Study on the Distribution of Flora and Fauna in the SIPCOT Industrial Park of Gangaikondan, Tirunelvelli District, Tamil Nadu, India

Jegan G and Muthuchelian K*

Centre for Biodiversity and Forest studies, Department of Bioenergy
School of Energy, Environmental and Natural Resources, Madurai Kamaraj University
Madurai – 625 021, Tamil Nadu, India
*Corresponding Author: drchelian1960@yahoo.co.in

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Abstract

The phytosociological study on flora and fauna diversity in Gangaikondan revealed that the diversity of the flora was more than the faunal diversity. Totally 59 floral species and 35 faunal species were listed out in the study site. For plants the species- area curves attained the stable position in 2nd and 3rd quadrats where for fauna it reached the observed species richness in 4th and 5th quadrats.

Keywords: Gangaikondan, fauna, flora, SIPCOT.

Introduction

Biological surveys, focusing on species diversity, are necessary on both national and global scales. National biological inventories provide a finer-grained view of biological diversity and can be used to establish national conservation programs and policies, whereas a global survey will provide much needed information on the extent, distribution, status, and fate of biodiversity worldwide. These efforts can serve not only to tell us the status of biodiversity, but to identify valuable biological resources, some of which are unknown, while others are locally known but have potential for much wider use. Many plants of current or potential commercial value were discovered in the course of routine plant surveys. Inventories and surveys also provide baseline data against which to monitor changes in biological diversity and to trace the environmental impacts of development projects.

In recent years a great deal of interest has surfaced in the quantification and valuation of biological diversity. The interest is largely motivated by findings from natural scientists that biodiversity is imperiled by human activities (Wilson 1992), especially the destruction of natural habitats (Primack 2000). Biodiversity has, however, proved both difficult to define in practice and difficult to relate to human welfare. Definition and valuation are closely related, of course. We cannot speak meaningfully of valuation without having some notion of what it is that is being valued. On the other hand, a definition that cannot be related to human values may propose "distinctions without differences."

Objective of our study was to screen the list of flora and fauna of the SIPCOT Industrial Park.

Materials and Methods
Study Site

The study site was SIPCOT industrial park of Gangaikondan, Tirunelvelli District, Tamil Nadu, India.
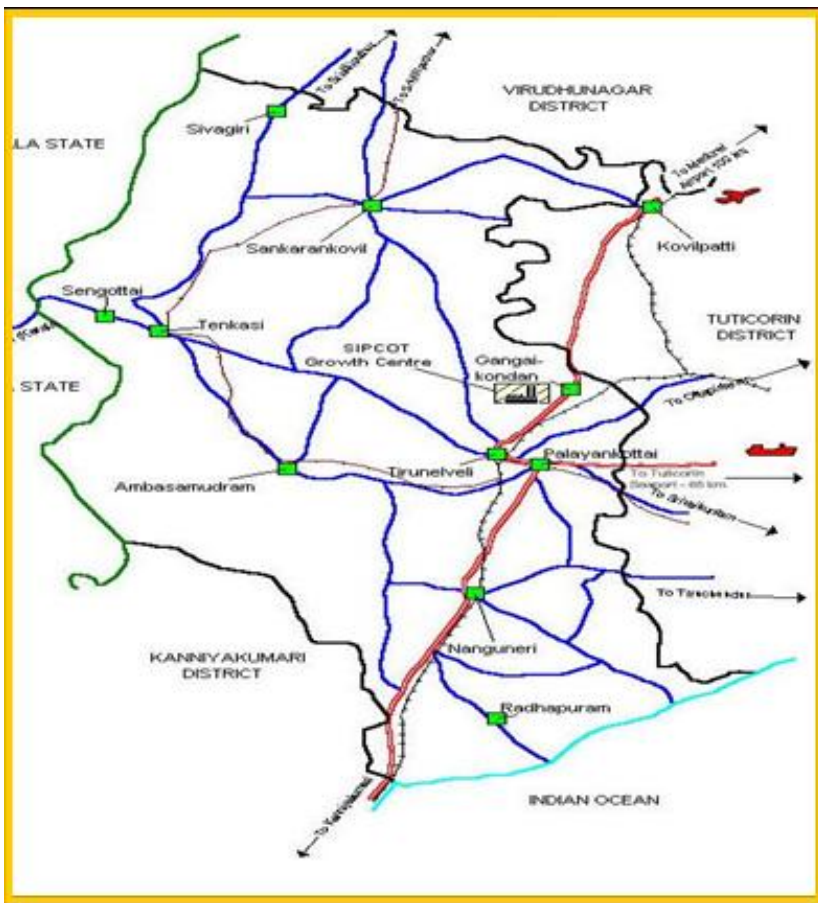
Map 1: Map showing the study site.

Sampling

In the SIPCOT Industrial Park the phytosociological study was carried out using 12 randomly placed quadrats (10m×10m) for trees (individual with DBH more than 30 cm) within them 5m×5m for shrubs and climbers and 1m×1m for herbaceous community.

Analysis

The diversity indices were analyzed using PAST and Biodiversity Pro beta Version 2. The species- area were raised with the help of EstimateS.

Chao 1: An abundance-based estimator of species richness

Jackknife 1: First-order jackknife estimator of species richness (incidence-based)

ACE: Abundance-based Coverage Estimator of species richness

Bootstrap: Bootstrap estimator of species richness (incidence-based)

ICE: Incidence-based Coverage Estimator of species richness

Results and Discussion

Floral Diversity

In the SIPCOT Industrial Park totally 59 plant species were found. Totally 972 individuals were representing 59 species. *Borassus flabellifer* L. was the dominant species among 59 species. *Cyperus rotundus* L. was having lower number of individuals (4). *Cuscuta sp.* a parasitic species was occurred in the proposed site which was a nuisance one to the common species like *Azadiracta indica*.

Diversity Indices

The diversity indices calculated for the SIPCOT Industrial Park showed the higher diversity of plant species. The dominance index of the proposed study site was 0.04. The Menhinick diversity index was also go hand with the Shannon index (Table 2).

Species – area curve

The assumption is that the species-area curves should reach the classic asymptotic form at assumption is that the species-area curves should reach the classic asymptotic form at a very early stage and forms a plateau (Chazdon *et al*., 1999).

In the SIPCOT Industrial Park, the species – area curves got stabled within 2nd and 3rd quadrats (Fig 1).

Principal Component Analysis

Principal component analysis was carried out by considering the distribution of species in the samples. Most of the species of the project site were following the similar pattern of distribution (Fig 2).

Correlations

Kulczynski Comparison was used for assessing species turnover between samples. Spearman's rank correlation coefficient was used to test for relationship between samples. The Mann-Whitney U test was a non-parametric ranking test for whether two independent random samples are drawn from populations having the same distributions. The variance-covariance matrix showed the variance of each sample in the leading (main) diagonal of the matrix and the sample by sample covariance in the other cells.

Faunal Diversity

In the SIPCOT Industrial Park totally 35 faunal species were found. Totally 504 individuals were representing 35 species. *Bufo melanostictus* was the dominant species among 35 species. *Danaus chrysippus* and *Acantholepis* were having lower number of individuals (7).

Diversity Indices

The diversity indices calculated for the SIPCOT Industrial Park showed the higher diversity of animal species. The dominance index of the proposed study site was 0.07. The Menhinick diversity index was also go hand with the Shannon index (Table 7).

Species – area curve

The assumption is that the species-area curves should reach the classic asymptotic form at assumption is that the species-area curves should reach the classic asymptotic form at a very early stage and forms a plateau (Chazdon *et al*., 1999).

In the SIPCOT Industrial Park, the species – area curves got stabled within 4th and 5th quadrats (Fig 3).

Principal Component Analysis and Cluster Analysis

Principal component analysis was carried out by considering the distribution of species in the samples. Most of the species of the project site were differed in their pattern of distribution (Fig 4). Most of the species showed above 50% of similarity in their distribution (Fig 5).

Table 1: List of flora in the in the SIPCOT Industrial Park and its surroundings.

S.No.	Botanical Name	Common Name
1.	*Azadiracta indica* A. Juss.	Vembu
2.	*Boerhhavia diffusa* L.	
3.	*Calotropis gigantea* (L.) R.Br.	Eruku

No.	Botanical Name	Common Name
4.	*Borassus flabellifer* L.	Panai
5.	*Cassia siamea* Lam.	
6.	*Cissus quadrangularis* L.	Nanmuga pirandai
7.	*Clerodendrum inerme* (L.) Gaertn	
8.	*Cleome gynandra* L.	
9.	*Cleome viscosa* L.	Naikaduku
10.	*Cocos nucifera* L.	Thenai
11.	*Commelina benghalensis* L.	Thankaipoo
12.	*Cynodon dactylon* (L.) Pers.	Arukanpull
13.	*Cyperus rotundus* L.	
14.	*Cassia fistula* L.	Sarakonai
15.	*Ficus benghalensis* L.	Alamaram
16.	*Ficus religiosa* L.	Arasamaram
17.	*Indigofera uniflora* Buch.	
18.	*Moringa pterygosperma* Goertn.	Murungai
19.	*Jasminum angustifolium* (L.) Willd.	Malligai
20.	*Mangifera indica* L.	Mango
21.	*Ficus racemosa*	
22.	*Delonix regia* (Boj. ex Hook.) Raf.	Myilkonrai
23.	*Carica papaya* L.	Pappali
24.	*Ocimum sanctum*	Tulsi
25.	*Pergularia daemia* L	Veliparuthi
26.	*Parthenium hysterophorus* L.	Parthenium
27.	*Abutilon indicum* (Linn.) Sweet.	Thuthi

S.No.	Botanical Name	Common Name
28.	*Tribulus terrestris* Linn	Nerunji
29.	*Prosopis julifera*	Karuvelam

S.No.	Botanical Name	Common Name
30.	*Polyalthia longifolia* (Sonner) Thw.	Nedulingam
31.	*Tamarindus indica* L.	Puli
32.	*Thespesia populanea* (L.) Soland.	Poovarasu
33.	*Aloe vera* (L.) Burm.f.	Sodrukathalai
34.	*Ricinus communis* L.	Athalai
35.	*Croton sparsiflorus* Morong	
36.	*Opuntia*	Kalli
37.	*Ziziphus*	
38.	*Aerva lanata* (L.) Juss. ex. Sch.	Kanupula sedi
39.	*Cassia auriculata* L.	Avarai
40.	*Morinda tinctoria* Roxb	Manchanathi
41.	*Cuscuta* L.	
42.	*Tectona grandis* L. f.	Thekku
43.	*Hibiscus rosa-sinensis* L.	Chembaruthi
44.	*Acacia planiformis* Wight & Arn	Odaimaram
45.	*Samanea samen* (Jacq.) Marrill.	Thungumungi maram
46.	*Millingtonia hortensis* L.	Pannerpoomaram
47.	*Tridax procumbens* L	
48.	*Leucaena leucocephala* (Lamk) Wit.	Subapull
49.	*Agave americana* L.	
50.	*Albizzia lebbeck* Benth.	Vagai

51.	*Terminalia catappa* L.	Vatham
52.	*Typha latifolia*	
53.	*Achyranthes aspera*	Nayuruvi
54.	*Jatropha gossifolia*	
55.	*Musa paradisiaca* L.	Vallai
56.	*Bougainvillea spectabilis*	Kakithapoo
57.	*Eucalyptus*	
58.	*Marsilea*	
59.	*Arundina*	
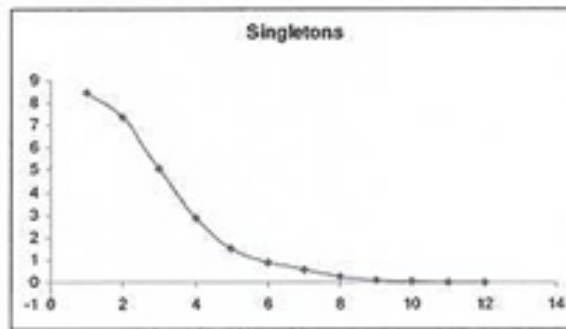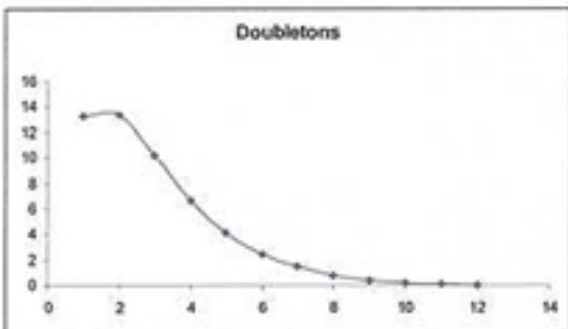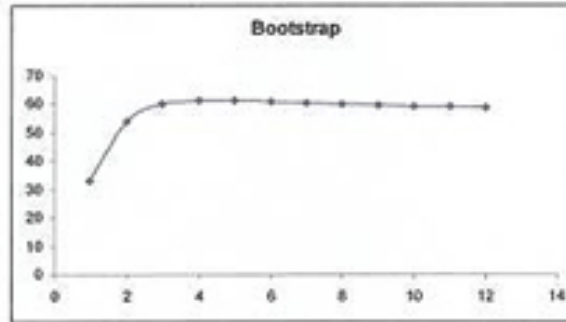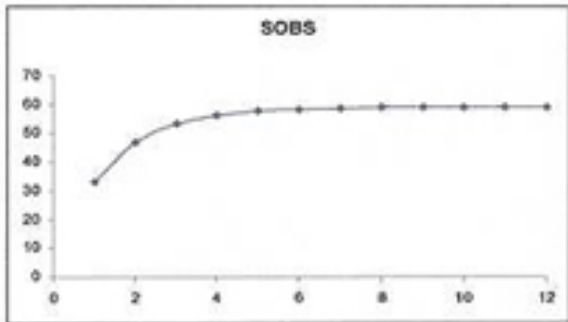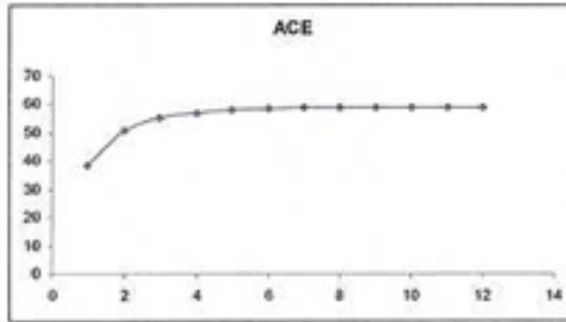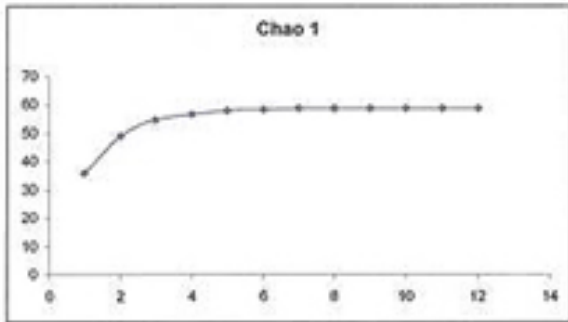
Fig 1: Observed and Estimated area – curves of the SIPCOT Industrial Park.

Table 2: Consolidated details on the floral diversity of the SIPCOT Industrial Park.

Number of Species	59
Number of Individuals	972
Dominance	0.041
Shannon Diversity	3.33
Simpson	0.95
Evenness	0.86
Menhinick	3.64
Margalef	7.23
Equitability index	0.95
Fisher alpha diversity	20.77
Berger-Parker	0.08
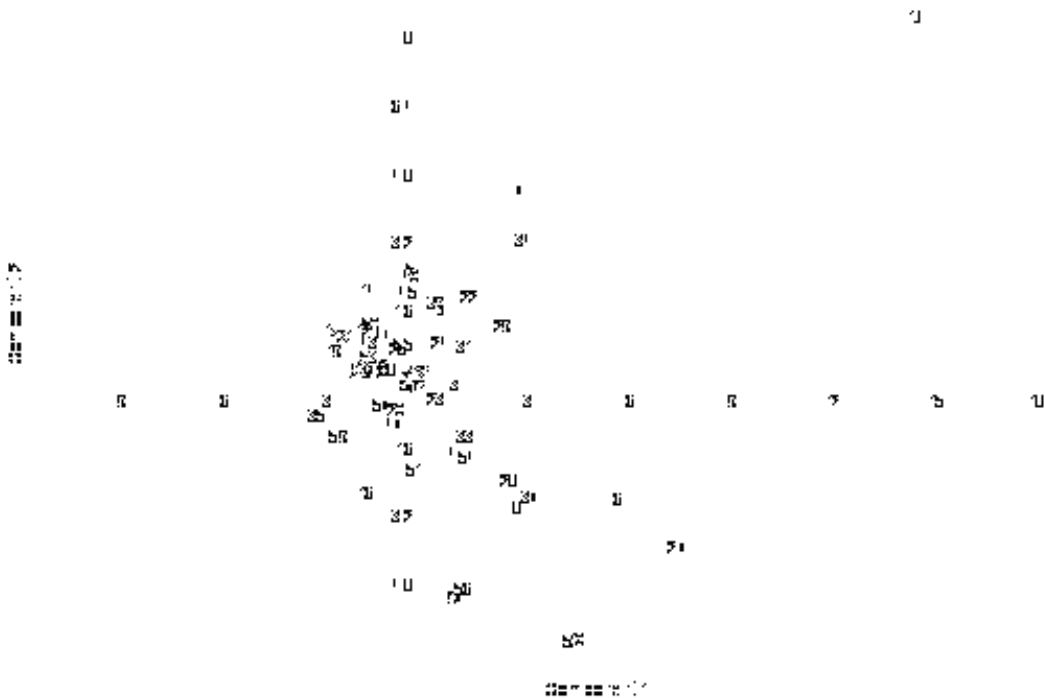
Fig 2: Principal Component Analysis of floral species distribution in the SIPCOT Industrial Park. Refer table 1 for the species list.

Table 3: Kulczynski Comparison

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12

Sample 1											
Sample 1	*	*	*	*	*	*	*	*	*	*	*
Sample 2	35*	*	*	*	*	*	*	*	*	*	*
Sample 3	64.17	40.66*	*	*	*	*	*	*	*	*	*
Sample 4	56.47	59.71	48.61*	*	*	*	*	*	*	*	*
Sample 5	60	50.91	61.11	43.92*	*	*	*	*	*	*	*
Sample 6	58.13	49.24	64.93	66.73	38.75*	*	*	*	*	*	*
Sample 7	63.38	57.33	71.25	53.62	66.4	46.62*	*	*	*	*	*
Sample 8	63.33	54.09	61.11	53.33	60	51.67	57.34*	*	*	*	*
Sample 9	65.61	59.45	64.91	52.94	65.61	54.69	64.01	53.68*	*	*	*
Sample 10	67.81	58.48	61.98	63.69	64.58	53.13	67.02	54.9	63.32*	*	*
Sample 11	65.59	56.3	51.03	55.5	45.91	60.33	59.29	62.31	61.5	44.46*	*
Sample 12	46.67	57.27	61.11	40.78	63.33	54.9	69.41	53.33	59.65	58.13	42.63*

Table 4: Rank Correlation

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Sample 1	1*	*	*	*	*	*	*	*	*	*	*	*
Sample 2	-0.1408	1*	*	*	*	*	*	*	*	*	*	*
Sample 3	0.3381	-0.2732	1*	*	*	*	*	*	*	*	*	*
Sample 4	0.2249	0.1709	0.0907	1*	*	*	*	*	*	*	*	*
Sample 5	0.2907	0.1201	0.2398	-0.0546	1*	*	*	*	*	*	*	*
Sample 6	0.2179	0.1652	0.3137	0.3891	-0.0705	1*	*	*	*	*	*	*
Sample 7	0.3009	-0.0091	0.2353	0.0591	0.2849	-0.1951	1*	*	*	*	*	*
Sample 8	0.4626	0.1044	0.2376	0.1292	0.328	0.1809	0.1102	1*	*	*	*	*
Sample 9	0.2162	0.1196	0.2846	-0.0256	0.2999	0.0856	0.1271	0.1475	1*	*	*	*
Sample 10	0.5101	0.0689	0.3127	0.2721	0.2896	0.1298	0.3712	0.2214	0.1771	1*	*	*
Sample 11	0.323	0.1352	0.1026	0.2227	0.0639	0.2384	0.1558	0.2088	0.2485	0.127	1*	*
Sample 12	-0.0108	0.2924	0.1059	-0.1334	0.4251	0.133	0.3012	0.2416	0.2356	0.2023	0.0156	1

Table 5: Mann- Whitney

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Sample 1	*	*	*	*	*	*	*	*	*	*	*	*
Sample 2	422*	*	*	*	*	*	*	*	*	*	*	*
Sample 3	534	502*	*	*	*	*	*	*	*	*	*	*
Sample 4	488	494	598*	*	*	*	*	*	*	*	*	*
Sample 5	367	310	410	384*	*	*	*	*	*	*	*	*
Sample 6	442	398	510	474	429*	*	*	*	*	*	*	*
Sample 7	516	464	592	550	490	590*	*	*	*	*	*	*
Sample 8	412	366	468	438	408	474	547*	*	*	*	*	*
Sample 9	518	461	599	558	511	608	697	561*	*	*	*	*
Sample 10	428	380	496	458	438	502	574	476	600*	*	*	*
Sample 11	452	403	535	498	368	450	526	410	531	446*	*	*
Sample 12	348	284	376	356	420	401	457	380	476	410	333*	*

Table 6: Variance – Covariance

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Sample 1	3.6014*	*	*	*	*	*	*	*	*	*	*	*
Sample 2	-0.3141	2.4535*	*	*	*	*	*	*	*	*	*	*
Sample 3	0.9696	-0.5269	2.1297*	*	*	*	*	*	*	*	*	*
Sample 4	0.3939	0.3326	0.2122	2.1321*	*	*	*	*	*	*	*	*

Sample 5	0.6715	0.72	0.3983	-0.2721	3.1794*	*	*	*	*	*	*	*
Sample 6	0.4191	1.6108	0.9205	0.7358	0.8545	4.1835*	*	*	*	*	*	*
Sample 7	1.0009	-0.358	0.3603	0.1514	0.6826	-0.8717	2.7656*	*	*	*	*	*
Sample 8	1.2271	0.4906	0.4424	-0.0357	0.9077	0.8816	0.3165	2.3308*	*	*	*	*
Sample 9	0.1739	0.8746	0.5488	-0.3109	1.0918	1.0529	0.322	0.5792	2.893*	*	*	*
Sample 10	1.5798	-0.2484	1.0473	0.6888	0.2756	0.1397	0.7934	0.3515	0.2706	3.1473*	*	*
Sample 11	0.3349	-0.1613	0.0544	0.3936	-0.0929	0.0921	0.2826	0.0856	0.3273	0.353	1.5675*	*
Sample 12	-0.6099	0.7688	-0.0561	-0.5181	1.1376	0.5362	0.6037	0.4205	1.0465	0.13	-0.1125	2.8369

List of Fauna in the in the SIPCOT Industrial Park and its surroundings

1. *Ovis aries-*   Sheep
2. *Capra aegagrus hircus* - Goat
3. *Canis lupus familiaris* - Dog
4. *Gecko* - Lizard
5. *Felis catus* - Cat
6. *Bos taurus* - Cow
7. *Macaca radiate* - Monkey
8. *Corvus splendens* - Crow
9. *Acridotheres tristis*- Common Myna
10. *Loriculus vernalis* - Parrot
11. *Collocalia esculenta*- Glossy Swiftlet
12. *Tyto alba*- Owl
13. *Columba rupestris* - Pigeon
14. *Dicrurus macrocercus*- Black Drongo
15. *Naja naja oxiana* - Central Asian Cobra
16. *Varanus sp*. - Monitor Lizard
17. *Chamaeleo gracilis* - Graceful Chameleon
18. Bufo *melanostictus* – Indian Toad
19. *Duttaphrynus melanostictus* – Toad
20. Anopheles *rufipes* - Mosquito
21. Anopheles *coustani* - Mosquito
22. *Culex annulioris* - Mosquito
23. *Ficalbia splendens* – Mosquito
24. *Musca domestica* – House fly
25. *Anochetus* - Ant
26. *Technomyrmex* – Ant
27. *Acantholepis* – Ant
28. Ardea *purpurea* - Peria vellai kokku
29. *Ardea cinerea* - Sambal narai
30. *Anaphaeis aurota* - The Pioneer butterfly
31. *Papilio demoleus* – The Lime Butterfly
32. *Pachliopta aristolochiae* – The common Rose Butterfly
33. Troides *Minos* - The Southern Birdwing
34. Danaus *chrysippus* – Plain tiger butterfly
35. *Mycalesis anaxias* – Indian common butterfly

Table 7: Consolidated details on the faunal diversity in the SIPCOT Industrial Park

Number of species	35
Number of Individuals	504
Dominance	0.07
Shannon index	2.70
Simpson index	0.92
Evenness	0.86
Menhinick	2.73
Margalef	4.46
Equitability index	0.94
Fisher alpha diversity	11.74
Berger-Parker	0.131251
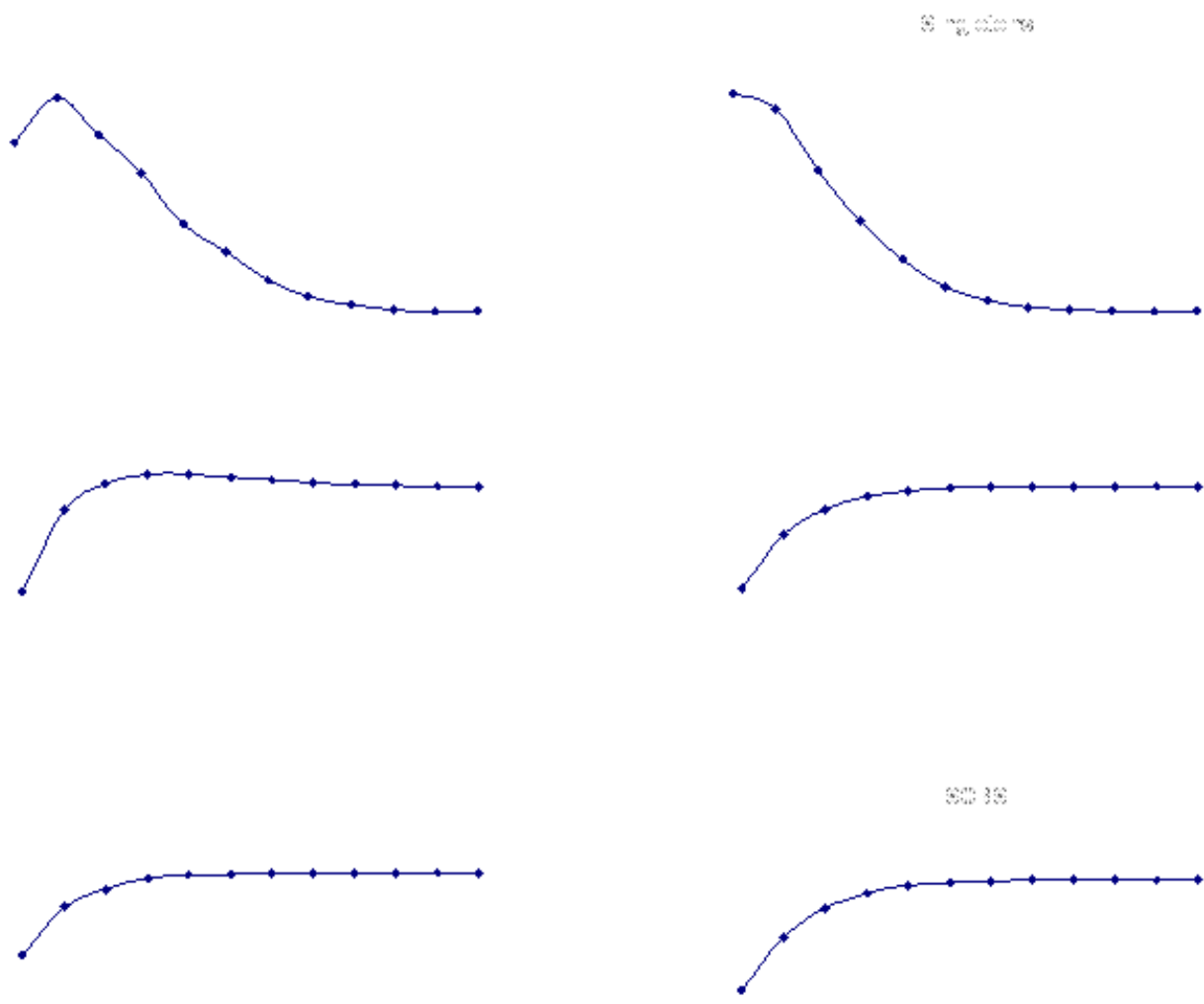
Fig 3: Observed and estimated species – area curves of fauna in the SIPCOT Industrial Park

Fig 4: Principal Component Analysis of faunal species distribution in the SIPCOT Industrial Park.
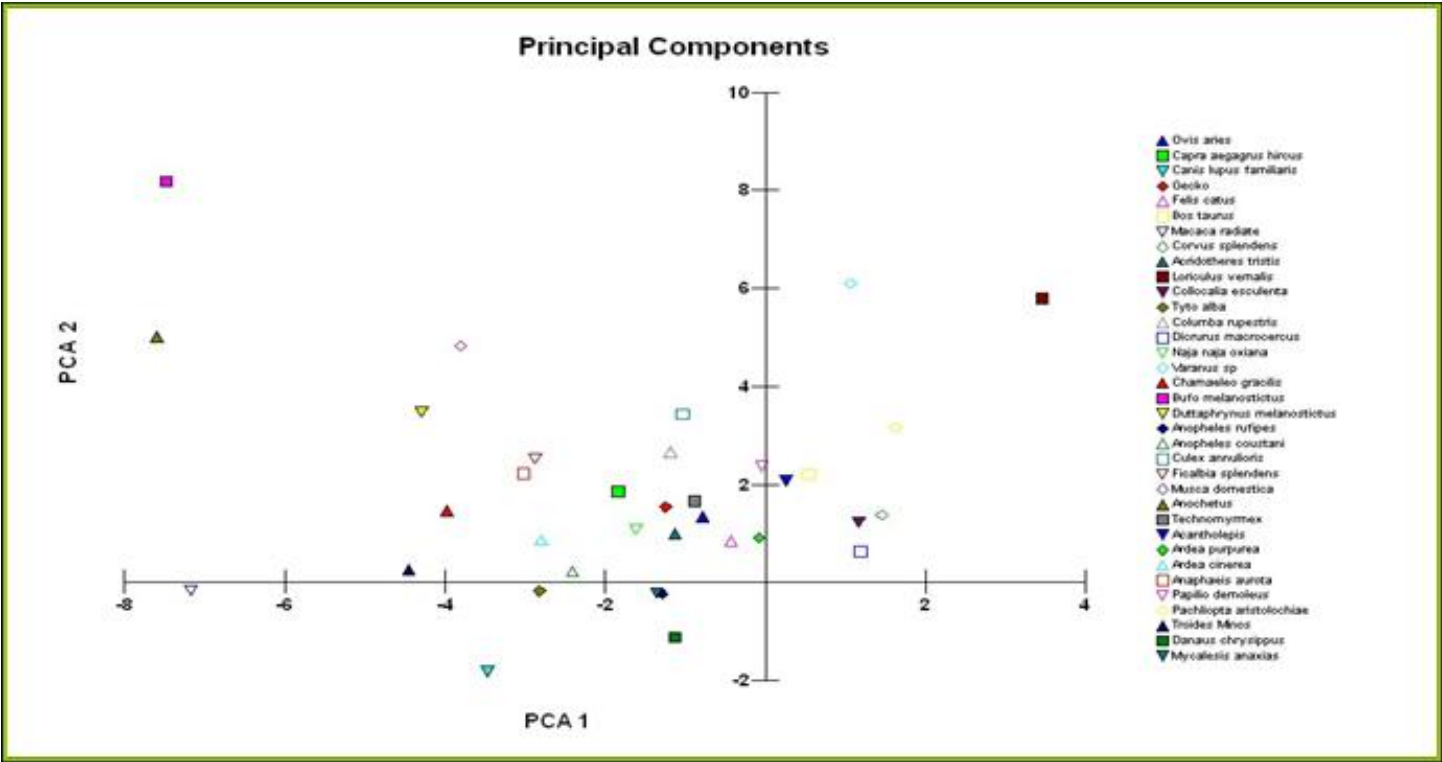
Fig 5: Cluster diagram produced by the distribution of faunal species in the SIPCOT Industrial Park.

Bray-Curtis Cluster Analysis (Single Link)

Pachliopta aristolochiae
Dicrurus macrocercus
Ardea purpurea
Tyto alba
Duttaphrynus melanostic
Danaus chrysippus
Troides Minos
Macaca radiate
Canis lupus familiaris
Anopheles rufipes
Anochetus
Chamaeleo gracilis
Musca domestica
Bufo melanostictus
Ardea cinerea
Naja naja oxiana
Corvus splendens
Bos taurus
Anaphaeis aurota
Columba rupestris
Papilio demoleus
Acantholepis
Collocalia esculenta
Acridotheres tristis
Anopheles coustani
Gecko
Capra aegagrus hircus
Technomyrmex
Varanus sp
Loriculus vernalis
Felis catus
Mycalesis anaxias
Ficalbia splendens
Culex annulioris
Ovis aries

0.   % Similarity   50.   100

Table 8: Kulczynski Comparison

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Sample 1	*	*	*	*	*	*	*	*	*	*	*	*
Sample 2	26.39	*	*	*	*	*	*	*	*	*	*	*
Sample 3	61.58	32.46	*	*	*	*	*	*	*	*	*	*
Sample 4	50	52.78	46.18	*	*	*	*	*	*	*	*	*
Sample 5	43.53	62.91	44.58	54.41	*	*	*	*	*	*	*	*
Sample 6	65.43	59.42	76.89	56.09	46.04	*	*	*	*	*	*	*
Sample 7	42.5	44.44	55.83	42.5	39.08	40.22	*	*	*	*	*	*
Sample 8	54.41	51.47	55.73	43.53	64.71	51.15	52.1	*	*	*	*	*
Sample 9	55	63.33	46.18	55	65.29	46.74	42.5	54.41	*	*	*	*
Sample 10	65.29	45.75	61.3	48.97	52.94	61.38	39.08	52.94	54.41	*	*	*
Sample 11	54.64	38.1	37.22	54.64	52.1	45.96	57.14	58.61	36.43	26.05	*	*
Sample 12	44.42	52.99	45.34	31.73	47.51	60.2	59.34	54.3	44.42	33.94	37.09	*

Table 9: Rank Correlation

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Sample 1	1	*	*	*	*	*	*	*	*	*	*	*
Sample 2	-0.2965	1	*	*	*	*	*	*	*	*	*	*
Sample 3	0.2432	-0.2781	1	*	*	*	*	*	*	*	*	*
Sample 4	-0.1931	0.0992	-0.1564	1	*	*	*	*	*	*	*	*
Sample 5	-0.1736	0.4461	-0.0585	0.1696	1	*	*	*	*	*	*	*
Sample 6	0.1095	0.2658	0.3797	0.119	0.1305	1	*	*	*	*	*	*
Sample 7	0.0626	0.1178	0.1882	0.1729	0.1499	-0.2383	1	*	*	*	*	*
Sample 8	0.1022	0.1034	0.2963	-0.0303	0.4698	0.0032	0.2838	1	*	*	*	*
Sample 9	-0.1734	0.3221	0.0091	-0.0851	0.4123	-0.0065	0.0632	0.1949	1	*	*	*
Sample 10	0.4336	-0.0174	0.3579	-0.0537	0.1733	0.2	0.0519	0.1997	0.0286	1	*	*

| Sample 11 | 0.1177 | 0.1141 | -0.0479 | 0.3098 | 0.3665 | -0.0052 | 0.3706 | 0.3638 | -0.0653 | -0.0152 | 1* | |
| Sample 12 | 0.0685 | 0.3791 | 0.2636 | -0.0141 | 0.3849 | 0.2704 | 0.5029 | 0.4091 | 0.2279 | 0.0721 | 0.182 | 1 |

Table 10: Mann- Whitney

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Sample 1	*	*	*	*	*	*	*	*	*	*	*	*
Sample 2	179	*	*	*	*	*	*	*	*	*	*	*
Sample 3	169	152	*	*	*	*	*	*	*	*	*	*
Sample 4	196	176	164	*	*	*	*	*	*	*	*	*
Sample 5	166	150	140	170	*	*	*	*	*	*	*	*
Sample 6	179	162	141	182	153	*	*	*	*	*	*	*
Sample 7	129	118	107	135	112	131	*	*	*	*	*	*
Sample 8	134	122	102	136	113	192	94	*	*	*	*	*
Sample 9	166	152	134	175	143	208	125	148	*	*	*	*
Sample 10	166	151	140	166	144	146	110	102	138	*	*	*
Sample 11	128	118	104	135	110	130	94	90	132	103	*	*
Sample 12	90	84	66	96	76	145	65	110	106	68	67	*

Table 11: Variance – Covariance

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12
Sample 1	3.0555	*	*	*	*	*	*	*	*	*	*	*
Sample 2	-0.7176	2.7529	*	*	*	*	*	*	*	*	*	*
Sample 3	0.3723	-0.8294	1.6168	*	*	*	*	*	*	*	*	*
Sample 4	-0.9933	0.4353	-0.5975	2.5748	*	*	*	*	*	*	*	*
Sample 5	-0.9521	0.8294	-0.1798	0.3748	2.4571	*	*	*	*	*	*	*
Sample 6	-0.195	1.1412	0.6504	0.6252	1.0429	3.7513	*	*	*	*	*	*
Sample 7	-0.058	0.0176	-0.2034	0.0571	-0.0193	-0.9807	1.963	*	*	*	*	*
Sample 8	-0.3361	-0.1176	0.521	-0.3866	1.0546	-0.084	0.4664	2.5042	*	*	*	*
Sample 9	-0.9748	0.7647	-0.0714	-0.7563	0.8319	0.3151	0.1555	0.4328	2.6639	*	*	*
Sample 10	0.637	-0.3882	0.7345	-0.5387	-0.2975	0.0622	-0.321	0.3445	-0.4832	1.8521	*	*
Sample 11	-0.3613	-0.0882	-0.4076	0.3697	0.3992	-0.2521	0.2521	0.3655	-0.5252	-0.3193	1.4202	*
Sample 12	-0.2353	0.6765	0.1471	-0.3824	0.8824	0.3529	0.8824	0.7647	0.6176	-0.2353	-0.1471	2.1176

Acknowledgements

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