IMPACT OF ABIOTIC FACTORS ON INSECT DIVERSITY OF AT LAWRENCE GARDEN, LAHORE

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ABSTRACT: Present study was carried out to study insect diversity and influence of abiotic factors such as temperature and humidity on insect population at Lawrence garden, Lahore from January 2009 to June 2009. Higher number of insect species was observed in Order Lepidoptera (17 species), Diptera (15 species), Hymenoptera (14 species) and Coleoptera (13 species). It was also revealed that increasing temperature and humidity from January to March positively affected the number of insect species but from April to June gradual decrease in humidity with increasing temperature reduced the number of insects. Similarly insects with chewing mouthparts were more abundant in the Lawrence Garden as compared to other insects.

Key words: Diversity, Insect fauna, Abiotic factors, Temperature, Humidity

INTRODUCTION

Biodiversity is the foundation of sustainable development and represents the biological wealth of a nation. Biodiversity is the base of all other fields of biology and provides a framework for behavioral, ecological and evolutionary studies (Murugan, 2006). Insects make more than half of the world's known animal species. The second largest and more diverse order is Lepidoptera of class Insecta (Aslam, 2009). Insects possess vital status in any ecosystem as they are involved in pollination, biological control, decomposition and herbivory. Insects are also being used as biodiversity indicators for monitoring the changes in habitats as diversity is found to be declined with increasing disturbance (Davis *et al*., 2001; McGeoch *et al*., 2002). The 'habitat heterogeneity hypothesis' is one of the cornerstones of ecology. It assumes that structurally complex habitats may provide more niches and diverse ways of exploiting the environmental resources and thus increase species diversity. In most habitats, plant communities determine the physical structure of the environment and therefore have a considerable influence on the distributions and interactions of animal species (Tews *et al*., 2004). The results of a study support the idea that landscape characteristics have been shown to be important for species condition as well as for species richness since landscape heterogeneity clearly was shown to be an important factor for butterfly species diversity. Both large-scale and smallscale heterogeneity are important for the composition of species (Weibull *et al*., 2000).

Insects and plants are at risk to become extinct because of pollution, habitat loss, overpopulation and global climatic changes. Generally the conversions of forest to any land use types have negative impacts on animals and plants diversity. There have many studies describing the impact of habitat modification on diversity of single taxonomic group of insects (Chey *et al*., 1997; Watt *et al*., 2002; Stork *et al*., 2003). Population ecology faces a central challenge in order to determine the interactions of multiple factors operating simultaneously for population regulation. Such factors mainly include environmental conditions, animal behavior and food quality. It is difficult to examine different factors in a single study. Temperature is a key driving force affecting feeding, metabolism, and development rates of insects. Global climatic changes may lead to large variations in temperatures which strongly affect other underlying interactions (Logan, 2007). Moisture content of the environment directly regulates the insect population and its effects are strongly modified by temperature. Insects survive in optimal range of moisture and temperature. Mortality may occur only under extreme conditions of moisture which are unsuitable for the active stages of many insect species (Ambrose, 2004). Studies on taxonomy are the foundations of biodiversity. Hence a survey was conducted in Lawrence Garden, Lahore to collect, identify and study the diversity of the insects. Thick vegetation of Lawrence Garden provides a good habitat opportunity for insects diversity.

MATERIALS AND METHODS

Lawrence Garden is a historical park in the city of Lahore, Pakistan. It is situated on Lawrence Road with a total area of 0.57 sq. km. Flying insects were collected by aerial nets while sweep nets were used to collect insects from grass, trees and shrubs by swinging the net through heavy foliage. A white paper sheet was placed under plants and the plants were beaten with a stick. The specimens falling onto the sheet were then collected. Pitfall traps were used to catch many ground beetles and other soil insects. A jar was buried in the soil and leveled with the rim. Attractive bait (cotton soaked with sucrose solution) was placed in the bottom and the insects fallen in it were collected. After collection the collected insects were killed in chloroform. Cotton soaked in chloroform was placed in a glass jar containing insects. Insects failed to breath in chloroform fumes and died (Ambrose, 2004).

Hard bodied insects were pinned through the thorax of body with the 0-3 size insect pin. The pin was usually just slightly to the right of the midline of the insect. Very small and soft bodied insects were mounted on the microscope slides. Spreading boards were used for proper spreading of large wings of butterflies and moths. After pinning and mounting insects were labeled by two types of labels.Date and locality label contained collection date, the place of collection and the collector's name. The order and scientific name of the insect was printed on identification label. Collected insects were identified with the help of dichotomous key (Triplehorn and Johnson, 2005). Relationship between number of insect species and temperature & humidity of each month of study period was tested using Pearson correlation coefficient (r) on the Minitab 14 version.

RESULTS AND DISCUSSION

The insects collected were identified and grouped in different orders of class Insecta. Insects belonging to twelve orders were recorded. One species of order Dictyoptera (*Periplaneta americana)* and one species of order Thysanura (*Lepisma saccharine*) were found through out the study period in the Lawrence garden. Two species of order Odonata (*Macromia magnifica, Argia fitmipennis*) were found in February, March, April, May and June. *Melanopus differentialis, Tettigidae lateralis* and *Allonemobizts fasciatus* were the

3 species of order Orthoptera observed in March, April, May and June,2009. *Euschistus servus* of order Hemiptera was found only in January, February & March while *Lygaeus kalmia* was observed in each month of study.

12 species of order Coleoptera were observed throughout the study period. Were *Hippodantia convergens, Harmonia axyridis, Cycloneda munda, Coccinella septempunctata, Harpalus pennsylvanicus* & *Pterostichus melanarius. Adalia punctata* was observed in January, February, March, April and May. *Calvia punctata, Ergates spiculatus* & *Amphicyrta dentipes* were observed in January, February, March and April. *Phyllophaga portoricensis* & *Phyllophaga crinita* were found in March, April, May and June. One species of order Dermaptera (*Chelisoches morio*) and one species *(Oligotoma minuscule)* of order Embioptera were observed in January, February, March, April and May.

Out of 15 species of order Diptera, *Musca domestica, Phaenicia sericata*, *Chrysoma rufifacies, Chrysosma leucopogon, Helophilus pendulus* & *Lucilia illustris* (flies) were observed in each month of study. *Sarcophaga auriforns*, *Homoneura ensifera, Austrosciapus connexus & Nephrotoma australasiae* were observed from January to May. *Allograpta oblique* & *Delia platura* were observed from January to April. *Exaireta spinigera* was found in January, February and March. *Aedes sollicitans & Culex pipiens* (Mosquitos) were found through out the study period. *Microtermes obese & Coptotermes heimi* of order Isoptera were observed in January, February & March and *Heterotermes indicola* was found in six months of study.

In the Lawrence garden 14 species of order Hymenoptera were observed during the study period. *Polistes fuscatus*, *Polistes fastidiotus* and *Vespula maculate* (Wasps) were observed throughout the study period. *Eumenes fraternus* and *Sphex ichneumoneus* were found in January, February & March. *Chzysis nitidula* was found in January, February, March, April and May. *Sceliphron caementarium* was observed in March, April, May & June. *Chelonus texanus* was found in January, February, March & April. *Apis mellifera* and *Xylocopa appendiculata* (Bees) were observed in each month of study. *Colletes hyalinus* was found in January, February, March, April & May. *Solenopsis invicta, Camponotus pennsylvanicus* and *Ochetellus glaber* (Ants) were observed throughout the study period.

During the study period 17 species of order Lepidoptera were observed. *Catoprilia pyranthe, Pieris canidia, Danias chrysippus, Junonia almana* and *Zizra maha* (Butterflies) were observed throughout the study period. *Papilio euiymedon* and *Junonia orithya* were found January to May. *Teries hecalae* was found in January, February, March & April. *Catochrysop cnejus* was found in January, February & March. *Heliothis zea, Agriopis marginaria* and *Habrosyne derasa* (Moths) were observed in each month of study. *Triphaena pronuba, Nontophilct neararctica, Spodoptera litura* and *Cydia pomonell*a were found in January, February & March. *Eupithecia absinthiata* was found in January, February, March, April & May. Many butterfly species have high demands for habitat quality including microclimate, vegetation structure, co-occurrence of vegetation types at a local scale and they often respond quickly to habitat deterioration. They are, therefore, generally considered to be useful indicators of habitat quality changes in particular terrestrial habitats and are possibly the best group for conservation planning (Maes and Dyck, 2001). Order Lepidoptra (17 species), Diptira (15 species), Hymenoptera (14 species) and Coleoptera (13 species) were the order of higher abundance (Fig.1). Insects of these orders are winged and actively flying insects. Flight allows insects to move easily from habitat to habitat in search of food. Wings help the insects to find potential mates and to escape from predators (Wotton, 1992).Order Dictyoptera, Thysanura, Dermaptera and Embioptera were the orders with least number of species which are either wingless or possess wings but are not actively flying insects.

First three months of study with temperature 12°C, 16°C & 20°C and humidity 69.67%, 56.57% & 50.87% respectively were highly favorable for insect reproduction and development. 65, 67 and 73 species of 12 orders were observed in January, February and March respectively (Fig.2). Temperature showed negative correlation (r = -0.790) and humidity displayed positive correlation (r =: 0.700) with number of insect species. The reason is that temperature alone does not determine the reproduction rate of insects. It works in combination of humidity (Ambrose, 2004). With gradual decrease in humidity in April, May and June (38%, 30% & 30% respectively) the species number was reduced (Fig.2).

Collected insects were grouped into various forms of mouthparts. 52%, chewing 1% chewing & lapping, 18% piercing & sucking, 6% sponging and 23% siphoning types of mouthparts were found among the collected insect species (Fig.4). The mouthparts diversity enables the insects to feed on a wide variety of substances. It gives more feeding opportunities and reduces competition between the insects (Ambrose, 2004). Insects with chewing mouthparts were found with higher percentage in the Lawrence garden that feed on tree barks, leaves, grains, decaying wood and ground litter.

The results of present study show that abiotic factors such as humidity and temperature greatly influence the abundance and diversity of insect species. These factors determine the rate of reproduction and development of insects. It is recommended from this study that for the protection of insect habitats, the Flora of Lawrence Garden should be protected and large scale use of insecticides and pesticides should be controlled.

Similarly, smoke pollution produced by vehicles and solid waste must be controlled as these adversely affect the insects and their habitats.

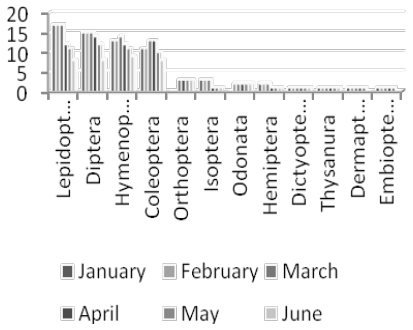

Fig. 1: Number of species of different insect orders collected from January to June

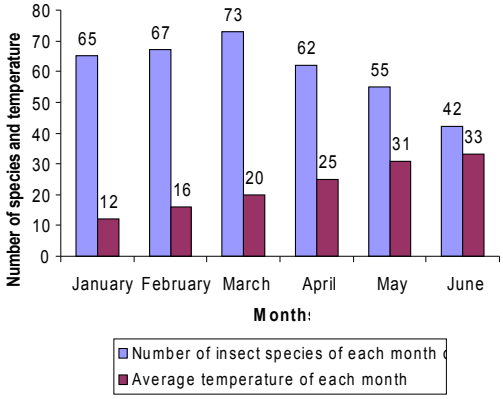

Fig. 2: Relation between total number of insect species and average temperature of each month of study

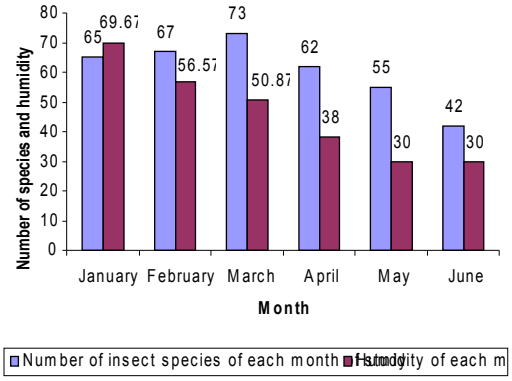

Fig. 3: Relation between total number of insect species and humidity of each month of study

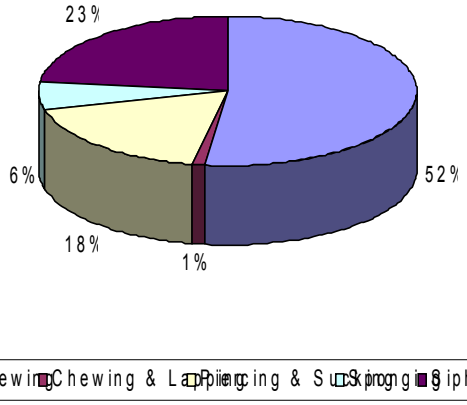

Fig.4: Mouthparts diversity of collected insects in Lawrence garden

Table: Showing the collected species of 12 insect orders in Lawrence Garden from January to June (2009)

Orders	Months					
	January	**February**	**March**	**April**	**May**	**June**
Dictyoptera (*Periplaneta americana)*	+	+	+	+	+	+
Thysanura (*Lepisma saccharine*)	+	+	+	+	+	+
Embioptera *Oligotoma minuscula*	+	+	+	+	+	+
Dermaptera (*Chelisoches morio*)	+	+	+	+	+	+
Coleoptera						
Hippodantia convergens	+	+	+	+	+	+
Harmonia axyridis	+	+	+	+	+	+
Cycloneda munda	+	+	+	+	+	+
Coccinella septempunctata	+	+	+	+	+	+
Harpalus pennsylvanicus	+	+	+	+	+	+
Pterostichus melanarius	+	+	+	+	+	+
Adalia punctate	+	+	+	+	+	-
Calvia punctate	+	+	+	-	-	-
Ergates spiculatus	+	+	+	+	-	-
Amphicyrta dentipes	+	+	+	+	-	-
Phyllophaga portoricensis	-	-	+	+	+	+
Phyllophaga crinite	-	+	+	+	+	+
Anthrenus verbasci	+	+	+	+	+	-
Diptera						
Musca domestica	+	+	+	+	+	+
Phaenicia sericata	+	+	+	+	+	+
Chrysoma rufifacies	+	+	+	+	+	+
Chrysosma leucopogon	+	+	+	+	+	+

Helophilus pendulus	+	+	+	+	+	+
Lucilia illustris	+	+	+	+	+	+
Sarcophaga auriforns,	+	+	+	+	+	-
Homoneura ensifera	+	+	+	+	+	-
Austrosciapus connexus	+	+	+	+	+	-
Nephrotoma australasiae	+	+	+	+	+	-
Allograpta oblique	+	+	+	+	-	-
Delia platura	+	+	+	+	-	-
Exaireta spinigera	+	+	+	-	-	-
Aedes sollicitans	+	+	+	+	+	+
Culex pipiens	+	+	+	+	+	+
Isoptera						
Microtermes obese	+	+	-	-	-	-
Coptotermes heimi	+	+	-	-	-	-
Heterotermes indicola	+	+	+	+	+	+
Hymenoptera						
Polistes fuscatus	+	+	+	+	+	+
Polistes fastidiotus	+	+	+	+	+	+
Vespula maculate	+	+	+	+	+	+
Eumenes fraternus	+	+	+	-	-	-
Sphex ichneumoneus	-	-	+	+	+	+
Chzysis nitidula	+	+	+	+	-	-
Sceliphron caementarium	-	-	+	+	+	+
Chelonus texanus	+	+	+	+	-	-
Apis mellifera	+	+	+	+	+	+
Xylocopa appendiculata	+	+	+	+	+	+
Colletes hyalinus	+	+	+	+	+	+
Solenopsis invicta	+	+	+	+	+	+
Camponotus pennsylvanicus	+	+	+	+	+	+
Ochetellus glaber	+	+	+	+	+	+

Lepidoptera						
Catoprilia pyranthe	+	+	+	+	+	+
Pieris canidia	+	+	+	+	+	+
Danias chrysippus	+	+	+	+	+	+
Junonia almanac	+	+	+	+	+	+
Zizra maha	+	+	+	+	+	+
Papilio euiymedon	+	+	+	+	+	-
Junonia orithya	+	+	+	+	+	-
Teries hecalae	+	+	+	+	-	-
Catochrysop cnejus	+	+	+	-	-	-
Heliothis zea	+	+	+	+	+	+
Agriopis marginaria	+	+	+	+	+	+
Habrosyne derasa	+	+	+	+	+	+
Triphaena pronuba	+	+	+	-	-	-
Nomophila neararctica	+	+	+	-	-	-
Spodoptera litura	+	+	+	-	-	-
*Cydia pomonell*a	+	+	+	-	-	-
Eupithecia absinthiata	+	+	+	+	+	-
Hemiptera						
Euschistus servus	+	+	+	-	-	-
Lygaeus kalmia	+	+	+	+	+	+
Odonata						
Macromia magnifica	-	+	+	+	+	+
Argia fitmipennis	-	+	+	+	+	+
Orthoptera						
Melanopus differetialis	-	-	+	+	+	+

In each cell (+) showing presence of species. In each cell (-) showing absence of species.

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