Int. J. Forest, Soil and Erosion, 2013 3 (4):122-128
ISSN 2251-6387

Research Paper

Pseudo-Mapping of Distribution and Abundance of Terrestrial Insect at Various Elevations in National Park, Pahang

Fauziah I.[1], Mohd Rasdi Z.[*2], Fairuz K.[3], Ismail R.[3], Hazmi A.D.[4], Mohd Hafezan S.[4]

1. Entomologist (PhD) (Associate Professor), Faculty of Plantation & Agrotechnology, Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, 40000, Malaysia
fauziah@salam.uitm.edu.my
*2. (Corresponding author) Senior Lecturer, Agriculture Entomologist, Faculty of Plantation & Agrotechnology, Universiti Teknologi MARA Pahang (UiTM), Pahang, 26400, Malaysia
dddpim@pahang.uitm.edu.my ; dddpim@yahoo.com
3. Faculty of Plantation & Agrotechnology, Universiti Teknologi MARA Malaysia (UiTM), Shah Alam, Selangor, 40000, Malaysia
4. Faculty of Plantation & Agrotechnology, Universiti Teknologi MARA Sabah, Sabah, Malaysia

Abstract: A study on pseudo-mapping of insects' distribution and abundance in Kuala Keniam, a part of National Park was carried out in December 2009 until March 2010. For the duration of study, a total of 1,640 of individual insects were identified, which then classified into orders. There was a wide range of insects species found in the study area, belonging to at least nine orders including spiders (order: Araneae). The data were analysed and presented as pseudo-mapping by using Global Positioning System (GPS) device. The richness and diverse groups of insects in the study area are more obvious and distinct on their distribution and dispersion by using pseudo-mapping means. In future, this information and the presentation of insect's distribution in a pseudo-mapping will be easily implemented to predict the population, dispersion and location of insect according to season. It could also encourage the ecotourism industry for providing and disseminating friendly-user information on the mesmerizing of the insects.

Keywords: Pseudo-mapping, distribution, diversity, Kuala Keniam and terrestrial insects

Introduction

Insects are the most numerous and diverse of all groups of arthropods and the number of insect species named has been estimated at close to one million, with thousands (perhaps million) of others species yet to be discovered and classified worldwide (Hickman *et al*., 1990). In general, the insect of Peninsular Malaysia forest, streams and rivers are more diverse than those of temperate waters, especially dragonfly (Odonata), beetles (Coleoptera), moth (Lepidoptera), and mayflies (Ephemoptera). Only stoneflies (Plecoptera) are comparatively impoverished (Crankbrook *et al*., 1990). The names of insects' order are derived from the characteristics of insects that belong to the group (Fauziah *et al*., 2007). These small creatures are important in human welfare, particularly because they pollinate food crop plants, control populations of others, harmful insects by predation and parasitism, and serve as food for other animals. Many insects are harmful to human interest as they feed on crop plants, and many are carries of important disease affecting humans and domestic animals (Hickman *et al*., 1990). Many insects are aquatic as larvae and terrestrial (aerial) as adults, thus transferring resources from one habitat to the other (Crankbrook and Furtado, 1990). The Kuala Keniam of National Park Pahang was chosen as a study area since it has the undisturbed rainforest which can give more likelihood to study on population and distribution of insect species. The study aimed to inspect the population distribution of insect in different locations at Kuala Keniam of National Park Pahang, and to exemplify in a map-like of insect present in the study area.

Materials and Methods

The study was carried out by means of two types of sampling namely yellow-pan water and pitfall traps. The sampling technique applied was systematic sampling. The selection of the trapping points were made randomly. The yellow-pan water and pitfall traps were set up for five replications at six different points. Each of point was estimated the coordinate using Global Positioning System (GPS) for pseudo-mapping purposes. The samplings were conducted at the months of April, June and October of 2010. First sampling was done on the last week of April. All through the samplings, it was rained and restricted the insect activity. The second sampling was conducted in the month of June, where that period was dried out. The total numbers of insect trapped were doubled in total compared to the first point. The third sampling was taken in the month of October where this period was also rained. The rainfall was not only limiting the insect activity but it also limits GPS reading. According to the Malaysia Meteorological Department, in the months of November, December of 2010 and January 2011, the east coast states such as Kelantan, Terengganu, Pahang, and half of Johore are the months with maximum rainfall, while June and July are the driest months in the most of districts. A good planning is required to make sure this study is completed successfully. All the works were divided into three phases which are i*n-situ* site, camp-site, and laboratory. All the data were analysed using Shannon Winner Index and 2 Sample t-tests. The geographical data was converted into pseudo-mapping to plot the areas which showing abundance with orders of insect. Yellow-pan water trap was used to trap the flying insects. Insects were attracted to the yellow colour of pan and drown in the detergent solution. The traps were left for 24 hours in the study area (Fauziah, 2010). All the data were compiled in data sheet form as shown in the appendices. Pitfall traps were also used to trap the crawling insects. The soil should be dig first

in order to ensure the insects were trapped. Then, the pitfall was filled up with water and detergent. Detergent was used for killing and drowning purposes. It was left for 24 hours (Fauziah, *et al*., 2007). All the data were compiled in data sheet form as shown in appendices. The altitude and longitude of each sampling point was recorded using GPS. Data taken included at the North and East coordinates and the elevation of the study points. The study area was selected following tracking which then divided into five different points of 50 meters. The samplings at each point were replicated for five replications in order to amplify the accuracy and to get more reliable data (Figure 1).

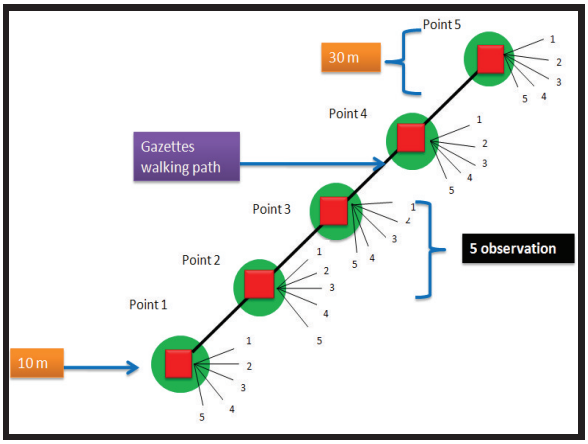

Figure 1: The sampling points and replications

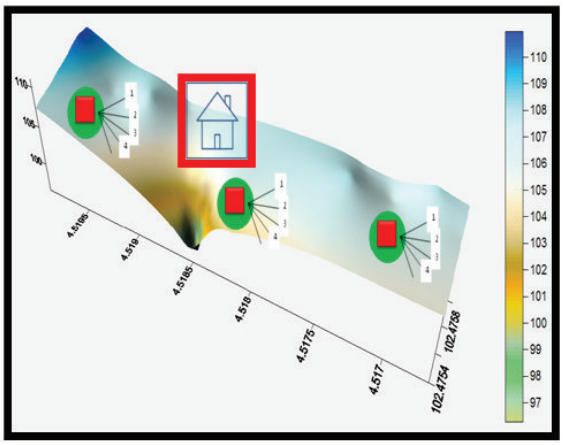

Figure 2: Geographical differences in the sampling area

Results and Discussion

Mapping of Sampling Area using 3D-map

Figure 2 shows the locations where samplings were done. Data coordination was collected using GPS. The highest elevation is 109 m while the lowest is 96 m. This area have undulating geographical exterior, thus probably influence the distribution of insect population due to the different range of temperature and the different types of vegetation. Although the seasonal and spatial temperature variations are relatively small (between 2°C to 3°C in the annual average), it affect insect to live better in their own suitable temperature. Moreover, the study was done at the undisturbed forest which the location was randomly chosen. There are hilly areas, dense forest, and even wild animals makes the study was stiff and risky to go deep in the forest. There was also lack of satellite signal and the sky was very cloudy and indirectly affects the accuracy of the GPS reading. Hence, selection of sampling sites takes the plant canopy as one of consideration. The GPS device cannot be utilized in the deep forest that having thick plant canopy. For the first point (Figure 3), the area is not too elevated but the trail is bending. The area is near to the river side and contains lots of vegetative that suitable for insect to live. This is also a trail for the visitors to Gua Luas which situated 8 km from the study area. The trail is slippery and contains lots of trees that leaves drop down as heading senescence stage, which provide an apposite place for the crawling insects to live and continue their generation. In the second sampling point (Figure 4) of the study area, the point was horizontal which make it easier to set up trappings. The most abundance plants at this point were bamboo and shrubs. At this point, the most abundance insect is Hymenopterans which in the family of Formicidae. This area was relatively hilly and undulating (Figure 5). The lowest and highest points were 96.5 m and 105 m respectively. In the regular condition, the 9 m differences is not to high but in the deep forest like National Park, the gap give significant differences. The numbers of shrubs are higher, the area slippery, the present of higher plants make the area unpredictable and interested to study.

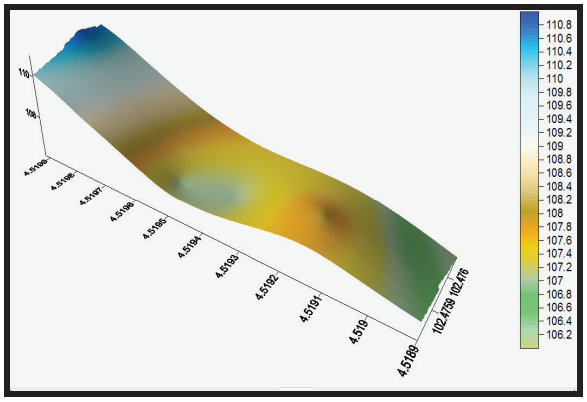

Figure 3: Map of the first sampling point in the study area

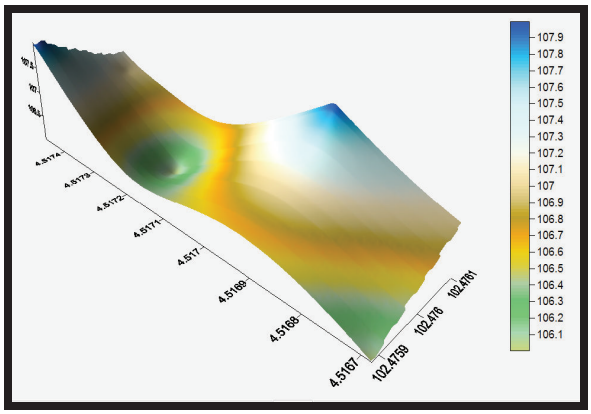

Figure 4: Map of the second sampling point in the study area

Results Pseudo-mapping of Insect Distribution

Figure 6 shows the distribution of insect belong to order Hemiptera. True bugs are common examples of insect in the order of Hemiptera. The sizes are varies between 1 to 150 mm. They have sucking type of mouthparts. Figure 7 shows that hymenopterans

are highly scattered in hilly area. Hymenoptera is one of the largest orders in the class of Insecta. Hymenoptera are very small to large insects and usually have two pairs of wings. The mouthparts are formed for chewing and biting types of mouthpart with well-developed mandibles. Figure 8 shows distribution of Diptera in Kuala Keniam. The common examples of insect in the order of Diptera are true flies, mosquitoes, black flies, midges, fruit flies, blow flies and house flies. Many species are particularly important as vectors of disease in man, animals, and plants. From the result, the Dipterans are widely distributed in both hilly and lowland areas. In the tropical rainforest, thousands of species of beetles and weevils are found. Many of them are leaf beetle (Chrysomelidae), weevils (Curculionidae), and longhorn beetles (Cerambycidae), which subsist in the canopy and feeding on leaves. Figure 9 shows the Coleopterans are widely distributed at the hilly area.

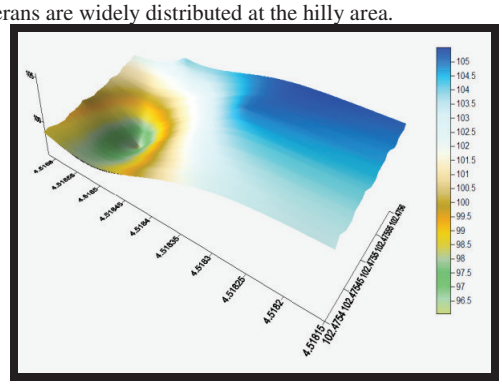

Figure 5: Map of the third sampling point in the study area

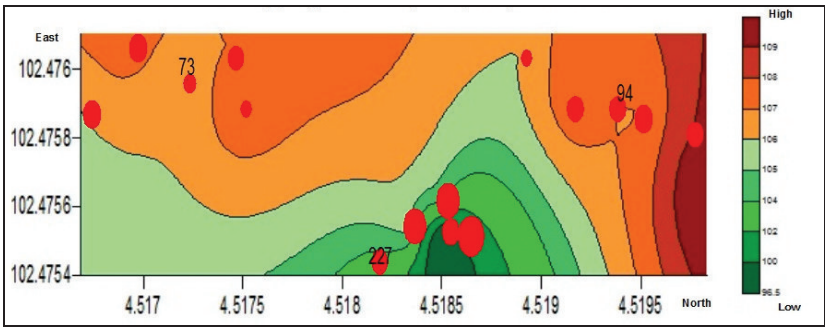

Figure 6: Pseudo-mapping distribution of order Hemiptera

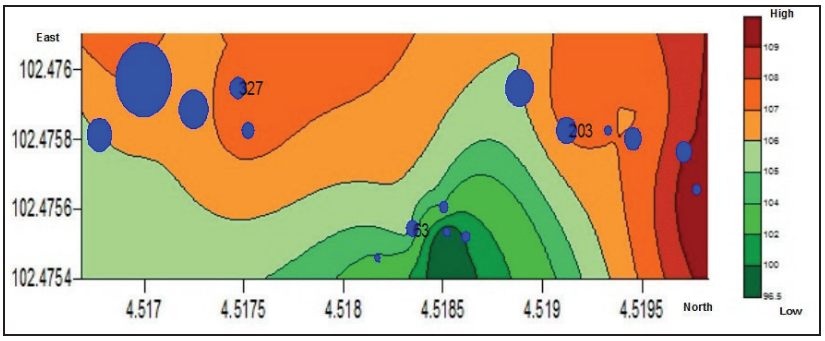

Figure 7: Pseudo-mapping distribution of order Hymenoptera

Overall Data Sampling for Insect Orders

There are three sampling points which were set up in this study areas based on transactions (Table 1). Sampling point 1 is the undulating area which visitors and local commuters pass by daily. Sampling point 2 is the hilly area near the stream which is the common habitat for insect to live. Sampling point 3 is a slightly opened area near to the Pahang River. Figure 10 shows sampling point 2 is the highest percentage which is 43% or in the actual quantity is 709 insects were trapped during this study. This point is in the hilly area and this is not a common part for tourist or visitors. It is the area that sheltered with thick forest vegetative and less disturbed. This is might one of the reasons for the abundance of insects found there. Less of human activities such as walking and clearing of the area probably resulting the high percentage of insect population. The abundance of vegetative and also the presence of stream make these study areas are more preferable by insect. Sampling points 2 and 3 show no significant different in number of insect were trapped. The total number of insect were trapped are 468 (29%), and 463 (28%) respectively. The sampling points 2 and 3 are more disturbed than sampling point 1. The sampling point 2 is open area near Sungai Pahang and exposed to human activity like cleaning and also the sound of boats which are the primary transportation for native people and staff of Department of Agriculture (DoA) in Kuala Keniam. Water is the main source for insect to continue living and there have

abundance of vegetation that not only provides food for them, but also shelter. Profusion of vegetation will slightly change and affect the temperature to be more moderate and suitable for insect to live. Sampling point 1 has surrounded with vegetation, however there are people and local commuters are passing by to go to Gua Luas. Thus, it can be categorized as a disturbed area due to the human activity. Two from three times we went for sampling, there was rainy days and it affects the results of the study. Even if the time was not suitable, high diversity and abundance of insect population gave the moderate results. Many orders of insect were identified and trapped at every sampling date. There are many ecological reasons why high biodiversity is evidently beneficial; some of these insects may impact environment conservation programme positively. Major reasons for maintaining ecosystem biodiversity include conservation of genetic resources, increased sustainability of the ecosystem, preservation of ecosystem aesthetic, support for wildlife populations, source of beneficial insects, improvement in soil and enhancement of ecosystem processes such as oxygen production and erosion control. In relation to activities of crop protection in agriculture ecology, beneficial insect is really needed nowadays to replace the usage of poisonous or chemical treatment toward pests and diseases and also to maintain the ecosystem.

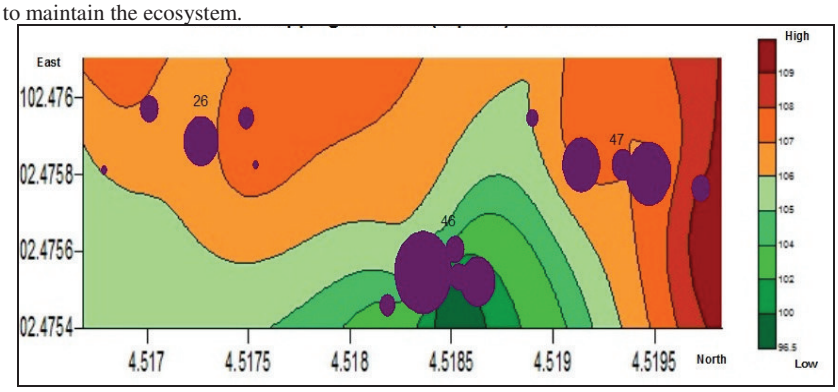

Figure 8: Pseudo-mapping distribution of order Diptera

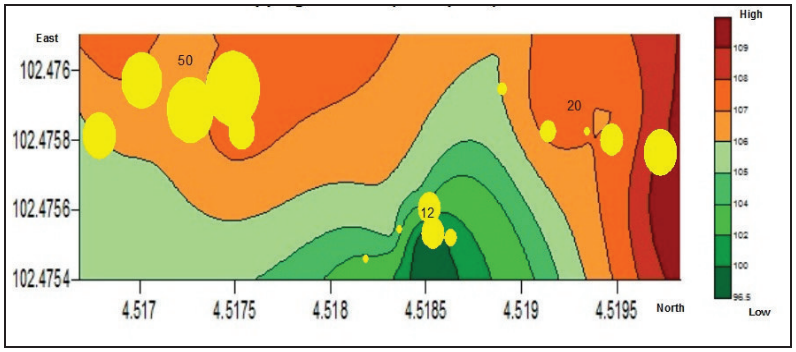

Figure 9: Pseudo-mapping distribution of order Coleoptera

Table 1: Total number of insects trapped in two different traps at three different sampling points

Trap \ Point	1	2	3	Total
Yellow pan water trap	195	325	257	777
Pitfall Trap	268	384	211	863
Total	463	709	468	1640

Overall Data Sampling for Yellow Pan Water Trap and Pitfall Trap

A total of eight orders were ensnared during the study namely Araneae, Coleoptera, Diptera, Hemiptera, Homoptera, Hymenoptera, Lepidoptera, Orthoptera and Isoptera. The other orders included Thysanura, Diplura and Microcrophybia. Orders Hemiptera (true bugs) and Hymenoptera (ants, bees and wasps) are in the same way, shows the highest percentage (28%) followed by Homoptera (11%), Diptera (9%) (mosquito and flies), Orthoptera (8%) (grasshopper and cricket) , Coleoptera (7%) (beetles) , Others (5?%), Araneae (2%), Lepidoptera (2?%) (butterfly) and Isoptera (0?%) (termites) (Figure 11). Hemiptera and Hymenoptera are the primary orders found in the study area. For the reason that of favourable environment and abundance of food such as nectars that come from wild-plants flowers. Moreover, the trap used is very suitable to trap this kind of insect. Kisimoto (1968) reported that yellow pan water trap attracts three times as many insect as white and green, while the attractiveness of black pan is the lowest because it is not as attractive as the former which is similar to that colour of flowers. Campbell and Hanula (2007) reported that flowering plants use colour, fragrances, rewards like pollen or nectar, and size or shape to attract plant pollinator such as Hymenopterans. The habitat is also suitable for survival of Hemipterans and Hymenopterans as of the presence of decaying wood and humus which are the main factor in survival of these insects. The number of Lepidopterous is less because of unavailability of suitable trap. Usually slow flying insects such as butterfly and moth will be wedged using sweeping net (Arbain, 2008). Order Isoptera or termite is a primarily cellulose feeder which feeds on decaying woods and occasionally on grass or topsoil. It shows the lowest percentage in the study because the trap used is not suitable to trap them. This trap is suitable for

crawling and flying insects and Isoptera is a social insect where most of them are crawling. Figure 12 shows the insect captured using pitfall trap. The highest percentage is 44% which comes from order of Hymenoptera that consist of insect such as some species of ants, bees, and wasps. The second highest is Hemiptera 21% (true bugs) and the smallest number of insects is from Isoptera 0% were termites. Hymenoptera is the highest probably because the sampling points have the favourable environment that is suitable for their survival. Besides that, Hymenoptera is proven to be captured more using pitfall trap since the characteristic of the trap itself is suitable to trap this insect mainly ants. The most common family of insect in the order of Hymenoptera is Formicidae. It is because the trap used was really suitable for trapping crawling insects such as Formicidae. The detergent added will sunk the insect and thus kill them immediately. The least number of insect caught is Isoptera with 0.003%. They are less trapped because of the rainy day at the national park. This was one of the limitations in this study where rain most likely limits insect activities. The Araneae together with orders Homoptera, Diptera, Orthoptera, Coleoptera and Lepidoptera are found moderately distributed in the study area.

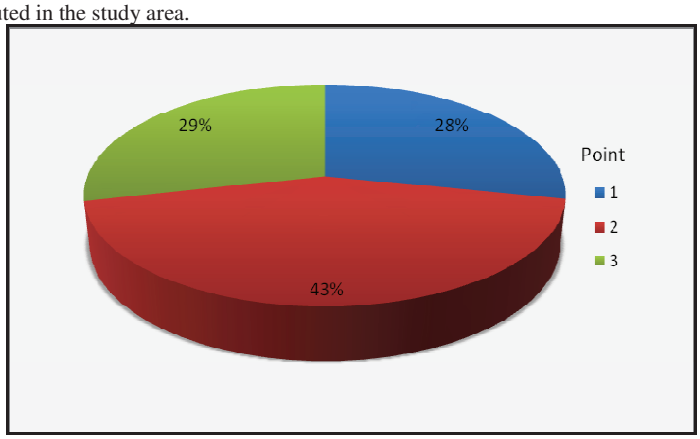

Figure 10: Overall data sampling based on different traps in different points

From the Figure 13 shows that order Araneae and Hymenoptera are suitable to sample by using pitfall trap, while orders Coleoptera, Diptera, Hemiptera, Homoptera, Lepidoptera, Orthoptera and Isoptera are affected sampled by yellow pan trap. Isoptera or the common name of termite is the least trapped in this study. They are polymorphic, social insects which live in nests or mounds of their own edifice. Pitfall trap that extensively used to estimate the activity of surface-active arthropods such as ants, beetles and spiders is less suitable to trap Isoptera. Termite can be estimated using sticky trap and also using bait of susceptible timber (Lee and Wood, 1971). The yellow pan water trap is more effective to trap more insect orders compare to pitfall trap. For the reason that yellow colour of the trap gives more likelihood to trap insects besides the wider characteristic which is triple that pitfall. Nevertheless, pitfall can trap many family of Formadicea as this trap was set up by digging into soil and very effective to trap of walking and crawling insects.

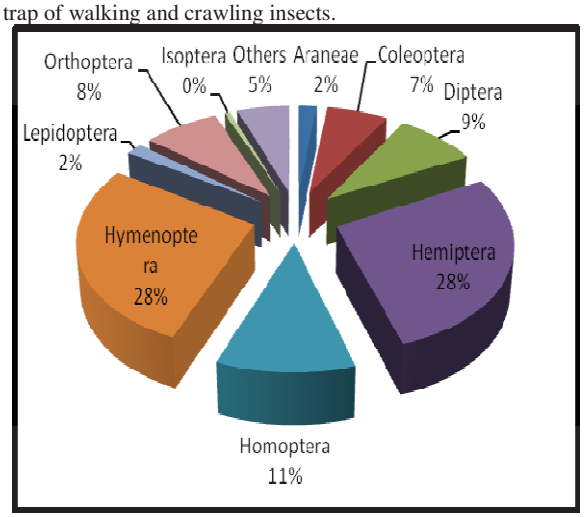

Figure 11: Insects captured using Yellow Pan Water Trap

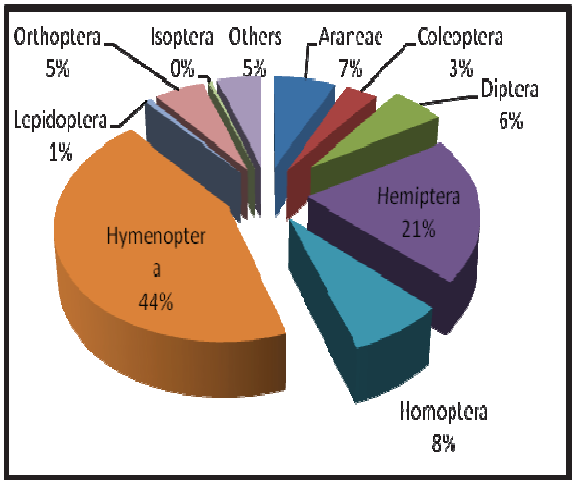

Figure 12: Insects captured using Pitfall Trap

Distribution of Insects (Shannon-Weiner Index)

Table 2 shows the insect distribution in Kuala Keniam, National Park Pahang by means of Shannon-Weiner index. The index of 1.8289 indicates that the insect in this study area are distributed in the similar pattern. This value is in between normally and evenly distribution, except is more to the distributed normally. The nine major orders of terrestrial insects were found in the study area do not have any differences among orders or species excluding Hymenoptera which is the highest numbers compared to other orders of insect. Many more insects in the study area perhaps are not facing extinction. Plenty of food and favourable environment are the main factors that affect this condition to sustain. The objective of the study is not achieved as insects are not evenly

distributed between the orders. Nevertheless, they are diverse between species, for the reason that, the limitations occurred during the study period. As far as these measures are concerned, this result can be a benchmark of the future study regarding conservation of insects in Kuala Keniam in near future. Results from comparing two sampling technique shows that there is no significant difference (t=-0.20 and P=0.845) between different insect orders at different places (Table 3). The insect number is less diverse because of the study area is a small proportion compared to the undisturbed area in the National Park, Pahang. The area enclosed in this study is only 200 m^2 out of 2,477 km^2 of National Park. Moreover, raining during the samplings probably minimize the insects activities and indirectly effect the results.

Table 2: The insect distribution in Kuala Keniam, National Park Pahang by Shannon-Weiner index

Order	Number	Proportion (Pi)	Log e (Pi)	Pi (Log e Pi)
Araneae	76	0.0463	-3.0726	0.1424
Coleoptera	82	0.05	-2.9957	0.1498
Diptera	119	0.0726	-2.6228	0.1903
Hemiptera	394	0.2402	-1.4263	0.3427
Homoptera	152	0.0927	-2.3784	0.2204
Hymenoptera	593	0.3616	-1.0172	0.3678
Lepidoptera	20	0.0122	-4.4063	0.0537
Orthoptera	110	0.0671	-2.7016	0.1812
Isoptera	8	0.0049	-5.3185	0.0259
Others	86	0.0524	-2.9488	0.1546
	1640	1		H' = 1.8289

Table 3: Data of two sample t-Test

Treatment	N	Mean	StDev	SE Mean
Yellow Pan Trap	10	0.971	0.959	0.30
Pitfall Trap	10	1.08	1.42	0.45

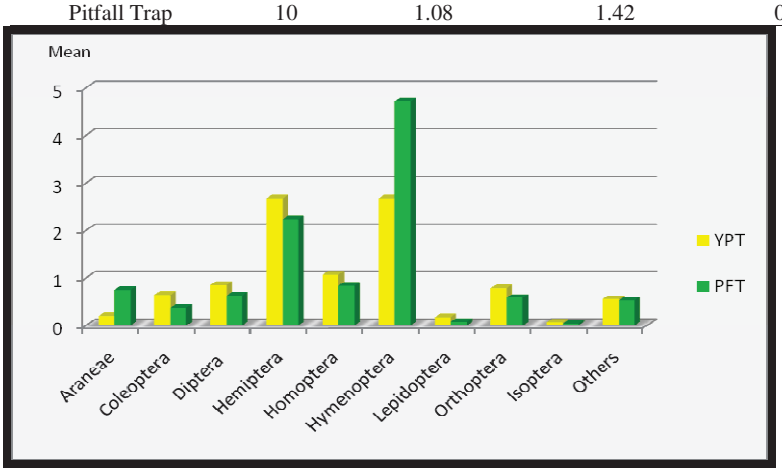

Figure 13: Comparison of insect trapped by Yellow Pan Water and Pitfall Traps

Conclusions

The highest orders of insect found in Kuala Keniam are Hymenoptera and Hemiptera. Population of predators and parasitiods particularly hymenopterans in Kuala Keniam are still higher and be a good indicator as these insects are play major role in ecological system. The distribution of insects is very much influenced by abiotic and biotic factors such as climate, temperature, vegetative, food, and rainfall. Blankets of vegetations not only provide food and shelter to insects but also moderates climate to a limited extend (Elzinga, 1931). Based on the findings of ecological indices (Shanon - H'), this study found that, most of the insects' orders were not evenly distributed, however, they are diverse between species. The study area is an undisturbed forest which the insect population is in the normal pattern of distribution and additionally less extinctions regarding to the world pollution. Instead of ecological indices to describe the diversity and distribution of terrestrial insects, pseudo-mapping techniques could potentially illustrate the pattern of distribution and intensity of the insects in a map form for users to understand in a friendly manner. In the future, this information and presentation of insect distribution in a pseudo-mapping could potentially encourage the ecotourism industry providing high-quality information on the mesmerizing of the insects. This will give comprehensible information on when and where to find these mysterious and unique insects for ecological tourists and scientists. Studies of conservation and sustainability in National Park are obtained fully support and recommended by researchers for helps insects to growth better; promote sustainability and the diversity of insects in this Park.

Acknowledgements

We were grateful to the Research Management Institute (RMI), UiTM Shah Alam and UiTM Pahang for providing facilities during study. This project was supported by the Fundamental Research Grant Scheme (FRGS: 600-RMI/ST/FRGS 5/3/Fst (36/2009). Thanks to anonymous referees.

References

Aizol A (2009). Spatial distribution of bagworm in oil palm plantation in UiTM Jengka, Pahang. Final Year Project Report. Universiti Teknologi MARA, 70pp.

Arbain A (2008). Abundance and species diversity of insect in Kuala Perkai, Taman Negara Pahang. Final Year Project Report. Universiti Teknologi MARA, 94pp.

Campbell JW and Hanula JL (2007). Efficiency of Malaise traps and coloured pan traps for collecting flower visiting insects from three forested ecosystems, Springer Science and Business Media B.V., 11:399-408.

Cranbrook E, Furtado JI (1990). Key Environments Malaysia, Pergamon Press, 236-241.

Fauziah I (2010). Concepts in Intergrated Pest Management (unpublished).

Fauziah I, Wan Mohamad WAK, Mohd Rasdi Z, Fairuz Khalid, Hazmi AD, Khairol I (2007). Special report on biodiversity of insects and geomorphology study in Kuala Keniam National Park, Pahang, Malaysia. (Phases I & II). 78pp.

Hickman CPJr, Roberts LS, Larson A (1990). Animal Diversity, (3rd ed.). Mc Grew hill, 212-250.

Kisimoto R (1968). Yellow pan Water trap for sampling the small Brown Planthopper, Laodelphax striatellus (FALLEN), Apl.Ent.Zool, 37-48.

Ober HK, Hayes JP (2008). Influence of forest riparian vegetation on abundance and biomass of nocturnal flying insects. Elsivier, 1124-1132.

Ross HH, Ross CA, Ross JRP (1982). A Text Book of Entomology. (4th ed.). John Wiley and Sons, 284-502.

Mohamed S (1990). Pengumpulan, pengawetan dan pengelasan serangga. Dewan Bahasa dan Pustaka, 25-55.

Santos SAP, Cabanas JE, Pereira JA (2007). Abundance and Diversity of Soil Arthropods in Olive Groove Ecosystems (Portugal) Effect of Pitfall Trap Type. Elsevier 77-83.