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EFFECT OF NATURAL HABITAT ON DIVERSITY OF HEMIPTERAN PREDATOR IN OIL PALM PLANTATION

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ABSTRACT

Effect of natural habitat on diversity of Hemipteran predator in oil palm plantation. Utillization of natural enemies in controlling oil palm pests still encounters obstacles, in particular, how natural enemies can survive and establish in oil palm plantations. The existence of natural habitats around oil palm plantations can allegedly support the occurence of natural enemies. The objective of this study was to investigate the effect of the presence of natural habitats on diversity of hemipteran predators in oil palm plantations. Field research was conducted in oil palm plantations located in Pangkalan Bun, Central Kalimantan. The plots were oil palm plantations with different distances from natural habitat i.e. near (less than 200 m), medium (about 2 km) and far (about 5 km). Each plot was selected six trees for fogging using insecticide with active ingredient lamda cyhalothrin. Based on research result, diversity of hemipteran predator in oil palm plantion was found 19 species belong to 2 families. The most dominant hemipteran predator was *Sycanus* sp., *Eocanthecona* sp. and *Reduviidae* sp5. The distance of oil palm plantation from natural habitat did not affect species richness, abundance and composition as well as recolonization of hemipteran predator in oil palm plantation. Abundance of hemipteran predator tend to decrease in different observation time, except *Sycanus* sp. *Sycanus* sp was likely has ability to rapidly recolonized and their occurrence were influenced by flowering vegetation in oil palm plantation.

Key words: Central Kalimantan, diversity, hemipteran predator, natural habitat, oil palm

ABSTRAK

Pengaruh keberadaan habitat alami terhadap keanekaragaman kepik predator Hemipteran pada perkebunan kelapa sawit. Pemanfaatan musuh alami dalam mengendalikan hama kelapa sawit masih mengalami kendala khususnya bagaimana musuh alami tersebut dapat terus berada pada perkebunan sawit. Keberadaan habitat alami disekitar perkebunan kelapa sawit disinyalir dapat mendukung keberadaan musuh alami. Penelitian ini bertujuan untuk mempelajari pengaruh keberadaan habitat alami terhadap keanekaragaman kepik predator hemipteran pada perkebunan kelapa sawit. Penelitian dilakukan di perkebunan kelapa sawit di Pangkalan Bun, Kalimantan Tengah. Plot pengamatan berupa lahan kelapa sawit dengan jarak yang berbeda dari habitat alami yaitu dekat (kurang dari 200 m), sedang (sekitar 2 km) dan jauh (sekitar 5 km). Setiap plot dilakukan pengasapan (*fogging*) pada enam pohon kelapa sawit menggunakan insektisida dengan bahan aktif *lamda cyhalothrin.* Berdasarkan hasil penelitian, keanekaragaman kepik predator hemipteran yang diperoleh 19 spesies dari 2 famili. Kepik predator yang dominan di perkebunan kelapa sawit yaitu *Sycanus* sp, *Eocanthecona* sp, dan *Reduviidae* sp5. Jarak dari habitat alami tidak berpengaruh terhadap kekayaan spesies, kelimpahan, kemiripan komposisi spesies dan rekolonisasi kepik predator pada perkebunan kelapa sawit. Kelimpahan kepik predator dominan cenderung menurun pada bulan pengamatan berbeda, kecuali *Sycanus* sp. *Sycanus* sp disinyalir mampu melakukan rekolonisasi dengan cepat dan keberadaannya dipengaruhi oleh vegetasi berbunga yang ada di lahan kelapa sawit.

Kata kunci: habitat alami, Kalimantan Tengah, keanekaragaman, kelapa sawit, kepik predator hemipteran

INTRODUCTION

In the cultivation of oil palm, pest attacks are still a serious problem due to it constantly occurs and difficult to control. Pest attack inhibits growth and development of oil palm plant and as consequence cause decrease in oil palm production. Important pests of oil palm such as nettle caterpillars (e.g. *Setothosea asigna* Eecke) and bagworms (e.g. *Mahasena corbetti* Tams) can cause significant yield loss (Kalshoven, 1981). According to Simanjuntak *et al*. (2011) attacked of nettle caterpillars and bagworms can reduce production of oil palm by 69% in the first year and increase to 96% after the second year. Oil palm pests attack starting from the seeding period until the plant produce and further attack can cause plant death (Corley & Tinker, 2003).

A control technique that commonly used to overcome pest problem is the usage of insecticides. However, the usage of insecticides has negative impact, beside economically high costs and reduces the competitiveness of oil palm products. According to Perangin-angin (2009), the cost of controlling nettle caterpillars and bagworms on oil palm plantations can reach Rp 20.67 million per hectare. In addition, the usage of insecticides also causes resistance and resurgence of insect pests, death of non-target organisms as well as environmental pollution. Therefore, it is necessary to use a control technique that are environmentally friendly and support for sustainable agriculture.

One of environmentally friendly technique to control pests is by utilizing natural enemies. Utilization of natural enemies such as predators can safely control the pest population and have no impact on the environment (Sudarmadji, 1991). In oil palm plantations, predators of nettle caterpillars and bagworms that often found are *Sycanus leucomesus* Stal. (Hemiptera: Reduviidae) and *Eocanthecona furcellata* Wolff (Hemiptera: Pentatomidae) (Susanto *et al*., 2012). Although often found, but the existence of those predators are still not widely utilized (Perangin-angin, 2009). To increase the population of predators, the farmers generally release predators that were mass-reared in the laboratory. However, predator population in the field still can not control the population of pests. This is related to the low ability of release predators to survive in the field and environmental factors that do not support for the predators establishment.

The existence of natural habitats or forests around agricultural land plays an important role in supporting the existence of benefit insects (Blitzer *et al*., 2012) including predators (Rusch *et al*., 2010). In the oil palm cultivation, the presence of natural habitats that have high conservation value has not been studied its role as source of predators. Natural habitats can act as alternative habitats and provide preys if the population of prey in oil palm plantations is lacking. However, not all natural habitats can support the presence of predators (Tscharntke *et al*., 2016). Therefore, this study was conducted to investigate the effect of the presence of natural habitat on diversity of hemipteran predator in oil palm plantations. We hypothesized that natural habitat fails to support hemipteran predators due to insufficient in amount, proximity, composition or configuration (Tscharntke *et al*., 2016).

MATERIALS AND METHODS

Research Site and Observation Plot Determination. The research was conducted in oil palm plantations owned by PT. Astra Agro Lestari, located in Pangkalan Lada, Kotawaringin Barat Regency, Central Kalimantan. The observation plots were determined based on the distance of oil palm plantations from natural habitats. There were four selected natural habitats located in Agro Menara Rahmat (AMR, 537 ha, Figure 1a), west region of Gunung Sejahtera Yoli Makmur (West GSYM, 18 ha, Figure 1b), east region of Gunung Sejahtera Yoli Makmur (East GSYM, 13 ha, Figure 1c), and Gunung Sejahtera Puti Pesona (GSPP, 63 ha, Figure 1d). In each region of natural habitat, oil palm fields with different distance from natural habitat i.e. near (less than 200 m), medium (about 2 km) and far (about 5 km) were selected for observation plots (Figure 2). Area of observation plot was about 2500 m^2 and six oil palm trees were selected as sampling unit. Determination of sample trees adapted the research method by Bos *et al*. (2008).

In this research, we did not determine observation plots in natural habitats due to vegetation type and plant characteristics were differed compare to oil palm plantation (Figure 1). We assumed and expected that the effect of natural habitat to oil palm plantation can be detected based on the distance of natural habitat to oil palm plantation.

Insects Sampling. Sampling of insects used that had fogging method adapted from Rizali *et al*. (2013). Insecticides used for fogging was lamda cyhalothrin and were applied using fogging machine of pulsFOG K-22 BIO. In each plot, fogging was performed on all sample trees and the killing insects were collected from an 8 m x 8 m sheet of white canvas placed directly under each tree. Fogging was done in early morning between 07.00 am until 08.00 am, with the application time of each

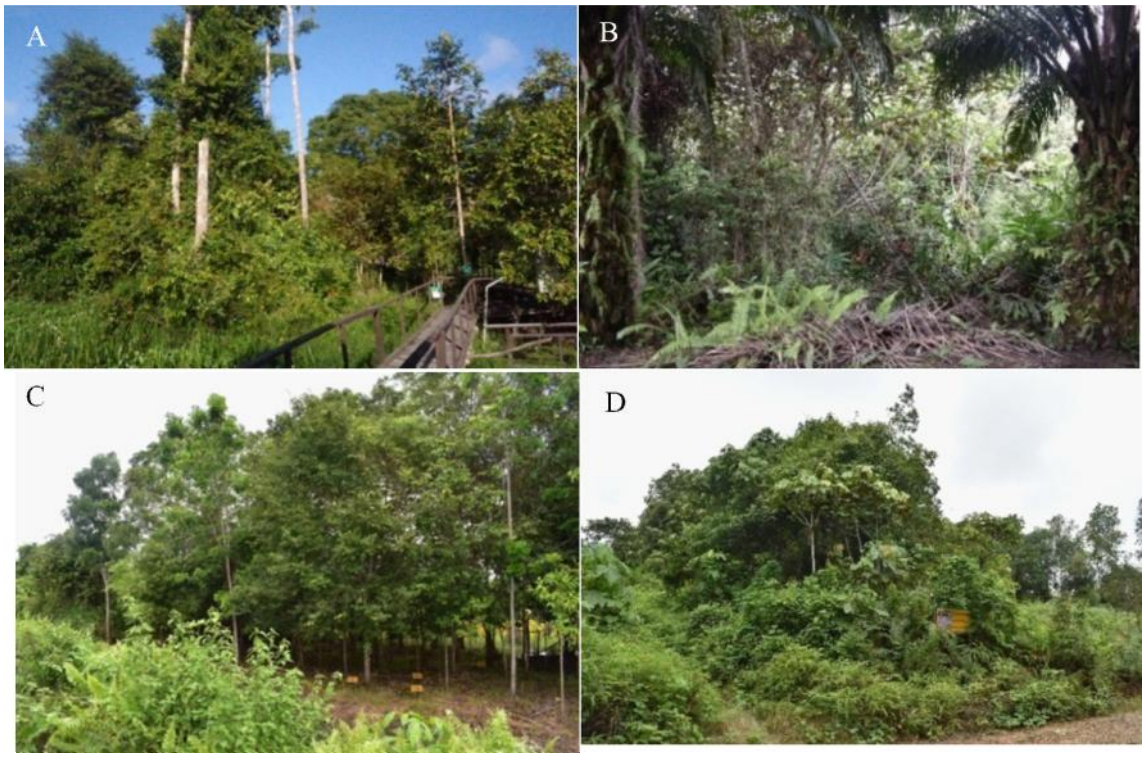

Figure 1. Natural habitat conditions; (a) Agro Menara Rahmat, (b) West region of Gunung Sejahtera Yoli Makmur, (c) East region of Gunung Sejahtera Yoli Makmur, (d) Gunung Sejahtera Puti Pesona.

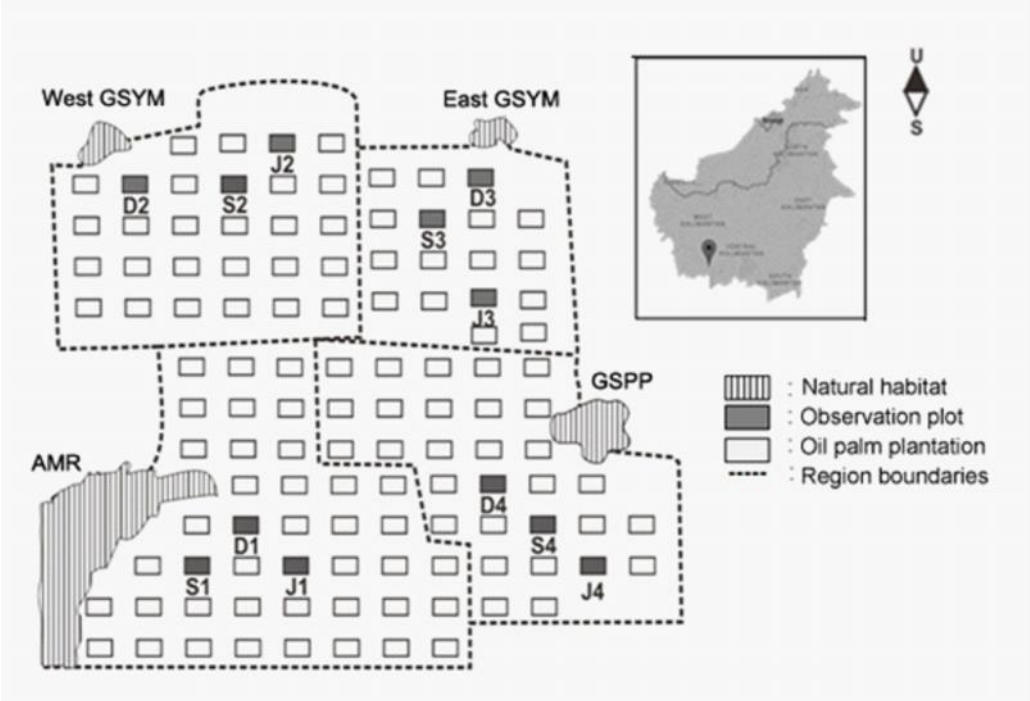

Figure 2. Position of observation plot at various distances from natural habitat; Nn = near n_i, Mn = medium n_i, Fn = far n_i with n_i = 1,2,3,4. AMR = Agro Menara Rahmat, West GSYM = west region of Gunung Sejahtera Yoli Makmur Barat, East GSYM = east region of Gunung Sejahtera Yoli Makmur Timur, GSPP = Gunung Sejahtera Puti Pesona.

tree was 5 minutes until all tree canopies were covered by fog. The killing insects were collected after 60 minutes application and were stored in a plastic vial containing 70% alcohol and taken to the laboratory for the identification process. Each observation plot, fogging was conducted every month during three months of observation from February to April 2017.

Vegetation Analysis. Vegetation analysis or vegetation diversity measurements were performed on each observation plot. Vegetation analysis was done by determining 10 random points on each observation plot with each point 1 m x 1 m size. Species richness and abundance of vegetation were calculated and taken the samples for identification. Vegetation was identified using identification book of Xu & Zhou (2017).

Insect Identification. Insect specimens were sorted into order level using the identification key of Borror *et al*. (1996). Identification of hemipteran predator was carried out until morphospesies of family level by distinguishing the morphological characters between specimens in the same family. In addition, if possible the specimens were also identified until genera level by using available identification key (e.g. https:// bugguide.net).

Data Analysis. Differences in species richness and abundance of hemipteran predator in various distances from natural habitats as well as different observation months were analyzed using analysis of variance (ANOVA). Differences in species composition of hemipteran predator in various distances from the natural habitat were analyzed using analysis of similarity (ANOSIM) based on Bray-Curtis similarity index. Pearson correlation analysis was used to see the relationship between diversity of hemipteran predator and vegetation. All analyzes were performed using R Statistic (R Core Team, 2017) and with vegan package (Oksanen *et al*., 2015).

RESULTS AND DISCUSSION

Effect of Natural Habitat on Species Richness and Abundance of Hemipteran Predator in Oil Palm Plantation. From all observation plots, we found 19 species and 1613 individuals of hemipteran predators belong to Family Reduviidae and Pentatomidae (Appendix 1). Species richness of hemipteran predator was not affected by the distance of oil palm plantation from natural habitat ($F_{2,9}$=0,845; P=0,461) (Figure 3a). Likewise, abundance of hemipteran predator did not also differ between oil palm plantations with different distance from natural habitat ($F_{2,9}$=1,742; P=0,229) (Figure 3b). The presence of natural habitat has no effect on richness and abundance of hemipteran predator in oil palm plantations. One of possible factor is the proportion of natural habitats that much smaller than the area of oil

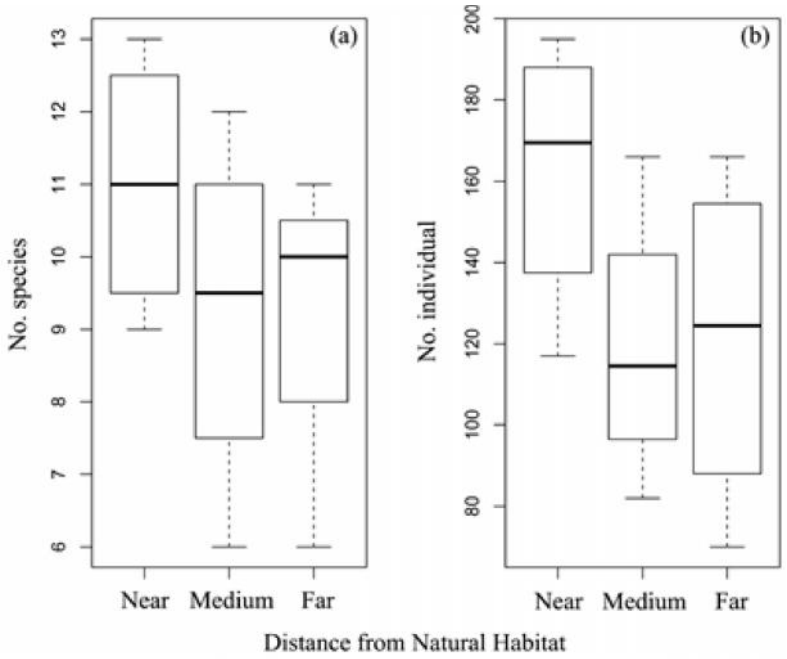

Figure 3. (a) Species richness and (b) abundance of hemipteran predator in oil palm plantations with different distance from natural habitats.

palm plantations. According to Holland *et al*. (2016), to support natural enemies in agricultural field, natural habitats must have sufficiently large and close enough to agricultural field. If natural habitats are too small or isolated will effect on low ecosystem services provided by natural enemies (Tscharntke *et al*., 2016). In addition, the same agricultural practice between oil palm plantations with different distances from natural habitats is also possible effect on the occurrence and abundance of hemipteran predator. Previous study by Matlock & de la Cruz (2002) shown that similar agricultural practices cause similar diversity of natural enemies in agricultural habitat.

The distance of oil palm plantation from natural habitats also did not affect on recolonization of hemipteran predators. Based on observation time, the abundance of hemipteran predators tend to decrease in the second and third observation month ($F_{2,31}$=9,347; P=0,0007) but no change in their species richness ($F_{2,31}$=2,686; P=0,084) (Figure 4). The decline in abundance between different observation time indicated that recolonization of hemipteran predator can not occurred within a month. The dominant hemipteran predators such as *Eocanthecona* sp. ($F_{2,31}$=11.092, P=0.0002) and *Reduviidae* sp5 ($F_{2,31}$=3.444, P=0.044), their abundance decreased in different observation time (Figure 5). Only *Sycanus* sp found its abundance did not differ between observation time ($F_{2,31}$=1,283, P=0.291). *Sycanus* sp. might have ability to survive or recolonize faster than other hemipteran predator. Based on De Clercq (2000), *Sycanus* sp. is a generalist predator that can grow and develop rapidly, high adaptability and good predation ability.

Based on correlation analysis, abundance of particular hemipteran predator have relationship with abundance of flowering vegetation in oil palm plantations. Abundance of *Sycanus* sp. tend to increase with increasing amount of flowering vegetation in oil palm plantations (r=0.580; P=0.047). In contrast, abundance of *Eocanthecona* sp. (r=-0.383, P=0.218) and *Reduviidae* sp5 (r=0.199, P=0.534) has no corrrelation with flowering vegetation. Flowering vegetation within or around oil palm fields was more influential to abundance of *Sycanus* sp. compared with natural habitat. This finding support our hypothesis that natural habitat fails to support hemipteran predators due to oil palm plantation can provide more important resources for natural enemies than natural habitats (Tscharntke *et al*., 2016). According to Tjitrosoedirdjo (1984), flowering vegetation in agricultural field are important as shelter, alternative hosts and additional food sources of nectar and pollen for natural enemies including predators.

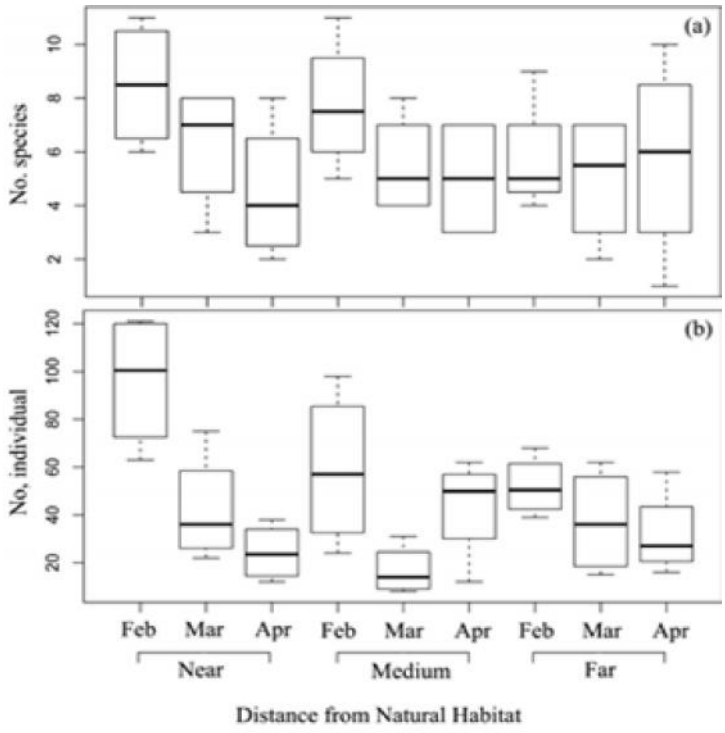

Figure 4. (a) Species richness and (b) abundance of hemipteran predator in oil palm plantations with different distance from natural habitats in different observation times (month).

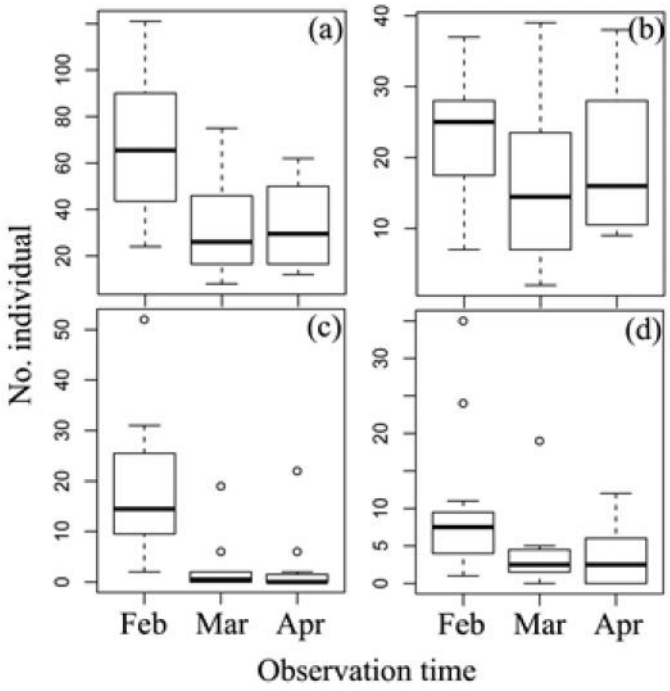

Figure 5. Abundance of dominant hemipteran predators in different observation times (month). (a) Total hemipteran predator ($F_{2,31}$=9.347, P=0.0007), (b) *Sycanus* sp. ($F_{2,31}$=1.283, P=0.291), (c) *Eocanthecona* sp. ($F_{2,31}$=11.092, P=0.0002), dan (d) *Reduviidae* sp5 ($F_{2,31}$=3.444, P=0.044).

Difference of Hemipteran Predator Species Composition in Oil Palm Plantation with Different Distance from Natural Habitat. Species composition of hemipteran predator in oil palm plantation was not affected by their distance from natural habitat (ANOSIM R=-0.045, P=0.641). Oil palm plantation that located in near vs medium distance from natural habitat had 83.2% similar species, while near vs far distance was 78.9% similar species and medium vs far distance was 84.8% similar species. In addition, 13 similar species of hemipteran predator were found in oil palm plantation located in medium and far distance from natural habitat, while near and far distance was found 12 similar species.

Species composition of hemipteran predator did not differ between oil palm plantations with different distances from natural habitat. This was allegedly due to similarity of vegetation types in the whole oil palm plantations. Based on vegetation analysis, we found 20 similar vegetation species in oil palm plantations between near, medium and far distance from natural habitat. According to Humprey *et al*. (1999), diversity of vegetation on agricultural habitat affects the composition of insects in it. Vegetation within or around oil palm field provide important contribution to the presence of hemipteran predator such as alternative habitat, shelter or resting habitat and food (prey) source.

The similarity of hemipteran predator species composition between oil palm plantations with different distance from natural habitat may also be influenced by similar habitat characteristics in each observation plot. Habitat characteristics such as food availability and habitat conditions are almost similar between observations plots and as consequence species composition of hemipteran predators were also similar. Previous research by Andrew & Hughes (2005) found that the similarity of hemipteran community can occurred due to guild similarity that related to habitat characteristics.

CONCLUSION

Diversity and species composition of hemipteran predator in oil palm plantations were not affected by distance of oil palm plantation from natural habitats. The presence of natural habitats also did not affect the recolonization of hemipteran predators in oil palm plantations. Abundance of dominant hemipteran predators showed decline in different observation times especially for *Eocanthecona* sp. and *Reduviidae* sp5, but not for *Sycanus* sp. *Sycanus* sp. was allegedly able to rapidly recolonize and its presence was influenced by flowering vegetation in oil palm plantation.

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