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The Diversity Of Grasshoppers (Subordo Caelifera) In The National Park Of Mount Merbabu And Mount Pangonan Central Java

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Abstract . This study aims to determine the diversity of grasshoppers in the National Parks of Mount Merbabu and Mount Pangonan. The research method used is the exploration method and purposive sampling. The results of research on grasshoppers in the National Park of Mount Merbabu and Mount Pangonan, respectively, were shannon-wiener index diversity (H '= 2.187 and H' = 1.089), number of individuals (N = 92 and N = 35), and species evenness index (E = 0.697 and E = 0.608). The grasshoppers species found were Phlaeoba fumosa, Phlaeoba infumata, Phlaeoba sp. 1, Phlaeoba sp. 2, Phlaeoba sp. 3, Phlaeoba sp. 4, Phlaeoba sp. 5, Phlaeoba sp. 6, Caryanda spuria, Cercinae sp., Chitaura sp., Oxya sp., Erucius sp. 1, Erucius sp. 2, Atractomorpha crenulata, Atractomorpha sp. 1, Atractomorpha sp. 2, Atractomorpha sp. 3, Atractomorpha sp. 4, Atractomorpha sp. 5, Atractomorpha sp. 6, Atractomorpha sp. 7, Tettigidea lateralis, and Tettigidea sp.

Keywords: Grasshopper, Mount Merbabu National Park, Mount Pangonan

INTRODUCTION

Grasshopper diversity can be found generally in various types of terrestrial areas such as forest ecosystems, agricultural areas and plantations, including population areas (Kalshoven, 1981; Amir & Kahono, 2003). In fact, grasshoppers can also be found in aquatic environments, as in Riyanto's (2017) research which shows that grasshoppers of the Orthoptera order can be found on the banks of the Musi River. The existence of grasshoppers in their habitat is influenced by many factors, including the availability of food sources, vegetation variations, predation and competition, seasons, and soil conditions and temperature (Wolda & Wong, 1988; Susanti et al., 2015). In forest ecosystems, grasshopper diversity is much more numerous and diverse (Rowell, 1987; Prakoso, 2017). Mountainous areas including various types of ecosystems and ecological components such as forest ecosystems, grassland ecosystems and the presence of plant vegetation associations and other biotic and abiotic factors, are components that support the diversity and abundance of grasshoppers. Plant vegetation in forest ecosystems is diverse and in large quantities. This means that feed for grasshoppers is available in abundance. In addition, there are various species of grasshoppers, supported by the diversity of plant vegetation. The cause is due to the presence of certain types of plants in the ecosystem, representing the presence of certain species of grasshoppers (Prakoso, 2017).

Mount Merbabu and Mount Pangonan National Parks are mountainous ecosystems with hill clusters. Each mountain has its own characteristic ecosystem, vegetation diversity, temperature, humidity, and light intensity. Mountain ecosystem is a type of ecosystem in which there are various types of ecosystem, such as the two locations have mountain forest ecosystems, river ecosystems, swamp ecosystems, and grassland ecosystems. The characteristics of the mountainous ecosystem support the presence of abundant and diverse grasshopper species. This is consistent with Saha et al., (2011) that the diversity of species of the order Orthoptera is higher in stable and undisturbed natural ecosystems.

MATERIALS AND METHODS

The research was conducted for 3 months, namely January-March 2020 in the National Park of Mount Merbabu Magelang and Mount Pangonan Dieng. Locust identification was carried out at the Entomology Laboratory of the Faculty of Biology, Gadjah Mada University, Yogyakarta. Sampling was carried out by purposive sampling to construct line transects by considering the area where grasshoppers were observed and the possible location for the transect line. Making the main transect line with a length of 100 meters, with a secondary transect of 20x10 meters. In addition, to find a more diverse species of grasshopper, direct roaming and catching methods were used using the hand piercing technique. Measurement of environmental parameters in the form of abiotic factors includes temperature and humidity using a hygrothermometer, soil pH using a soil tester, and light intensity using a lux meter. The collected grasshopper specimen data were analyzed and interpreted by the following two data analyzes.

1. **Diversity Index of ShannonWiener (H ')**

$$H' = - \sum pi \ln pi$$

Information
H ': Shannon diversity index;
p*i*: relative population type I; pi = (ni / N);
ni: abundance of species;
N: the total number of all individuals

2. **Evennes Index**

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

Information
H ': Shannon-Wiener diversity index;
S: number of species

RESULTS AND DISCUSSION

1. Diversity of Grasshoppers (Suborder Caelifera) in the National Parks of Mount Merbabu and Mount Pangonan

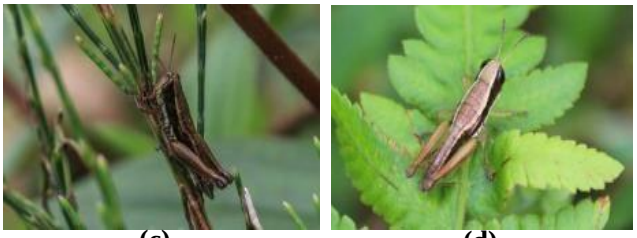
The results of the study at two locations showed that a total of 92 individual grasshoppers in the Mount Merbabu National Park area consisted of 4 families, 8 genera, and 23 species. On Mount Pangonan, there are 35 total individuals, 2 families, and 6 species.

No	Famili	Spesies	Jumlah Individu	
			TNGMb	GP
1.	Acrididae	*Phlaeoba fumosa*	5	-
		Phlaeoba infumata	2	1
		Phlaeoba sp. 1	1	-
		Phlaeoba sp. 2	1	-
		Phlaeoba sp. 3	1	-
		Phlaeoba sp. 4	-	1
		Phlaeoba sp. 5	1	-
		Phlaeoba sp. 6	1	-
		Caryanda spuria	2	-
		Cercinae sp.	18	11
		Chitaura sp.	26	20
		Oxya sp.	-	1
2.	Chorotypidae	*Erucius* sp. 1	1	-
		Erucius sp. 2	1	-
3.	Pyrgomorphidae	*Atractomorpha crenulata*	21	-
		Atractomorpha sp. 1	1	-
		Atractomorpha sp. 2	1	-
		Atractomorpha sp. 3	1	-
		Atractomorpha sp. 4	1	-
		Atractomorpha sp. 5	1	-
		Atractomorpha sp. 6	1	-
		Atractomorpha sp. 7	3	-
4.	Tetrigidae	*Tettigidea lateralis*	1	-
		Tettigidea sp.	1	1
5.	Total individu (N)		92	35
6.	Jumlah spesies (S)		23	6

Table 1. Grasshopper species data

The species that is easiest to find occupying the research area in the Mount Merbabu National Park is Chitaura sp. with 26 individuals, Atractomorpha crenulata with 21 individuals, and Cercinae sp. with the number of individuals 18.

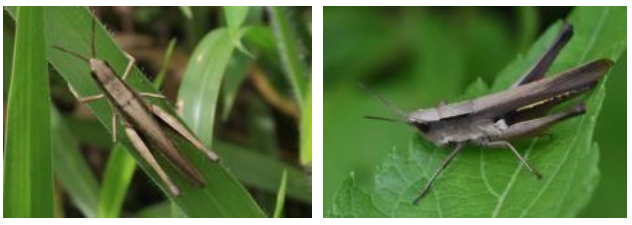
(a) **(b)**



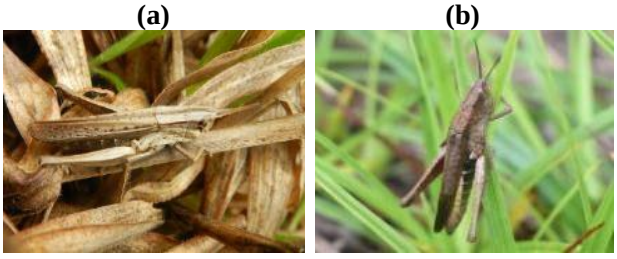
(c) **(d)**

Image 1. Species (a) Chitaura sp. (b) Atractomorpha crenulata , (c) and (d) Cercinae sp.

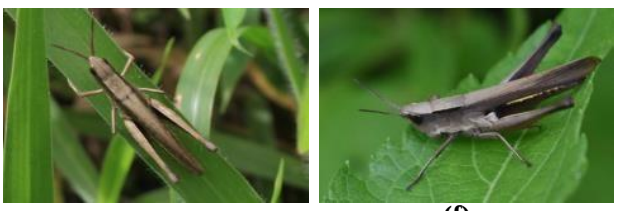
Grasshoppers that have high diversity are grasshoppers with the genus Phlaeoba with the discovery of species Phlaeoba fumosa, Phlaeoba infumata, and Phlaeoba sp. 1 to Phlaeoba sp. 6 with very striking morphological differences in each individual, each of which was only found 1 in the observed area except for Phlaeoba fumosa. Mount Pangonan found two species of Phlaeoba infumata and 1 species of Phlaeoba sp. 4. The genus Atractomorpha was also found to have a fairly high diversity, especially in terms of morphology, so that it is divided into Atractomorpha sp. 1 to Atractomorpha sp. 7 which were found 1 each in the research area of Mount Merbabu National Park. Diversity and abundance in the genus Phlaeoba and Atractomorpha are related to the diversity and abundance of vegetation in their habitat. Based on Mandal et al., (1991), the genus Phlaeoba sp. is a pest on vegetables and food plants, but when cultivated in the laboratory Phlaeoba infumata likes nut grass (Cyperus rotundus). In addition, in the two research locations, shrubs and grasses are very abundant, especially on Mount Pangonan, which is precisely located in Savana Pangonan.



(a) **(b)**



(c) **(d)**



(e) **(f)**

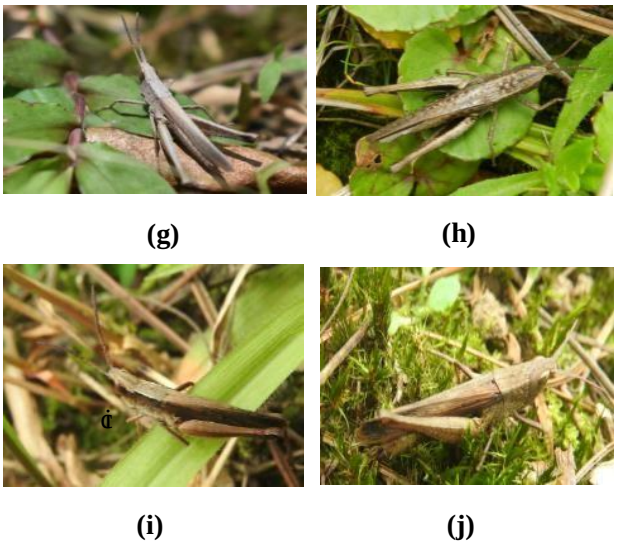


Image 2. Species (a) Phlaeoba fumosa, (b) Phlaeoba infumata, (c) Phlaeoba infumata, (d) Phlaeoba infumata, (e) Phlaebo sp. 1, (f) Phlaeoba sp. 2, (g) Phlaeba sp. 3, (h) Phlaeba sp. 4, (i) Phlaeoba sp. 5, (j) Phlaeoba sp. 6

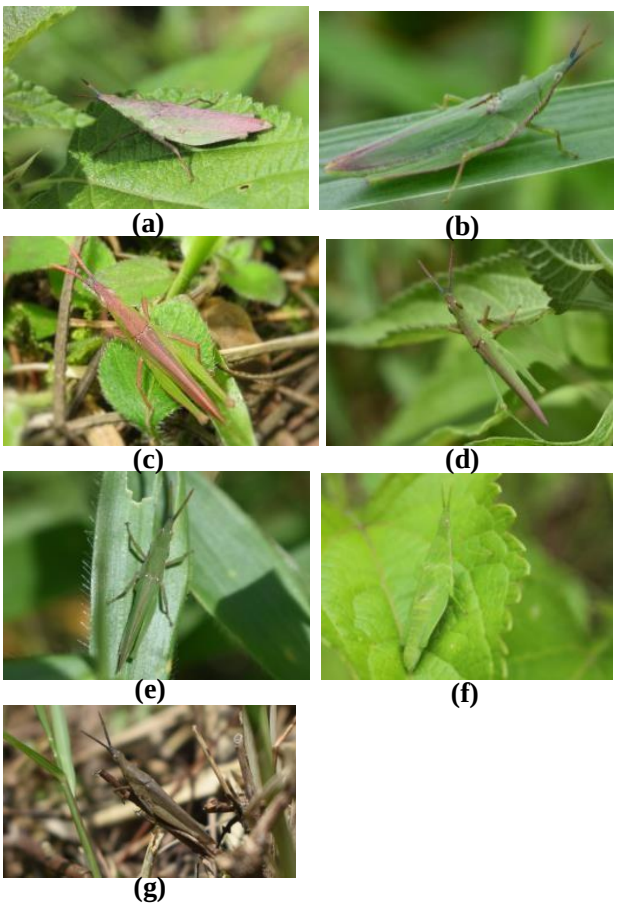


Image 3. Species (a) Atractomorpha sp. 1, (b) Atractomorpha sp. 2, (c) Atractomorpha sp. 3, (d) Atractomorpha sp. 4, (e) Atractomorpha sp. 5, (f) Atractomorpha sp. 6, (g) Atractomorpha sp. 7

Atractomorpha sp. which is a pest of agricultural and plantation crops. The traditional zone of Mount Merbabu National Park in the area where all species of Phlaeoba sp. and Atractomorpha sp. is an area that is not used directly by humans but is not far from the residents' plantation areas. Based on Morris (2006) in Prakoso (2017), changes in vegetation community diversity can cause variations in specific patterns of grasshopper biodiversity. Thus, the composition of plant species affects the diversity of insect species. Erucius sp, Tettigidea lateralis, and Tettigidea sp found in small numbers in the Mount Merbabu National Park. These three species are found in a separate area from the discovery of other species. The location of the discovery of these three species is in the exploration area in the southern part of the fern resort, which is a narrow, steep area leading to the ravine of the former river. Tettigidea lateralis and Tettigidea sp. found in grasses, shrubs, and moist substrates. Tettigidea are a group of aquatic grasshoppers whose habitat prevalence is in areas close to water sources or moist habitats such as the substrate in relation to their food source which is moss, algae, and plant parts that have fallen and are damp (Tan et al., 2017). In accordance with the habitat conditions of Tettigidea sp was found. Meanwhile, Erucius sp. found perched on ferns and shrubs. Research on grasshoppers Erucius sp. the so-called monkey grasshopper is still very rare, so references to describe this grasshopper are still difficult to find.

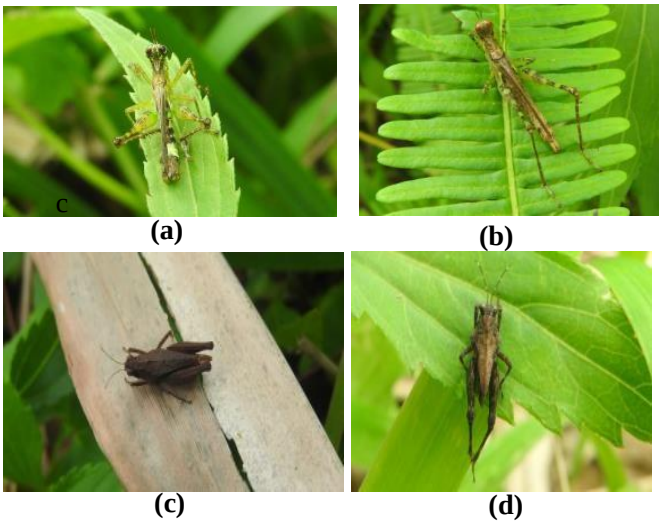


Image 4. Species (a) Erucius sp. (b) Erucius sp. (c) Tettigidea lateralis, and (d) Tettigidea sp.

Other species found are Caryanda spuria which is only found in Mount Merbabu National Park and Oxya sp which is only found on Mount Pangonan.

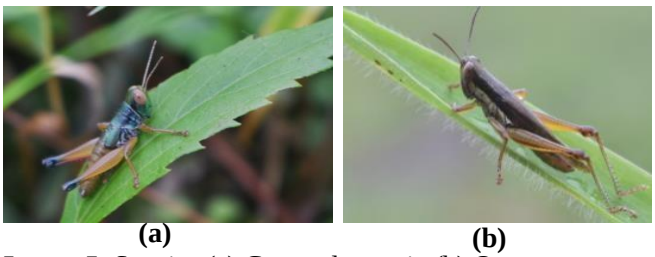


Image 5. Species (a) Caryanda spuria (b) Oxya sp.

2. Diversity Index of ShannonWiener (H')

TNGMb	GP
H' = 2,187	H' = 1,089

Table 2. H' index in the National Parks of Mount Merbabu (TNGMb) and Mount Pangonan (GP)

The table shows that Mount Merbabu National Park has an H 'of 2.187 and Mount Pangonan has an H' of 1.089. Based on Pradhana et al., (2014), H 'in the range of 1.00 - 3.00 indicates a moderate level of diversity. This means that the two research locations show the same level of diversity but higher in the Mount Merbabu National Park.

The differences in terrestrial conditions (landscape) and vegetation components between the National Parks of Mount Merbabu and Mount Pangonan have a close relationship with the diversity and abundance of grasshoppers that inhabit the area. The factors of plant, abiotic, and landscape complexity are followed by the complexity of the insects that inhabit the area (Erawati and Kahono, 2010). Based on Falahudin et al., (2015), the conditions of the terrestrial type and the vegetation components that make up an area affect the abundance of grasshoppers for food sources, shelter, and reproductive activities. The types and numbers of flora and fauna populations that make up an area are closely related to the type of ecosystem. Including mountainous ecosystems, which tend to be more natural and protected from human activity disturbances so that the constituent species components are more stable (Saha et al., 2011).

3. Evennes Index (E) TNGMb GP

TNGMb	GP
E = 0,697	E = 0,608

Table 3. Evennes Index in the National Parks of Mount Merbabu (TNGMb) and Mount Pangonan (GP)

The evennes index is the comparison of the H' value with the number of species found at the research location. The evennes index is used to determine the distribution of species diversity so that the presence or absence of certain species dominance is known. The range of E values is 0-1, the higher the value indicates the high evenness of the distribution of the species or the low dominance of certain species (Insafitri, 2010). In table 7, it can be seen that the E value at the two research locations is 0.6 with slightly higher at GNGMb (i.e. close to 0.7). The high E value (close to 1) indicates the low dominance of certain species. The species found at the research location have a fairly even distribution.

4. Environmental Parameters

	TNGMb	GP
Temperature	30 – 33ºC	20 - 27 ºC
Humidity	43 – 68%	70 – 81%
Soil pH	6	6,6
Light intensity (x100 lux)	773,9	243,5

Table 4. Environmental parameters measured in the National Parks of Mount Merbabu (TNGMb) and Mount Pangonan (GP)

Comparison of environmental parameters such as temperature, humidity, soil pH, and light intensity. The temperature at both locations ranges from 20-30oC. Insects generally can survive up to 45oC, with a minimum temperature of 15oC and an optimum temperature of 25oC (Jumar, 2000). The air humidity in TNGMb ranges from 43 - 68%, while at GP is 70 - 81%, or in other words, the humidity of TNGMb is lower than GP. Based on Borror et al., (2005) in Sulistiyowati (2015), the humidity range of 40-50% includes low humidity but can still support insect life. The light intensity of Mount Pangonan tends to be lower, namely, 243.5 lux compared to TNGMb with light intensity of 773.9 lux. This is because the temperature at GP also tends to be lower. Based on Taradipha et al., (2018), high light intensity is related to high temperatures and supports insect biological activities in the form of larval development, foraging for food, flying, mating, laying eggs, and metabolism.

Other factors that also have an effect are the season and altitude of the terrain in the research location. This research was conducted in JanuaryMarch 2020 which is the rainy season. Season affects growth and the presence of vegetation which also affects the survival of insects (Erawati & Kahono, 2010). The rainy season, has an influence on insect abundance. The altitude of the land affects the presence of grasshoppers. In the Mount Merbabu National Park, data collection and exploration is carried out in the traditional zone of the fern resort area which is at an altitude of 1,500 masl (meters above sea level). In addition, explorations and observations were made up to post 2 of the Wekas climbing route, which is at an altitude of 2,510 masl. In post 2, only a few species of Cercinae sp. and Chitaura sp. This is possible because in post 2, the vegetation structure and ecological components are not as complex as in the traditional zone where grasshopper diversity is high. Referring to Wolda (1983) in Erawati & Kahono (2010), upland areas have lower species diversity than lowlands. In addition, when compared to the Mount Pangonan grassland which is at an altitude of 2,150 meters above sea level, there is still a diversity of grasshoppers even though the numbers are not so abundant, the difference is in the ecological type of the Mount Pangonan meadow which is more complex.

CONCLUSIONS AND RECOMMENDATIONS

The diversity of grasshoppers (suborder: caelifera) in the mountains of Central Java was obtained from two research locations, namely the National Park of Mount Merbabu Magelang and Mount Pangonan Dieng. In Mount Merbabu National Park, there were 92 individual grasshoppers consisting of 4 families, 8 genera, and 23 species. At Mount Pangonan, there were 35 individuals from 2 families and 6 species. So that the total collection of grasshoppers obtained was 127 individual grasshoppers from 4 families. These families are, Acrididae, Chorotypidae, Pyrgomorphidae, and Tetrigidae. In the two research locations, the most common species were Cercinae sp. and Chitaura sp. The Shannon-Wiener diversity index of both locations is in the medium range, but the highest is Mount Merbabu National Park with an H' of 2.187. The Evennes index at both locations shows moderate evenness

(E = 0.6), but at TNGMb the E value is close to 0.7 or the evenness of the distribution of grasshoppers is high.

Research on the diversity of grasshoppers, especially in the two research locations, can be developed further considering the high diversity of grasshoppers at the research location. Further research can increase knowledge about the condition of the Mount Merbabu and Mount Pangonan National Parks from time to time, as well as the policy direction for the development of the two locations to be more sustainable.

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