	0.026	0.000	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000
	Atractomorpha crenulata	0.024	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.000	0.000	0.000	0.000
Araneae	*Marpissa* sp.	0.039	0.000	0.000	0.061	0.000	0.000	0.053	0.000	0.000	0.000	0.042	0.000	0.019	0.000	0.000
	Theriodion sp.	0.036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000
	Castianeiria sp.	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.000	0.000	0.000	0.000	0.000	0.043	0.000

Table 3: Contd ....

Insect		*Industrial*											*Non-industrial*			
Order	*Species*	*FAL*	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
Eudominant (>10%)		3	5	4	5	2	4	4	3	4	4	5	1	4	3	6
Dominant (5.1-10%)		2	3	2	3	3	1	3	3	5	3	2	7	5	6	3
Subdominant (2.1-5.0%)		13	1	5	3	7	1	6	3	1	0	3	6	2	2	0
Recedent (1.1-2.0%)		4	2	6	2	1	0	0	0	0	0	0	1	6	2	1
Subrecedent (<1%)		1	2	1	1	1	1	0	0	0	0	0	0	2	1	0

Table 4: Bootstrap estimation of species diversity of six arthropod orders from all the study sites

	FAL	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
No. of species	**23**	**13**	**18**	**14**	**14**	**7**	**13**	**9**	**10**	**7**	**10**	**15**	**20**	**14**	**10**
No. of individuals	2559	1026	2112	1231	840	1443	2070	2551	1668	1737	2766	3151	2859	1803	2392
Simpson Diversity Measure (1-D)															
Bootstrap Estimate	**0.926**	**0.869**	**0.894**	**0.883**	**0.817**	**0.729**	**0.886**	**0.802**	**0.866**	**0.833**	**0.863**	**0.913**	**0.915**	**0.908**	**0.885**
95% CL	0.922	0.863	0.890	0.877	0.799	0.718	0.882	0.794	0.860	0.828	0.859	0.910	0.912	0.906	0.883
Upper limit	*0.929*	0.875	0.899	0.888	0.833	0.740	0.890	0.810	0.871	0.838	0.866	0.916	0.917	0.910	0.887
Reciprocal of Simpson Diversity Measure (1/D)															
Bootstrap Estimate	**13.384**	**7.577**	**9.438**	**8.502**	**5.441**	**3.687**	**8.761**	**5.041**	**7.425**	**5.971**	**7.281**	**11.469**	**11.698**	**10.824**	**8.667**
95% CL Lower limit	*12.809*	7.243	9.068	8.117	4.953	3.537	8.448	4.848	7.139	5.792	7.090	11.124	11.346	10.583	8.521
Upper limit	*13.958*	7.9170	9.830	8.886	5.944	3.835	9.069	5.237	7.716	6.145	7.470	11.804	12.063	11.057	8.811
Shannon - Wiener Diversity (H Prime)															
Bootstrap Estimate	**4.112**	**3.147**	**3.594**	**3.336**	**3.039**	**2.175**	**3.374**	**2.687**	**3.086**	**2.687**	**3.041**	**3.704**	**3.828**	**3.542**	**3.182**
95% CL Lower limit	*4.076*	3.095	3.552	3.290	2.951	2.126	3.340	2.65	3.053	2.663	3.014	3.682	3.795	3.515	3.165
Upper limit	4.146	3.198	3.637	3.382	3.123	2.222	3.407	2.722	3.119	2.710	3.066	3.726	3.861	3.568	3.199
Number of Equally Common Species (N(1))															
Bootstrap Estimate	**17.291**	**8.863**	**12.080**	**10.103**	**8.224**	**4.517**	**10.371**	**6.440**	**8.492**	**6.441**	**8.230**	**13.035**	**14.206**	**11.648**	**9.077**
95% CL Lower limit	16.870	8.550	11.731	9.781	7.737	4.369	10.132	6.275	8.298	6.334	8.082	12.837	13.879	11.433	8.970
Upper limit	17.705	9.175	12.438	10.425	8.707	4.664	10.607	6.599	8.686	6.544	8.376	13.233	14.532	11.857	9.184
Brillouin Diversity (H)															
Bootstrap Estimate	**4.074**	**3.103**	**3.560**	**3.294**	**2.981**	**2.157**	**3.347**	**2.671**	**3.061**	**2.670**	**3.025**	**3.682**	**3.799**	**3.510**	**3.163**
95% CL Lower limit	4.038	3.051	3.518	3.248	2.893	2.108	3.314	2.634	3.027	2.646	2.998	3.661	3.765	3.483	3.147
Upper limit	4.108	3.153	3.602	3.339	3.064	2.203	3.380	2.707	3.093	2.693	3.050	3.704	3.831	3.535	3.180

{Bias-adjusted confidence limits (CL) from Efron and Ibshirani (1986), *Statistical Sciennce*, **1**: 54-75, equation 7.9}

Table 5: Comparative chart of evenness measures of arthropods inhabiting *Calotropis procera* in 15 study sites

Sites	*FAL*	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
Simpson (1/D) measure	0.585	0.586	0.527	0.611	0.390	0.528	0.676	0.562	0.745	0.855	0.730	0.767	0.588	0.778	0.869
Camargo measure E’	0.601	0.533	0.513	0.563	0.477	0.503	0.627	0.559	0.683	0.774	0.661	0.715	0.548	0.703	0.790
Smith and Wilson measure	0.739	0.566	0.543	0.817	0.691	0.899	0.789	0.627	0.716	0.386	0.532	0.387	0.542	0.332	0.701
Modified Nee *et al.* measure	0.236	0.385	0.188	0.137	0.216	0.316	0.265	0.276	0.342	0.456	0.234	0.298	0.189	0.342	0.606

Six similarity coefficients, Bray-Curtis (Table 6), Canberra (Table 7), Morisita (Table 8), Horn (Table 9), Euclidean distance (Table 10) and percent similarity (Table 11), were done to assess the similarity of fauna among 15 sites. Similarity index values differ for all the six measures. Maximum similarity index is found between DIG-KAN for Bray-Curtis and Horn, SAR-NUR for Canberra, DON-VID for Horn, Morisita and percent similarity whereas IB - KHA shows maximum Euclidean distance. The minimum similarity value is seen between FALSPS1 - SAR for Bray-Curtis, FAL - BIB for Canberra, SAR - KAN for Morisita, FAL -VID for Horn, and SAR - KHA for percent similarity while minimum Euclidean distance is observed for FALPS1 - DON.

Lognormal distribution of arthropod community in 15 sites, around Falta shows maximum estimated mean of lognormal distribution value in NUR and minimum in FALPS2 (Table 12, Fig. 1). Interestingly, calculated total number of species in all the sites is the same as those of actual species count. It is found that 8 among 15 sites namely, SAR, DIG, IB, NAI, NUR, VID, KHA and BIB exhibit mean lognormal values over 2. Perfect similarity between observed and expected frequencies, considering the observed value exists in FAL, BUR, DIG, IB, NAI, NUR, KHA and BIB. This shows that more than fifty percent of study sites exhibit ideal lognormal distribution patterns.

Analysis of logarithmic series of arthropod fauna of 15 sites provides α value of each site (Table 13, Fig. 2). Alpha (α) denotes species diversity, which is found to be highest in FAL and lowest in NUR with SAR being very close to it. In both the cases it was less than 1. It is found that the value

Table 6: Similarity matrix (Bray-Curtis measure) of total arthropod populations in all study sites

	FAL	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
FAL	1	0.40	0.63	0.49	0.43	0.47	0.56	0.48	0.47	0.53	0.45	0.57	0.65	0.54	0.50
FALPS1		1	0.52	0.64	0.49	0.34	0.57	0.39	0.55	0.49	0.45	0.40	0.50	0.64	0.39
BUR			1	0.59	0.46	0.57	0.62	0.56	0.63	0.76	0.62	0.62	0.68	0.65	0.61
DON				1	0.53	0.43	0.63	0.41	0.68	0.59	0.55	0.43	0.52	0.67	0.50
FALPS2					1	0.47	0.41	0.38	0.44	0.43	0.36	0.39	0.40	0.42	0.41
SAR						1	0.44	0.64	0.47	0.59	0.52	0.37	0.48	0.43	0.46
DIG							1	0.46	0.59	0.73	0.65	0.55	0.76	0.69	0.61
I.B.								1	0.45	0.57	0.57	0.53	0.57	0.44	0.45
NAI									1	0.61	0.65	0.45	0.58	0.66	0.63
NUR										1	0.63	0.61	0.65	0.68	0.64
VID											1	0.55	0.61	0.55	0.61
KHA												1	0.62	0.55	0.57
KAN													1	0.66	0.71
VASA														1	0.67
BIB															1

Table 7: Canberra metric similarity co-efficient of total arthropod populations in 15 study sites

	FAL	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
FAL	1	0.26	0.50	0.33	0.28	0.27	0.33	0.32	0.26	0.22	0.24	0.43	0.59	0.34	0.21
FALPS1		1	0.47	0.63	0.59	0.55	0.61	0.53	0.63	0.58	0.56	0.58	0.36	0.63	0.49
BUR			1	0.43	0.39	0.45	0.39	0.38	0.50	0.52	0.44	0.53	0.46	0.51	0.44
DON				1	0.43	0.47	0.64	0.46	0.66	0.57	0.61	0.46	0.42	0.57	0.55
FALPS2					1	0.58	0.47	0.52	0.51	0.5	0.48	0.51	0.3	0.49	0.45
SAR						1	0.51	0.74	0.64	0.76	0.64	0.49	0.31	0.59	0.58
DIG							1	0.47	0.56	0.71	0.64	0.58	0.56	0.61	0.62
I.B.								1	0.63	0.72	0.66	0.61	0.35	0.54	0.59
NAI									1	0.75	0.75	0.54	0.37	0.63	0.64
NUR										1	0.75	0.63	0.39	0.67	0.76
VID											1	0.50	0.32	0.52	0.64
KHA												1	0.49	0.57	0.56
KAN													1	0.42	0.47
VASA														1	0.61
BIB															1

of X of Logarithmic series is highest in I.B and minimum in FALPS2. The result of this analysis is in conformity with the 95.0 percent confidence limit. Comparison between *x* in relation to *N/S* has been shown (Fig. 3). Lognormal distribution of all the collected species is plotted for each study site (Figs. 4 to 7).

DISCUSSION

The present abundant data on the arthropod community inhabiting *Calotropis procera* are estimated for logarithmic series analysis. This parametric measure of diversity mathematically explains the distribution pattern of samples collected from a variety of sites. The constant α value is an expression of species diversity in the community, and is found highest in FAL that is FAL community exhibits maximum diversity. Bootstrap analysis of diversity indices also pointed FAL as the most diverse community. Alpha value and the number of species is hypothetical to be directly proportionate, that is, when alpha is low, the number of species is low and higher alpha value is proportional to higher species number (Krebs 1999). However, this is not always applicable as per present data. Fourteen species with variable individual numbers are recorded from three sites, that is DON (1229), FALPS2 (840) and VASA (1083), but α values are quite different. Moreover, 15 species that were collected from KHA (3149) exhibit less α value than the sites with lesser members of species richness. Similar discrepancies were also recorded by Jana et al. (2012). According to Wolda (1983), α of the log series is the best measure of species diversity, while May (1975) considered α as a practical description of a sample from a community. Taylor (1978) supposed that α is relatively genuine by variation in magnitude of the sample. The above-mentioned opinions and comments are not exactly fitting to the present data. There are also subrecedent (<1%) fauna collected from these sites. The intense quadrat sampling (per month for three years) resulted in collection of a number of subrecedent arthropod fauna. It implies that these recedent and subrecedent species are not regularly visiting the habitat and utilising, rather sharing, fractions of niche space with the other members of the community. Boswell and Patil (1971) and May (1975) supposed that a variation in log series design would depend on intervals between the arrivals of these species, that is, random rather than regular. This is also reflected in the monthly sampling data of the 15 study sites. Thus, it is proposed that both the parametric analyses (lognormal and logarithmic series) may be quite useful for community studies to explain the arthropod diversity.

There are a number of measures used in analysis of species richness, heterogeneity and similarity index. It is important to choose appropriate measures for explaining a particular aspect of community analysis. Hubálek (2000) assessed 24 measures of species diversity, species richness, and equitability using both abundance data of a bird population and simple replication tests. Among these 24 measures, Hubálek (2000) recommended Fager's NMS, Shannon's H', reciprocal Simpson's lambda for α diversity and simple S or rarefaction method for species richness. Usha and Vimala (2015) used Alpha diversity measures such as, Dominance index D, Shannon index H, Margalef's richness index R, Evenness (Buzas and Gibson's evenness) E2, Relative dominance to study the insect diversity in some areas of Thrissur, Kerala, India. Though the authors have recorded a total of 58 species and 529 individual insects belonging to 9 orders and 38 families and studied their diversity, details of the analysis either based on family or species were not obtainable. In the present study, besides analysis of monthly data (Margalef, Shannon-Weiner and Pielou), 5 bootstrap diversity estimates, 4 evenness measures, 6 similarity coefficients, and two parametric analyses of diversity and distribution (logarithmic series and lognormal) have been employed to explain and characterise the community structure or arthropod assemblage on *C. procera*. Among these measures, five bootstrap estimates, four evenness measures, three similarity coefficients, and two parametric analyses are found useful in explaining the community structure of the arthropods inhabiting *C. procera*. It is apparent from the quantitative analysis that the impact of industrialisation (FEPZ area) on species richness is observed only in Coleoptera, Hymenoptera, and Orthoptera. Both Hemiptera and Araneae virtually show no impact from industrialisation.

Quantitative estimation of biodiversity is essential and provides tools to explore categories in species richness to formulate conservation strategies (Wessels et al. 2000; Hortal et al. 2001). Developing countries always select a place for the use of industrial set up taking into consideration human welfare. People are careless about their remote phylogenetic relatives. It becomes a common practice to neglect the invertebrate assemblage during Environmental Impact Assessment (EIA) studies. But increasing human interference from various levels eliminates many of the invertebrate community day-by-day resulting in uncertainty in the future.

Pyle et al. (1981) remarked that urbanisation is related with a variety of effects on arthropod population, which includes pollution, habitat

Table 8: Morisita's index similarity matrix of total arthropod populations in 15 study sites

	FAL	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
FAL	1	0.53	0.77	0.64	0.58	0.55	0.71	0.62	0.55	0.71	0.55	0.64	0.79	0.72	0.70
FALPS1		1.01	0.80	0.82	0.55	0.50	0.87	0.66	0.80	0.75	0.81	0.56	0.84	0.82	0.65
BUR			1	0.88	0.73	0.71	0.82	0.82	0.76	0.92	0.82	0.76	0.82	0.82	0.74
DON				1.01	0.76	0.70	0.88	0.79	0.88	0.85	0.94	0.69	0.83	0.83	0.78
FALPS2					1.01	0.89	0.59	0.84	0.68	0.68	0.78	0.59	0.66	0.59	0.69
SAR						1	0.57	0.9	0.62	0.72	0.65	0.44	0.58	0.52	0.59
DIG							1	0.69	0.75	0.87	0.80	0.64	0.92	0.86	0.73
I.B.								1	0.72	0.83	0.69	0.55	0.70	0.62	0.62
NAI									1	0.72	0.84	0.57	0.75	0.79	0.79
NUR										1	0.79	0.72	0.77	0.79	0.72
VID											1	0.71	0.76	0.81	0.75
KHA												1	0.66	0.75	0.70
KAN													1	0.91	0.82
VASA														1.01	0.91
BIB															1

Table 9: Horn Similarity Index of total arthropod populations in all the study sites

	FAL	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
FAL	1	0.62	0.80	0.66	0.67	0.63	0.7	0.67	0.57	0.66	0.56	0.71	0.81	0.69	0.61
FALPS1		1	0.76	0.81	0.71	0.59	0.85	0.72	0.8	0.72	0.81	0.71	0.84	0.85	0.67
BUR			1	0.78	0.73	0.72	0.74	0.75	0.74	0.86	0.75	0.82	0.8	0.80	0.70
DON				1	0.73	0.64	0.85	0.69	0.85	0.77	0.91	0.69	0.79	0.80	0.75
FALPS2					1	0.74	0.67	0.78	0.73	0.64	0.75	0.79	0.73	0.67	0.71
SAR						1	0.59	0.84	0.6	0.71	0.64	0.57	0.63	0.61	0.58
DIG							1	0.63	0.72	0.82	0.79	0.71	0.88	0.84	0.74
I.B.								1	0.67	0.75	0.69	0.69	0.71	0.65	0.59
NAI									1	0.72	0.86	0.64	0.71	0.77	0.74
NUR										1	0.8	0.78	0.73	0.81	0.75
VID											1	0.67	0.69	0.77	0.72
KHA												1	0.74	0.76	0.71
KAN													1	0.84	0.78
VASA														1	0.85
BIB															1

degradation and loss, etc. The authors considered urbanisation as one of the main causes for the deterioration in arthropod population. Urbanisation also affected the synanthropic fly population (Majumdar et al. 2007). Human influences negatively affect biodiversity. Gaston and Spicer (2004) have identified four main causes, that is, direct exploitation, introduced species, habitat loss and degradation, and extinction forces, for loss and declines species composition due to negative human impacts. McIntyre (2000) commented that arthropod populations are significantly affected by

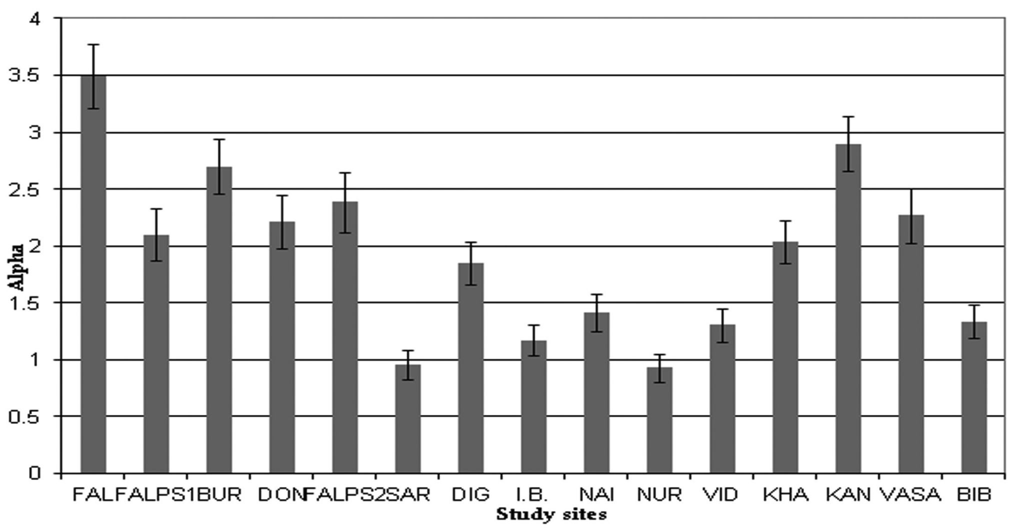

Fig. 2. Logarithmic series distribution of arthropod assemblage on *C. procera* in and around Falta

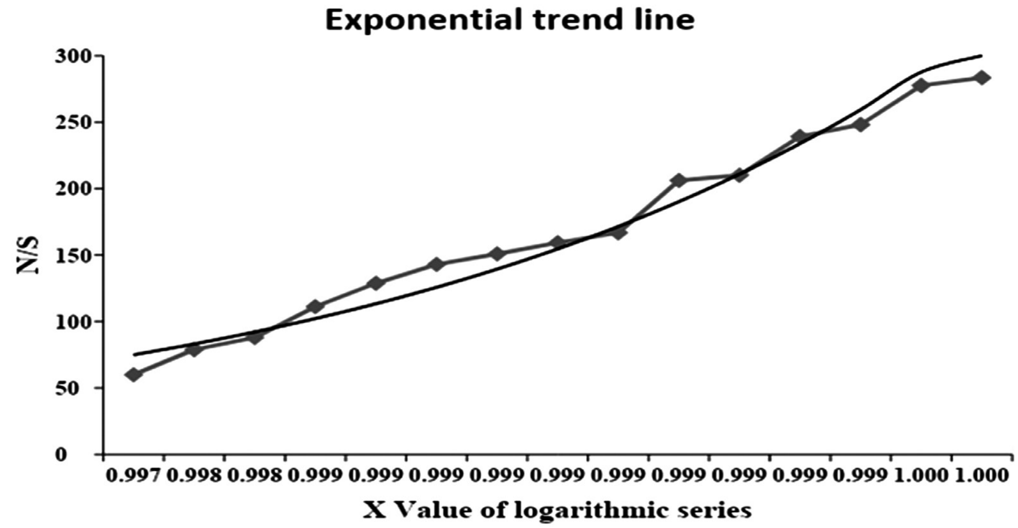

Fig. 3. Logarithmic series analysis of arthropod fauna from 15 study sites. Values of x in relation to N/S of the logarithmic series; x = value of logarithmic series, S = total number of species in the sample, N = total number of individuals in the sample

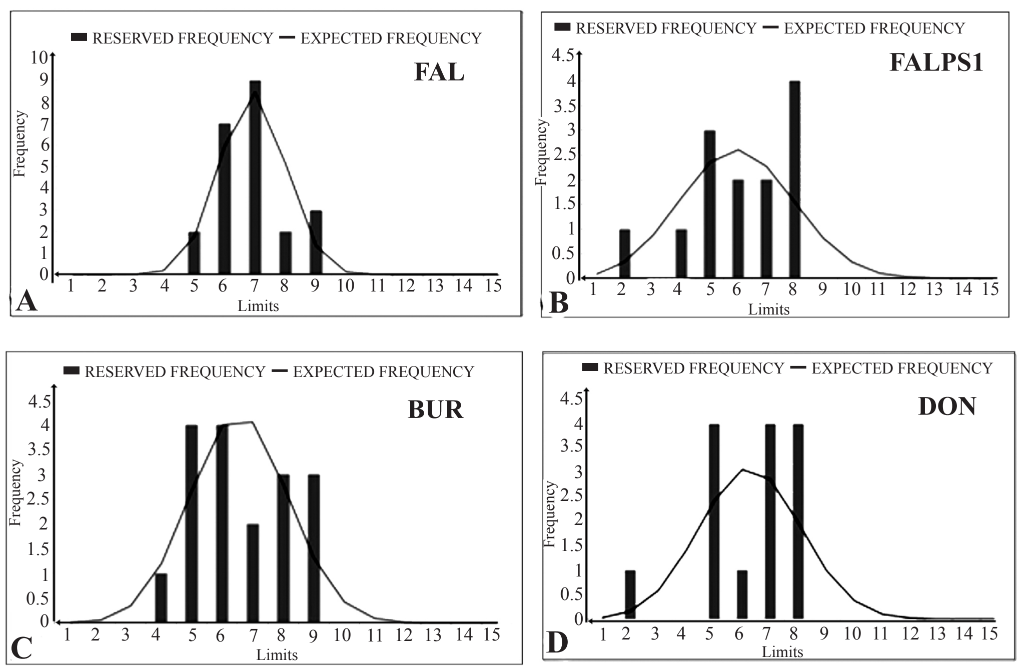

Fig. 4 (A-D). Graphical representation of lognormal distribution of twenty one fly species on four study sites

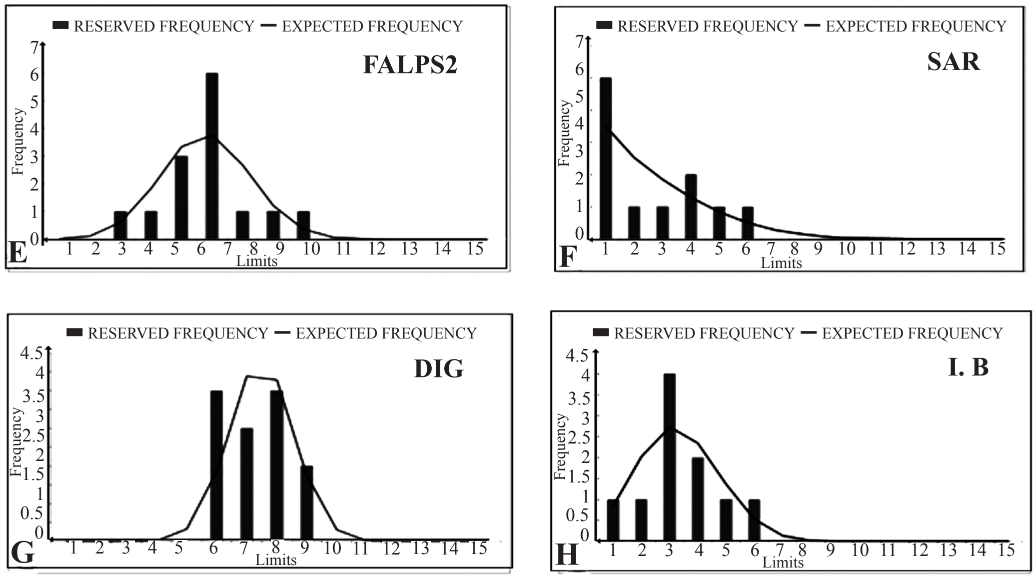

Fig. 5 (E-H). Graphical representation of lognormal distribution of twenty one fly species on four study sites

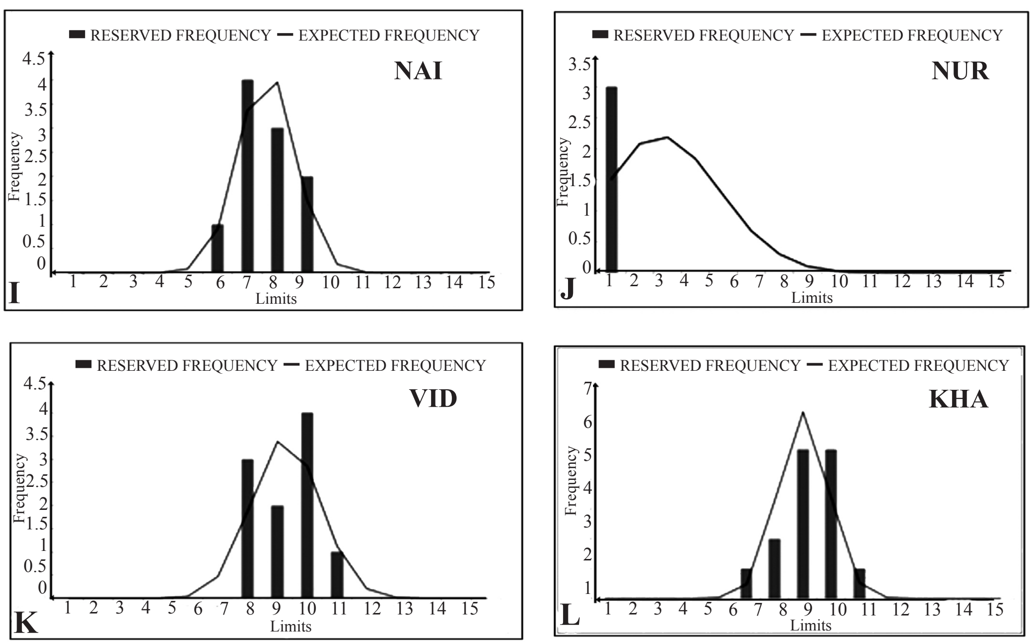

Fig. 6 (I-L). Graphical representation of lognormal distribution of twenty one fly species on four study sites

Table 10: Euclidean distance among total arthropod populations in 15 the study sites

	FAL	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
FAL	0	116.702	91.895	106.37	108.621	117.75	104.61	163.59	122.34	96.097	169.31	144.21	103.87	97.078	116.55
FALPS1		0	89.151	49.101	69.093	127.07	83.476	184.98	77.717	98.63	151.75	155.66	110.7	63.509	126.94
BUR			0	75.63	95.525	93.975	82.583	130.04	89.818	49.694	119.68	119.73	94.006	78.417	110.08
DON				0	53.115	101.5	78.072	165.51	62.82	81.633	129.28	140.44	107.03	60.866	110.8
FALPS2					0	90.798	111.8	171.7	89.459	107.65	154.61	151.25	127.26	86.13	122.74
SAR						0	127.01	110.58	116.17	105.34	148.35	169.24	128.37	122.19	132.12
DIG							0	159.51	93.982	69.03	124.88	143.19	65.428	72.319	113.57
I.B.								0	161.04	134.64	169.21	189.97	147.09	175.21	173.82
NAI									0	99.665	122.97	151.29	106.87	73.223	99.064
NUR										0	126.08	120.86	98.00	81.261	112.5
VID											0	145.99	129.79	130.52	135.33
KHA												0	146.51	127.19	136.12
KAN													0	82.412	95.984
VASA														0	77.957
BIB															0

urbanisation at a unique rate. "Evidence suggests that overall richness and abundance of arthropod communities, inhibiting creosote bush, were lower in urban deserts than in fringe deserts" (Rango 2005). It is now considered that expansion of human inhabitation is a major driving force of biodiversity loss in both developing and underdeveloped countries (Pauchard et al. 2006).

Now underdeveloped countries, besides urbanization, are establishing a Special Economic Zone (SEZ), where human interference is exceedingly high. The present work is in agreement to the concept that development of human settlement including SEZ areas negatively affects arthropod communities.

Multivariate statistical analyses were performed on binary data to estimate the species composition. The present study also included estimation of abundance of species, diversity measures and heterogeneity measures. Results of multivariate analyses were compared with the species richness facts for all the 15 study sites. The present analysis of continuous lognormal distribution displays that the observed and predictable number of species is equal for all the 15 study sites. The constant alpha value is found highest in FAL five bootstrap estimates, 4 evenness measures, 3 similarity coefficients and 2 parametric analyses are found useful in explaining the community structure of the arthropods inhabiting *C. procera*.

The whole work reflects the effect of industrialisation on the local and regional diversity pattern of five arthropod orders in the Falta Export Processing Zone (FEPZ) and in non-industrial expanse of South 24 Parganas district of West Bengal, India. The impact of industrialisation (FEPZ) on species richness is observed only in Coleoptera, Hymenoptera, and Orthoptera, while Hemiptera and Araneae exhibit no effect. The various assessment procedures cannot find any rare species in these study areas. Mean abundance values of arthropod orders from industrial and non-industrial study areas are 11.5 and 11.6, respectively. Abundance patterns remain more or less similar between the two groups of study sites. The species richness is more in the present study sites than from Haldia (Jana et al. 2012). The overall mean abundance value of all the arthropod fauna of FEPZ is 69.1 percent to that of 83.0 percent from non-industrial areas, which indicates a reduction of 13.9 percent fauna in FEPZ whereas overall

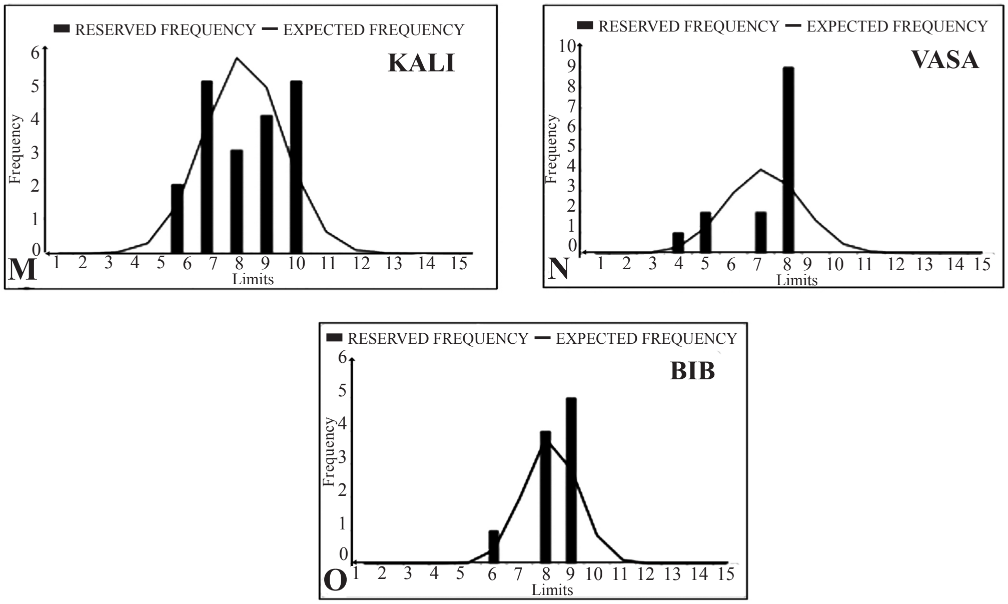

Fig. 7 (M-O). Graphical representation of lognormal distribution of twenty one fly species on three study sites

decline in 23.33 percent fauna in Haldia industrial zone is recorded (Jana et al. 2006). Deterioration in abundance of arthropod assemblage in FEPZ might be due to change in land use pattern and unplanned human settlements. Effect of industrial pollution is more in Haldia because of the establishment of a number of large-scale industries. While, the effect of industrial pollution is less in FEPZ and adjoining non-industrial area than Haldia due to set up of small to medium scale processing industries.

Table 11: Percent similarity among total arthropod populations in all the study sites

	FAL	*FALPS1*	*BUR*	*DON*	*FALPS2*	*SAR*	*DIG*	*I.B.*	*NAI*	*NUR*	*VID*	*KHA*	*KAN*	*VASA*	*BIB*
FAL	100	43.87	60.57	52.41	45.40	38.82	55.83	47.82	46.25	49.74	46.26	56.09	66.49	57.21	49.45
FALPS1		100	62.77	64.22	48.32	38.9	74.13	51.39	64.78	59.15	66.89	51.13	68.01	67.63	56.93
BUR			100	70.66	57.41	49.61	62.68	59.25	62.67	73.3	64.08	62.03	66.58	67.24	61.15
DON				100	56.56	46.42	73.22	58.71	71.76	69.98	79.5	53.68	67.67	66.82	64.13
FALPS2					100	63.8	49.33	62.18	53.93	47.52	56.29	56.39	50.57	46.65	53.08
SAR						100	38.5	70.91	43.91	54.31	43.38	35.24	40.54	39.77	39.85
DIG							100	48.52	57.13	70.09	65.21	56.64	77.12	70.83	63.53
I.B.								100	53.7	62.36	56.16	51.29	55.02	49.12	45.7
NAI									100	62	68.12	48.52	55.93	64.68	64.16
NUR										100	65.55	57.23	57.15	66.78	66.99
VID											100	54.15	60.4	66.17	61.71
KHA												100	60.35	64.27	55.11
KAN													100	75.99	68.01
VASA														100	78.51
BIB															100

Table 12: Lognormal distribution of arthropod assemblage inhabiting *Calotropis procera*

Study sites	*Number of species in sample*	*Total number of individuals in sample*	*Estimated mean of Lognormal distribution*	*Estimated variance of Lognormal* distribution	*Estimated total number of species in community*
FAL	23	2559	1.9288	0.09992	23
FALPS1	13	1026	1.6387	0.35863	13
BUR	18	2112	1.8808	0.17512	18
DON	14	1231	1.7374	0.29187	14
FALPS2	14	840	1.5613	0.18383	14
SAR	7	1443	2.0606	0.3177	7
DIG	13	2070	2.0992	0.09755	13
I.B.	9	2551	2.3038	0.14079	9
NAI	10	1668	2.1491	0.07217	10
NUR	7	1737	2.3593	0.03531	7
VID	10	2766	2.3414	0.11091	10
KHA	15	3151	2.2601	0.0599	15
KAN	20	2859	1.9896	0.17317	20
VASA	14	1803	1.9879	0.16474	14
BIB	10	2392	2.3153	0.0909	10

The present study reveals that programming of industrialisation with the consideration of environmental impact can save to a considerable extent the invertebrate fauna in their mother land and preserve biodiversity. It is proposed that instead of large-scale industries, small and medium scale industries with less pollutant emitting sources can save native soil and terrestrial fauna and flora.

CONCLUSION

The result reflects the bearing of industrialisation on the local and regional diversity pattern of five arthropod orders inhabiting *Calotropis procera* in the Falta Export Processing Zone and in non-industrial expanse of South 24 Parganas district of West Bengal, India. The impact of industrial

Table 13: Logarithmic series analysis of arthropod collection inhabiting *C. procera*

Study sites	*Total number of individuals*	*Total number of species*	*Alpha (α)*	*Variance of Alpha from Anscombe*	*S. E. of Alpha (α)*	*95% confidence limits for Alpha (α)*	*X of logarithmic series*
FAL	2559	23	3.4935	0.077	0.2775	2.9396 - 4.0274	0.998641
FALPS1	1026	13	2.0988	0.054	0.2323	1.6434 - 2.5542	0.997957
BUR	2112	18	2.6994	0.0583	0.2415	2.2260 - 3.1728	0.998725
DON	1231	14	2.2143	0.0542	0.2329	1.7578 - 2.6708	0.998202
FALPS2	840	14	2.3857	0.0699	0.2644	1.8676 - 2.9039	0.997169
SAR	1443	7	0.9563	0.0166	0.1289	0.7037 - 1.2088	0.999337
DIG	2070	13	1.8512	0.0354	0.1882	1.4824 - 2.220	0.999107
I.B.	2551	9	1.1689	0.0181	0.1346	0.9051 - 1.4327	0.999542
NAI	1668	10	1.4128	0.0265	0.1629	1.0953 - 1.7321	0.999154
NUR	1737	7	0.9279	0.0151	0.1227	0.6873 - 1.1684	0.999466
VID	2766	10	1.3037	0.0204	0.1427	1.0240 - 1.5835	0.999529
KHA	3151	15	2.0422	0.0352	0.1876	1.6747 - 2.410	0.999352
KAN	2859	20	2.8981	0.0578	0.2404	2.4268 - 3.9693	0.998988
VASA	1803	14	2.2682	0.0589	0.2426	1.7927 - 2.7437	0.99791
BIB	2392	10	1.3337	0.2109	0.1481	1.0434 - 1.624	0.999443

development in this area on species richness is observed only in Coleoptera, Hymenoptera, and Orthoptera, while Hemiptera and Araneae exhibit no effect. The quantitative study indicates that human activities and land use patterns resulted in habitat degradation in this area indicating a reduction of 13.9 percent fauna in FEPZ. The result also specifies that a single host plant can deliver a distinct diversity pattern of arthropod fauna. The outcome of the present study may be of immense significance to find out bioindicators, which may be supportive in setting up new industries.

RECOMMENDATIONS

Setting up of small and medium scale industries are preferable for industrial set up in juxtaposition to human settlements. Strict measures are to be taken by endorsing authorities for recommending a new industrial complex. This area may be suitable for the Micro-Small-Medium Enterprise (MSME) sector.

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