DERMAPTERA COMMUNITY STRUCTURE ON OIL PALM ECOSYSTEM IN DHARMASRAYA DISTRICT, INDONESIA

STRUKTUR KOMUNITAS DERMAPTERA PADA EKOSISTEM KELAPA SAWIT DI KABUPATEN DHARMASRAYA, INDONESIA

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ABSTRACT

The oil palm ecosystem is one of the suitable habitats for the order Dermaptera. Several physical factors, especially humidity in the oil palm ecosystem, support these insects' existence. In the oil palm ecosystem, Dermaptera has several functions, including as a predator of oil palm pests, but on the other hand, these insects also prey on Elaeidobius kamerunicus Faust, the primary pollinator of oil palm plants. For that reason, research was conducted to study the structure of the Dermaptera community in the ecosystem of oil palm plantations in the Sitiung sub-district. This research was a survey conducted at three locations- Sitiung, Gunung Medan, and Sungai Duo Villages—the collection of insect samples by hand collection. Identification of insect samples was carried out at the species level according to Burr (1910) and Borror et al. (1996). In this study, 214 individuals of the order Dermaptera were found to consist of three species: Cheslisoches mario, Forficula auricularia, and Vostox brunneipennis. C. mario was the dominant Dermaptera species found with an Importance Value Index (IVI) was 1.27. Based on this research, it is known that the community structure of the order Dermaptera was simple because it has low diversity values.

Keywords: Chelisoches, diversity, evenness, natural enemies

INTRODUCTION

Oil palm plantations are a human-built ecosystem with a monoculture cropping pattern (Nasution et al., 2022). This ecosystem is synonymous with low diversity because of the supporting resources for the presence of various organisms that make up that diversity. However, several organisms can live in oil palm plantation ecosystems, especially insect groups (Heriza et al., 2017; Ikhsan & Suhendra, 2023). This is due to several physical factors in the oil palm plantation ecosystem suitable for forming insect populations, one of which is humidity. The moisture is formed because oil palm plants have long fronds that block sunlight to the soil surface, so the microclimate around oil palm plantations tends to be humid (Andoko, 2008; Wong et al., 2023).

One of the insects that requires such high humidity is Dermaptera. Dermaptera is one of the orders of the Insecta class, which is characterized by a body length of 5-35 mm, a flattened, slender, black or brown body, *filiform antennae*, well-developed compound eyes, and the presence of *forceps* on the back

of the body (Elzinga, 2004). The main characteristic of the order Dermaptera is a folded rear wing and a forcep-like cerci (Haas & Kukalova-Peck, 2001; Mao, 2020). Dermaptera's wings are not used for flight but only to cover its body (Pracaya, 2007).

In West Sumatra, a study on the community structure of the order Dermaptera on oil palm plants has been reported by Setiawati (2018) in Pulau Punjung District, Dharmasraya Regency, which obtained four species, namely *C. mario, Vostox apicedentatus, Doru aculeatum,* and *Euborellia arcanum* in oil palm plantations aged six years. Based on this research, finding other species from the Order Dermaptera is still possible. The study aimed to study the structure of the Dermaptera community in Sitiung sub-district, Dharmasraya Regency, West Sumatra.

MATERIALS AND METHODS

Insect sampling was carried out on oil palm plantations located in Sitiung District. The insect samples were identified at the Laboratory of the Department of Plantation Cultivation, Andalas University, Campus III Dharmasraya. The research has been carried out from March to July 2020. The materials used are 96% alcohol, label paper, and *clear hoarder* (material for labels on oil palm sample crops). The tools used are stereo microscopes, tweezers, gloves, cameras, collection bottles, machetes, rulers, and stationery.

Determination of research location

This research is in the form of a survey that determines the observation location by *purposive sampling*. Site selection is based on several criteria, one of which is the age of the plant, which is four years with a land area of 1 ha. These criteria determined three nagari in Sitiung District: Nagari Sitiung, Nagari Gunung Medan and Nagari Sungai Duo. Each of these nagari is set as much as one land with an area of 1 ha. The transect method determined sample plants in each of these fields. In the transect line, sample plants are determined with a distance between plants, one tree. The total number of sample plants in one field was ten stems. In the sample plants, insect observations of the order Dermaptera were carried out

Collection of insect examples

Sampling is done by *hand collection* method, carried out in the morning around 08.00-10.00 WIB. Observations were made on several parts of the sample plants, especially at the base of the midrib, male and female flowers, and fruit bunches, especially rotting fruits. An insect sample inaccessible was taken using tweezers. Sampling was carried out three times with intervals between sampling for one month. Collected sample insects are stored in labeled collection bottles and previously filled with 96% alcohol so that sample insects are not decomposed during storage before the identification process. Next, the sample insects were taken to the laboratory for identification.

Insect identification

The sample insects are identified in the laboratory using stereo microscopy to determine the morphology (body color, antennae segments, abdomen, thorax, legs, and claws) of the observed sample insects. The identification stage consists of taking photos with the help of microscopes and cameras; then, the sample insect images are matched with the images found on the https://bugguide.net/ page (Iowa State University). Furthermore, the identification process continued to the species level, according to Borror *et al.* (1996). The next stage is calculating the number of individuals at each observation location that has been identified and processing or analyzing the data from the identification.

Data analysis

Data on species composition and number of individuals of the order Dermaptera on oil palm plants were used to analyze diversity and equity. The measures used are the Shannon-Wienner Diversity Index and the Simpson Evenness Index (Krebs, 1999).

1. Diversity Index

The Shannon-Wienner hellish index equation is as follows:

$$H' = -\sum p_i (\log e. p_i)$$
$$P_i = n/N9$$

Information:

H = Shannon-Wienner diversity index

p_i = Proportion of i-th morphospecies individuals in the community

n = Abundance of i-th morphospecies individuals

N = Total number of all individuals of all morphospecies

2. Evenness Index

To analyze the evenness of species or the proportion of each species in a community, it is calculated using the Simpson evenness index equation as follows:

$$D = 1 - \sum p_i^2$$

Information:

D = Simpson evenness index

P_i = Proportion of individuals of the i-th morphospecies

3. Important Value Index (INP)

To determine the dominance of one species in a particular community, the Important Value Index (INP) is calculated, which ranges from 0 to 3. The INP value is calculated using the following equation:

$$INP = RD_i + Rf_i$$

a. Density (Di) with the formula:

$$D_i = n_i/A$$

Information:

In: Density for Species I

n_i: Total number of individuals for species i

A: Total area of sampled habitat

b. Relative Density (RDi) with the formula:

$$RD_i = n_i/\sum n \text{ or } Rd_i = D_i/TD = D_i/\sum D$$

Information:

RDi: Relative density of species i

Ni: Total number of individuals for species i10

$\sum n$: Total number of individuals of all species

At: Species density

TD: Density for all species

$\sum D$: Total density of all species

c. Frequency (Fi)

$$F_i = J_i/K$$

Information:

Fi: Species frequency i

Ji: Number of samples in which species I was present,

K: Total number of samples obtained

d. Relative frequency (RFi) with the formula:

$$RF_i = F_i/\sum F$$

Information:

Rfi: Reclamative frequency of species i,

Ji: Species frequency i,

$\sum F$: Number of frequencies for all species

RESULT AND DISCUSSION

Description of the research location

The research was conducted in smallholder oil palm plantations in Sitiung District, Dharmasraya Regency, Sungai Duo, Sitiung, and Gunung Medan. Table 1 shows the geographical location of the three nagari chosen to be the observation location in

Sitiung District. The sub-district is one of the largest oil palm producing areas in Dharmasraya Regency with a land area of 3,318 Ha (BPS Dharmasraya, 2020). The observation location has a height ranging from 94 -103 meters above sea level.

Table 1. General description of research locations

Sub-district	Coordinate		Elevation (mdpl)
	South latitude	East longitude	
Sei Duo	1°01'01.9"S	101°40'51.9"E	94
Sitiung	0°59'31.2"S	101°40'27.2"E	98
Gunung Medan	1°00'47.5"S	101°36'12.3"E	103

The varieties of oil palm plants planted in each location are D×P Simalungun varieties with a planting distance of 8×9 meters. Based on discussions with landowners, it is known that the oil palm land has never used herbicides for weed control. Likewise, insecticides and fungicides are used to control the disease. Based on field observations, there are many pests and diseases in oil palm plants such as Nagari Sungai Duo, namely bagworm pests (*Mahasena corbetti*), horn beetles (*Oryctes rhinoceros*) and leaf rust disease. In oil palm plants in Nagari Sitiung and Nagari Gunung Medan, there are pests of rats, fireworms (*Setothosea asigna*), sac caterpillars (*Mahasena corbetti*), pigs and horn beetles (*Oryctes rhinoceros*).

Description of Dermaptera Species in Oil Palm Ecosystems

Based on the study results, three species of the order Dermaptera were found associated with oil palm plants, namely *C. mario, F. auricularia*, and *V. brunneipennis*. The morphology of each species can be seen in Table 2.

The body length of this species is 1-2 cm. This species has a total of 18 antennal segments. The internodes on the 11th, 12th, and 13th sections are yellowish. The number of segments in the abdomen of this species consists of 5 segments. The body of this species is generally black, ranging from the caput, thorax, abdomen except for the brownish forceps. This species' forcep shape is unique because this species forcep is longer than other species called black Dermaptera. The shape of this species forceps is unique because the tip is curved inward and has serrations inside the forcep.

Table 2. Description of Dermaptera Order Species in the Oil Palm Ecosystem

Species	Description
Chelisoches mario	The body length of this species is 2-3 cm. This species has a total of 18 antennal segments. The internodes on the 11th, 12th, and 13th sections are yellowish. The number of segments in the abdomen of this species consists of 7 segments. The body of this species is generally black, ranging from caput, thorax, abdomen to forceps, so this species is called black Dermaptera. The shape of this species of forceps is unique because the tip is curved inward and has serrations inside the forceps.
Forficularia auricularia	The body length of this species is 2 cm. This species has a total of 18 antennal segments. The internodes on the 12th, 13th, and 14th sections are yellowish. The number of segments in the abdomen of this species consists of 8 segments. The body of this species is generally brownish, ranging from caput, thoracic, abdominal to forceps. This species is unique in that it has a color on its wings called a white band. The forceps in this species are slightly curved inward and have fine bristles on the forceps.
Vostox brunneipennis	The body length of this species is 1-2 cm. This species has a total of 18 antennal segments. The internodes on the 11th, 12th, and 13th sections are yellowish. The number of segments in the abdomen of this species consists of 5 segments. The body of this species is generally black, ranging from the caput, thorax, abdomen except for the brownish forceps. The forcep shape of this species has the uniqueness that this species forcep is quite longer than other species.

Dermaptera Community in Oil Palm Ecosystem

Based on the results of research conducted in Sitiung District, three species of the order Dermaptera were found. Of the three species, a total number of individuals was found, as many as 214 individuals. The three species found belong to different families. In Nagari Sitiung there are as many as 110 individuals of three species, and in Nagari Gunung Medan there are 64 individuals of three species. The lowest number of individuals is found in the Duo River Nagari, where only 40 individuals of two species and families are found, namely *Chelishocidae, Forficulidae,* and *Spongiphoridae.*

The number of individuals of the order Dermaptera species at each study site varies; the most common species found is *Chelisoches mario*. This is because, in oil palm plants, there are male flowers. After all, male flowers, eggs, and larvae of *Elaedobius*

kamerunicus are prey for *Chelisoches mario,* which is classified as a generalist predator. This species is more widely obtained than others because of food availability in oil palm plants. The second largest species is *Forficula auricularia*; the number of this species dropped quite significantly from *the C. mario* because sampling was done in the morning, while this species is the most found in the afternoon because this species is nocturnal so many activities occur in the afternoon to night (Famukti, 2013). Buxton (1974) reported that *F. auricularia* is an important predator that can prey on eggs and active stages of Lepidoptera, Coleoptera, Diptera, and Homoptera.

Table 3. Dermaptera Order Communities in the Oil Palm Ecosystem

Species	Sub-district		
	Sitiung	Sungai Duo	Gunung Medan
Chelisoches mario	95	37	51
Forficula auricularia	12	3	10
Vostox brunneipennis	3	0	3

Apart from being a predator, Dermaptra is reported as a detritivor insect in rice fields (Rizali et al., 2002). The distribution of this species covers Europe, Africa and Asia (Burr, 1910). The lowest number of species obtained in this study was *Vostox brunneipennis*. This is because *V. brunneipennis is* quite commonly found around dead leaves. However, at the time of field observation, *V. brunneipennis* was found in rotten oil palm fruits because the rotten oil palm fruits were quite moist. In oil palm plants, quite a few rotten fruits are obtained; therefore, this species is not obtained.

Dermaptera's Important Value Index

The highest Important Value Index of the Order Dermaptera is found in *the species Chelisoches mario* with a value of 1.27, and the lowest Important Value Index is *the species Vostox brunneipennis* with a value of 0.24. The Important Value Index (INP) of Dermaptera in oil palm plants is presented in Table 4. The Important Value Index is determined to determine the dominance of a species in a particular community. In Table 4, you can see different density values. The species *Chelisoches mario* has a much higher density compared to other species. So, it has a higher INP value. The same species that benefit from each other have higher density values than if there were only one species in the habitat.

Table 4. Importance Value Index of the Dermaptera Order in the Oil Palm Ecosystem

Species	Density	Relative density	Frequency	Relative Frequency	INP
Chelisoches mario	61,00	0,86	1,00	0,42	1,27
Forficula auricularia	8,33	0,12	0,90	0,38	0,49
Vostox brunneipennis	2,00	0,03	0,50	0,21	0,24

Krebs (1978) stated that insects generally need high humidity for their bodies to be obtained directly through air and plants that contain water. During environmental research, the oil palm ecosystem was less moist because the young leaves of the oil palm were four years old and had yet to bloom. This condition makes direct sunlight shine on the oil palm plant area, causing its Abundance to be low. Michael (1984) states that a community in poor environmental conditions has a small abundance of species. In a good environment, many species are significant, but none are abundant.

A study on the diversity of Dermaptera in oil palm plantations was conducted in the Cimulang plantation of PTPN VIII Bogor reported by Famukti (2013), where it was concluded that there were three species, namely *Chelisoches* sp., *Forficula* sp. and *Labia* sp. In male flowers of oil palms within a study period of 3 months. This research was previously conducted using traps on oil palm flowers. The Famukti study (2013) only examined male flowers of oil palm, in contrast to this study, researchers examined the entire oil palm plant. One of the distinguishing factors in this study is using traps, while *the hand collection* method was used in this study.

In West Sumatra, a study on the Order of Dermaptera community structure on oil palm plants has been reported by Setiawati (2018) in Pulau Punjung District, Dharmasraya Regency. Those who got four species were *C. mario, V. apicedentatus, D. aculeatum, and E. arcanum* in oil palm plantations aged six years. The distinguishing factor in the study (Setiawati, 2018) with this study is the age of oil palm plants because the higher the oil palm age, the more humid the condition of oil palm. This study was conducted with the criteria of oil palm planting age of 4 years. In this study it was seen that at the age of 4 years the humidity in oil palm plants was less and

supported in some research locations there were no plants that became protective or could make plants more moist, therefore there were only three species. Humidity is important; insects generally need high humidity for their bodies, which is obtained directly through the air and plants containing water (Krebs, 1978).

Dermaptera Diversity Index (H') and Equity (E') in Oil Palm Ecosystems

The Shannon-Wiener Index calculation results show that Dermaptera's diversity level in oil palm plants is in different conditions. The diversity index is in Nagari Sitiung with values of H'= 0.46, E'= 0.42, Sungai Duo with values of H'= 0.26, E'= 0.38, and Mount Medan with values of H'= 0.61, E'=0.55. Based on Krebs (1989), the observed Dermaptera diversity index is classified as low category (H'<1) and uneven distribution (E'= 0.38-0.55). Data on the species diversity of Dermaptera are presented in Table 5.

Table 5. Number of Species, Individuals, Diversity Index (H'), and Evenness (E') of the Order Dermaptera in Three Research Locations.

Parameter	Sitiung	Sei. Duo	Gunung Medan
Number of species	3	2	3
Number of individuals	110	40	64
H'	0,46	0,26	0,61
E'	0,42	0,38	0,55

The diversity in this study is relatively low because low diversity describes the dominance of a species. The species diversity index aims to see the number of diverse species living in a particular community. Species diversity can be used to determine community structure. The greater the number of species with the same or close to the same level of number of individuals, the higher the

degree of heterogeneity. Conversely, if the number of species is minimal and there are significant differences in the number of individuals between species, the heterogeneity of a community is lower (Setiawati, 2018). Soegianto (1994) stated that a community is said to have a high diversity index value if the community is composed of many individuals with the same or almost the same Abundance of individuals.

Conversely, if the community comprises many individuals and only a few individuals are dominant, then the species diversity is low. Species diversity can be used to see the complexity of a community. The higher the level of diversity, the higher the possible interactions between species (Krebs, 1999).

Diversity will be seen in landscape changes when we cross landscapes where physical conditions (soil, temperature, rainfall) appear to change. One species is found in every location, even replaced by the presence of species found in each location difference, even replaced by the presence of another species not initially found in the previous location. The landscape is dynamic and changes according to the surrounding environment and the type of local human activity (Setiawati, 2018).

CONCLUSIONS

Three species of the order Dermaptera are found in oil palm plantations in Situng sub-district, namely *Chelisoches mario, Forficula auricularia* and *Vostox brunneipennis*. The highest species diversity is found in Nagari Sitiung, and the lowest is in the Duo River. The same thing is also found in the highest species evenness index found in Nagari Gunung Medan and the lowest in the Duo River. The order of Dermaptera species with the highest abundance is *C. mario,* while the lowest is *V. brunneipennis.* The INP value obtained in this study is 2, while the total value of diversity and equity is 1.33 and 1.35.

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