Spatio-temporal pattern of wolf spiders on oil palm plantation

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Abstract. Spatio-temporal pattern of spiders are important in ecosystems because from the pattern we can see the interaction of spiders population with their habitat. In this paper the spatio-temporal pattern of wolf spiders (Lycosidae) in oil palm plantation was studied. It was conducted at Yayasan Pahang Oil Palm Plantation, Endau Rompin, Pahang, Peninsular Malaysia which were managed by the Yayasan Pahang Plantation Sdn. Bhd in two selected blocks (B36 and B37) for one plot each. Samplings were made from May 2010 to April 2011 using pitfall trap method and operated at different temporal spans. This was to compare the variations in spatial-temporal pattern at different plots and times. Pitfall traps were arranged in grid 10 x 5 for each plot and the pitfall were flushed into the ground. This sampling method was effective for ground-dwelling arthropods besides it was low cost methods and continuous sampling effort (active during day and night). The samples were preserved into 70% ethyl alcohol and 30% of glycerol. A total of 272 individuals of Lycosidae were collected during the study periods. Spatial pattern of Lycosidae were analysed using SADIE while the maps for the distribution were generated using SURFER. The environmental factors such as soil properties, climatic conditions, prey predator interactions and management practices for the plantations might be affecting the population and distribution for Lycosidae which were needed further investigation. In conclusion, the abundance and distribution patterns of Lycosidae were vary greatly between months.
Keywords: Lycosidae, pitfall-traps, oil palm plantation, spatio-temporal

Introduction

Spatial pattern has been used widely in landscape ecology (Gustafson 1998). The spatial and temporal variation of a system property that can be detected depends on the spatial and temporal scale such as different spatial location and the sizes of the mapping unit (Gustafson 1998; Legendre *et al*. 2002). At different spatial scale the animal species respond to their environment (Holland *et al*. 2005). The characteristics of the species have been hypothesized to explain the scale at which different species respond to their environment, some of these by affecting the movement distance of the species.

Spatio-temporal pattern of spiders in ecosystems were important to study because from the pattern we can see the interaction of spiders population with their habitat (Abraham 1983). It can give us the relationship or interactions of the spiders with their environment especially to control pest in that ecosystems. Spiders are insects eater and it found everywhere, and it abundant in areas with rich vegetation (Nyffeler 2000;Abdelmoniem *et al*. 1999; Buchholz 2009; Kathrin 2010). Most of the study before this focused to forest ecosystems (Kathrin 2010). Because of it are abundant in nature (Wise 1993), easy to collect, and can found on many types of habitat spiders serve a good bio-indicators to the ecosystems of the area (Marc *et al*. 1999; Nyffeler 2000; Kathrin 2010). However, the spiders studies in oil palm ecosystem are less and it is interesting to study on that ecosystems because it will function as biological control agent like in the nature. In natural ecosystems, the spider is a very important as ecological indicators for the area (Jogar *et al*. 2004).

Lycosidae or wolf spiders are worldwide family on ground living spiders (Murphy & Murphy, 2000) were selected organisms in this study. Pearce & Zalucki, 2006 stated that the wolf spiders were beneficial to human because they eat all the insects including insects pest. It also act as biological control agent and it movement does not affect the environment. Most of the spiders were distribute clustered depend to the area and species. This study emphasis on spiders as a target group because there are very little is known about spiders in Malaysia especially in oil palm plantations. Most of oil palm plantations were from forest. The conversions cause the ecological problems such as habitat destruction and fragmentation, soil, air and water pollution and also

endangerment of wildlife species (Brown & Jacobson, 2005). These problems can affect other organisms such as insects (Turner & Foster, 2009). The objective of this study is to determine the spatio-temporal pattern of wolf spiders (Lycosidae) in oil palm plantation.

Materials and Methods

In this study, spatio-temporal pattern of wolf spiders were determined. This ecological study was conducted at Endau Rompin (ER) plantations Yayasan Pahang Oil Palm Plantation which were located at Endau Rompin, Pahang (2° 36'N, 103° 34'E). Pahang was located in Peninsular Malaysia, while the ER plantation was located at Southeast tips of Pahang state. This plantation (ER) owned by Yayasan Pahang Plantation Holdings Sdn. Bhd. and located on 3922.30 hectares of land. ER plantation area was from peat swamp forest. The oil palm trees cultivation in this plantation was started early 1995 and planted in blocks. The oil palm blocks are divided into four rows (drainage, planting row, harvesting path and stack row). The selected blocks were B36 and B37 and choose based on soil types (deep peat and shallow peat). The detailed study was using plots. One plot was established at each block. The sampling design was uniform and the plots were in grid. The sampling methods that was used is pitfall trapping. For each plot 50 units of pitfall traps were placed on. So, the sum of pitfall traps that were placed on the both plots was 100 units. Along each row, ten pitfall traps were placed approximately 5m apart. The first pitfall was placed approximately 30m into the plantation rows to reduce the edge effect. Samplings were conducted from May 2010 till April 2011.

Pitfall were placed on the plots for 24 hours for prevent the sample damage or broken besides for collected the ground-active spiders or other invertebrates (Murphy & Murphy 2000) but in this study only Lycosidae (wolf spiders) were focused. Pitfall has been widely used for spider surveys (Coddington *et al*. 19991). They are employed by many surveys in agricultural ecosystems (Green 1999) because of low cost methods and continuous sampling effort (can operate on a full time basis (active during day and night)). But, the limitation of this method is that the number of individuals trapped is affected by environmental, weather and species-specific factors. Among of environmental factors that affecting the collections are temperature and moisture. Each trap consisted of a plastic cup (7.6 cm diameter and 9cm deep) contained solution of ethyl alcohol, detergent and water. The function of ethyl alcohol was as a preserving agent, the detergent was to make the surface of cup smooth and the water used to dilute both solutions. Then, samples were preserved into 70% ethyl alcohol and 30% of glycerol. For this, Ethyl alcohol also acted as preserving agent while glycerol was prevented the preserving agent from evaporating (Whitmore *et al*. 2002). All samples were placed in vials and stored at Terrestrial Ecology Lab, Centre for Insects Systematics, Universiti Kebangsaan Malaysia for later reference.

The spatio-temporal patterns were determining using SADIEShell software. SADIE (Spatial Analysis by Distance Indices) were calculates the number of individuals in each plots, for total distance which individuals would have to move in order to get them all in a regular form. From SADIE we can get the aggregation index (I_a), Mean V_i and Mean V_j. Indices I_a indicate overall degree of clustering; values of I_a =1 indicate randomly arranged counts, while I_a > 1 indicate aggregation of counts into clusters. V_j is the average over all inflows indicating presence of clustering into gaps with its associated probability of departure from randomness. V_i is the average over all outflows indicating patchiness with associated probability of departure from randomness. While the maps for each plots were generated using the surfer 8.01 mapping software (Golden Software Inc. 2002) based on the local indices of clustering.

Results and Discussion

A total of 272 individuals of wolf spiders were collected during the study period. There were 84 individuals collected at deep peat soil and 188 individuals at shallow peat soil. At shallow peat more individuals collected in October 2010 and end November 2010 because more immature spiders trapped. Basically, the spatio-temporal patterns of Lycosidae in this study were random (Figure 2 and Figure 3). Clustering of wolf spiders at both sites never achieved significance ($P>0.05$) at any scale and this showed randomly distributed (Table 2). It randomly distributed because of most of wolf spiders randomly move (Jogar *et al*. 2004) and it related to their food source beside it like to hunt during the day. Wolf spiders are benefit to human by control the insect pest because it eats all insect (Pearce & Zalucki, 2006). In oil palm plantation the litter are less compare to the forest ecosystems, this factor also affect the availability of Lycosidae. High amounts of litter presence the high abundance and diversity of spiders because it used the litter as shelters as well as it also good for hunting sites (Abdelmoniem *et al*. 2003).

Table 1: Total abundance of wolf spiders (Lycosidae) during the study periods at Endau Rompin (ER) plantations, Yayasan Pahang Oil Palm Plantation, Rompin, Pahang, Peninsular Malaysia.

Month	Deep peat	Shallow peat	Total
May 2010	9	3	12
Early June 2010	6	12	18
End June 2010	3	9	12
Jul-10	6	5	11
Early Aug. 2010	4	4	8
End Aug. 2010	9	12	21
Sept. 2010	4	10	14
Oct. 2010	14	43	57
Early Nov. 2010	8	4	12
End Nov. 2010	4	51	55
Feb 2011	3	3	6
March 2011	9	16	25
April 2011	5	16	21
Total	84	188	272

Table 2. Summary of the results from spatial pattern analysis with SADIE software for wolf spiders (Lycosidae) at ER Plantations, Yayasan Pahang Oil Palm Plantation, Rompin, Pahang, Peninsular Malaysia.

Plots		MAY 2010	EARLY JUNE 2010	END JUNE 2010	JULY 2010	EARLY AUG. 2010	END AUG. 2010	SEPT. 2010	OCT. 2010	EARLY NOV. 2010	END NOV. 2010	FEB 2011	MARCH 2011	APRIL 2011
A (B37)	I_a	1.205	0.861	1.317	1.075	0.984	1.227	0.834	0.81	1.175	1.086	1.168	1.28	1.041
	Min V_i	1.237	0.903	1.348	1.17	0.96	1.204	0.841	0.823	1.255	1.07	1.19	1.284	1.062
	Min V_j	-1.205	-0.85	-1.3	-1.064	-0.981	-1.22	-0.834	-0.809	-1.173	-1.094	-1.163	-1.286	-1.029
B (B36)	I_a	0.882	1.047	0.855	1.113	0.956	1.076	0.906	1.018	1.017	0.903	0.835	0.879	0.919
	Min V_i	0.923	0.963	0.777	1.12	0.917	1.043	0.91	1.025	1.021	0.878	0.825	0.868	0.927
	Min V_j	-0.876	-1.066	-0.866	-1.122	-0.967	-1.074	-0.904	-1.018	-1.018	-0.906	-0.835	-0.878	-0.909

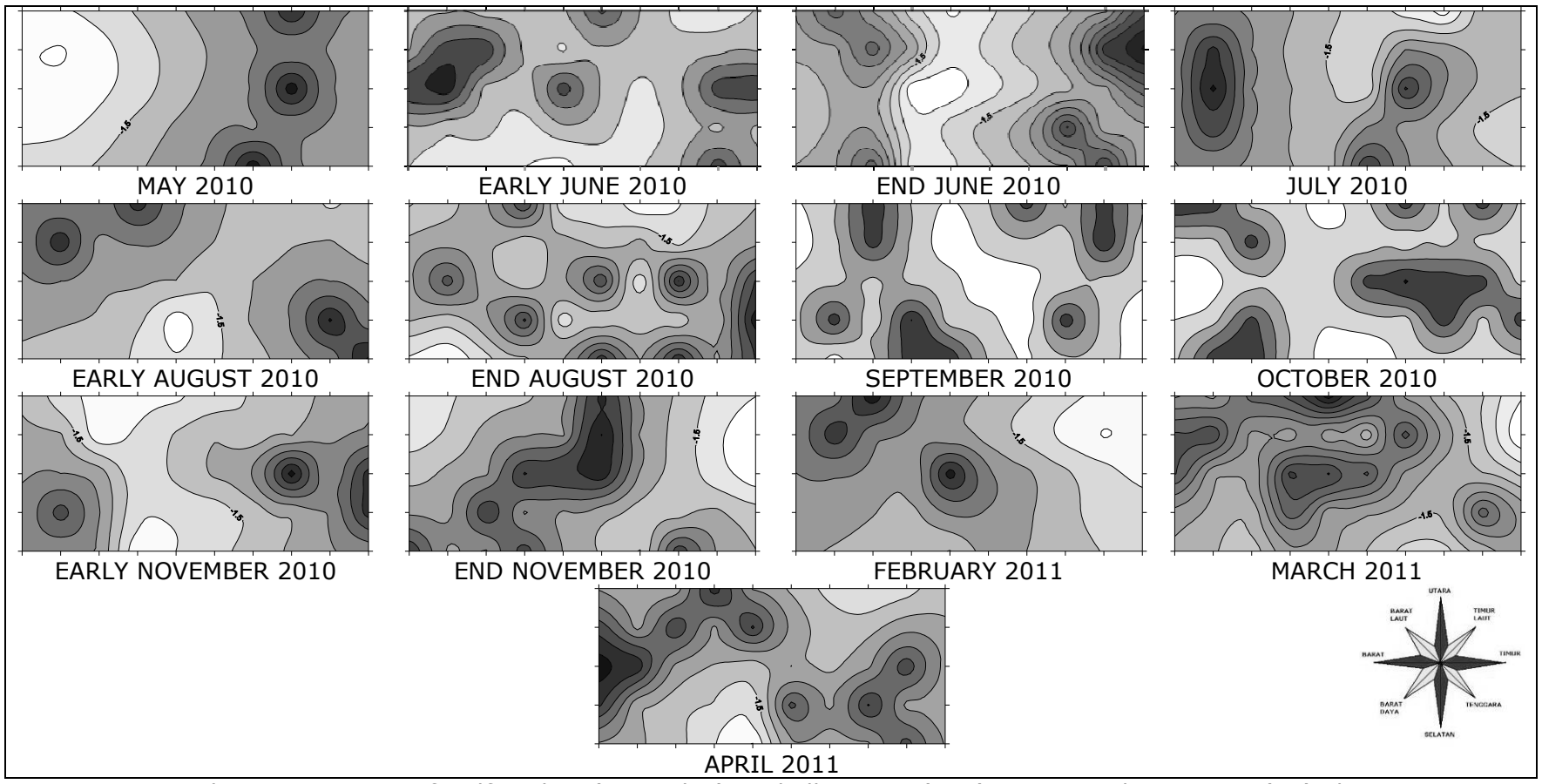

Figure 2. Clustering pattern of wolf spiders (Lycosidae) at shallow peat (B37) area in Endau Rompin (ER) plantations, Yayasan Pahang Oil Palm Plantation, Rompin, Pahang, Peninsular Malaysia.

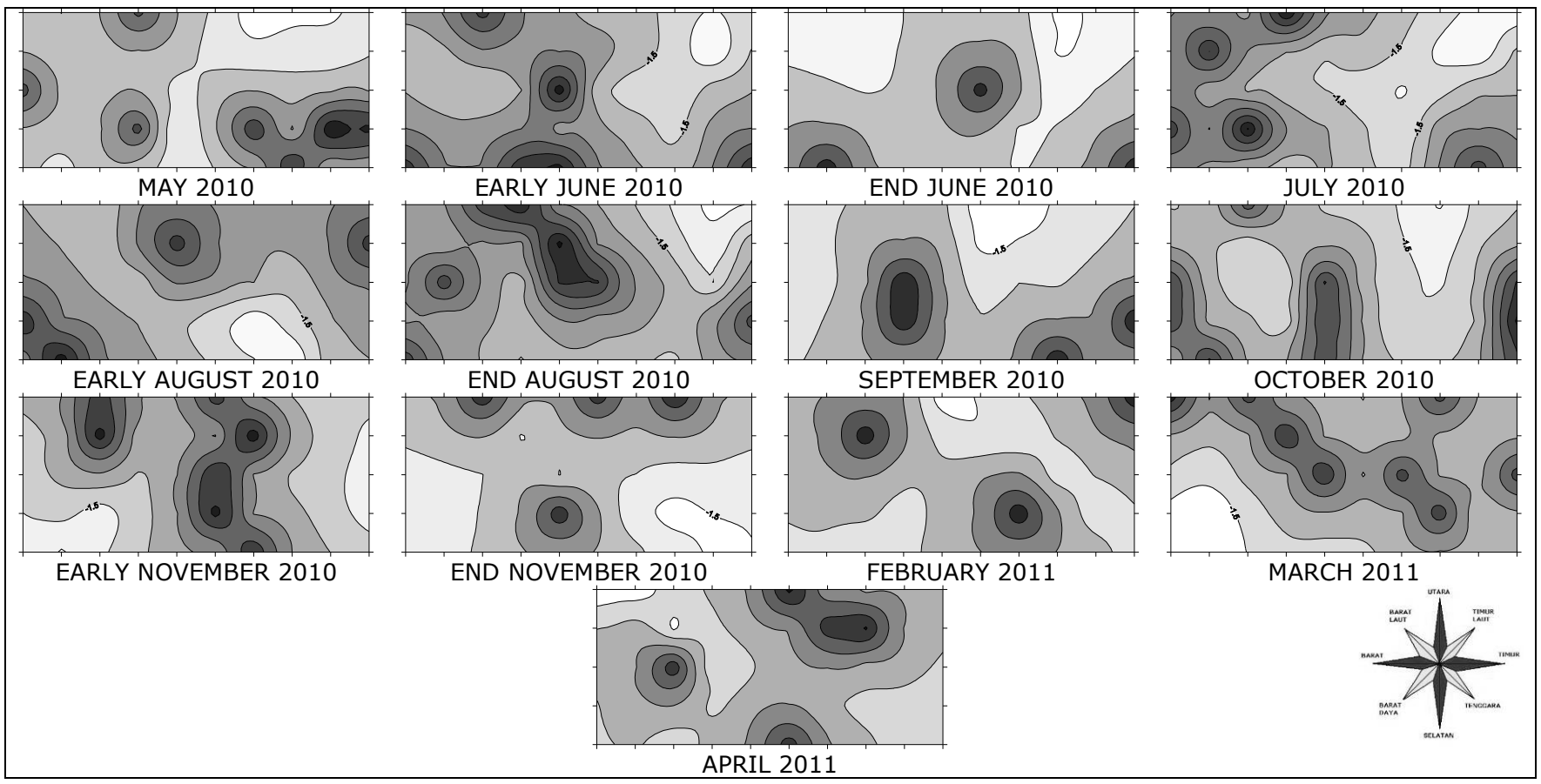

Figure 3. Clustering pattern of wolf spiders (Lycosidae) at deep peat (B36) area in Endau Rompin (ER) plantations, Yayasan Pahang Oil Palm Plantation, Rompin, Pahang, Peninsular Malaysia.

Conclusions

Distribution and movement of wolf spiders at shallow and deep peat soil are random. It moves randomly due to their habits which was hanging around for food searching and search the suitable habitat. In forest if more leave litter around more wolf spiders were found. The number of wolf spiders collected showed that wolf spiders move alone not in group. The distribution of wolf spiders shown in map indicated that it move randomly in both plots. The factors such as variation in soil properties, micro and macroclimatic conditions, intra and interspecific competition, predation and parasitism and chemical and cultural treatment or management practice of the land probably affect the wolf spiders population and distribution at the both of blocks. Therefore, studies on wolf spiders in the future should assess the variations in these factors to better understand the ecology of the wolf spiders. For oil palm plantation industry, this study can help them to control insect pest.

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