RUMPHIUS PATTIMURA BIOLOGICAL JOURNAL
2021, 3 (1): 1-6
E-ISSN : 2684-804X

ABUNDANCE AND DIVERSITY OF COLLEMBOLA INSECTS IN SWITCHING FIELDS IN WAAI VILLAGE CENTRAL MALUKU

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Received: 9 October 2020 Accepted: 1 January 2021 Published: 25 March 2021

ABSTRACT

Collembola are a good example of the diversity of soil animals and play an important role in nutrient cycling, organic matter decomposition and soil formation which are important parts of forest ecosystems. This research was conducted on cassava land and a vegetable garden in Waai village, Salahutu sub-district, Central Maluku district, on July 18 2020. This study aims to determine the abundance and diversity of the Collembola insect in shifting cultivation in Waai village, Salahutu sub-district, Central Maluku district and its relationship with environmental factors. Results The study obtained 3 families and 6 species with a total abundance of 12.2 individuals/m2. There are differences in the abundance of Collembola found in vegetable gardens and cassava fields. The abundance of Collembola found in the vegetable garden was 3.6 individuals consisting of 2 families and 2 species, while in cassava fields it was 8.6 individuals divided into 2 families and 4 species.

Keywords: *abundance, diversity, collembola.*

To cite this article:
Tuasella, F., Moniharapon, M., Suriani, S. 2021. Abundance and diversity of collembola insects in switching fields in waai village Central Maluku. *Rumphius Pattimura Biological Journal*. 3 (1): 1-6. *DOI:https://doi.org/10.30598/rumphiusv3i1p1-6*

INTRODUCTION

Ecosystems are generally occupied by organisms with high diversity. Various types of organisms play an important role in maintaining ecosystem stability through complex interactions in food webs. Organisms that are often found associated with soil and plants are Collembola (Indriyati & Wibowo, 2008). Human-built ecosystems are ecosystems whose formation, designation and development processes are aimed at meeting human needs, agricultural ecosystems or agro-ecosystems are one example of human-built ecosystems (Profit, 2006). For rural communities, their lives are largely determined by natural resources, namely land and the environment itself. Agricultural ecosystems are systems that dynamically vary from one place to another. Insects are included in the agricultural ecosystem because insects interact with agricultural conditions. As stated by Oka (2005) which says that herbivorous plants and insects are interactions between two different trophic levels, plants as producers include the first trophic level and herbivorous insects as consumers including the second trophic level.

The existence of sustainable forest management activities is to maintain the function and role of the forest. In addition, forest management activities are expected to provide benefits to communities around the forest. Shifting cultivation is a form of traditional farming system that has long been practiced in several

areas outside Java in Indonesia, namely on the islands of Sumatra, Kalimantan, Sulawesi, Maluku and Irian. (Monk, 2000). A positive view of shifting cultivation states that, although shifting cultivation cannot be expected to be more environmentally friendly than natural forests, shifting cultivation provides a better environment than more intensive farming systems. Shifting can be a form of farming system that is in great demand from the past until now. Abundance is the number of individuals for each species, abundance is also defined as the number of individuals per unit area per unit volume (Ratnasari, 2015). Species diversity is a community trait that shows the level of diversity of the types of organisms in it. Obtain this species diversity, it is sufficient to have the ability to recognize and differentiate species even though one cannot identify the type of pest (Putra, 1994). In a stable ecosystem, the population of a type of organism is always in a state of balance with other populations of organisms in its community. This balance occurs because there is a control mechanism that works in a negative feedback manner that operates at the inter-species level (predation competition) and the inter-species level (territorial competition) (Rosalyn, 2007). To be able to recognize living things, especially animals based on their characteristics, can be done through observing morphological characteristics, habitat, ways of breeding, types of food, behavior, and several other observable characteristics (Michael, 1995).

The existence and density of a type of soil animal in an area is highly dependent on environmental factors, both abiotic environmental factors and biotic environmental factors (Suin, 1989). Insects have lived on earth approximately 350 million years ago, compared to humans, which were less than two million year. Micro factors that affect the life of soil insects are litter thickness, organic matter content, pH, fertility, soil type, soil density, and soil moisture, while macro factors are geology, climate, altitude, plant species, and land use (Purwowidodo, 2003). Collembola are organisms that are generally known to live in the soil and are grouped as mesofauna because they have a body size between 0.25 mm and 8 mm. Collembola plays an indirect role in the breakdown of organic matter and as an indicator of changes in soil conditions (Suhardjono et al. 2012). Geographically, the country of Waai is bordered to the east by the Haruku/Laut Strait, to the west by Morela/Mamala country, to the south by Tulehu country and to the north by Liang country. So that the people of Waai country have a job to fulfill their needs is farming, for this reason the purpose of this study is to find out the abundance and diversity of Collembola insects in shifting cultivation in Waai village, Salahutu District, Central Maluku Regency and its relationship with environmental factors.

METHODE

Type of research qualitative and quantitative research in two observation stations. This research was conducted on 10 February 2020 – 15 March 2021 in Waai Village, Salahutu District, Central Malukui Regency. The sampling method used in this study is the pitfall traps method. The tools used in this study were hoes, scissors, cameras, GPS meters, raffia rope, pegs, plastic caps, microscopes, small pudding glasses, label paper, Collembola books and painting brushes. The material used is 70% alcohol. The working method is divided into three stages, namely determining the observation plot, setting traps, and collecting insects. Analysis of the diversity index, abundance index and similarity index was carried out using the formula:

Diversity Index

$$H' = -\Sigma Pi \ln Pi$$

information:

Pi= Comparison of the number of individuals of a species with the whole species (ni/N)

Ni= Number of individuals of type I

N= The total number of individuals of all species

Abundance Index

$$K = \frac{Ni}{A}$$

Information:

K = Abundance

Ni = The total number of individuals of species-i

A = The total area of the sampled area

Index evenness

$$E = \frac{H'}{\ln S}$$

Information:
E = Index evenness
H'= Index diversity
S = Number of species

DISCUSSION RESULT

Waai Village is located in the Salahutu district, which is a country located under the foot of Mount Salahutu with a population of 8,047 people, most of whom are farmers with a population of 290 people. Since ancient times, people in rural areas have used forests as the main source of meeting their needs and they are easy to use, one of which is used as a place for shifting cultivation. Based on the results of the study, it was shown that there were two families, namely Entomobrydae and Oncopoduridae, and two genera, namely Orchesella sp and Proisotoma sp, in vegetable fields, while in cassava fields there were two families, namely Entomobrydae and Isotomidae, and 4 genera, namely Isotomus sp, Oncopodura sp, Ascocytrus sp and Tomecerus so it can be seen that station b is more moderate compared to station a which is low. From the results of calculating the abundance and diversity values of Collembola in shifting cultivation in Waai Village, Salahutu District, it can be seen in the following table.

Table 1. Collembola abundance and diversity

No	Genus	∑ Individual	Ki Individual	Index Diversity	Criteria
1	*Orchesella sp*	163	3,26	0,311	Low
2	*Oncopodura sp*	17	0,34		

Based on the results in the table above, it can be seen that there are two genera found in vegetable fields, namely Orchesella sp and Oncopodura sp which have a different number of individuals and have a diversity of 0.3115 which is very low compared to cassava fields.

Table 2. Abundance and diversity values of collembola on cassava land shifting cultivation in Waai village, Salahutu District, Maluku

No	Genus	∑ Individu	Ki Individu	Index Keragaman	Criteria
1	*Tomecerus sp*	130	2,6	1,371	Currently
2	*Proisotoma sp*	80	2,4		
3	*Arcocytrus sp*	120	2		
4	*Isotomurus sp*	100	1,6		
Amount			8,6		

Based on the results of the study, it can be seen that the abundance value of Collembola is found more in cassava fields than in vegetable fields. This is because there are four genera from two families, namely Tomecerus sp, Arcocytrus sp, Proisotomasp, Isotomurus sp which have a high abundance in cassava fields. The high and low diversity of the genus is determined by the number of genera and the total number of individuals. However, in general, the index value of diversity in cassava fields is 1.371, which is much lower than that in vegetable fields.

Table 3. Collembola evenness value on vegetable land shifting cultivation in Waai village, Salahutu District, Maluku

No	Genus	H'	Ln S evenness	Index evenness	Criteria
1	*Orchesella sp*	163	3,26	0,50	Unstable
2	*Oncopodura sp*	0,311	0,34		

Results of the table above on vegetable land, it can be seen that Collembola with two families, namely Entomobrydae and Oncopodura, has the most unstable evenness value with a value of 0.50 compared to cassava land. This is caused by abiotic and biotic factors which also influence the Collembola so that the environmental conditions themselves become unstable.

Table 5. Collembola evenness value on cassava land shifting cultivation in Waai village, Salahutu District, Maluku

No	Genus	H'	Ln S	Index evenness	Criteria
1	*Tomecerus sp*			1,371	Stable
2	*Proisotoma sp*				
3	*Arcocytrus sp*	1,371	1,386	0,989	
4	*Isotomurus sp*				

The results of the table above on cassava fields, it can be seen that Collembola with two families, namely Entomobrydae and Isotomidae, has the most stable evenness value with a value of 0.989 compared to vegetable fields. This is caused by the condition of the land which is located in the mountains and is strongly influenced by abiotic factors.

Table 6. Results of measurement of physical-chemical factors in shifting cultivation in Waai village, Salahutu District, Maluku.

No	Parameter	Measurement
1	Temperature	26^0C
2	pH	6

The results in the table above show that the temperature on the two lands in Waai village, Salahutu District, Maluku is 26^0C and pH 6, it can be said that the two lands have good quality for the growth of Collembola insects and the growth of other soil insects in them.

Research conducted at 2 different locations showed varying abundance and diversity of land use types. The results obtained indicated the Collembola genus from both lands which were located in cassava land locations which were at high altitudes and vegetable garden locations which were close to residential areas, namely 3 Families, and 6 genera with a total abundance of 12.2 individuals/m2. The abundance of Collembola found in vegetable gardens was 3.6 individuals consisting of 2 families and 2 genera. Whereas in cassava land there were 8.6 individuals which could be divided into 2 families and 4 species. Among the abundance of the Entomobrydae family, it had the highest abundance, reaching 373 individuals, both in vegetable gardens and cassava fields. It is very possible that this is caused by differences in existing environmental conditions. The abundance and variety of collembola species is closely related to an individual's ability to adapt to changes in the environment and food sources (Amir, 2008). There are generally fewer Collembola species in residential vegetable fields than cassava fields. This is possible because cassava land has long-lived vegetation and produces a lot of litter. Vegetation on cassava land namely bananas, jackfruit, clove plants, teak trees, wild plants, durian and rambutan. the existence of this vegetation supports the distribution of collembola so that more species are found. Meanwhile, the vegetation on vegetable land is plants such as spinach, mustard greens, eggplant, sweet potato, corn. This plant relatively does not produce litter because it

is directly harvested and cleaned by farmers. The use of pesticides and tillage also affect soil conditions and the behavior of soil animals.

Based on the different results between vegetable plantations and cassava fields have different diversity indexes. However, based on the Shanon-Winer criteria, the diversity value of 1.371 on cassava land was classified as Medium. while in vegetable land 0.3115 which is relatively low. Evenness data shows the level of individual distribution of existing species (Leksono, 2011). This research shows that the index of evenness of species in each habitat is descriptively different. suspect that this is influenced by the food chain, namely the longer the food chain, the higher the evenness index value. Evenness tends to increase following the diversity of habitat structures. When comparing the index values of evenness between habitats, it can be said that Collembola in agriculture tends to dominate even at very low levels. Another factor that affects the abundance and diversity of Collembola is interference from human activities. In forest ecosystems, disturbance from human activity is still minimal, while in plantations there are many human activities. This is supported by the statement of Erniyani et al (2010) that the higher the diversity index the higher the decomposition rate, so the soil fertility is getting better. High abundance and diversity can be seen in cassava land with a diversity index of 1.371 and in vegetable land 0.3115, and an increased Collembola population can be seen in cassava land which is categorized as medium compared to vegetable land which is categorized as low.

The air temperature obtained at the research site in Waai Village, Salahutu District, Maluku, in the morning was 26^0C, this temperature was still within the temperature range for insects to develop properly. The measurement of pH in the morning was carried out at around 08.00. It was obtained at the research location that the soil pH was in the range of 6-7. This pH measure can still allow insects to live and be active on the soil surface. As a component of the ecosystem, Collembola has a role that is not small and varies depending on the type or group. These roles include, among others, being a decomposer of organic matter, a fungus eater, an indicator (indicator) of changes in soil conditions, a balancer of soil fauna, predators, pests and pollinators. The role of Collembola in soil fertility is very important. So that the Entomobrydae family can be found in plantations in Waai Village because it has a very high diversity because it is easy to find on the soil surface and it likes soil habitats very much.

CONCLUTION

The total abundance observed in the two fields was 12.2 individuals consisting of 1 order, 3 families and 6 genera. There is a difference between cassava fields located in mountainous areas (8.6 individuals) and vegetable fields (3.6 individuals). Cassava land has moderate diversity but low agriculture.

The two habitats have different evenness, cassava land has high evenness from agriculture. there are differences in species diversity that can increase in cassava fields because of the land. This is possible because cassava fields have long-lived vegetation and produce a lot of litter compared to vegetable fields which after harvest are immediately cleaned by farmers.

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