Diversity of Insect in Coconut Plant in Kelurahan Besar, Medan Labuhan District, North of Sumatra

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***Abstract*---**This research was conducted in the Coconut Plantation in KelurahanBesar, Medan Labuhan District, North of Sumatra from June to July 2019 using diagonal methods (size sampler is 23 x 23 m) of 5 plots, each plots using 3 traps (*sweep net, yellow sticky trap, fit fall trap*) for 5 x observations at 2 day intervals. The results showed consist of 9 insects were identified in the coconut plantations, 33 families, 43 genera with a total of 786 individuals. The most caught insect families are from the Family Chironomidaeas much as 357 individuals, followed by the Ceratopogonidae family of 116 individuals, and family Ectobidaeare 102 individuals. Score of Absolute Density (AD), Relative Density (RD) are performed with fluctuating values. Based on insect status, there were 20 species is categorized into pests (720 individuals); predators (19 species, 59 individuals); parasitoids (4 species; 6 individuals) and 1 as pollinators is *Lucilia* sp. When the Type of Richness Index value is calculated as R = 8.42; Evenness Index (E = 0.55), and Insect diversity index (H '= 2.07), which can be categorized as moderate, meaning that insect diversity is still commonly found in coconut palms. This criterion shows the diversity of pests and natural enemies which mutually increase in number of populations towards balance, where environmental conditions are not yet disturbed.

Keywords*---*Diversity; Insects; Coconut plants; Medan Labuhan; North Sumatra.

I. INTRODUCTION

Coconut (*Cocosnucifera* L.) is a multifunctional plant that can be utilized by all parts of the plant. Coconut provides benefits as a source of food, fiber, feed, and fuel. Coconut is economically an important service and contributes greatly to Indonesia. Coconut through copra as a raw material for making coconut oil and was once the prima donna of Indonesia's plantation commodity exports, nearly 40% of state revenue came from copra exports [1].

The higher the human needs, the need for coconut (copra) is increasing. But there is no balance, where every year the demand for coconuts increases, while coconut production decreases. This is due to: (1) The average plant passes the productive age (60 years and over), (2) The treatment of cultivation is very minimal, both maintenance, fertilization, and prevention and eradication of pests and diseases and (3) the presence of pests/endless illness, even though the eradication effort has been carried out intensively [2].

Insect development in nature is influenced by two factors, namely internal factors (which are owned by the insect itself) and external factors (which are in the surrounding environment). Factors that also determine the high and low levels of insect populations include: the ability to breed, sex ratio, nature of self-defense, life cycle and imago age. While one of the external factors that influence the development of insects is a physical factor, which consists of: temperature, humidity/rain, light/color/ smell, wind and topography. Furthermore it is stated that the high and low population of an insect species at a time is the result of meeting these two factors [3].

The diversity of living things can be characterized by differences, color, size, shape, number, texture, appearance, and other properties. The diversity of

living things can also be seen by the similarity of characteristics between living things. To be able to recognize living creatures, especially in animals based on the characteristics they have, can be done through observing morphological characteristics, habitats, ways of breeding, types of food, behavior, and several other characteristics can be observed [4].

Factors that govern population density can be divided into 2 groups, namely external factors and internal factors. External factors include competition between individuals in a population or with other species, changes in the chemical environment due to secretions and metabolism, lack of food, predator attacks, parasites or disease, emigration, climate factors such as weather, temperature and humidity. While internal factors are genetic changes in the population [5].

II. MATERIALS AND METHODS

Place and Time of Research

This research was carried out in the community garden owned by Mr. Singa in KelurahanBesar, Medan Labuhan District with a height of ± 25 meters above sea level during June 2019 until July 2019.

Materials and Tools

Materials used in this study were 1-year old coconut plantation, captured imago, clean water, 70% alcohol, formalin, detergent, adhesive glue, yellow sticky trap.

The tools used in this study were killing bottles, insect nets (Sweep net), fit fall traps using cups, cameras, microscopes, syringes, hygro thermometer, temperature gauges, digital soil pH, identification reference books namely [6], [7]and stationery.

Research Implementation

Determination of Observation Location

The location of the observation was conducted in the resident's cococnut plantation owned by Mr. Singa in KelurahanBesar, Medan Labuhan District with an area of 2 hectares.

Sampling

Sampling is done by observing and collecting insects that are caught at each point of the trap sample that has been diagonally determined with a size of 23 x 23 m totaling 5 plots each plot using 3 traps (sweep net, yellowsticky trap, fit fall trap) with 5 x observations by 2 day intervals.

Sweep Net Procedure Sampling

These traps are made of lightweight and strong materials such as gauze, are easy to swing and the insects that are caught can be seen. Swings are carried out 10 times. The captured insects are then collected, then put into a sample storage container to be identified and counted. Catching insects is done in the morning at 8:00 to 10:00 a.m. or in the afternoon at 16:00 to 17:00 a.m.

Yellow Trap Procedure Sampling

This trap is made of yellow paper with a size of 25 cm x 20 cm which is applied with glue. Installed in the morning at 08.00 WIB with monitoring interval every two days with 5x monitoring time for 2 weeks. Insects obtained in this trap are collected, identified and counted.

Fit fall Traps Procedures Sampling

This trap is used to catch insects that live above ground level. Installation is carried out at predetermined sample points. At each predetermined sample point placed and planted a plastic cup 9 cm in diameter, coated with yellow plastic and then filled with 150 ml of water plus a little detergent solution. Traps were installed in the morning at 08.00 WIB trapped insects were put into sample bottles and counted and identified. Observations were made every 24 hours for 5 times the data collection.

Insect Identification

All insect samples obtained from the field are taken to the laboratory. Then grouped according to the sampling location and preserved with 70% alcohol. Furthermore insects are identified by observing the outer shape (morphology) with the help of a loop, microscope, and reference books to [6],[7] Identification is carried out to the level of Genera or Species.

Observed Variables

1. Number and Type of Insects Caught

Insects caught are collected. Identified and calculated according to the respective family groups of each insect at each observation.

2. Value of Absolute Frequency, Relative Frequency, Absolute Density and Relative Density at each observation.

By knowing the number of captured insect populations that have been identified, it can be calculated the value of absolute frequency, relative frequency, absolute density and relative density at each observation.

3. Value of species Richness Index

Species wealth index serves to determine the species richness of each species in each community found.

4. Value of Evenness Index

Index of Evenness (Index of Evenness) serves to determine the equality of each type in each community that is found.

5. Value of Diversity Index

After the number of insects caught in each observation is known, the diversity index values of each observation are calculated using the Shanon-Weiner index formula (H ').

III. RESULTS AND DISCUSSION

Number and Type of Insects Caught

Field observations showed that the number of insects caught using traps in coconut plantations was identified as many as 9 orders, 33 families, 43 genera with 786 individuals. From Table 1 can be seen that the most number of insects is from the family Chironomidae as much as 357 individuals, followed by the family Ceratopogonidae of 116 individuals, then family Ectobidae of 102 individuals. This is because in the study area there are habitat which the family Chironomidae of the Order Diptera often lay eggs in water. Supported by research conducted by [8] which states that Chironomidae tends to choose a place to lay eggs in water that contains high nutrients and has a complexity of habitat structure.

Table 1. Number of insects caught on coconut plantations

Order	Family/Genera/Spesies	Observations					Total	Means
		1	2	3	4	5		
Araneae	Lycisidae/*Lycosidae*	5	2	4	3	0	14	2.8
Blatodea	Ectobiidae / *Blatella*	8	17	21	16	30	102	18.4
	Carabidae / *Pheropsophus*	5	0	1	0	1	7	1.4
Coleoptera	Curculionidae/*Baris*	0	0	2	0	0	2	0.4
	Salpingidae/ *Lissodema*	3	3	3	1	3	13	2.6
	Staphylinidae/*Paedorus fuscipes*	1	0	0	0	1	2	0.4
	Asilidae / *Promachus*	1	0	0	0	0	1	0.2
	Bombyliidae / *Toxophora*	0	0	1	0	0	1	0.2
	Calliphoridae/ *Lulicia*	0	0	1	0	0	1	0.2
Diptera	Ceratopogonidae	89	0	6	1	21	116	23.4
	Chironomidae / *Chironomus*	18	19	21	15	16	89	17.8
	Chironomidae/*Glyptotendipes*	58	24	46	94	46	268	53.6
	Culicidae / *Anopheles* sp	7	1	10	7	15	40	8
	Dolichopodidae / *Condylostylus*	2	2	0	1	1	6	1.2
	Muscidae / *Musca domestica*	13	6	0	3	2	24	4.8
	Psycodidae / *Psychoda*	0	0	1	1	1	3	0.6

	Sarcophagidae / *Sarcophaga*	5	1	0	0	0	6	1.2
	Tipulidae / *Tipula*	1	2	1	0	1	5	1
Hemiptera	Alididae / *Leptocorisa acuta*	1	0	0	0	1	2	0.4
	Cicadellidae / *Kolla*	1	3	0	1	0	5	1
	Coreidae/*Cletus*	0	1	3	0	2	6	1.2
	Delpachidae	1	1	0	2	5	9	1.8
	Braconidae / *Cotesia*	1	0	0	0	0	1	0.2
	Chrysdidae / *Chrysis*	0	1	0	1	0	2	0.4
	Chrysdidae/ *Chrysura* sp	0	0	1	0	1	2	0.4
Hymenoptera	Formicidae / *Dolichoderus*	1	0	0	0	1	1	0.2
	Formicidae / *Solenopsis*	4	0	0	3	2	9	1.8
	Ichneumonidae / *Amblyteles armatorius*	0	0	1	0	0	1	0.2
	Specidae/ *Isodantia*	0	2	0	0	0	2	0.4
	Specidae / *Sceliphron*	0	3	1	0	1	5	1
Lepidoptera	Vespidae/ *Gribodia*	0	0	1	0	0	1	0.2
	Vespidae / *Ropalidia*	1	0	0	0	0	1	0.2
	Erebidae / *Arctiidae*	0	1	1	0	0	2	0.4
	Coenagrionidae/*Agriocnemis femina*	2	1	0	2	0	5	1
Odonata	Coenagrionidae/ *Ceriagrion calaminem*	0	0	0	0	2	2	0.4
	Coenagrionidae/*Ischnura senegalenensis*	0	0	1	0	0	1	0.2
	Libellulidae / *Acisoma panorpoides*	0	1	0	0	0	1	0.2
	Libellulidae/ *Crocothemis servilia*	0	0	1	0	0	1	0.2
	Libellulidae / *Neurothemisintermedia*	1	0	0	0	0	1	0.2
	Libellulidae/ *Pantalaflavescens*	0	0	0	2	0	2	0.4
	Orthetrum/ *Orthetrumsabina*	0	1	0	2	0	3	0.6
Orthoptera	Gryllidae/ *Gryllus*	7	5	3	5	1	19	4.2
	Phygomorphidae/*Atractomorphasimilis*	0	1	0	1	0	2	0.4
Total		**236**	**98**	**131**	**161**	**153**	**786**	**155.8**

Table 2: Value of Absolute Density (AD), Relative Density (RD), Absolute Frequency (AF) and Relative Frequency (RF)

Order	Family	Genus/Spesies	AD	RD(%)	AF	RF(%)
Araneae	Lycisidae	*Lycosidae*	14	1.78	4	3.8
Blatodea	Ectobiidae	*Blatella*	102	12.99	5	4.76
	Carabidae	*Pheropsophus*	7	0.89	3	2.85
Coleoptera	Curculionidae	*Baris*	2	0.25	1	0.95
	Salpingidae	*Lissodema*	13	1.66	5	4.76
	Staphylinidae	*Paedorus fuscipes*	2	0.25	2	1.9
	Asilidae	*Promachus*	1	0.13	1	0.95
	Bombyliidae	*Toxophora*	1	0.13	1	0.95
	Calliphoridae	*Luculia*	1	0.13	1	0.95
Diptera	Ceratopogonidae	*Ceratopogon*	116	14.78	4	3.8
	Chironomidae	*Chironomus*	89	11.34	5	4.76
		Glyptotendipes	268	34.14	5	4.76
	Culicidae	*Anopheles*	40	5.1	5	4.76
	Dolichopodidae	*Condylostylus*	6	0.76	4	3.8
	Muscidae	*Musca domestica*	24	3.06	4	3.8

	Psycodidae	*Psycoda*	3	0.38	3	2.85
	Sarcophagidae	*Sarcophaga*	6	0.76	2	1.9
	Tipulidae	*Tipula*	5	0.76	4	3.8
Hemiptera	Alididae	*Leptocorisa acuta*	2	0.25	2	1.9
	Cicadellidae	*Kolla*	5	0.64	3	2.85
	Coreidae	*Cletus*	9	1.15	4	3.8
	Delpachidae		6	0.76	3	2.85
	Braconidae	*Cotesia*	1	0.13	1	0.95
	Chrysdidae	*Chrysis*	2	0.25	2	1.9
		Chrysura	2	0.25	2	1.9
Hymenoptera	Formicidae	*Dolichoderus*	1	0.13	1	0.95
		Solenopsis	9	1.15	3	2.85
	Ichneumonidae	*Amblyteles armatorius*	1	0.13	1	0.95
	Specidae	*Isodantia*	2	0.25	1	0.95
		Sceliphron	5	0.64	3	2.85
Lepidoptera	Vespidae	*Gribodia*	1	0.13	1	0.95
		Ropalidia	1	0.13	1	0.95
	Erebidae	*Arctiidae*	2	0.25	2	1.9
	Coenagrionidae	*Agriocnemis femina*	5	0.64	3	2.85
		Ceriagrion calaminem	2	0.25	1	0.95
		Ischnura senegalenensis	1	0.13	1	0.95
Odonata	Libellulidae	*Acisoma panorpoides*	1	0.13	1	0.95
		Crocothemis servilia	1	0.13	1	0.95
		Neurothemisintermedia	1	0.13	1	0.95
		Pantalaflavescens	2	0.25	1	0.95
	Orthetrum	*Orthetrumsabina*	3	0.38	2	1.9
Orthoptera	Gryllidae	*Gryllus*	19	2.42	5	4.76
	Phygomorphidae	*Atractomorphacrenulata*	2	0.25	2	1.9
Total			786	100	107	100

Value of Absolute Frequency, Relative Frequency, Absolute Density and DensityRelatively

Value of Absolute Frequency, Relative Frequency, Absolute Density and Relative Density of insects caught in coconut plantations in Kelurahan Besar, Medan Labuhan District can be seen in table 2.

From the observations found in table 2. It shows that the highest Relative Frequency (RF) value is found in the family of Ectobiidae, Salpingidae, Chironomidae, Culicidae, Gryllidae which is 4.76%. This shows that the insect is often present in the field of observation and widespread insect distribution. This is consistent with the statement of which states that the relative frequency indicates the presence of a type of insect in the habitat and can describe the spread of the insect type.

The lowest relative frequency values are found in the family of Curculionidae, Acylidae, Bombyliidae, Calliphoridae, Braconidae, Formicidae, Ichneumonidae, Specidae, Vespidae, Coenagrionidae, Libellulidae which are 0.95%. According to [9] researchers insects that are rarely present on plantations are caused by competition between insects for food and the environment. This is supported by research conducted by [10] which states the lowest frequency values are found in the Tettigonidae, Carabidae, Chysomalidae, Coccinelidae, Scarabidae, Tenebrionidae, Vespidae and Pompilidae families with a Relative Frequency (RF) value of 2.61%. Influencing factors are competition between individuals in a population or with other species due to secretions and metabolism, food shortages, predator parasitic/disease attacks, emigration of climate factors such as weather, temperature, humidity, while internal comes from genetic changes in a population.

The highest Relative Density (RD) value of insects is found in the Chironomidae family that is equal to 34.14% and the lowest is found in the family of Acylidae, Bombyliidae, Calliphoridae, Braconidae, Formicidae, Ichneumonidae, Vespidae, Coenagrionidae, Libellulidae which is 0.13%. The amount of RD showsthe number and type of insects found in the habitat. The more the number and types of insects that are caught, the greater the RD value. According to [11] states that in the theory of competition where high competition in a narrow niche will produce more species that can enter the habitat.

Insect Diversity Index Value

We can see the insect diversity index for coconut crop in Kelurahan Besar, Medan Labuhan District in table 3. Based on the data from the analysis, it can be seen that the insect diversity index (H ') with a value of 2.075 is in the medium category. This criterion shows the diversity of pests and natural enemies which are increasing in number with increasing population towards balance. According to [12], there are 3 criteria for insect species diversity, namely low species diversity if H = <1 (unstable environmental conditions), desang species diversity when H = 1-3 (Medium Environmental Conditions), and high species diversity if H => 3 (stable environmental conditions).

For the Richness (R) wealth index the value is 8,421 included in the High category. This shows that the area around the observation is stable because species diversity and habitat are closely related to each other, which means that the higher the diversity of habitats, the higher the diversity of species. According to [13], there are 3 criteria for wealth index, namely R <2.5 indicates a low level of species wealth, 2.5> R> 4 indicates a moderate level of wealth and R> 4 indicates a high level of wealth.

Evenness Evenness Index (E) values are listed in Table 3. the value is 0.551 in the moderate category classified as stable. According to [14], there are 3 criteria of environmental community based on the value of evenness, namely if E '<0.50 then the community is in a depressed condition. If 0.50 <E '≤ 0.75, the community is in a stable condition while 0.75 <E' ≤ 1.00, then the community is in an unstable condition. Evenness index value (E ') can describe the stability of a community. The smaller the value of E 'or close to zero, the more uneven distribution of organisms in the community dominated by certain types and vice versa the greater the value of E' or close to one, then the organisms in the community will spread evenly.

Table 3. Diversity Index Value (H '), Wealth (R) and Evenness (E)

No.	Calculation of indices scores	Observations					Mean	Categorized
		1	2	3	4	5		
1	Richness (R)	7,686	9,180	8,615	8,625	8,360	8,421	Higher
2	Evenness (E)	0,551	0,628	0,576	0,444	0,559	0,551	Medium
3	Shanon-Weiner (H')	2,074	2,362	2,168	1,670	2,103	2,075	Medium

Environmental Factors

Based on the data in table 4. It is known that the average temperature from the 1st to 5th observations made in the field is 29.58. average soil pH is 7, humidity (RH) is 81% and for rainfall (RR) the average is 6.16 mm. This shows that the diversity of insects in the field of observation is influenced by several environmental factors. This is supported by the statement of Jumar (2000) which states that the development of insects is influenced by two factors, namely internal factors (owned by the insect itself) and external factors (which are in the surrounding environment).

The air temperature around the observation area is included in the optimal temperature range of 27º - 29ºC. This is in accordance with the statement of [15] which states that the optimal temperature for the development of insect pests is 20º - 35ºC. If the temperature is <15ºC then marriage becomes limited because insects are less active fly to mate at these temperatures, while at temperatures> 35ºC insects can die from dehydration.

Measurement of air humidity in the study location is around 79% - 82%. The size of the humidity is still in normal size which is around 50% - 90% which can still be tolerated by insects to live and breed in that place. Humidity can affect insect activity. Supported b y [16] that air humidity plays a very large role in the body's moisture content of insects and the life cycle of insects so as to regulate the activity of organisms and the spread of insects. Generally the higher the place the lower the humidity for the tropics.

The presence of insects can also be influenced by soil pH. Soil pH values affect the diversity index, because pH that is too acidic or too alkaline can result in insect mortality. According to [17] that the soil's pH value affects the number of insect species, because a pH that is too acidic or too alkaline can result in death in insects because there are some insects that cannot survive at a certain pH. The acidity (pH) of the soil is a limiting factor for the life of the organism. PH conditions that are too acidic or basic will cause organisms to experience imperfect life or even experience death. The average pH at the observation field is 7 pH measures which are still within tolerance limits that can allow insects to live and breed on the surface of the soil. According to [18] the optimum pH that is tolerated by insects ranges from 5-7.

Tabel 4: Temperature ,Soil pH, Relative Humanity (RH), Rainfall (RR)

Parameter	Observation P2 P3 P4 P5					Mean
	1	2	3	4	5	
Temperature (^{0}C)	28,8	28,6	27,9	28,5	29,1	29,58
Soil pH	7	7	7	7	7	7
Relative Humanity (%)	82	82	79	81	81	81%
Rainfall (mm)	0	0	30,01	0	0,8	6,16

Insect Status in Coconut Plantations

The most insects caught in the field are 20 types of pests with a population of 720 individuals, 19 species of predators with a population of 59, 4 species of parasitoids with a population of 6 and 1 type of pollinator with a number of 1. The above table shows that the number of pest insects is higher than natural enemies. This is caused by natural factors that influence the emergence of insect population explosion, environmental factors that support the growth of insects and the availability of food. According to [19] theoretically the growth of pest population will be followed by the growth of natural enemy populations. However, many natural factors, such as climate and the availability of food all the time for certain pests, can cause the pest population to exceed critical limits.

Table 5. Status Insects on Coconut Plantation

Family/Genera/Spesies	Status of Insects	Total Individul
Lycosidae	Predator	14
Blatella	Hama	102
Pheropsophus	Hama	7
Baris	Hama	2
Lissodema	Hama	13
Paedorus fuscipes	Predator	2
Promachus	Predator	1
Toxophora	Predator	1
Lucilia	Polinator	1
Ceratopogonidae	Hama	116
Chironomus	Hama	89
Glyptotendipes	Hama	268
Anopheles	Hama	40
Condylostylus	Predator	6
Musca domestica	Hama	24
Pychoda	Hama	3
Sarcophaga	Hama	6
Tipula	Hama	5
Leptocorisa acuta	Hama	2
Kolla	Hama	5
Cletus	Hama	9
Delpachidae	Hama	6
Cotesia	Parasitoid	1
Chrysis	Parasitoid	2
Chrysura	Parasitoid	2
Dolichoderus	Predator	1
Solenopsis	Predator	9
Amblyteles armatorius	Parasitoid	1
Isodantia	Predator	2
Sceliphron	Predator	5
Gribodia	Predator	1
Ropalidia	Predator	1
Arctiidae	Hama	2
Agriocnemis femina	Predator	5
Ceriagrion calaminem	Predator	2
Ischnura senegalenensis	Predator	1
Acisoma panorpoides	Predator	1
Crocothemis servilia	Predator	1
Neurothemisintermedia	Predator	1
Pantalaflavescens	Predator	2
Orthetrumsabina	Predator	3
Gryllus	Hama	19
Atractomorphasimilis	Hama	2

CONCLUSIONS

The insects that were caught and identified were 9 orders of 33 families, 43 genera with a total of 786 individuals. The highest Relative Frequency (RF) value are found in the family of Ectobiidae, Salpingidae, Chironomidae, Culicidae, Gryllidae that is equal to 4.76%. The lowest Relative Frequency (RF) values are found in the family of Curculionidae, Acylidae, Bombyliidae, Calliphoridae, Braconidae, Formicidae, Ichneumonidae, Specidae, Vespidae, Coenagrionidae, Libellulidae which are 0.95% by 34.14%. Then the lowest Relative Density (RD) value is found in the family of Asilidae, Bombyliidae, Calliphoridae, Braconidae, Formicidae, Ichneumonidae, Vespidae, Coenagrionidae, Libellulidae which is 0.13%. Insect diversity index (H ') with a value of 2.0754 is in the medium category (1 <H' <3). The Richness (R) wealth index is 8,4218 included in the High category (R> 4).

While the Evenness Evenness Index (E) value is 0.551 in the moderate category (E 0.21 <E <1). The most insects caught in the field are 20 types of pests with a population of 720 individuals, 19 predators with a population of 59, 4 parasitoids with a population of 6 and 1 polinator with 1 is *Lucia* sp.

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