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Diversity and the abundance of the insect of Coleoptera orders at Mamberamo river bank of Papua Province, Indonesia

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ABSTRACT

This study aims to determine the diversity and abundance of the order Coleoptera on the riparian of the Mamberamo river in Papua Province. The method used is a survey method. Determining the location and station of research was conducted by purposive sampling method. Sampling the species of the order Coeloptera was done by direct sampling, insect nets and traps insects. Samples were analyzed using species diversity index, relative abundance index, dominance index and evenness index. The results found were 437 individuals, 29 species and 12 families of the order Coleoptera. Family of the order Coleoptera cover, namely Carambycidae, Carabidae, Chrysomilidae, Ciidae, Coccinellidae, Curculionidae, Dystiscidae, Melandryidae, Phalacridae, Scarabidae, Staphylinidae, and Tenebrionidae. The family of Coccinellidae and Chrysomilidae have the highest number of species, namely 8 species. The highest number of individuals was found in the family Chrysomilidae of survey sites Station I, which is a species Lema diversa (114 individuals). Based on the survey area, the highest individual number of the order Coleoptera was found in the Station I (451 individuals). The species diversity of Coleoptera covers the riparian of the Mamberamo river in Papua different. Diversity index of insect order Coleoptera in four locations in Papua Mamberamo river riparian has been classified as moderate or not so diverse. Evenness index of the order Coleoptera in four survey sites of Papua Mamberamo river riparian lower appears quite evenly. Dominance index species of the order Coleoptera on the riparian of Mamberamo River in Papua showed the value <0.50, meaning do not happen dominance of certain species. The information of this research results is expected to be the initial information diversity and abundance of the order Coleoptera on the riparian of the Mamberamo river, Papua Province.

***Keywords*:** Biodiversity, Coleoptera, Mamberamo River, Papua Province

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1. INTRODUCTION

Insect diversity of the order Coleoptera is higher in the tropics compared to the temperate region. Abiotic factors such as temperature are one factor that greatly determine the density distribution of Coleoptera [1]. Coleoptera orders have the largest number of species. These orders make up about 40% of all insect species and are a major component of animal diversity [2]. Indonesia is a country that is included in the tropics, of course Indonesia has a diversity and abundance of high order Coleoptera insects including insects from the Coleoptera order found in the Mamberamo riverbank area of Papua Province. Seeking universal characteristic properties of ecosystem integrity, which may be optimised over time, and measure the complexity, well-being and functionality of an ecological network has been a long-standing goal in ecology. While ecological complexity is often measured in terms of solely structural properties of the trophic topology, ecological integrity and ecosystem functioning actually depends on the interplay between all species and how they act together. organisation or integrity has thus to account for both structural and functional aspects of the ecological network and integrate the structural constraints with their effect on the functional behaviour of the system [3]. The Mamberamo River is part of the major rivers in Indonesia. Along with the development, the Mamberamo River has undergone many land use changes or has changed functions to become tourist areas, settlements, markets, ports and agricultural land. The Mamberamo River is under a multifunction, namely as a means of transporting water, a source of water for domestic and waste water disposal sites. Changes in physical and chemical quality of waters can be relevant of flora communities such as phytoplankton [4].

The effects of human activity around the Mamberamo River have an impact on the diversity and abundance of fauna in the region including insects of the order Coleoptera [5] Stated that the application of insecticides decreases the diversity of species of order Coleoptera. In this case, the order of Coleoptera as a non-target organism, but at present the presence of the order of the order Coleoptera is still found in the vegetation of the plants of the Mamberamo River in Papua Province. Coleoptera is one of the components of the ecosystem in the waters of the Mamberamo River. Coleoptera is an insect order that plays an important role in terrestrial ecosystems and aquatic ecosystems.

The role of order Coleoptera insects in ecosystems is as eaters of decaying organic substances, decomposers of organic material and natural predators [6-8]. Based on the magnitude of the role of insects of the order Coleoptera, it is necessary to know the diversity and abundance of insects of the order Coleopteran in these waters. Research on species diversity and abundance can be useful for research monitoring ecosystem changes. Therefore, the purpose of this study is to obtain information on the diversity and abundance of insects of the order Coleoptera on the banks of the Mamberamo River in Papua Province.

2. RESEARCH METHOD

The location of the study ranges from 10 - 11 masl. The four research locations were on the banks of the Mamberamo River, namely the IV Station, Station III, Station II and Station I. Station IV represented the coastal area (Station), Station III represented the forest area, Station II represented the residential area and Station I represented the agricultural area. The research location or insect habitat of the Coleoptera order is still found in various kinds of plant

vegetation. The temperature of the research location ranged from 22 – 25 ºC and the humidity of the study location ranged from 78% - 82%.

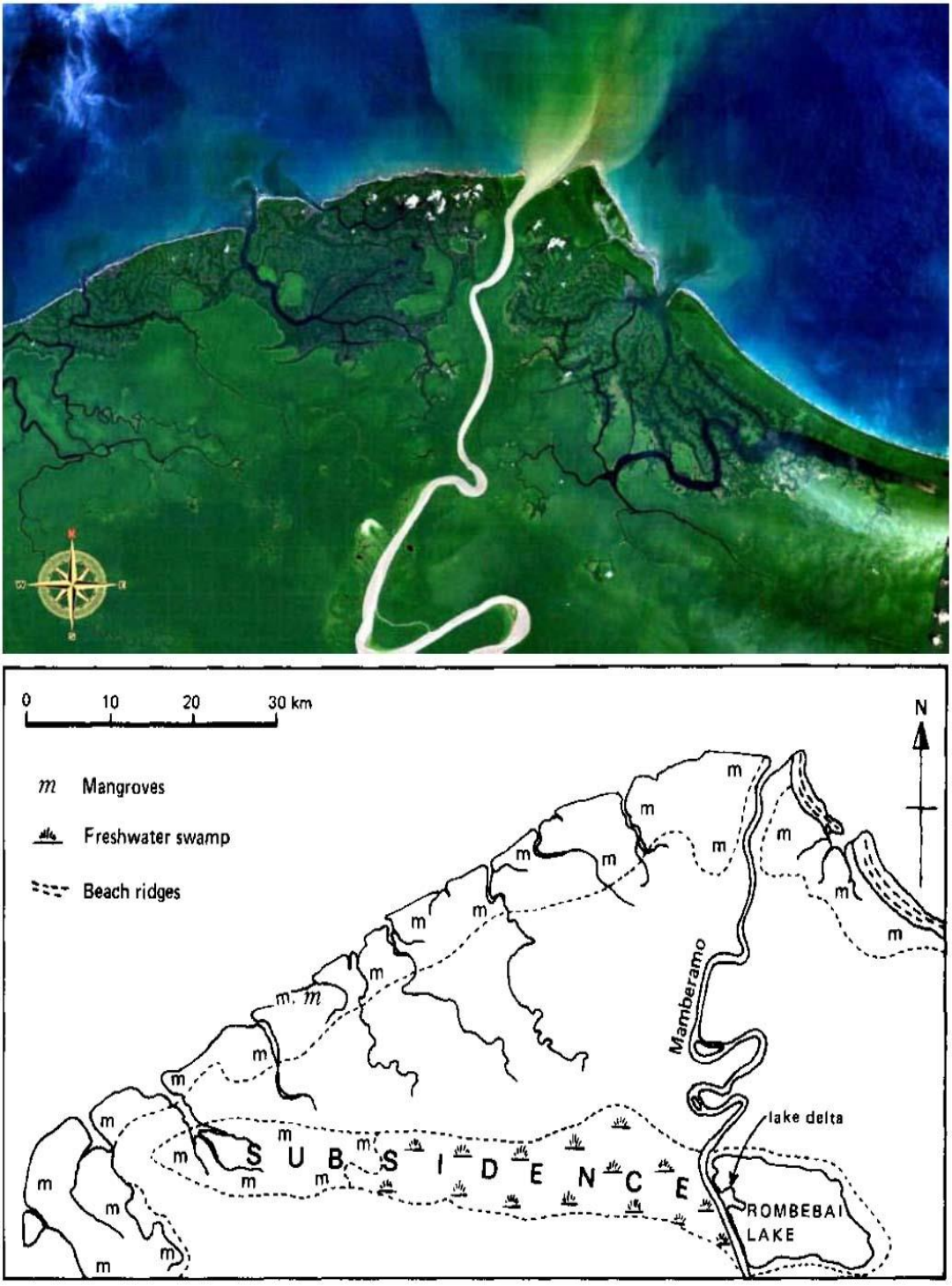

Fig. 1. Location of research on the banks of the Mamberamo river, namely as an agricultural, residential, forest and coastal area where the insect habitat of the order Coleoptera, Papua Province, Indonesia

2. 1. Terrestrial and aquatic Coleoptera collection

The insect sample collection is carried out using roaming techniques, which are explored as far as 2 km on vegetation on the banks of the Mamberamo river (land and water). In the roaming area 4 observation stations are made. The order of the order of Coleoptera insects is carried out by direct sampling, insect nets and insect traps (light trap, pitfall trap and light intercept traps) for 24 hours. The survey for each location was performed 4 times. Exact sampling and insect nets are carried out at 8:00 a.m. to 10:00 p.m. and afternoon at 3:00 p.m. to 5:00 p.m. WIT. Especially the collection of examples of aquatic insects, a collection of examples of insects is carried out only at stations found in vegetation of aquatic plants. Insect nets are inserted in water around plant vegetation, then doused with water or sorted until Coleoptera water is found. In the Mamberamo river water the clear Coleoptera collection is carried out by direct observation [1, 4, 8-13].

2. 2. Identification of Coleoptera

Examples of Coleoptera obtained are then inserted into a collection bottle containing alcohol. Bottle collection samples of Coleoptera are labeled including information on the place, date and time of collection. Identify Coleoptera samples founded on morphological characters. Identification of Coleoptera is generally carried out to the genus level. If possible identification is carried out to the species level. The identification of Coleoptera uses a book, based on [2, 14-18].

2. 3. Data analysis

Coleoptera identification results are included in the table to be analyzed using ecological indices. The indices are Shannon-Wiener (H') diversity index, relative abundance index (KR), dominance index (C) Simpson and type evenness index (E) [19, 20].

3. RESULTS AND DISCUSSION

3. 1. Species of Order Coleoptera are found on the banks of the Mamberamo River in Papua

The results of the study found 546 individuals, 29 species and 12 families of the order Coleoptera. The families of the order of Coleoptera, namely Carambycidae, Carabidae, Chrysomilidae, Ciidae, Coccinellidae, Curculionidae, Dystiscidae, Melandryidae, Phalacridae, Scarabidae, Staphylinidae, and Tenebrionidae (Table 1)

Table 1 above shows the number of species and the number of individuals from each family in the order of Coleoptera. Of the 12 families of the order Coleoptera, the family Coccinellidae and Chrysomilidae have the highest number of species, namely 8 species. The highest number of individuals was found in the Chrysomilidae family of Station I survey locations, namely Lema diversa species (114 individuals). For the lowest number of species found in the family Staphylinidae with the number 1, namely a Paederus sp. Based on the location of the survey the number of individuals from the Coleoptera order from the highest were 451 individuals (Station I), 25 individuals (Station II), 50 individuals (Station III) and 18 individuals (Station IV). It is suspected that the composition and number of different species of Coleoptera orders at the survey location is due to habitat differences and the influence of human

activities. This statement is supported by the opinion of [21, 22] that habitat differences and the influence of human activities affect the composition and number of species of the order Coleoptera.

Table 1. Family and species of Coleoptera orders found on the banks of the Mamberamo River in Papua Province.

No	Orders/Family/ Species/Indent	Survei Location (Σ)				Σ	Σ per family
		Station I	Station II	Station III	Station IV		
	Carambycidae						7
1	*Morimonella bednoriki*	7	0	0	0	7	
	Carabidae						4
2	*Pterostichus quadrifoveolatus*	0	2	0	0	2	
3	*Indent* sp. 1.	0	0	2	0	2	
	Chrysomilidae						206**
4	*Agelastica alni*	15	2	0	0	17	
5	*Kuschelina vians*	0	1	0	0	1	
6	*Lema diversa*	114*	0	0	0	114*	
7	*Podontia lutea*	3	0	0	0	3	
8	*Oulema melanopa*	0	9	6	0	15	
9	*Charidotella* sp.	41	1	0	0	42	
10	*Aspidomorpha* sp.	10	0	0	0	10	
11	*Chaetocnema hortensis*	0	0	0	4	4	
	Ciidae						14
12	*Cis fuscipes*	14	0	0	0	14	
	Coccinellidae						107
13	*Coelophora maculata*	9	2	0	0	11	
14	*Coelophora pupillata*	13	0	13	0	26	
15	*Coelophora reniplagiata*	6	0	0	0	6	

16	*Scymnus rubricaudus*	5	0	0	8	13	
17	*Verania lineata*	16	0	0	2	18	
18	*Ileis koebelei*	0	1	0	0	1	
19	*Micraspri frenata*	0	3	0	0	3	
20	*Epilachna argus*	0	0	29	0	29	
	Curculionidae						40
21	*Conotrachelus nenuphar*	17	0	0	2	19	
22	*Hylobius pales*	14	0	0	2	16	
23	*Myrmex subglaber*	5	0	0	0	5	
	Dystiscidae						88
24	*Acilius* sp.	88	0	0	0	88	
	Melandryidae						3
25	*Emmesa labiata*	0	3	0	0	3	
	Phalacridae						3
26	*Phalacrus politus*	3	0	0	0	3	
	Scarabidae						11
27	*Apogonia expeditionis*	11	0	0	0	11	
	Staphylinidae						1
28	*Paederus* sp.	0	1	0	0	1	
	Tenebrionidae						60
29	*Helops laetus*	60	0	0	0	60	

Information: * the highest number of species and ** the highest number of families found in four locations surveying the order of Coleoptera on the banks of the Mamberamo river in Papua Province

For more details about the number of species and the number of individuals from each family of the Coleoptera order from the banks of the Mamberamo River, Papua Province can be seen in the Figure below.

Figure 2 and Figure 3 show that the highest number of species is found in the family Chrysomilidae and Coccinellidae, which are 8 species (29%) respectively. The number of Coccinellidae family species in this study is lower than the results of studies reported by [23, 24]. [23] found 51 species and [24] found 22 species from the family Coccinellidae. Likewise

the number of Chrysomilidae family species, the results of this study are less than those reported by [25]. [25] reported the family of Chrysomilidae there were 55 species in Turkey. It is believed that the difference in the number of species is due to the location of the survey wider and longer conducting field surveys from this study. The first and the second highest number of individuals found in the family Chrysomilidae (204) and Coccinellidae (107).

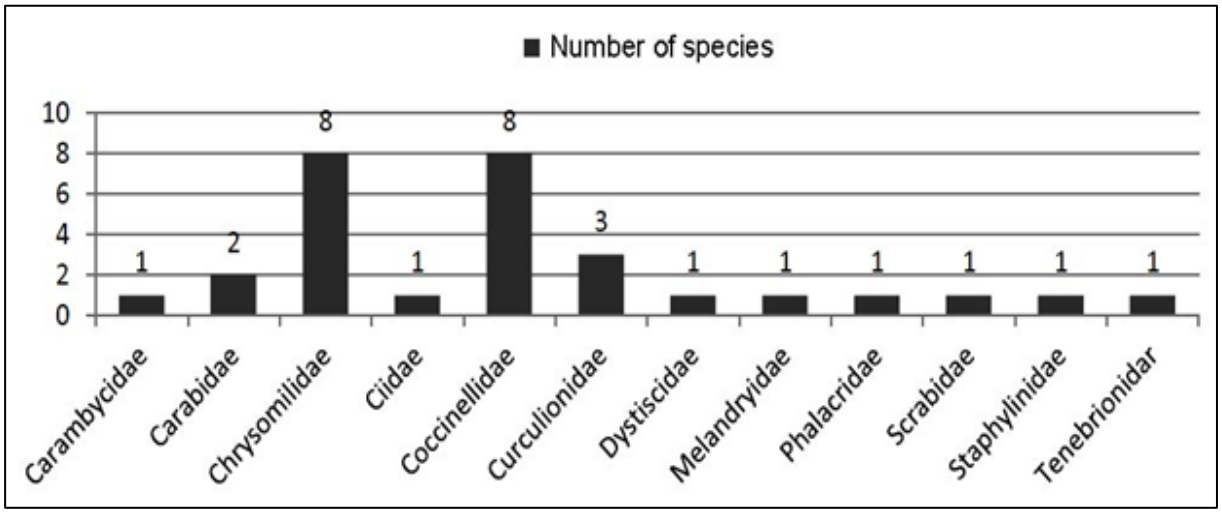

Fig. 2. Number of species from each family of the order of Coleoptera from the banks of the Mamberamo River, Papua Province

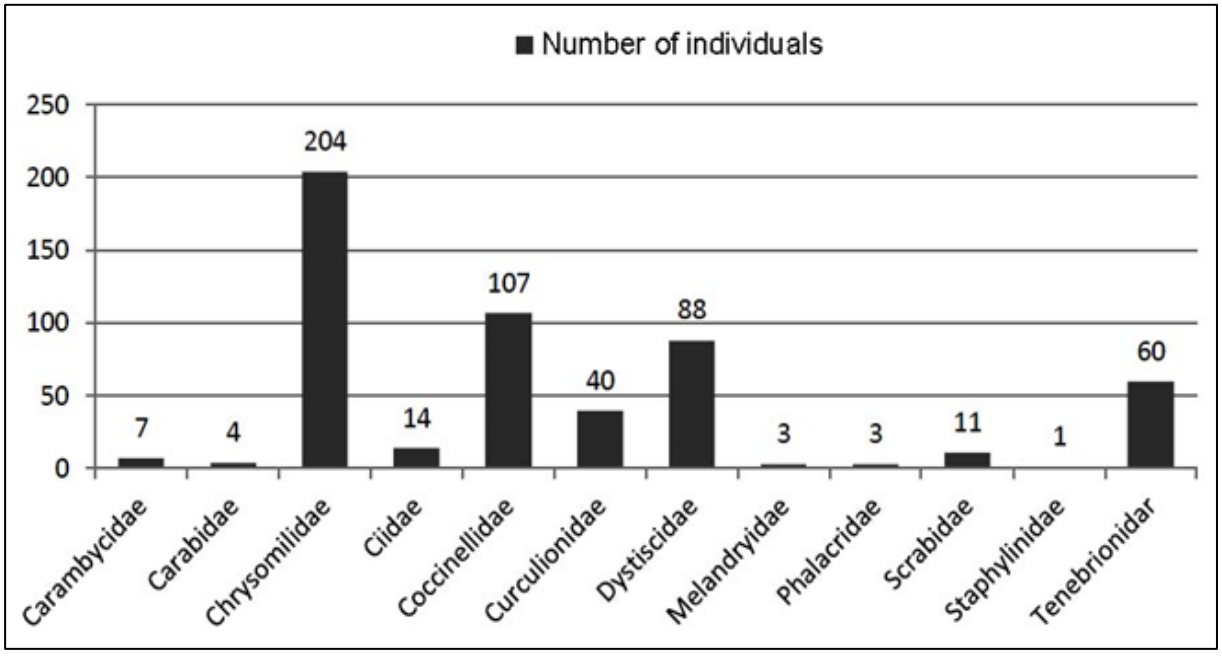

Fig. 3. Number of individuals from each family of the order of Coleoptera from the banks of the Mamberamo River, Papua Province

In this study, the number of families found was only 12 families of the order Coleoptera. [26] state that the order of Coleoptera has around 160 families, so based on this data the number of families found on the banks of the Mamberamo River in Papua Province is around 6.9% of the total family of Coleoptera found throughout the world. The difference in survey location area greatly influences the number of species and number of individuals obtained, because the wider the location of the survey, the more diverse habitats are sampled. This statement is supported by the opinion of [27] who stated that the number of species obtained was influenced by the size of the study location and the intensity of sampling.

Based on the type of family food Chrysomelidae classified as phytophag insects, while insects from the family Coccilinidae are classified as predatory insects. According to [28,29], the diversity of phytophag insects is influenced by plants and the conditions of the surrounding environment. The high abundance of Lema diversa from the Chrysomelidae family in Station I is due to the abundance of food sources for fitophag insects at this location. [30] say the presence of a type of insect in a habitat is closely linked to the food activity of the insect. Station I is an area that still has a lot of natural vegetation and swamps, and the level of human activity is lower than other locations. Natural vegetation and swamps provide a diverse food source that supports the survival and diversity of phytophagic insects. In addition, it is suspected that the presence of predatory insects that prey on phytophag at Station I is lower. Insects from the family Coccilinidae are oligophagic predators that prey on aphids and insect pests. The abundance of the family of Coccillinidae which is high in the second shows that these family insects have also been well adapted as predators.

3. 2. Species Diversity Order Coleoptera found on the banks of the Mamberamo River in Papua

Community characteristics of the study area included diversity index, evenness, dominance and relative abundance. The results of the study show the banks of the Mamberamo river, especially the survey locations, namely Station I, Station II, Station III and Station IV which have a variety of medium Coleoptera orders. To be more clear, can be seen in Table 2 below.

Table 2. Based on the survey location of the diversity index of the Coleoptera order in four survey locations on the banks of the Mamberamo River in Papua Province.

Community Characteristics	Lokasi Survey			
	I	II	III	IV
Species diversity index	2.53*	2.31	2.35	1.79
Dominance Index of species	0.24	0.28	0.20	0.33*
Species evenness index	0.79	0.85	0.84	0.92*

Information: * Diversity index, species dominance index and highest species evenness index

The results of the research that have been conducted show that the region that has the highest diversity index is Station I, which is 2.53 followed by Station III 2.35, Station II 2.31

and Station IV 1.79. Based on the Shannon-Wiener diversity index 4 regions representing the Mamberamo river, Papua Province have a moderate level of diversity. The insect diversity of the order of Coleoptera on the banks of the Mamberamo river Papua Province is not so diverse. It is suspected that there are disturbances or environmental pressure factors such as changes in ecosystems and human activities around the river which causes Coleoptera to not occupy the ecosystem optimally. [30-33] state that diversity tends to be low in ecosystems that are physically controlled, or get environmental stresses. [31, 34] state that human activities in agriculture can influence the composition of the order of Coleoptera. [30] states that if the habitat of a species of insect is disrupted, then the insect will move to find a new habitat that suits its needs. The difference in diversity index at each location of this study was due to disturbances in the ecosystem in the region. Changes that occur around the ecosystem can occur due to human intervention, causing instability of the ecosystem. Ecosystems on the banks of the Mamberamo River Papua Province have undergone many land use changes.

Among the 4 survey locations, Station I had the highest diversity level followed by Station III. This is because this location has more natural habitats, fewer residential settlements, no large market or industry found that can disrupt the survival of the order of the Coleoptera. The sufficient number of agricultural and rice fields in this location can be a food source and support the survival of insects such as Coleoptera. Station IV has the lowest diversity index, low diversity shows the stability of ecosystems in the area is also low. [30] states that diversity shows an indicator of the stability of an ecosystem. The low diversity index and the low stability of the ecosystem in this location are caused by changes in land use. The establishment of a number of industries on the banks of the Mamberamo Station IV such as the port and the Pertamina oil industry, densely populated settlements, densely populated houses, even reaching the banks of the river. Changes in land use almost half of the area along the Mamberamo Station IV river causes disruption of ecosystems or habitat for Coleoptera which is thought to reduce the diversity of species of Coleoptera on the banks of the Mamberamo River of Papua Province.

Station IV has the highest evenness index, which is 0.92, followed by Station II and Station III which has almost the same diversity index, which is 0.85 and 0.84. Station I has the lowest evenness index of 0.79. The evenness index states the existence of individual species found in a community [20]. According to the Hill evenness index, these four locations have an almost even or fairly evenness index. Evenness index is influenced by diversity index, in this study the diversity index is included in the medium category, so the evenness of Coleoptera on the banks of the Mamberamo river in Papua Province is stable and fairly even. [20] says diversity is identical to the stability of an ecosystem, namely if the diversity of an ecosystem is high, then the condition of the ecosystem tends to be stable.

Station IV has a dominance index higher than other locations, which is 0.33, while the lowest dominance index is found at Station I, which is 0.24. According to the Berger-Parker dominance index, if the value of d is <50, the dominance of species in the region is low. Dominance index (d) species of order Coleoptera on the banks of the Mamberamo river, Papua Province shows that the value of <i 0.50 means that there is no dominance of certain species. If the dominance value is close to 1, it means that in the community there are species that dominate other species, on the contrary if the value of the dominance index 0 means that in the community there is no species that dominates other species [25]. The dominance index of a community is closely related to the high and low levels of diversity.

The high dominance index shows the presence of one or several certain species that are very dominant. If this happens, then the diversity in the community will be low, whereas if the

dominance index is low, it means that there is no species that is too dominant in that community, the level of diversity will be high. This means that the dominance index is inversely proportional to the diversity index [35-39].

4. CONCLUSIONS

The results of the study found 546 individuals, 29 species and 12 families of the order Coleoptera. The family of the order of Coleoptera, namely Carambycidae, Carabidae, Chrysomilidae, Ciidae, Coccinellidae, Curculionidae, Dystiscidae, Melandryidae, Phalacridae, Scarabidae, Staphylinidae, and Tenebrionidae on the banks of the Mamberamo River Papua Province. The family of Coccinellidae and Chrysomilidae has the highest number of species, namely 8 species. The highest number of individuals was found in the Chrysomilidae family of Station I survey locations, namely Lema diversa species (114 individuals). Based on the location survey the number of individuals from the order Coleoptera from the highest at Station I 451 Individual insects.

The diversity of species of order Coleoptera on the banks of the Mamberamo river in Papua Province varies in each survey location. Diversity index of seraangga Coleoptera order in four survey locations of the Mamberamo River in Papua Province is classified as moderate or not very diverse. The evenness index of the Coleoptera order in the four survey locations on the banks of the Mamberamo river in Papua Province means quite evenly. Dominance index of species of order Coleoptera on the banks of the Mamberamo river Papua Province shows a value of <0.50, meaning that there is no dominance of certain species.

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