Study On The Richness of Insect Population in a Scrub JungleEcosystem at Chennnai,TamilNadu

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ABSTRACT *Urbanization and uncontrolled plastic usage of the growing population and other sources are dire threats to the loss of biodiversity as well as environmental quality of a scrub jungle ecosystem. A study of diversity of the insect species present in two different habitats in the ecosystem was done from June to August 2014. A total of 47 species of insects were identified in both areas. Areas void of population is highly rich with small plants and trees, with leaf litter serving mainly as an ecosystem for a variety of insects. The Species richness in such an ecosystem is found to be abundant and a well balanced niche is maintained. Polluted areas have a greatly reduced number of biotic factors as the area is densely covered with non-degradable synthetic polymers and biological waste resulting in a decrease in insect population. As a result of pollution, there is a great variation in soil temperature and pH in both areas contributing to the loss of biodiversity.*

Keywords: *Ecosystem, Niche, Pollution*

INTRODUCTION

The Madras Christian College, the 365-acre campus is known for its deer and trees and it is distinguished by a lake encompassed within the campus. The campus is well known for its biodiversity in which variety of species are found.

Biological diversity, or "biodiversity", refers to the variety of life on earth. As defined by the United Nation Convention on Biological Diversity, it includes diversity of ecosystem, species and genus, and the ecological processes that support them Rabosky, Daniel L (1 August 2009). Natural diversity in ecosystems provides essential economic benefits and services to human society, such as food, clothing, shelter, fuel and medicines. It also enhances ecological, recreational, cultural and aesthetic values and thus plays an important role in sustainable development.Genetic diversity is one in which variation between individual of the same species occur. This includes genetic variation between individuals in a single population, as well as variations between different populations of the same species Butler D. (1994). Genetic differences can now be measured using increasingly sophisticated techniques. These differences are the raw material of evolution.

Species diversity is an index that incorporates the number of species in an area and also their relative abundance. This can either be determined by counting the number of different species present, or by determining taxonomic diversity P. Davis (1996). Taxonomic diversity is more precise and considers the relationship of species to each other. It can be measured by counting the number of different taxa (the main categories of classification) present. For example, a pond containing three species of snails and two fish is more diverse than a pond containing five species of snails, even though they both contain the same number of species. High species biodiversity is not always necessarily a good thing. For example, a habitat may have high species biodiversity because many common and widespread species are invading it at the expense of species restricted to that habitat. Species diversity is one of the components of the concept of biodiversity.

The term ecosystem was coined in 1930 by Roy Clapham. Ecosystem diversity, communities of plants and animals, together with the physical characteristics of their environment (e.g. geology, soil and climate) interlink together as an ecological system, or 'ecosystem' Christopherson (1997). Ecosystem diversity is more difficult to measure because there are rarely clear boundaries between different ecosystem and they grade into one another. However, if consistent criteria are chosen to define the limits to an ecosystem, then their number and distribution can also be measured.

Species richness is the fundamental unit which is used to assess the homogeneity of an environment. Typically, species richness is used in conservation studies to determine the sensitivity of ecosystems and their resident species. The actual number of species calculated alone is largely an arbitrary number. These studies, therefore, often develop a rubric or measure for valuing the species richness number(s) or adopt one from previous studies on similar ecosystem.

There is a strong inverse correlation in many group between species richness and latitude: the farther from the equator, the fewer species can be found. Equally, as altitude increases, species richness decreases, indicating an effect of area, available energy, isolation and/or zonation (intermediate elevations can receive species from higher and lower). A biodiversity hotspot is a region with a high level of endemic species. Dense human habitation tends to occur near hotspots. Most hotspots are located in the tropics and most of them are forests.

The release of pollutants into the environment can kill organisms outright, change the biogeochemical conditions and processes occurring within a system and result in systemic changes that degrade habitats and make ecological processes dysfunctional. Biodiversity associated with sites intensively used by humans may be most at risk, although the non-point based effects of pollution on biodiversity such as downstream water pollution and downwind air pollution can be significant.

Potential effects of pollutants on ecosystems include changes in the abundance of species, interruption to energy and nutrient flows, modification of habitats, reduction in soil, water and air quality, and changes to the stability and resilience of ecosystems. Where species consumed by humans are affected by pollution, there is the potential for serious human health problems. The release of total nitrogen and phosphorus into the environment results in many changes including the likelihood of more frequent and intensive algal blooms in waterways.

One of the major types of pollution is plastic. Plastic pollution involves the accumulation of plastic products in the environment that adversely affects wildlife, wildlife habitat, or humans. Many types and forms of plastic pollution exist. Plastic pollution can adversely affect lands, waterways and oceans David U et.al. Plastic reduction efforts have occurred in some areas in attempts to reduce plastic consumption and promote plastic recycling. The prominence of plastic pollution is correlated with plastics being inexpensive and durable, which lends to high levels of plastics used by humans. Chlorinated plastic can release harmful chemicals into the surrounding soil, which can then seep into groundwater or other surrounding water sources and also the ecosystem. This can cause serious harm to the species that drink up the water. Landfill areas are constantly piled high with many different types of plastics. In these landfills, there are many microorganisms which speed up the biodegradation of plastics. Regarding biodegradable plastics, as they are broken down, methane is released, which is a very powerful greenhouse gas that contributes significantly to global warming. Plastic pollution has the potential to poison animals, which can then adversely affect human food supplies. Some marine species, such as sea turtles, have been found to contain large proportions of plastics in their stomach

Insects are mostly solitary, but some insects, such as certain bees, ants, and termites are social and live in large, well-organized colonies. Some insects like earwigs, show maternal care, guarding their eggs and young. Insects can communicate with each other in a variety of ways. Male moths can sense the pheromones of female moth over distances of many kilometers. Other species communicate with sound- crickets stridulate or rub their legs together to attract a mate and repel other males. Lampyridae (coleopteran) communicate with light. Humans regard certain insects as pests and attempt to control those using insecticides and a host of other techniques. Some insects damage crops by feeding on sap, leaves or fruits a few bite humans and livestock, alive and dead to feed on blood and some are capable of transmitting disease to humans, pets and livestock.

Tews*et al*., 2004 studied that the global comparisons make several strong and apparently generalizable points about diversity , within regions , local diversity correlates strongly with various aspects of ecology, including climate, habitat structure, and mesoscale (that is, landscape) heterogeneity.

Kempton 1979 mentioned that the structure of species abundance at site may provide a better characterization of the environment than the list of named species. A diversity index is an attempt to give a one-dimensional description of this structure. Hill (1983) has defined a family of functions of the species relative abundances, which contains the Simpson and Information diversity index and the total species count as special cases. Diversity measures which are based primarily on the pattern of abundance of those species with medium abundance and give undue emphasis to neither the very common or rare species are found to be most consistent over years at the same site and give greatest discrimination between sites. Different diversity indices may give inconsistent orderings of a group of communities.

Janzen and Schoener, 1968 had studied and the insect abundance and diversity between wetter and drier sites. The samples were the compared with respect to numbers of individuals, numbers of species, size frequencies, weight, developmental stages, species diversity, trophic levels, taxonomic composition and species exclusiveness. The absolute numbers of species increased from Areas 1 through IV; the numbers of individuals, frequency of small insects, dry weight, individuals per species and percent parasitic species increased from Areas 1 through 111. The several indices of species diversity calculated for the samples only show partial agreement in relative values and trends. The data clearly demonstrate that adjacent tropical communities can have greatly different insect components. The possible effects of the differences between the insect communities of Areas 1 to 111 on vertebrate predators and plants are discussed. When compared with temperature data on insect communities there are indications that the four tropical communities examined have a much greater number of species and possibly a greater internal uniqueness than similar temperature communities.

Howe, 1967 studied the influence of temperature on the biochemistry of insect development. The most prominent problem is temperature control. Insect metabolism produces heat and if this is not dissipated it causes a local rise of temperature. Temperature is usually a key factor of the environment, but it interacts jointly with others such as humidity, food and light.Tauber and Tauber, 1981 discussed on the cyclic changes associated with seasonal progression probably constitute the most important and all-encompassing set of environment variables that organisms encounter. Therefore, a fundamental and unifying aspect of each 'species or population's life history is the adaptations that determine its seasonal cycle, i.e. the timing of the period of development, reproduction, and dormancy, and migration in relation to seasonal changes in biotic and abiotic factors. Such coordinated sets of seasonal adaptations are popularly referred as "strategies."

Whittaker, 1972 expressed that given a resource gradient (eg light intensity prey siz) in a community, species evolve to use different parts of this gradient; competition between them is thereby reduced. Species relationships in the community may be conceived in terms of a multidimensional coordinate system, the axes of which are the various resource gradients (and other aspects of species relationships to space, time, and one another in the community)Birch, 1953 observed the effects of natural or experimental environmental perturbations on population can be diverse, simultaneously affecting several life history variables. Temperature, moisture and food on the innate capacity for the increase of insect species. The insect tend to increase in number in favorable places or tends to increase during favorableseason.Southwood*et al*., 1979 had studied the relationships of plant and insect diversities in succession and found that up to a successional age of 16 months, the taxonomic diversities of plants and insects rose; thereafter the diversity of the plant species declined far more than the insect species diversity.it was concluded that in the later successional stages the maintenance of a high level of taxonomic diversity of these orders of insects is correlated with the rising structural diversity of the green plants, which virtually compensates for their falling taxonomic diversity.Mulder*et al*., 1999 student that insects can alter relationship between plant species diversity and ecosystem function in grassland communities, by (i) altering biomass across a plant diversity gradient, (ii) altering relative abundances of plant species, or (iii) altering ecosystem function directly. Reducing insect populations resulted in greater evenness of relative plant species richness and above-ground biomass. Reducing insects also changed the relationship between plants species richness and decomposition.

Rosenzweig, 1995 highlighted that, the resulting effect of habitat heterogeneity/diversity on species diversity is subject to the measurement of species diversity. In general, species diversity is a measure of the number of component species and their abundance at a defined point in space and time.Sanders, 1998 mentioned that the smallest spatial scale the diversity of animal species measured is the result of individual behavior, i.e. habitat selection, and of course sampling chance. Here, rarefaction is one widely used method to scale down to the same number of individuals between habitats.Anderson and Marcus, 1993 studied that larger sample areas generally yield larger measurement. For example, the measurement of species diversity change from 68 to 99, an increase of 38% in an area of high density, as the sample area change from a small local area to a square 400 km per side. No single area size is intrinsically better than other. This effect need to be taken into consideration in order for meaningful comparisons of studies to be made when different size of sample areas has been used.Chazdon*et al*., 1998 mentioned that data's from numerous small sub-samples provide a basis for extrapolating to a larger area. Such extrapolating must take into account the well-supported observation that estimates of local species richness depend strongly on the number of individual and the area sampled. SrinivasanBalakrishnan*et al*., investigated the biodiversity of some insect fauna in different coastal habitat of Tamil Nadu, Southeast coast of India and also tried to clarify the relationship between surrounding coastal environmental ecosystem of three coastal habitats (station-I estuarine complex, station-II mangrove area and station-III sandy beach), in order to, eventually, contribute to biodiversity conservation as well as to management of coastal habitat in India. Insect were collected from the three sites, from January 2008 to December 2008. Studies regarding diversity of insects available on coastal environments are very few. A total of 929 insects belong to 23 families and 6 orders were recorded from the 3 sites. Among them, 487 species are from station-II 259 species from station-I and 183 species are from station-III were recorded. Statistical tools PRIMER (Ver. 6.1.11) were employed to find the species diversity, richness and evenness were calculated.

MATERIALS AND METHODS

The study was conducted for four months starting from August 2014 till November 2014. For the data collection, note book, pen, camera, thermometer were used. The soil temperature and pH were recorded. Observations was done without any disturbance on the area, insects were counted and noted. The observation was done during morning, noon and evening. Iron rod was used to mark the quadrats and observe the insects which were present under fallen leaves. Hand lens was used to observe the small insects which were present in trees and ground.

RESULTS

After compiling the data from polluted and unpolluted area, number of species and the number of individuals were calculated.

<u>Unpolluted area</u>

Total species identified – 44

Number of individual - One thousand four hundred and forty nine (1449)

<u>Polluted area</u>

Total species identified - 28

Number of individual - One thousand and sixteen (1016)

Table 1; UNPOLLUTED AREA.

SL/NO	COMMON NAME	SCINTIFIC NAME
1.	Carpenter Bee	*Xylocopaviolacea*
2.	Ant	*Andrena sp.*
3.	Ant	*Formica sanguinea*
4.	Ant	*Myrmica sp.*
5.	Ant	*Lasiusfuliginosus*
6.	Ant	*Camponotusligniperda*
7.	Garden Carabus	*Carabushortensis*
8.	Asian lady beetle	*Harmoniaaxyridis*
9.	Rove Beetle	*Velleiusdilatatus*
10.	Damsel Bug	*Prostemmaguttula*
11.	Damselbug	*Nabis sp.*
12.	Forest bug	*Pentatomarufipes*
13.	Green shield Bug	*Palomenaprasina*
14.	Spined stink Bug	*Picromerusbidens*
15.	Great Eggfly	*Hypolimnasbolina*
16.	Crimson rose	*Pachliopta hector*
17.	Comma Butterfly	*Polygonia c-album*
18.	Chestnut Heath	*Coenonymphaglycerion*
19.	Dark Blue Tiger	*Tirumalaseptentrionis*
20.	False Grayling	*Arethusanaarethusa*
21.	Painted Lady	*Vanessa cardui*
22.	Queen	*Danausgilippus*
23.	Ringlet	*Aphantopushyperantus*
24.	Small Heath	*Coenonymphapamphilus*
25.	Clouded Yellow	*Coliascroceus*
26.	Small Cabbage White	*Pierisrapae*
27.	Common Blue	*Polyommatus Icarus*
28.	Dusky Large Blue	*Maculineanausithous*
29.	Green-underside Blue	*Glaucopsychealexis*
30.	Reverdin's Blue	*Plebejus cf. argyrognomon*
31.	Great Eggfly	*Hypolimnasbolina*
32.	Black Meadowhawk	*Sympetrumdanae*

33.	Black-tailed Skimmer F	*Orthetrumcancellatum*
34.	Broad Scarlet Darter	*Crocothemiserythraea*
35.	Club-tailed Dragonfly	*Gomphusvulgatissimus*
36.	Common Darter Dragonfly	*Sympetrumstriolatum*
37.	Ditch Jewel	*Brachythemiscontaminata*
38.	Ground Skimmer	*Diplacodestrivialis*
39.	Blue Bottle Fly	*Calliphoravomitoria*
40.	Chironomid	*Chironomusplumosus*
41.	Cranefly	*Ctenophorapectinicornis*
42.	Eyed hawkmoth	*Smerinthusocellata*
43.	Owlet Moth	*Spiramaretorta*
44.	Handmaiden Moth	*Syntomoidesimaon*
45.	Beet Webworm Moth	*Spoladearecurvalis*
46.	Common wasp	*Vespula vulgaris*

Table; 2.POLLUTED AREA

1	Common Blue	*Polyommatus Icarus*
2	Dusky Large Blue	*Maculineanausithous*
3	Green-underside Blue	*Glaucopsychealexis*
4	Reverdin's Blue	*Plebejus cf. argyrognomon*
5	Great Eggfly	*Hypolimnasbolina*
6	Black Meadowhawk	*Sympetrumdanae*
7	Black-tailed Skimmer F	*Orthetrumcancellatum*
8	Broad Scarlet Darter	*Crocothemiserythraea*
9	Club-tailed Dragonfly	*Gomphusvulgatissimus*
10	Common Darter Dragonfly	*Sympetrumstriolatum*

11	Ant	*Andrena sp.*
12	Ant	*Formica sanguinea*
13	Ant	*Myrmica sp.*
14	Ant	*Lasiusfuliginosus*
15	Ant	*Andrena sp.*
16	Cranefly	*Ctenophorapectinicornis*
17	Eyed hawkmoth	*Smerinthusocellata*
18	Owlet Moth	*Spiramaretorta*
19	Cuckoo wasp	*Hedychrumrutilans*
20	Asian lady beetle	*Harmoniaaxyridis*
21	Rove Beetle	*Velleiusdilatatus*
22	Damsel Bug	*Prostemmaguttula*
23	Damselbug	*Nabis sp.*
24	Forest bug	*Pentatomarufipes*
25	Termite	Termitoidae
26	Queen	*Danausgilippus*

27	Ringlet	*Aphantopushyperantus*
28	Antlion	*Myrmeleontidae*

Table 3; Abundance of insect in POLLUTED AREA

Ants	277
butterfly	121
Bee	125
Beetle	37
Dragonfly	18
ant lion	91
flies	253
Crickets	50
Bugs	35
seven spotted cockroach	75
Wasp	12
Ants	277

Figure 1: Abundance of insect in POLLUTED AREA.

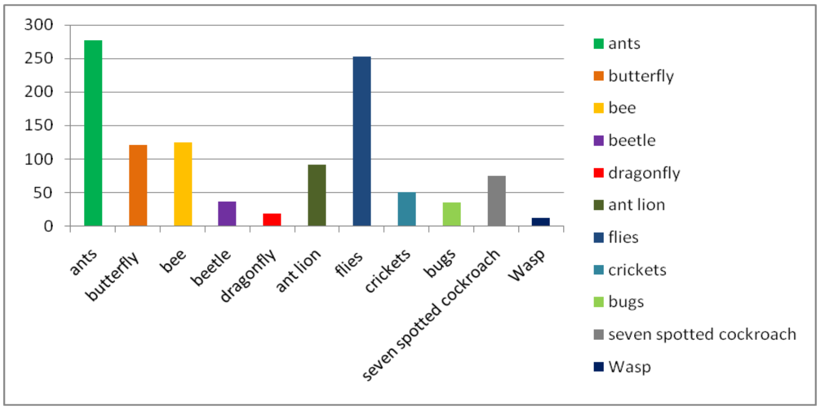
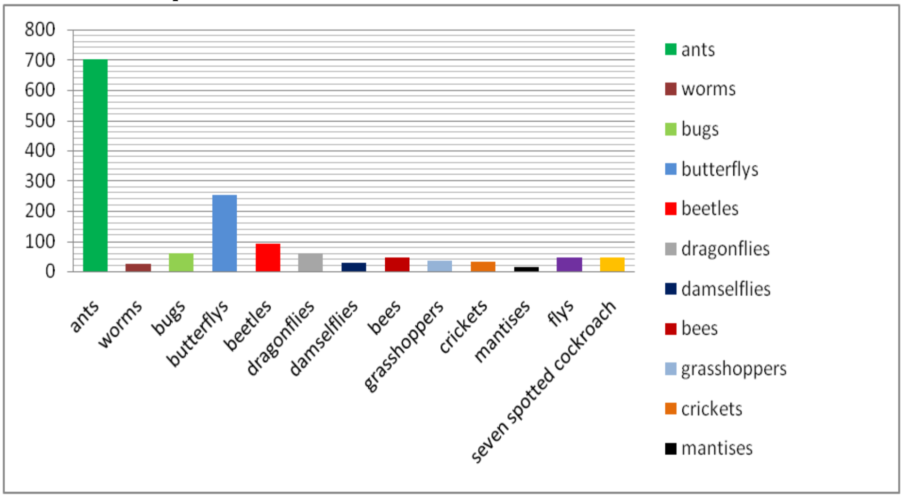


Table 4 Abundance of insect speciesin UNPOLLUTED AREA

ants	702
worms	24
bugs	61
butterflys	253
beetles	93
dragonflies	61
damselflies	29
bees	46
grasshoppers	35
crickets	32
mantises	13
flys	47
seven spotted cockroach	45
ants	702
worms	24
bugs	61

Figure 2Abundance of insect species in UNPOLLUTED AREA



DISCUSSION

The study of insect biodiversity in polluted area (Table 2) and unpolluted area (Table 1) in Madras Christian College campus was done by the observation of insects during day time (morning, noon and evening).

The insect species diversity of the unpolluted area is higher than the polluted area. This is due to the location of the spot which is being undisturbed (Figure 2). The area of study spot which is the scrub jungle behind the Bishop Heber Hall, where food source is available with a climatic temperature of 23°C which is favorable for the insects, ants, butterflies and *Blatta sp.* was found to be highest in number from unpolluted area. This is because of thick scrub jungle with a minimum light exposure with wet and damp soil. The *Blatta sp.* was found under the fallen leaves. The minimum insect diversity was observed from unpolluted area (Figure 1). Ants, butterflies and beetles were mostly found in the unpolluted area. They have the ability to exploit a wide range of food resources either as direct or indirect herbivores, but a few have evolved specialization ways of obtaining nutrition. Leafcutter ants (*Atta* and *Acromyrmex*) fed exclusively on a fungus that group only within their colonies. They continually collect leaves which were taken to the colony, cut into tiny pieces and placed in fungal gardens. Soil moist content is very high in unpolluted area.

In the polluted area the insect diversity is comparatively lesser than unpolluted area. This is due to the continuous deposition of domestic waste that cause the diversity of insects. Large number of insects disappeared and some flies and bees fed on the domestic waste as food.in this area. Hence the diversity of bees and flies were found to be relatively higher than the other insects. The minimum insect diversity was observed from polluted area. The polluted area was continuously disturbed and the soil temperature was 27°C.the disturbed area is covered with plastic waste and other domestic waste.

Insects were found mostly where the food was available. Insects like grasshoppers were found maximum in the grass, antlion larvae were found in sandy soil where they can easily dig the soil for catching their prey. Butterfly mainly fed on nectar of flowers. Some also derived nourishment from pollen, tree sap, rotting fruit, dung, and decaying flesh and dissolved minerals in wet sand or dirt.

Figure 3: Pie diagram showing the insect diversity of unpolluted area.

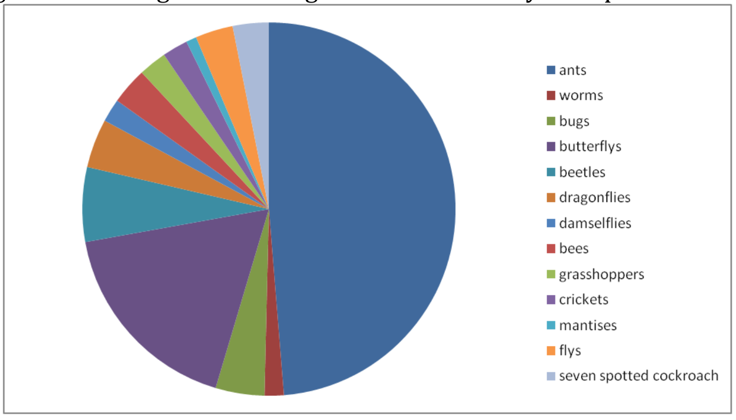
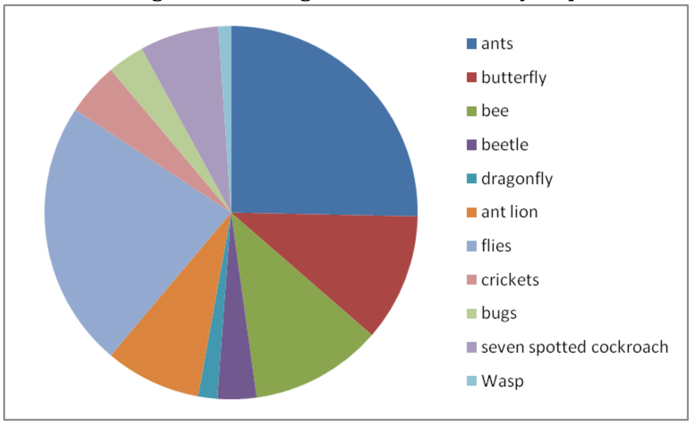


Figure 4: Pie diagram showing the insect diversity of polluted area.



References

1. Andrerson, s. and Marcus, L. F. (1993). Effect of quadrat size on measurement of species density. Journal of biogeography. 20, 421-428.
2. Andow, D. A. (1991). vegetation Diversity and Arthropod Population Response. Annual Review of Enromology. Vol.36: 561-586.
3. Birch, L. C. (1953). Experimental background to the study of the Distribution and Abundance of Insects: I. the Influence of Temperature Moisture and Food on the InnateCapacity for Three Grain Beetles.Ecology , vol. 34, no. 4. PP. 698-711.
4. Chazdon, R. L., colwell, R. k., Denslow, J. S. and Guariguata, M. R. (1998)-statistical method for estimating species richness of Woody regeneration in primary and secondary rain forests of northeastern costa Rica. Forest biodiversity research, monitoring and modeling. Vol. 20, chapter 16.
5. David, B. v. and Ananthakishnan, T. N. (2004). General and Applied Entomology. Tata Mcgraw-Hill publishing company Ltd. PP. 3-20.
6. Howe, R. W. (1967). Temperature Effects on Embryonic Development in Insects. AnnualReview of Entomology. Vol. 12: 15-42.
7. James, F. C. and rathbun, S. (1981). Rarefaction, Relative Abundance and Diversity of avian communities. The auk, vol. 98, No. 4, PP. 785-800.
8. Janzen, D. H. and schooner, T.W. (1968). Differences in insect Abundance and Diversity Between wetter and a Tropical Dry season. Ecology, Vol. 49, No. 1 .PP. 96-110.
9. Jones, R. E. (2001). Mechanisms for location resources in space and time: Impacts on the abundance of insect herbivores. Austral ecology volume 26, Issue 5, pages:518-524.
10. Kempton, R. A. (1979). The Structure of Species Abundance and Measurement of Diversity. Biometrics, Vol. 35, No. 1, perspectives in Biometry, PP. 307-321.
11. Lewis, C. S., Swindel, B. F. and Tanner, G. W. (1988). Species Diversity and Diversity Profiles: concept, measurement, and Applications to Timber and range Management. Vol. 41, No. 6, PP. 466-469.
12. McIntosh, R. P. (1967). An Index of Diversity and the Relation of Certain Concepts to Diversity. Ecology, Vol. 48, No 3, PP. 392- 404.