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Diversity and Abundance of Beetles (Coleoptera) in the Village of Luksagu, North Tinangkung District and its Utilizationasa Learning Media

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Abstract

This study aims to determine the diversity and abundance of beetles and to make the research results a learning medium in the form of a pocket book. This type of research is descriptive research using the Coleoptera roaming technique method at observation stations. The results showed that the level of diversity and abundance of Coleoptera was moderate, namely $\hat{H}$ = 1.08, K = 5.50 with the number of Coleoptera obtained 14 species from 8 families of Coleoptera. The output of this study is a pocket book with a percentage of 82% (Very Appropriate) to be used as a biology learning medium. 64 Cd to 17,200 Cd and wind speeds ranging from 0.15 knots to 6.95 knots. The output of this study is a pocket book with a percentage of 82% (Very Appropriate) to be used as a biology learning medium. 64 Cd to 17,200 Cd and wind speeds ranging from 0.15 knots to 6.95 knots. The output of this study is a pocket book with a percentage of 82% (Very Appropriate) to be used as a biology learning medium.

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Introduction

Insects are the dominant animal group on this earth, whose numbers exceed all the animals from the animal kingdom group. Insects are classified into several orders, including Lepidoptera (butterflies), Hymenoptera (ants), Hemiptera (ladybugs), Odonata (dragonflies), Isoptera (termites), Orthoptera (grasshoppers), Diptera (flies), and Coleoptera (beetles). Each of these orders has unique characteristics in terms of shape, size and way of life (Borror, 1992).

Coleoptera is one of the orders that most often gets attention from researchers because it has various roles in plants including as a pollinator, predator and as a decomposer that is able to eat and destroy decaying organic matter in the form of dead plant or animal remains. Coleoptera species those who have a snout usually use the snout to help in foraging and laying eggs (Sangkertdati, 2008).

The results of Sugiyarto's (2007) showed that insects from the order Coleoptera family Melolonthida are a group of insects that damage and reduce fruit productivity on plantations. According to research by Harumi (2011) the Coleoptera population has an effect on fruit productivity, when the population is high,it is assumed that fruit sets are also high. Conversely, if the population is low, it is assumed that the fruit set is also low.

Factors that can influence the existence of cerambycid beetle communities are tree species, canopy cover, litter, rotten trees and rotting. Forest damage is a major cause of loss of biodiversity and a threat to ecosystem function and sustainable land use (Hoekstra et al. 2005 & Cardillo, 2006).

Insect diversity is influenced by several factors including land use type, land use intensity, habitat fragmentation, temperature (climate) changes, landscape complexity, human activity, changes in plant age and habitat conditions with natural forests, seasons, diversity of plant vegetation and mass of organic matter. As well as air and soil temperature (Borror, 1992).

Changes in land use functions from forest to plantation and agricultural land have resulted in the loss of several species of beetles (Pradana, 2012). Insects play an important role in maintaining forest balance and can be used as an indicator of the condition of the forest ecosystem. Clearing of forest for agricultural land or other purposes causes a decrease in the abundance and diversity of forest species. Beetles are a group of insects that play an important role in trophic structures (Packham et al. 1992).

Media is a tool used to convey information. In relation to learning, the media is defined as an intermediary or tool used in the learning process so that the material presented can be accepted by students well (Daryanto, 2016).

Setyono (2013) states that pocket books can be interpreted as books that are small in size, light in weight, easy to carry everywhere, and can be read. Anytime. According to Ranintya & Kriswanto (2015) a pocket book is a small book containing writing and pictures in the form of explanations that can direct or provide instructions regarding knowledge, easy to carry anywhere. The process of providing media information has a very important meaning, because in this activity the material conveyed can be assisted by using the media as an intermediary (Daryanto, 2016).

The Lomou Forest Landscape consists of various ecosystems, both forest and plantation commodity crops, such as rubber and oil palm. Lomou forest is one of the highland forests in the village of Luksagu, North Tinangkung District, Banggai Islands Regency, which was originally a permanent production forest area, limited production forest and other use areas. Lomou Forest has an area of 500 ha with an altitude of 0-200 m above sea level and average rainfall of 2-490 mm per year. Lomou Forest is part of a conservation area in Indonesia which has been transformed by planting commodity crops such as rubber, oil palm and cocoa. Due to differences in land use, as well as the catch of beetles for sale.

The Lomou Forest Area of Luksagu Village is included in the North Tinangkung District, Central Sulawesi where the Lomou Forest contains a variety of Coleoptera species, however research on beetles in the Lomou forest has never been carried out even though the benefits of some of these species have been felt by the surrounding community. Research on the diversity and abundance of Coleoptera in Luksagu Village has never been carried out. In addition, there is no scientific data that explains the species of beetles in the Lomou Forest, even though the data on the diversity and abundance of these beetles can be used for learning information to be made in the form of a pocketbook. Based on this, research on the diversity and abundance of Coleoptera in the lomou forest was carried out.

Research on "Diversity and Abundance of Beetles (Coleoptera) in Luksagu Village, North Tinangkung District and their use as a learning medium" can provide an overview of the types of beetles found in the area and can be used as a source of basic information on the types of beetles in the Lomou forest. This research can be used as a learning medium in the form of a pocketbook to develop educational science, especially knowledge about the diversity and abundance of beetles in the Lomou forest area of Luksagu village.

Materials and Method

This type of research is descriptive. With the intention of to know how is the diversity and abundance of beetles (Coleoptera) in Luksagu Village, North Tinangkung District, Banggai Islands Regency. This research is intended to describe the existing phenomena, in which there is an attempt to describe, record, analyze, and interpret the conditions that are currently occurring. Descriptive research aims to obtain information about the current situation. Then the results of this research will be made as a learning medium in the form of a pocketbook.

This research was conducted in the second week of April 2020. The determination of the research location was carried out by purposive sampling with consideration of the environmental baseline around the Lomou Forest, Luksagu Village, Tinangkung Utara District, Banggai Islands Regency. The population and samples in this study were all types of coleoptera that were sampled on the existing lines on each line of the observation transect line of the Lomou Forest, Luksagu Village, Tinangkung Utara District, Banggai Islands Regency.

The tools and materials used in this research include insect tissue, Hygrometer, a Lux meter, Anemometer, Camera, Stationery, Rope, a meter, a stake, and label paper.

The station was determined based on the habitat of Coleoptera and three locations were designated as research stations, namely community plantations, oil palm land, and cocoa plantations. The area of the observation location in the research area is ± 1000 m and uses the cruising technique. The sampling area will be determined by 3 stations, each station will be drawn 3 transects with a length of 100 m, the distance of each transect is 10 m to the left and 10 m to the right of the transect line, then the beetles around the transect line are sampled.

Determining the physical-chemical conditions of community plantations, oil palm

plantations and cocoa plantations by measuring the physical chemical conditions in the field, air temperature, humidity, light intensity and wind speed.

Data analysis. To find out the diversity index is calculated based on the formula according to Shannon-Wienner (H') and to find out the abundance index based on the formula Haryono (2007).

$$Ki = \frac{ni}{ST}$$

K = abundance
ni = number of individuals of type i
St = The number of stations occupied by type i

The criteria for the level of abundance according to Haryono (2007),

0 = none
1-10 = less
11-20 = enough
> 20 = Much

Making and validating learning media, the stages are:

1) Designing learning media
   At this stage the researchers designed learning media in the form of pocket books.
2) The steps for making learning media
   a) Take photos of each type of Coleoptera obtained in the study.
   b) Identify each type of Coleoptera
   c) Design a pocket book
   d) Print pocket book
3) Learning media validation
   After the learning media creation stage is complete, then the learning media validation is carried out by expert lecturers. The purpose of this validation is to help improve quality and find out the advantages and disadvantages of the learning media.
4) Revision of instructional media design
   This revision of learning media is carried out to improve the weaknesses of the learning media based on the results of the previous revisions.
5) Media feasibility trial
   After the learning media is validated by instructional media experts, the next stage is the media trial stage for 30 students from the Biology Education Study Program, Faculty of Teacher Training and Education, Tadulako University which consists of 20 large group students and 10 small group students. Person.

Analysis of the feasibility of learning media as follows:

$$\text{Formula: } P = \frac{\Sigma x}{\Sigma xi} \times 100\%$$

Information:
P : Percentage
∑x : Total score obtained
∑xi: Total overall score

After the percentage value is obtained, it is interpreted in a sentence with the criteria as stated by Haryono (2007).

Results and Discussion

Based on the results of the research, the three stations are still in normal condition. For more details, see Table 1.

Table 1. Results of measurement physical-chemical conditions

No.	Station	Parameter		
		Temperature (°C)	Intensity light (Cd)	Wind Speed (Knots)
1.	I	28.4°C	0.195 - 15,100	0.15 - 3.15
2.	II	27.6°C	0.64 - 17,200	1.85 - 6.95
3.	III	29.4°C	9,050 - 13,650	2.5 - 4.85

Based on the results of research conducted at three observation stations, overall there were 14 types of Coleoptera consisting of 8 families. For more details, see Tables 2 and 3.

Table 2. The types of Coleoptera found in Luksagu village

No.	Order	Family	Genus	Species
1.	Coleoptera	Lucanidae	Dorcus	*Dorcus titanus*
			Prosopocoilus	*Prosopocoilus savage*
			Cyclommatus	*Cyclommatus metalifer*
			Odontalabis	*Odontalabis belicosa*
			Prosopocoilus	*Prosopocoilus bruijni* P
2.		Scarabaeidae	Chalcosoma	*Chalcosoma caucasus*
			Agestrata	*Agestrata orichalca*
3.		Buprestidae	Chrysochroa	*Chrysochroa fulminans*
4.		Histeridae	Hypocaccus	*Hypocaccus rugiceps*
5.		Cerambycidae	Aeolesthes Nemophas	*Aeolesthes sarta* *Nemophas bifasclatus*
6.		Melyridae	Melyris	*Melyris fabricius*
7.		Curculionidae	Rhynchophorus	*Rhynchophorus vulneratus*
8.		Carabidae	Chlaenius	*Chlaenius femoratus*

Table 3. The types of Coleoptera found at each station

No.	Species name	Station 1	Station 2	Station 3	Σ
1.	*Chrysochroa fulminans*	9	-	9	18
2.	*Hypocaccus rugiceps*	7	8	7	22
3.	*Chlaenius femoratus*	5	3	-	8
4.	*Melyris fabricius*	4	5	-	9
5.	*Agestrata orichalca*	4	7	-	11
6.	*Nemophas bifasclatus*	-	3	-	3
7.	*Dorcus titanus*	-	4	-	4
8.	*Prosopocoilus bruijni P.*	-	4	4	8
9.	*Cyclommatus metalifer*	-	2	5	7
10.	*Prosopocoilus savage*	-	4	-	4
11.	*Aeolesthes sarta*	-	3	-	3
12.	*Chaicosoma caucasus*	-	-	8	8
13.	*Odontalabis belicosa*	-	-	4	4
14.	*Rhynchophorus vulneratus*	-	-	6	6
	Amount				115

The results of research on the diversity of beetles (Coleoptera) in the village of Luksagu, North Tinangkung district, Banggai Islands Regency from the three research stations, the diversity index can be seen in Table 4.

Table 4. Beetle diversity index (Coleoptera)

STATION	IK	Pi (ni / N)	In (Pi)	Pi Ln Pi
STATION I	1,491	0.26121	-1.34243	-0.35065
STATION II	2,321	0.40662	-0.89987	-0.36590
STATION III	1, 896	0.33216	-1,10213	-0.36608
	5,708			-1.08

Note: H ' = - Σ (Pi In Pi)
= - (-1.08)
= 1.08 (Medium Diversity Level)

The results of the study on the abundance of beetles in the village of Luksagu, North Tinangkung District, Banggai Islands Regency, from the three research stations, obtained an abundance index can be seen in Table 5.

Table 5. Abundance beetle (Coleoptera)

Abundance		
Station I	Station II	Station III
5.8	4.6	6.12
	5,50	

The results of the assessment of learning media about pocket books, which were carried out by content experts, media experts, design experts (Lecturers) stated that the learning media in the form of pocketbooks were suitable for use as learning media and could support the learning process, the percentage obtained was 76.52%. Testing on students got a percentage of 81.5%.

This research was conducted at 3 stations with different environmental conditions, these three stations include community plantation land, oil palm land and cocoa plantation located in Luksagu Village, Tinangkung Utara District, Banggai Islands Regency, after conducting research for 1 week, 14 sample data were obtained. Species belonging to the order Coleoptera. During the research activities, several samples were found on different substrates including litter, oil palm tree trunks and grass.

Based on the research results, station I is located on community plantation land adjacent to a highway which is dominated by a variety of plants, both high and low. The results of measurement of chemical physics factors at the station I obtained an average temperature of 28.4 ˚C, light intensity

0.195 - 13.650 Cd and wind speed 0.15-3.15 Knots. The results showed that the types of beetles were Chrysochroa fulminans, Hypocaccus rugiceps, Chalaenius femoratus, Melyris fabricius, Agestrata orichalca. The level of diversity at this station is $\hat{H}$ = 1.491 which is classified as moderate. Based on the level of diversity and the measurement results of environmental physics and chemistry factors, it can be seen that this station is still in a stable state. This is in accordance with the opinion of Kumar & Ahmad (2007), who said if the humidity is high then the temperature is low, this is the time the insects are active, and insect activity is moderate at normal humidity and temperature. The advantages of this research location are that it is dominated by a variety of plants, both high and low, which allow the beetles to get sufficient food intake. The deficiencies in this research location are influenced by environmental stress factors such as changes in the ecosystem and human activity around the research location which causes the beetles not to occupy the ecosystem optimally. This is in accordance with Darmawan et al. (2005), saying that diversity tends to be low in ecosystems that are physically controlled, or are subject to environmental stress. Argyropoulou et al. (2005) stated that human activity in agriculture can affect the composition of the order coleoptera.

Observation II pension is located on oil palm land. It has a level of diversity $\hat{H}$ = 2.201 which is classified as moderate. Measurement of chemical physics factors obtained an average temperature of 27.6 ˚C, light intensity 0.64 - 17.200 Cd, and wind speed 1.85-6.9 Knots. The results showed that the types of beetles were Hypocaccus rugiceps, Melyris fabricius, Chlaenius femoratus, Nemophas bifasclatus, Dorcus titanus, Agestrata orichalca, Prosopocoilus bruijni P. Cyclommatus metalifer, Prosopocoilus savage. Wind speed is slightly higher, but it is still in a stable condition so that it does not have a significant effect on the presence of beetles, this can be seen from the moderate level of diversity.

Observation station III is located in a cocoa plantation adjacent to the main road and is dominated by coconut, areca, and mango trees. Has a level of diversity $\hat{H}$ = 1,896 which is classified as moderate. The measurement results of environmental chemical physics factors at this station on average have a higher level compared to other locations. It is also estimated that this is one of the factors that cause the low diversity level of Coleoptera at that location, with an average temperature of 29-32.5.ºC, light intensity 9,050-13,650 Cd, wind speed 2.5–4.85Knots. The results showed that the types of beetles were Chrysochroa fulminans, Hypocaccusrugiceps, Odontalabis belicosa, Prosopocoilus bruijni P, Cyclommatus metalifer, Chaicosoma caucasus, Rhynchophorus *vulneratus*. The relatively high wind condition is one of the factors that causes the moderate level of coleoptera diversity at this location, this is in accordance with the opinion of Ysvina (2010) and Noerdjito (2010), who says air movement is an important factor in the spread of insects. The direction of the spread of insects sometimes follows the direction of the wind, and strong winds can also prevent insects from laying eggs and can even kill them. Food conditions are also one of the factors that cause moderate Coleoptera diversity, at this station where is dominated by large plants and few flowering plants so it is likely not too attractive for Coleoptera to visit.

The level of diversity of Coleoptera found in the village of Luksagu, Tinangkung Utara district, Banggai Islands Regency is classified as medium. This can be seen from the Shanoon-Winer diversity index, namely $\hat{H}$ = 1.08 (can be seen in Table 5). Based on these results, it can be seen that the conditions at the research location are still stable, because the high and low diversity of insects can be influenced by several factors such as factors including reproductive ability, self-defense, life cycle, and external factors including temperature, humidity, light and wind. As stated by Kamarudin et al. (2005) insect populations sometimes change at the start of the season, mainly by environmental factors such as rainfall, temperature, and humidity. The optimal air temperature will indirectly affect the waste decomposition. This causes the waste to be more completely decomposed. According to Supriyadi (2008), temperature affects the rate of decomposition of organic matter.

Based on Table 5 the abundance of Coleoptera species based on the distribution of station I (community-owned plantations), station II (oil palm land), and station III (cocoa plantation land), the abundance of Coleoptera is low or slight. The abundance level of Coleoptera at each station is also influenced by environmental dynamics. The dynamics that occur are in the form of plant phenology, physical conditions, and climate from time to time which can affect the production

process, growth, and mortality. It is this change that directly or indirectly causes a change in the number of Coleoptera. This is in accordance with the thought Andrewartha & Birch (1954), who stated that the factors that influence population growth, development, and density are the availability of resources such as food and living space as well as resource accessibility and the ability of individual populations to reach and obtain resources (including the nature of distribution, dispersal, and searchability).

The rainfall factor also affects the weathering of litter, and stalks, and becomes suitable organic material to become food and habitat for Chrysochroa fulminans beetles. This is in accordance with research conducted by Pujiastuti et al. (2010).

The abundant type of Station II is Hypocaccus rugiceps. This species is found in dry and decomposed leaf litter which is useful for obtaining food intake, the large number of fallen oil palm trees in this location are used to lay eggs. The condition of oil palm plantations that are left neglected is one of the favorite places for livestock to find food, taking shelter from the hot sun. The large number of livestock in this place results in an abundance of manure which is used by this species of beetles as a place for the growth and development of larvae to become imago. This Hypocaccusrugiceps beetle lives by using its front legs to penetrate the surface of the dung to make a tunnel for temporary nesting sites. With this behavior pattern, this beetle has a fairly wide distribution pattern and is widespread in various types of climates. This is in accordance with research conducted (Noerdjito, 2011).

Kustandi & Sutjipto (2013) learning media is a tool that can help the teaching and learning process and functions to expand the meaning of the message conveyed. So that it can achieve learning goals properly and perfectly. According to Rahmawati et al. (2013) that students tend to like interesting reading with few descriptions and lots of pictures or colors. If the media carries messages or information that are instructional or contain teaching intent, then the media is learning media.

The making of instructional media for printed books was initially carried out with the stages of preparation, observation, to the research stage in Luksagu Village, North Tinangkung District, Banggai Islands Regency. Furthermore, identifying the types of beetles found in the research area, the next process is designing learning media in the form of pocketbooks. After that, validation was carried out by a team of expert lecturers, namely content experts whose average score was 78%, design experts at 77.3%, and media experts at 74.28% to find out the weaknesses of the pocketbook and then repaired it. The improved instructional media design was then tested on 30 students of the Biology Education Study Program consisting of 20 large group students whose average score was 81.2% and 10 small group students with an average score of 82.7%. Based on the feasibility analysis of the pocketbook learning media conducted by students, it was stated that the pocketbook was suitable for use as a learning medium and could support the learning process with a percentage of 82%. This is in accordance with the research conducted by Saputra (2018), concerning the Making of a Pocket Book on the diversity of living things at SMPIT FazarIlahiBatam in the 2016/2017 academic year.

Books as a learning medium can reduce verbalistic and abstract characteristics in learning. In addition, one of the functions of pocketbooks according to Sulistyani et al. (2013), namely an attention function, is that pocketbook media printed in small packages and full color can attract students' attention to concentrate on the content of the material written in it.

Conclusions

Based on the results of research that has been carried out in Luksagu Village,North Tinangkung District, Banggai Islands Regency, it can be concluded as followsDiversity and abundance of Coleoptera species in Luksagu Village, Tinangkung Utara District, Banggai Islands Regency are classified as moderate, they are H '= 1.08 and the abundance is low = 5.50. The results of the research on the diversity and abundance of beetles (Coleoptera) in the village of Luksagu were applied as a pocketbook and suitable for use as a learning medium.

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