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Insects Diversity and Abundance in Agricultural Ecosystems of Mount Klabat, Kauditan Subdistrict, North Minahasa Regency

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Abstract- The objectives of this study were to determine the diversity and abundance of insects in agricultural ecosystems. Stages of this study consisted of which was to determine the locations of the sample, the sample units, and agricultural ecosystems. This research was conducted using survey methods, identification and data analysis. Results this study showed that diversity (orders) and density (individuals) of insects in corn field (100 - 200 m asl); eggplant field I (100-200 m asl); and eggplant field II (> 100-300 m asl) respectively Hemiptera 16, Diptera (18), Hymenoptera (19), Coleoptera (6), Lepidoptera (2), Homoptera (66), and Odonata (4); Hemiptera (9), Hemiptera (12), Diptera (6), and Orthoptera (3); Hymenoptera (12), Coleoptera (6), Orthoptera (4), and Blattodea (2). The highest diversity of insects found in eggplant fields I (H'= 2:04) followed by corn field (H' = 1.99) and eggplant field II (H' = 1.84).

Keywords: Diversity, abundance, agricultural ecosystems, mount Klabat

I. INTRODUCTION

North Minahasa regency is a region located in North Sulawesi. Part of the mountain slopes Klabat is agricultural land, plantation, fruit, forest and mining. Subdistrict Kauditan is part of North Minahasa Regency has 11 villages. Every village in the district Kauditan has agricultural land and plantations. Farmland and plantations are found around the slopes before harvest fruits such as mango, langsat, mangosteen and others, and found some species of insects. The increase in the insect population at the time of flowering and fruiting plants. Insect species found during the season were of the order Diptera and Hymenoptera.

The emergence of the existence of the diversity of insects when the harvest season is any directional changes in time called succetion.structure community is one of the important properties of these changes [1]. A number of trends have been assosiated with vegetation succetion generalist or strategis generally dominate early successional stage [2]. Level is very high diversity of insects that can adapt to the conditions of both the natural habitats such as primary forests and man-made habitats such as agricultural land and plantations [3]. Agricultural and plantations land on the slopes of Mount Klabat generally in the highlands. Therefore, it is necessary to identify insects at some altitude. Identification of the insects intended to determine the diversity of insects on a different slope [4].

Forest sites around the mountainside Klabat has a population density of plant species is higher compared to plantations or agriculture, therefore, in the amount of forest habitat herbivorous insects and insect species diversity is also much higher and more complex than the agro-ecosystem [5]. Many insects leaf chewers drop leaf pieces or fragments of leaves to the forest floor. [6]. If the forest insects disturbed habitat due to logging, rice fields and fields, and mining the forest insects could become extinct or migrate to other areas, is likely to compete with the most important insect pests in agriculture. When the forest insects migrate into agricultural ecosystems because its habitat is disturbed then a succession may occur in community structure. Insects are the components of biodiversity at most, have important ecological functions and is often an indicator of environmental degradation [7]. Nevertheless most of the forest canopy can be disrupted each year by insect herbivores [8]. Diversity of insects around the plantation area adjacent to the foot of the mountain will decline as a result of deforestation. Herbivorous insects that diteli by researchers in Britain said that 80% of the insects herbiforous is monofag [9]. Herbivore behavior scanned by the availability of light for the plants through effects on leaf phytochemicals [10]. Different land use will also affect changes in the structure and composition of vegetation on the ground and will ultimately affect the stability of the new ecosystem. The new ecosystem involves not only vegetation, but also involves a good fauna that live in and the land surface, which means that fauna will also experience a sequence of changes in parallel with the level of fiber production. The insect fauna of Kuwait has undergone a change since the first period of 474 species consisting of 356 genera, 109 family, 19 orders) but the number increased to 492 species (273 genera, 116 families, 19 orders) during the second period. [11]. Prevention of the emergence of new pests around due to deforestation of the mountain Klabat is through extension to the farmers who grow the plants in the forest that should not be mined

in the slopes of the forest, and reforestation of areas deforested by mining so that the food chain and the life cycle of insects re-formed.

Natural phenomenon will affect the food chain and the life cycle of insects, as well as changing the habitat and landscape changes. Assess the impact of changes in the landscape due to differences in soil and geography can be done through the identification of species and the composition of insects are there to be used as bio-indicators to predict changes in habitat or ecosystem. It is the relationship between biotic and abiotic environmental factors, in which species or populations of plants and animals including insects and microorganisms will change presence, vitality and their response to the influence of environmental conditions. Each species will respond to environmental changes depending on the stimuli received. The response they have shown occurred because of a change and the level of pollution in the environment [12].

II. MATERIALS AND METHODS

2.1 Time and Place of Research

Research was conducted on corn fields (100-200 m asl); eggplant field I (100-200 m asl); and eggplant field II (> 100-300 m asl) with an average temperature of 25-30^0 C. There are gardens on the slopes of Mount Klabat, about 25 km from the village of Kaima. The study was conducted for six months consisting of four months at the field site for sampling insects and two months for the identification of insects in the Laboratory of Plant Pests and Diseases, Faculty of Agriculture, University of Sam Ratulangi Manado, North Sulawesi.

2.2. Research Procedure

2.2.1. Sampling Method

Insects sampling was done with insect sweep nets. Sweeping were performed 3-6 times.

2.2.2. The Method of Determination of the Sample Unit

This method uses a device consisting of a roller meter and altimeter or GPS. At locations that will be used to advance research surveyed to see location suitable for sampling. Topographic location or altitude measurement location using recording devices height is altimeter or a GPS location. Altimeter only serves to measure sea surface elevation, whereas GPS can measure elevation, latitude and longitude. Having in mind the location of ecosystems with high distance measuring instrument, then made experimental plots.

2.2.3. Implementation of the Study

Several studies in the field of implementation procedures comprising:

(1). The land area for each plot experiment with the size of 20 x 20 meters consisting of three replications / plot. Each plot experiment labeled. A1, A2, and A3. Also on the same sample bottles labeled in order to be identified.

(2). Catching insects begin at 07:00 am to 10:00 am with nets. .

(3). Prior to the implementation of research first initial and final temperatures measured.

(4). References are used as references for identification were Chapman [13], Triplehorn and Johnson [14], and Anonymous [15].

2.2.4. Data Analysis

Analysis of insect diversity in the ecosystem and the location of different heights Shannon index [16]

$$H' = - (n.i/N)\ln(n.i/N) \quad \text{.....1}$$

Where,

H = Shannon Diversity Index,
Ni = Number of individuals of species i/total number of samples
N = Number of species
In = Natural log

III. RESULTS AND DISCUSSION

In Table 3.1. was presented diversity and abundance of species of insects in some agricultural ecosystems. The number of insect species derived from ecosystems cornfield age of 2.5 months after planting (100-200 m asl), eggplant field I aged two months after planting (100-200 m asl), and eggplant field II (> 100-200 m asl) which comprises 195 species of 9 orders, 30 families. The highest population abundance of insects found in a cornfield (100-200 m asl) that is 140 people, followed by eggplant fields I and II respectively of 30 individuals and 27 individuals. Diversity of insects in corn fields that is eight orders (Homoptera, Hemiptera,

Diptera, Odonata, Coleoptera, Hymenoptera, Orthoptera and Lepidoptera), which consists of 16 family (Cicadellidae, Berytidae, Reduvidae, Lygalidae, Otitidae, Hellomycidae, Stratomycidae, Tetinidae, Caloppterygidae, Zygoptera, carolidaeTenebrionidae, Agromycidae, Acrididae and Tetigonidae). Family Cicadellidae has the highest population (66 individuals) compared different groups of individuals in the ecosystem. Insects found in the field of eggplant I namely four orders (Hymenoptera, Diptera, and Hemiptera and Orthoptera) consisting of six family (Halectidae, Colltidae, Cranefly, Cauxaplidae, Bertidae, Miridae, Braconidae, and Tetygonidae). In the garden eggplant II, there are five orders (Orthoptera, Hemiptera, blattaria, Coleoptera and Hymenoptera), which consist of nine family (Agrididae, Grylidae, Nabididae, Miridae, Coreidae, Blattidae, Endomycidae, Chrysmeidae and Multidae). The highest diversity index was found in eggplant fields II (H '= 2:04), followed by corn fields (H' = 1.99) and eggplant field II (H '= 1.84), but the values of diversity index were relatively low to moderate.

Percentage of population abundance of insects in corn field that is 47% Homoptera, Diptera 13%, 14% Hymenoptera, Lepidoptera 1%, Orthoptera 3%, 12% Hemiptera, Coleoptera Odonata 6% and 4% (Figure 3.1). In the garden eggplant I, the highest percentage of the Hemiptera insect population 40%, followed by 30% Hymenoptera, Diptera 20%, and Orthoptera 10% (Figure 3.2). In Figure 3.3, the highest percentage of the population that is 45% Hemiptera, Coleoptera, followed by 22%, 15% Orthoptera, Hymenoptera 11%, and 7% blattaria.

Insect diversity index on conventional agro-ecosystem was low because farmers use a monoculture system, the use of artificial fertilizers and pesticides, and also the vegetation structure. As a result of these treatments, the non-target insects die (including natural enemies), and certain hebivor host no longer so they leave this place [17]. Insect diversity at the highest corn fields (eight orders) compared with eggplant fields II (five orders) and eggplant fields I (four orders). In corn fields, insect diversity highest since around cornfields are fallow gardens. According to [18] that soybean fields bordering the gardens fallow has herbivors dam prdator / parasitoid more than the soybean gardens bordering the cultivated garden. Fallow garden serve as reservoirs of biodiversity for insects, birds, and plants mammals and insects from the garden can be split into cultivated gardens [19]. Number of individual insects in corn field more than in the garden eggplant I and II is mainly caused by the presence of leafhopper (Homoptera: Cicadellidae). Each individual can birth pathogenic leafhopper nymphs 30-80, but not everyone can survive because it is controlled by their natural enemies, as well as abiotic environmental factors that are not conducive to their growth [20].

Diversity of insect on eggplant eggplant fields I and II of different fields because there are natural enemies (spiders, family Araneida). The presence of members of the Araneae this affects the population density and diversity of insects [21]. Differences habitat and topography can affect the diversity of spiders as predators that have the ability to make nets and hunters can limit the population abundance fitopagus of the order Homoptera, Coleoptera and Diptera on agricultural crops ([22]. Some species prefer habitat that is open and undisturbed, in addition to habitat disturbed decomposition and nutrient cycling also bias effect on diversity in an ecosystem [23]. The difference in elevation or topography at an agricultural ecosystem could affect the state species of flora and fauna that occupy an area will form the different ecosystems [24].

Number of individuals of Hemiptera in eggplant fields I and II are the highest compared with other orders (Figure 3.2 and 3.3). This happens because around eggplant fields are gardens planted peanuts, flowers and vegetables. Hemiptera members also eat these plants, so these gardens serve as a reservoir of Hemiptera then split into eggplant fields [25]. In addition, the complexity of the structure of the plant or the height of vegetation has an effect on the number of arthropods in agroecosystem habitats [26].

table 3.1 insect diversity in agricultural ecosystems

Agricultural Ecosystems	Ordo	Famili	Number of Individuals	Total Number of Individuals
Corn Field (100 - 200 m asl)	Homoptera	Cicadellidae	66	66
	Hemiptera	Bertidae Reduvidae Lygalidae	11 2 3	16
	Diptera	Otitidae Hellomyzidae Stratomycidae Tettimidae	5 3 6 4	18
	Odonata	Calopyteygidae Zygoptera	6 3	9
	Coleoptera	Carabidae Terebrionidae	4 2	6
	Hymenoptera	Agromyzidae	19	19
	Orthoptera	Acrididae Tetygonidae	2 2	4
	Lepidoptera	Chareutidae	2	2
	Total		140	140

	Index Shannon		1,99	1,44
Eggplant Field I (100 - 200 m asl)	Hymenoptera	Halectidae	7	7
	Hemiptera	Bertidae Miridae	7 5	12
	Diptera	Tipulidae Cauxapilidae	4 2	6
	Orthoptera	Tetygonidae	3	3
	Total		28	28
	Index Shannon		1,84	1,27
Eggplant Field II (>100 - 300 m asl)	Hymenoptera	Multidae	3	3
	Hemiptera	Coreidae Miridae	7 5	12
	Orthoptera	Acrdidae Grylidae	2 2	4
	Coleoptera	Endomycidaechrysmidae	2 4	6
	Blattodea	Blattidae	2	2
	Total		27	27
	Index Shannon		2,04	1,43

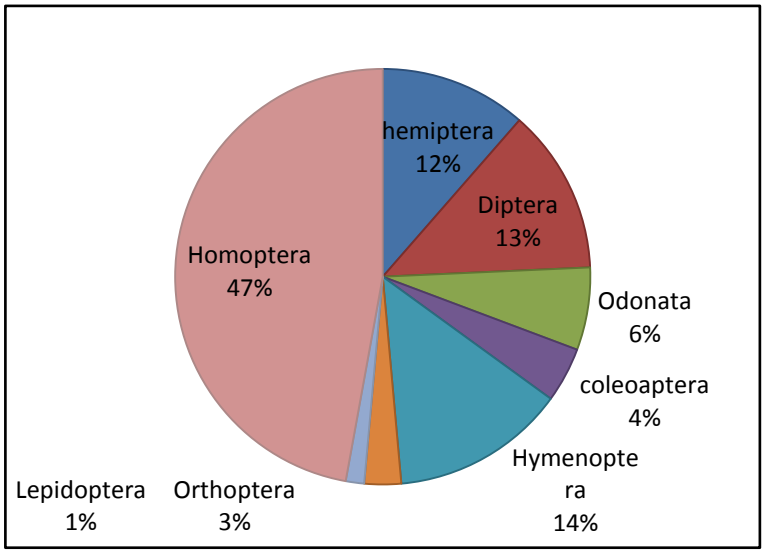

Figure 3.1. Insects Population Abundance Percentage in Corn Fields.

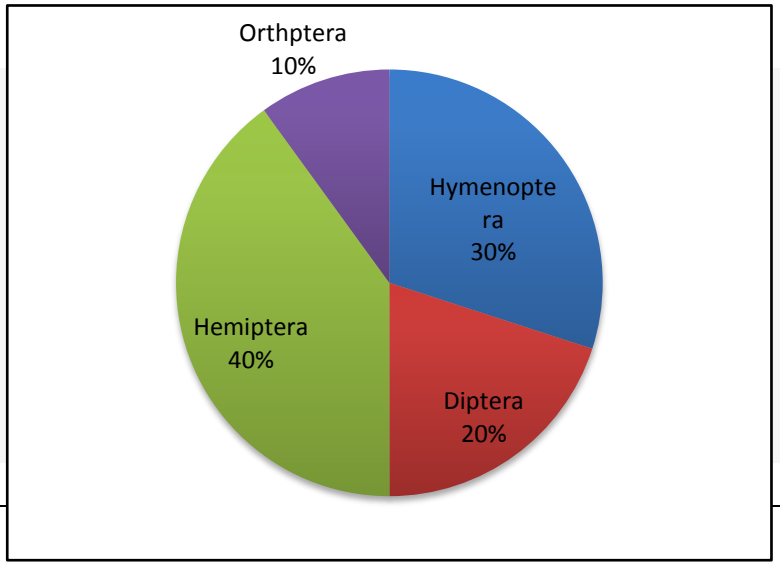

Figure 3.2. Insects Population Abundance Percentage in Eggplant Fields I.

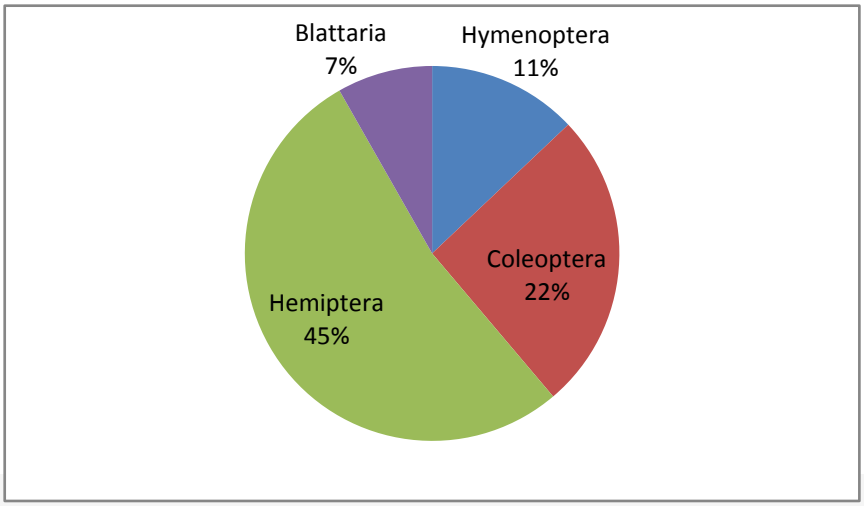

Figure 3.3. Insects Population Abundance Percentage in Eggplant Fields II.

IV. CONCLUSIONS

1. Diversity (orders) and density (individuals) of insects in corn field (100 - 200 m asl); eggplant field I (100-200 m asl); and eggplant field II (> 100-300 m asl) respectively Hemiptera 16, Diptera (18), Hymenoptera (19), Coleoptera (6), Lepidoptera (2), Homoptera (66), and Odonata (4); Hemiptera (9), Hemiptera (12), Diptera (6), and Orthoptera (3); Hymenoptera (12), Coleoptera (6), Orthoptera (4), and Blattodea (2). The highest diversity of insects found in eggplant fields I (H'= 2:04) followed by corn field (H' = 1.99) and eggplant field II (H' = 1.84).
2. The highest density of insects found in corn field (140 individuals), followed by eggplant field I (28 individuals) and eggplant field II (27 individuals).

REFERENCES

[1]. S.J. Rondonuwu-Lumanauw, Insect Diversity, Teaching materials to S3 at Sam Ratulangi University, 2006.
[2]. V.K. Brown and P.S. Hymann, Succesional Communities of Plants and Phytophagus Coleoptera, Journal of Ecology 74: 963-975, 1986.
[3]. Siswanto and Wiratno, Biodiversity of Insect on plants Vanilla (Vanilla planipolia) with Cover Crops, Arachis Pintoi K, Proceedings of the National Seminar III, Entomology Association of Indonesia, Bogor, 2000.
[4]. S.Archer and D.A.Pyke, Plant Animal Interaction Affecting Plant Establishment and Persistence or Revegetated Rangeland, Journal of Range Management, 44(6): 558-565, 1991.
[5]. D.H. Janzen, Insect Diversity of a Costa Rica Dry Forest : Why it, and How?, BioJ.LinneanSoci 30: 343-356,1987.
[6]. S. Risley, The Influence of Herbivores on Seasional Leaf Fall Premature Leaf Abscission and Petiole Clipping, Journal of Agricultural Entomology, 3:152 -162, 1986.
[7]. T.D. Schowalter, Insect Ecologi: An Ecosystem Approach, San Diego: Academic Press, 2000.
[8]. M.D. Lowman, Leaf Growth Dynamics and Herbivory in Five SPESIES of Australian Rain Forest Canopy Trees, Journal of Ecology,80: 433 – 447, 1992.
[9]. I.M.T. Schoohoven and Jermy van Loon, Insect Biology: From Physiology to plant Evolution, London: Chapman & Hall, 1998.
[10]. R.Van der wale,M, Egas,A. Van der veen, .&J.P. Bakker, Effect of Resource Competion herbivory on Plant Performance a long Nature Productivity Gradient, Journal of ecologyno, 88 pp 1 – 16, 2000.
[11]. Al.HoutyWasnia, Insect biodiversity in Kuwait International, Journal of Biodiversity and Conversation “, 1 (8): 25 – 257, 2009.
[12]. M.R. Speight, M.D. Hunte, and A.D. Watt, Ecology of Insects: Conceps and Applications, ley-Blackwell Hoboken, NJ, 1999.

[13]. D.J. Borror, C.A. Triplehorn, and N.F.Johnson, Introduction Lesson Insects, Gadjah Mada University Press, Yogyakarta, 1992.
[14]. Anonymous, Bug Guide Iowa State University Department of Entomology. http://bugguide.net/node/view/15740, 2012 (Accessed July 1, 2013).
[15]. C.J. Krebs, Ecology: The Experiment Analysis of Distribution and Abudance,Third Arper&raws Edition Publisher,New York, 1985.
[16]. M.D.G. Muller, Insect Diversity in Agricultural Grasslands: The Effects of Management and Landscape Structure, Doctoral Dissertation University of Zurich, 2000.
[17]. M.A. Altieri and D.K. Letournean, Vegetation Management and Biological Control in Agroecosystems, Crop Protection (4): 405 – 430, 1982.
[18]. F.J.A. Bianchi, C.J.H. Booij,and T. Scharntke, Sustainable Pest Regulation in Agricultural Landscape: a Review on Landscape Composition, Biodiversity and Natural Pest Control, Proceedings of the Royal Society B: Biological Sciences 273(1595):1715-27, 2006
[19]. G. Moya-Raygoza, A.M. urias, and C.A. Uribe-Mu, Habitat, Body Size and Reproduction of the Leafhopper, Dalbulus elimatus (Hemiptera: Cicadellidae) During the Winter Dry Season, Florida Entomologist 95 (2): 382 – 386, 2012.
[20]. V. Memah, M. Tulung, J. Warouw, and R.T.D. Maramis, Diversity of Spider Species in Some Agricultural
[21]. Crops in North Sulawesi, Indonesia, IJSER, 5 (6): 70 – 75, 2014.
[22]. S.E. Riechert and K. Lawrence, " Test for Predation Effect of Single Versus Multiple Species of eneralist redators : Spiders and Their Insect Prey, Entomol. Exp. Appl, 84: 147 – 155. 1997.
[23]. W.G. whitford, Decomposition and Nutrient Cycling in deserts. In: Whitford WG (ed) Pattern and Process in Desert Ecosystems. University of New Mexico Press, Albuquerque, NM pp 93–117, 1986.
[24]. B. Morrison, S. Douglas, and G.J. Stone, Environmental Assessment (Flora and Fauna) for a Proposed Development at Lot 1 DP 14039 , Parish of Southend, Wombarra, NSW, Woodlands Environmental Management, 1 – 37, 2010.
[25]. Anonymous, Hemiptera. https://en.wikipedia.org/wiki/Hemiptera, 2016 (Accessed August 11, 2016).
[26]. A.P. Borges, V.K. Brown. Phytophagus Insects and Wed Building Spiders in Relation to Complexity Ecography 24(1):68-82 , 2001.