

The Diversity of Ants (*Formicidae*) in Gunung Palung National Park as a Biology Learning Resource

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Abstract: Gunung Palung National Park (GPNP) has a diversity of ant, but the information as a source of learning is still lacking. This study aims to determine the diversity of ant species in the TNGP area and its potential as a source of learning. Research using descriptive qualitative method. Sampling used a pitfall trap placed on a line transect that passes through an alluvial soil forest. Collecting data on potential learning resources using the results of a questionnaire. The results showed that there were 90 individuals from 9 ant species specifically *Dinomyrmex gigas*, *Polyrhachis bihamata*, *Rhytidoponera araneoides*, *Dolichoderus thoracicus*, *Axinidris Acholli*, *Hagensia havilandi*, *Myrmicaria brunnea*, *Anonychomyrma myrmex*, *Notostigma carazzii*. The diversity of species of ants has the potential as a source of learning with indicators of clarity of potential (85%), ease of access (58.33%), security (91.66%), time efficiency (75%), cost (91.66%), suitability with learning objectives (100%), clarity of material objectives (100%), and clarity of information disclosed (100%). This research shows that information about ant diversity is very suitable as a source of learning biology, especially in the subjects of biology, biodiversity, and the classification of living things.

Keywords: Ants; Diversity; Gunung Palung National Park; Learning resource

Introduction

Learning resources are something that is used in teaching and learning activities by teachers and students to make it easier to learn and understand the subject matter (Ulandari et al., 2015). Learning resources are used to make it easier for someone to achieve learning goals to understand the field of knowledge being studied. With the existence of learning resources, learning activities carried out are easier to learn and more meaningful. The selection of learning resources is very important to determine learning resources that are appropriate to the learning being carried out. Teachers independently or together with students can determine the learning resources used in studying and understanding new knowledge (Ulandari et al., 2015). Learning resources are materials that are used and needed in the learning process, in the form of books, print media, electronic media, and the surrounding

environment, some of which are available in the environment around learning which function to help optimize learning outcomes (Purnomo et al., 2013).

Biology learning is learning that places more emphasis on giving direct experience by utilizing the surrounding environment. According to Suryaningsih (2015), learning biology as part of education that studies living things is a window for students to get to know biodiversity and its interactions with the environment. According to Susilo (2018), biology learning is still dominated by the lecture method, the interaction between learning subjects and biology learning objects is still minimal, while the essence of biology learning is the actual interaction between biology learning subjects. Biology as part of science, demands learning competencies in the realm of comprehensive high-level understanding (Nurrohman et al., 2016). This makes the learning process not boring (Irwandi et al., 2020). Meanwhile, according to Ilhami et al. (2018), the use of

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the surrounding environment has a positive contribution to the achievement of student learning outcomes and several studies on the use of the environment in learning prove that there is a very good influence. Learning biology as a part of education has great potential in utilizing the environment as a learning resource (Situmorang, 2016).

Sitepu (2014) states that an environment is a place of learning or circumstances around which can be used as information in learning activities. New information and knowledge obtained from the learning process using the environment will be fun and meaningful because it can interact directly with the environment. The right environment for the learning to be carried out can provide accurate information in its implementation.

Gunung Palung National Park (TNGP) area of North Kayong Regency. Gunung Tung national park is a tropical forest conservation that has eight types of habitats. The eight habitat types are peat swamp, freshwater swamp, heath, alluvial, lowland sandstone, lowland granite, upland granite, and mountains (Setiawan, 2015). Gunung Palung National Park is located in North Kayong Regency and Ketapang Regency, West Kalimantan. Meanwhile for the alluvial soil forest area which is a type of soil with many organisms divided from alluvial deposits. Soil properties vary depending on the parent material deposited and their distribution is not affected by altitude or climate, namely in alluvial soil forests. Ants like areas with high organic matter content, because ants will take nutrients from soil organic matter (Herwina et al., 2013).

Ants are social insects that belong to the order Hymenoptera and the family *Formicidae* which has approximately 12,000 species (Romarta et al., 2020). Ant habitat is a very broad habitat covering all terrestrial (land) habitats from mountainous areas to the coast (Falahudin, 2012). Some subfamilies are endemic to an area. From the results of previous insect, research carried out in the Gunung Palung National Park Area among Insect Pests on Seeds of Four Meranti Species in Gunung Palung National Park, West Kalimantan, and Dung Beetle Species (Coleoptera: Scarabaeidae) in Gunung Palung National Park, West Kalimantan. Ants are bioindicators of environmental changes such as forest fires, disturbance of vegetation, logging, mining, waste disposal, and land use factors because ants have a tolerance for environmental changes and can respond to changes that occur in ecosystems (Pećarević et al., 2010). Griffith et al. (2018) stated the role of ants in the food and energy chains at the base of tropical forests.

Biodiversity plays a crucial role in sustaining ecosystems and contributes significantly to the understanding of ecological processes. Ants (*Formicidae*), being a diverse and ecologically important

group of insects, have been the focus of numerous ecological studies. Gunung Palung National Park, situated in the heart of Indonesian Borneo, stands out as a unique and biodiverse ecosystem, providing a rich habitat for various flora and fauna, including ants.

This study aims to explore the diversity of ants within the Gunung Palung National Park, emphasizing their significance as a valuable resource for biology learning. Ants, being highly social insects, exhibit complex behaviors, ecological interactions, and adaptations that make them intriguing subjects for educational purposes. The park's diverse habitats, ranging from lowland forests to montane areas, offer a dynamic environment for studying different ant species and their ecological roles.

Understanding the ant diversity in Gunung Palung National Park not only contributes to the broader field of entomology but also serves as an exemplary case for integrating real-world biodiversity into biology education. By highlighting the diverse ant species present in this national park, educators can utilize these findings to enhance biology curricula, providing students with hands-on experiences that foster a deeper appreciation for ecological interactions and conservation.

Furthermore, this study emphasizes the importance of Gunung Palung National Park as a living laboratory for biology education. The unique combination of biodiversity and ecological dynamics in this park offers a distinct opportunity for students to engage with diverse ant species, promoting a holistic understanding of ecosystems and fostering a sense of environmental stewardship.

In summary, this research delves into the diversity of ants in Gunung Palung National Park, recognizing their significance not only as integral components of the park's ecosystem but also as invaluable resources for enriching biology education. The findings presented herein contribute to the broader understanding of biodiversity and underscore the potential for utilizing natural habitats as effective tools for immersive and impactful learning experiences.

This research offers a unique contribution to the scientific literature by exploring the diversity of ants (*Formicidae*) in Gunung Palung National Park. Biodiversity, especially within the ant group, is often not fully understood, and this study fills a knowledge gap by presenting comprehensive and detailed data on the ant species present in the region. The diversity of ants is not only important for natural ecology but also holds significant potential as an engaging resource for biology learning.

Method

This study used two stages, the first was observing ant species, and the second was finding out the potential of ants as a source of learning biology. Research in Gunung Palung National Park uses a qualitative descriptive method. Sampling directly from the observation location, by utilizing existing data sources in nature. Laying traps using a line transect. Traps used to determine the diversity of species of ants using pitfall traps. Data collection was repeated 2 times per 24 hours, 5 plots measuring 5x5 square meters were made with a distance of 2 meters per plot and 5 pitfall traps were laid per plot with traps starting at 08.00 WIB. In addition to the observation method, this research also uses the direct observation method and the documentation method to complement the primary data. To calculate the data analysis of ant species diversity, it was carried out in 3 stages, namely: Shannon-Wiener diversity index, as equation 1.

$$H' = -\sum Pi.Ln Pi \tag{1}$$

Description:

H' =species diversity index

Pi =the proportion of the ith species of the total individuals

Ln =natural logarithm

Species evenness index

$$E' = H' / Ln S \tag{2}$$

Description:

S = Species

The Simpson dominance index

$$D = \sum Pi^2 \tag{3}$$

To find out the potential feasibility of ant diversity in the Gunung Tulung National Park area as a source of learning biology, that is using validation sheets and teacher response questionnaires. To calculate the percentage of the teacher's questionnaire and the percentage of eligibility, the following equation 4 (Riduwan, 2015).

$$P = \frac{f}{n} \times 100\% \tag{4}$$

Description:

P = Percentage

f = Total score obtained

N = Maximum score

Table 1. Table of Feasibility Category as Learning Resources (Riduwan et al., 2013)

Percentage (%)	Interpretation
81 ≤ score ≤ 100	Very feasible
61 ≤ score ≤ 80	Feasible
41 ≤ score ≤ 60	Fairly feasible
21 ≤ score ≤ 40	Not enough feasible
0 ≤ score ≤ 20	Infeasible

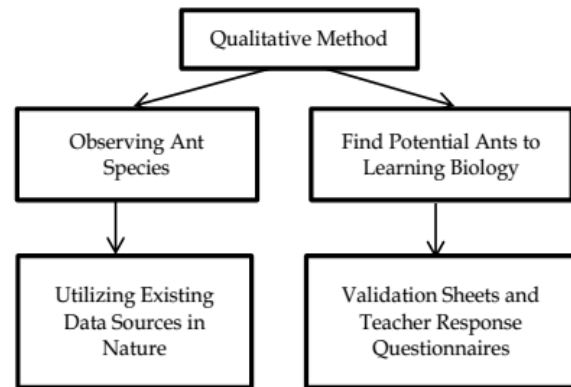


Figure 1. Research Methodology

Result and Discussion

The Diversity of Ant Species in TNGP

The environmental factors observed were air temperature, light intensity, soil temperature, soil moisture, and soil pH. The alluvial forest area has habitat characteristics. From the results of environmental factor measurements, the data obtained is the height of the research site, which is 34 meters above sea level. The results of light intensity measurements are 302 to 675 Lux with an average of 488.5 lux, the results of wind speed data are 0.05 to 0.07 km/h with an average of 0.06 km/h, the results of air measurements are obtained in the temperature range ranging from 27.04°C to 27.08°C with an average of 27.06°C, humidity data ranges from 93% to 94% RH with an average of 93.05% RH.

The results of field observations carried out in the Gunung Palung National Park area used a line transect line with 10 plots which have a vulnerable distance per plot of 5 meters and each plot has 5 pitfall traps. Some types of ants trapped at the location of the traps found 90 individuals from 1 family and 9 different species. There are 3 species of ants from the *Dolichoderinae* subfamily, 3 types of *Formicinae* subfamily, 1 species of the *Myrmicinae* subfamily, 1 species of the *Ponerinae* subfamily, and 1 species of the *Ectatomminae* subfamily. The types of ants found are as table 2.

Table 2. Table of the Types of Ants Found in the Gunung National Park Area Trough

Family	Species	Total (Individual)
<i>Formicidae</i>	<i>Dinomyrmex gigas</i>	4
	<i>Polyrhachis bihamata</i>	9
	<i>Rhytidoponera araneoides</i>	2
	<i>Dolichoderus thoracicus</i>	8
	<i>Axinidris Acholli</i>	8
	<i>Hagensia havilandi</i>	32
	<i>Myrmicaria brunnea</i>	19
	<i>Anonychomyrma myrmex</i>	6
	<i>Notostigma carazzii</i>	2
	Amount	90

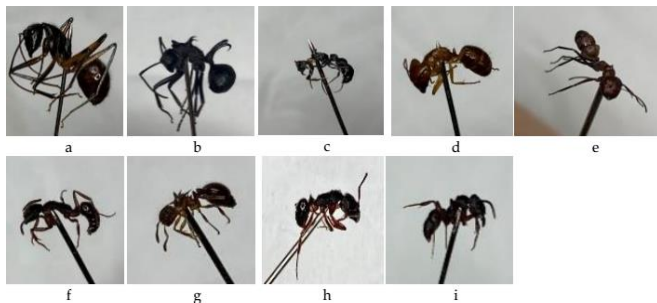


Figure 2. Ants found in the Gunung National Park Area. (a) *Dinomyrmex gigas*, (b) *Polyrhachis bihamata*, (c) *Rhytidoponera araneoides*, (d) *Dolichoderus thoracicus*, (e) *Axinidris acholli*, (f) *Hagensia havilandi*, (g) *Myrmicaria brunnea*, (h) *Anonychomyrma myrmex*, (i) *Notostigma carazzii*

The ants found were only the *Formicidae* family because ants with this family tend to like moist places and soils that contain a lot of organic matter, such as the land used in this study, namely alluvial soil. It can be seen from the results of the table above that 90 species were identified and trapped in pitfall traps in the line transect area. Ants are a non-predatory species that consume the sugar solution contained in the pitfall trap, a large number of which are trapped, namely *Hagensia Haviland* with a total of 32 individuals with a percentage of 0.13%. While the few individual ants found were *Rhytidoponera araneids* and *Notostigma razzia* with a total of 2 species. The results of this study could be influenced by various factors, resulting in a low and species diversity index value. This is reinforced by a statement from (Wayan, 2010), which states that the species diversity index depends on species richness and evenness. One of the differences in the number of species obtained during this study was due to the availability of feed around the study area and the type of trap used during sampling.

The existence of certain ant species can be influenced by food availability (Guénard, 2013), nesting sites (Lindgren et al., 2002; Uno et al., 2010), and microclimate (Torchote et al., 2010). According to research from Ikbal et al. (2014), the type of trap used also affects the type and abundance of ants obtained.

Differences in the number of ant species found can be due to differences in geographical location (Wetterer et al., 2017), habitat conditions (Berman et al., 2013), methods when sampling ants (Tista et al., 2011) or the presence of human activities (Kozon et al., 2013).

Table 3. Table of Ant Species Diversity in the Gunung National Park Area Trough

Index	Total (N)
Species diversity (H')	1.84
Dominance (D)	0.20
Evenness of type (E')	0.97

From the table above, it is found that the results of the calculation of the ant species diversity index obtained a moderate percentage of diversity, a low percentage of dominance index or almost no individuals dominate, and a moderate or almost even percentage of species evenness. Diversity is said to be high if the number of individuals of each species found does not occur in any one species. Conversely, if it is composed of only one species or only a few species, then the diversity is low. In addition, diversity can also be said to be low if there are several species but with an unequal number of individuals. The existence of a high number of species in one of the species found can also cause a low value of the diversity index at that location.

Potential of Ants in TNGP as a Source of Learning Biology

Meanwhile, the feasibility of the potential diversity of ant species as a learning resource was analyzed based on the criteria of learning resources, namely ease of access, security, time efficiency, cost, suitability with learning objectives, and clarity of material objectives. The feasibility of potential ants was obtained based on the results of filling out a questionnaire by 12 teacher respondents from 7 schools namely, at SMPN 1 Matan Hilir Selatan, SMP PGRI 01 Pulau Kumbang, MTsN 02 Kayong Utara, SMAN 2 Simpang Hilir, SMAN 1 Rasau Jaya, MAN 1 Kubu Raya, and SMA Muhammadiyah 1 Pontianak.

Table 4. Feasibility Table Potential Diversity of Ant Species in the Park Area Gunung Palung National

Aspect	Percentage	Interpretation
Potential clarity	85 %	Very feasible
Ease of access	58.33%	Fairly feasible
Keamanan	91.66%	Very feasible
Time efficiency	75%	Feasible
Cost	91.66%	Very feasible
Conformity with learning objectives	100%	Very feasible
Clarity of material objectives	100%	Very feasible
Clarity of disclosed information	100%	Very feasible
Average	85.70%	Very feasible

This study uses eight aspects to determine research results as learning resources. Data collection at school used a questionnaire which was seen from the aspects of potential clarity, ease of access, security, time efficiency, cost, conformity with learning objectives, clarity of material objectives, and clarity of information disclosed. The results of the teacher's response to the potential for ant diversity have received the interpretation of "very feasible" to be used as a biology learning resource.

Utilizing the various potentials that exist in the surrounding environment certainly makes students not only understand the module theoretically but also integrate with local potential so that it is more applicable and cares about the environment around the school (Hamidah et al., 2020). The regional (local) potential is the potential of specific resources owned by an area including natural, human, technological, and cultural resources so that they can be developed to build national independence (Sarah et al., 2014). One of the biological materials that are in harmony with the approach or utilizing the surrounding environment is material about biodiversity. Material characteristics in KD 3.2 Analyzing observational data on various levels of biodiversity (genes, species, and ecosystems) in Indonesia. Main material: The concept of diversity of genes, species, ecosystems, Indonesian biodiversity (genes, species, ecosystems), flora, fauna, micro-organisms, and the classification system. The suitability of the material for the diversity of ant species obtained in the Gunung Palung National Park Area can be seen based on the high school biology syllabus for class X Curriculum K13.

As for the material related to teaching materials for the diversity of ant species with biology teaching materials in Class X, namely; material on the scope of biology, biodiversity, and classification of living things. The benefits of the environment as a learning resource include: the problem of limited media and learning resources can be resolved, students can play an active role in carrying out teaching and learning activities (Wulandari, 2020), students feel happy, are more active in exploring their knowledge, learning does not feel boring (Salina, 2016), and learning outcomes increase (Hendarwati, 2013).

This research was to find the diversity of ant species in the Gunung Palung National Park area to link the diversity of ant species as a source of learning biology. Therefore it can be said that in the Gunung Palung National Park Area, it can be used as a learning resource. According to Najmulmunir (2010), the criteria for learning resources consist of ease of access, time efficiency, cost, and adjustment to the material being taught. For the teacher's questionnaire response that Gunung Palung National Park has the potential as a source of learning biology for class X SMA following

Basic Competence 3.2, namely analyzing observational data about various levels of biodiversity (genes, species, and ecosystems) in Indonesia.

According to Kustandi et al. (2011), learning media is a tool that can help the learning process and serves to clarify the meaning of the message conveyed so that it can achieve learning objectives better and more perfectly. Good learning resources are those that are around us and are easy to get (Samsinar, 2019). Ease of access Obtaining information in the Gunung Palung National Park Area is quite easy because there are lots of references that can be obtained or accessed to explore the potential for learning in the Gunung Palung National Park Area in the Gunung Palung National Park Area, for example, information can be obtained from the Internet. The learning resources used in one learning process should be diverse to enrich the information obtained by students, learning resources can be formulated as anything that can provide convenience to students in obtaining some information, knowledge, experience, and skills in the learning process (Mia et al., 2020).

The surrounding environment provides a source of information related to knowledge, concepts, laws, and theories, by using nature as a student learning resource, students can explore information and biology learning concepts that can be found directly in the surrounding environment, interaction, and students with the environment can be carried out through activities observation, as well as data collection in the field (Alie et al., 2018). The costs needed to carry out research to find learning resources in the Gunung Palung National Park area can be reached to carry out research activities. According to Samsinar (2019), learning resources must be practical, easy to carry, simple, do not require special equipment, are not expensive, and do not require especially skilled workers who will use it, how long it will be used, whether or not the incident occurs, and whether the message conveyed is accurate or not.

Utilizing the diversity of ant species can also help students to observe, identify, classify, and analyze the types of ants. According to Cholvistoria et al. (2020), the learning resources used in one learning process should be diverse as an effort to enrich the information obtained by students and learning resources can be formulated as anything that can provide convenience to students in obtaining a certain amount of information, knowledge, experience, and skills in the learning process. Biological concepts have a relationship with the physical environment of students so that students can directly interact with their natural environment. Biology learning needs to emphasize concepts that can be seen, felt, and analyzed according to students' real environmental conditions. Students can apply biological knowledge to solve real problems found in everyday life (Sukirno et al., 2020).

For clarity on the material diversity of ant species in the Gunung Palung National Park area, the results of learning objectives can be found that can be used as a source of learning on biodiversity material, analysis of invertebrates, and classification of living things. Based on the results of the teacher's questionnaire, it can be concluded that the Gunung Palung National Park area has the potential as a source of learning biology. The requirements for learning resources according to Djohar (Suratsih, 2010) are clarity of potential, suitability with learning objectives, clarity of objectives, clarity of information that can be disclosed, clarity of research guidelines, and clarity of expected gains. The information to be disclosed is based on research results based on local potential. Information that can be revealed from the results of this exploratory research is in the form of research processes and products. The information in the form of a process in this research is using an exploratory research approach with a roaming system, making it easier for students to do it.

Information from this research was obtained from the identification results of ants equipped with a clear methodology and photo documents resulting from the identification of the diversity of ant species found in the Gunung Palung National Park area. The types of ants that have been found can be used as a source of learning biology. Based on the results of an analysis of the potential diversity of ants on biology material, it was found that it was following the high school biology syllabus as a learning resource in class X, namely material including; the scope of biology, biodiversity, and classification of living things. This is in line with Titin's opinion (2016) that the material scope of biology studies the meaning of biology, branches of biology, the benefits of biology for life, the level of organization of life, and problems of biology at the level of organization of life.

Conclusion

Based on the research results, the following conclusions were obtained: There were 9 types of ants, namely *Dinomyrmex gigas*, *Polyrhachis bihamata*, *Rhytidoponera araneids*, *Dolichoderus thoracicus*, *Axinidris Aholi*, *Hagensia havilandi*, *Myrmicaria brunnea*, *Anonychomyrma myrmex*, and *Notostigma razzia*. Potential biology learning resources with indicators of potential clarity, ease of access, security, time efficiency, cost, compatibility with learning objectives, clarity of material objectives, and clarity of information disclosed. Potential diversity of ant species per class X material, namely material on the scope of biology, biodiversity, and classification of living things.

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This research stands out due to its innovative approach in utilizing the diversity of ants as a learning resource in the field of biology. It may present new and effective teaching methodologies to harness biodiversity as a learning tool in educational settings. Moreover, this research is also notable for its strong connection to nature-based learning approaches or experiential learning outside the classroom. It may offer innovative lesson plans or educational resources for biology teachers and instructors.

Conflicts of Interests

The researcher has academic or professional interests that may influence the interpretation or presentation of research results, such as having relationships with institutions or organizations that seek to promote the learning approach used in this study. The researcher also has personal interests related to the research findings, such as the desire to gain recognition or reputation in a specific field. This can affect the objectivity of the research and the presentation of data.

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