Herb-Strata Vegetation Species Diversity in Ancient Mujil Volcano Yogyakarta as Biology Learning Source in Senior High School

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Abstract. This research is intended to understand the vegetation species in herb strata which have the highest and lowest Importance Value Index (IV), the diversity of vegetation species of herb strata, the relevance between measured abiotic environment condition to the stand grouping pattern of vegetation species of herb strata, and analyze the research result as a biology learning source of first-grade senior high school in biodiversity material.The sampling in this research utilizes plotless method (Point Intercept). Based on the descriptive method, this research result has potential is analysed as biology learning source for senior high school.The research result shows that there are 29 species of herb strata vegetation in the study area with the highest IV comes from Cynodon dactylon (27,91%) and Centhotheca lappacea (0,50 %) as the lowest IV. Diversity index (H') vegetation species of herb strata is relatively low ranging between 0.11-0.14. The abiotic environment condition correlated with the stand grouping pattern vegetation species herb strata are the soil humidity, soil pH, and the light intensity, while the abiotic factors which are not correlated are air humidity, air temperature, and soil temperature. This study result has a potential to be the learning source for the first-grade senior high school biology subject in the biodiversity study material.

Keywords: *Ancient Mujil volcano, species diversity, Learning Source, Herb Strata Vegetation*

INTRODUCTION

Learning source is everything that is intentionally designed or not that could be utilized independently or together to help the learning process of the learners (Hafid,2011). Learning resources are all sources in the form of data, human and any forms that can be used by students for learning, either separately or in combination to make it easier for students to achieve learning goals or achieve certain competencies (Cahyani, A, 2019). The learning source contains materials utilized and needed in the learning process such as printed books, printed media, electronic media, speakers, and surrounding environment which could increase the involvement of the learners in the learning process. The environment can be used as a learning resource if it is used optimally. The existence of environmental potential in each different area requires the ability to utilize environmental potential learning resources as a learning resource. The learning process is expected to be more interesting and students' understanding and knowledge will increase after interacting directly with biological objects. Utilization of the environment as a source of learning biology can create and increase one's awareness of the environment (Hendriani, 2005). The environment as a learning resource is grouped into three, namely the social environment, the natural environment and the artificial environment. The social environment is an environment related to human interaction and community life such as culture, education, and value systems. The natural environment is everything that is natural, such as geographical conditions, flora, fauna, and natural resources. The artificial environment is an environment that is intentionally created for certain purposes that

are beneficial to human life. The relationship and interaction between humans and the environment is very close. Humans and the environment influence each other, both material and immaterial, life and death. The process of reciprocal relationships that influence each other between the environment and living things form a system called an ecosystem). The environment, when used as a learning resource, has advantages such as not boring learning activities, more meaningful learning, varied material being studied, and more comprehensive learning. One of the learning processes that could be made as an alternative in local potential utilization balanced with the contextual approach will ease the learners to understand the material that will be given with something real in the environment. One of the materials that have to be mastered by the first-grade high school according to the curiculum 2013 is the biodiversity. The environment can be used as a learning resource outside the classroom. This material is included in 2013 Curriculum is written in KD 3.2 which is analyzing observation data regarding levels of biodiversity (genes, species and ecosystem).

One of the environment that can be made as a learning source is the Ancient Mujil volcano located in Girimulyo sub-district, Kulon Progo district with an elevation of 265 msl (mean sea level) and area of 18 Ha. Mount Mujil is close to Mount Prau and Mount Ijo, geographically, it is directly close to Pengasih and Kokap sub-districts in the south, Kalibawang and Samigaluh in the north and directly close to Purworejo Regency in the west, Nanggulan in the east. Mount Mujil is located in the Menoreh highlands which stretches from north to south, this makes Mount Mujil has different characteristics from the mountains of southern Java which generally extends from south to east, and the soil in the mountains contains minerals in the form of hydrothermal magnetic deposits formed at high temperatures, and high pressure (Hartono, 2015). Mount Mujil is or remains of an ancient volcano where this area is composed of volcanic breccia rocks, igneous rocks and basalt andesite. In addition, with the presence of andesite rocks, a dome with a dip leading to the east is formed, indicating that this volcano was active in its time. Its geological attractiveness will affect the diversity of species in the Mujil Ancient Volcano area. This proves that once there was magma in the area that had been saturated, such as sulphide and arsenopyrite. According to Hartono & Pambudi (2015) Mujil volcano is one of the ancient volcanoes which is detached from the volcano system in the Kulon Progo mountains. Ancient Mujil volcano is the remaining of an ancient volcano where this region is composed of volcanic breccia rocks, igneous rocks, and basalt andesite. Based on the preliminary observation of Ancient Mujil volcano region there are many vegetation species in particular herb strata. In the education field, this region is very attractive if it is made as a biology learning source which is quite contextual for the first-grade senior high school students for the biodiversity learning material. Hence, a study is needed about the Herb-Strata Vegetation Species Diversity in Ancient Mujil Volcano Yogyakarta as Biology Learning Source in Senior High School.

RESEARCH METHODS

This research is included an explorative research species. The data sampling method in this study uses plotless method which is point intercept. To understand the relevance between the measured abiotic environment condition (soil humidity, soil pH, light intensity, air temperature, soil temperature, and air humidity) with the stand grouping pattern of herb-strata vegetation, cluster analysis is utilized. Vegetation parameters measured are dominance, frequency, relative dominance, relative frequency, importance value index, and diversity index.Based on Barbour, et. al (Handayani, 2018) the formula which are used to find the vegetation parameters are as follow:

a. Frequency = × 100 %
b. Relative Frequency = × 100 %
c. Dominance (cover) = × 100 %
d. Relative dominance= × 100 %
e. Importance Value Index (IV) = Relative Frequency + Relative Dominance
f. Species Diversity Index can be calculated using Diversity Index Shanoon Wienner (Fachrul, 2012):

$$H' = -\Sigma \, pi \log pi$$

Annotation:

H'	= Diversity Index
pi	=
n	= i-th importance value of a species
N	= Amount of importance values of a species

Based on the results of exploratory research. Furthermore, the results will be studied descriptively to determine the potential of the research results as a source of learning biology for senior high school First Grade on the material of biodiversity ecosystem level.

The study of potential biology learning sources referred to Djohar's opinion (Suhardi, 2012) which takes into account the:

a. clarity of potential and availability of the objects and issues raised,
b. conformity with learning objectives,
c. clarity of targets and purposes of the material,
d. clarity of information to be revealed,
e. clarity of exploration guidelines, and
f. clarity of benefits to be achieved.

In addition to Djohar's opinion, the potential learning source was examined in accordance with Dick and Carey (Supriadi, 2015) criteria as follows:

a. The availability of local sources
b. The availability of fund, resources, and sufficient facility to conduct a learning source
c. The flexibility, practicality and learning source security factors for a relatively long period.
d. Cost effectiveness for a relatively long period

RESULTS AND DISCUSSION

A. Importance Value Index (IV)

Based on the research result shows that in all of the study area there are 29 herb strata vegetation species with the highest and lowest IV can be seen in the Figure 1. below:

Figure 1. Graphic of Importance Value Index (IV) herb-strata vegetation species in all of the study area

Based on the Figure 1. It can be known that the herb-strata vegetation species that has the highest IV is Cynodon dactylon with 27.91% and the lowest IV is Centhotheca lappacea with 0.50%. Cynodon dactylon which has the highest IV means that this plant has a vital role in the Ancient Mujil volcano. Biodiversity with important functional roles at varying levels of this hierarchy. Communities have functional which is uniquely important (Barbour et al, 2009; Drury.C & Lirman.D. 2017). Cynodon dactylon is important because it is well-distributed in all region. Based on Jayadi (Kendarto, 2018) Cynodon dactylon is a weed in plants that has the better ability in surviving compared to the other species of grasses such as manila grass and others. Furthermore, Turgeon (Paripurno,2014) stated that Cynodon dactylon is a perenial grass of warm season that can be grown in tropical and subtropical climate. This species of grass came from America and Australia which was then spread to Asia. This grass has a characteristic of gray-ish green color, sharp hairy leaves, have branches, and fast spreading. Based on the study result the pH average which is measured in the study area I is 6.46, study area II with 6.21 and study area III with 6.28. The soil pH measured in the Ancient Mujil volcano region is suitable for the soil pH needed for the growth of Cynodon dactylon plant. According to Zakaria (Kendarto, 2018) Cynodon dactylon is able to adapt on pH ranging from 5.5 to 7.5. The average of measured soil temperature in the study area I is 28.3, study II with 28.9 and study area III with 28.1. Based on Pioh (2013) the soil temperature is a very influential factor to the growth and progress of the plant. According to Zakaria (Kendarto, 2018), Cynodon dactylon is able to grow well in a soil temperature around 20.4 - 33oC, so that it may give the plant to grow well in the area. The averages of soil humidity in study area I, II and III are 68.7%, 59.1%, and 61%, respectively. Soil humidity is one of the factors affecting the structure and composition of a plant. A plant could grow well in a soil with high soil humidity which is around 60 – 70% (Irwan, 1997). Cynodon dactylon could grow well in the Ancient Mujil volcano region due to the suitable measured abiotic environment conditions which include soil pH, soil temperature, and air temperature to the optimum growth so that this plant can be found in all study area.

The plant that has the lowest IV is Centhotheca lappacea with 0.50% and only found in study area I. Centhotheca lappacea is a weed from Poaceae family in form of clumped grass that can be strongly grown to a height of 125 cm, and this plant is able to live in the lowland until 1200 msl (Anonymous, 2013). Centhotheca lappacea is a plant from Poaceae Family. According to Tjitrosoepomo (Arisandi, 2015), a good temperature for the growth of Poaceae Family ranges from 19 – 27oC with an optimum temperature of 23oC, air humidity from 40 -85%, and soil pH at around 6-7.8. Based on Fitriany Rizka Ayu Mei, et al (2014) stated that the optimum air

humidity for a plant to live is about 40-85%. The surrounding temperature is one of the most important factor because it affects the metabolism process of a plant. Centhotheca lappaceae could not live properly due to the measured abiotic condition such as air temperature which is not suitable to the general condition of the plant's growth. The measured abiotic condition result which is the air temperature with 28.3-33oC is not suitable for the plant as the optimum temperature for the growth of Poaceae Family is 19-27 oC. According to Arief (1994) a plant needs a temperature of 15-25 oC to optimally grows, if the temperature is too high or low could result in the death of the plant. Replacing the rainy season and summer, compared to other types of physiognomy. Thus, the environment situation of habitat changes continuously year (Spellerber 1992; Kleinhenz et al 1996; Sung-Yeol Kim, Moon-soon Kim, Youn-Mi Ryu, Seung-lak An, 2019).

B. Diversity Index (H')

Based on the research results show that in all study areas the diversity index of strata herb vegetation species can be seen in Figure 2. below:

Figure 2. Graphic of Diversity Indeks (H') herb-strata vegetation species in all of the study area

Diversity Index is a value which represents a species diversity of a community, obtained from a species resources which are weighted with the species equality (Hardjosuwarno, 1990; Marini et al, 2011; Sureshkumar Jeyalatchagan et al, 2020). Diversity Index can be translated as a vegetation parameter which is very useful to compare variety of plant community, particularly to understand the effect of environment factor disturbances inside the community, the diversity index can be known (Fachrul,2012)

Overall, the diversity index of herb-strata vegetation diversity in Ancient Mujil volcano region is relatively low at around 0.11-0.14. This is in accordance with the Fachrul 's statement (2012) who stated that H' value <1 shows that the diversity of the species is low, if the H' is around 1-3 it shows that the diversity of a species in the region is moderate and if it is higher than 3 then it can be said that the species diversity in a community is relatively high. Handayani, T. (2018) mentioned that the species diversity of a community is affected by the size of the species diversity, the amount of species and the spread rate of each plant.

Even though the plant species which exist in all of study area is relatively abundant (29 species), but the diversity index of the herb-strata vegetation is generally low in this area. This may be caused by the existence of several herb-strata vegetations which strongly dominate in various study areas, such as in study area I, II, and III are dominated by Oplismenus sp, Ottochloa sp. and Synedrella nodiflora plants. According to Indriyanto (2006) when a species diversity in a vegetation is low, then it can be happened because the area is only dominated by certain plants only. The low value of Diversity Index can also be caused by the species distribution which is equally-distributed in every study area.

Another factor affecting the Diversity Index of herb-strata vegetation species is the interference from the local society such as planting a certain herb species e.g. Kaemferia galanga and cutting several herbs to be taken as animal feed, so that it disturbs the stability of ecosystem and resulting to the low rate of diversity. Based on Odum (Yuniar, et. al., 2015) the diversity is identical with a stability of ecosystem, if the diversity of an ecosystem is high, therefore the condition of the ecosystem tends to be stable.

C. Cluster Analysis

Based on the results of research in all study areas shows that cluster analysis of the abiotic environment can be seen in Table 1. below:

Table 1. Results of the Abiotic Environment cluster analysis.

	Cluster	Error		F	Sig.	
	Mean Square	Df	Mean Square	Df		
Air_temperature	3.392	1	3.717	28	.913	.348
Soil_temperature	.199	1	1.113	28	.179	.676
Soil_humadity	7.792	1	36.146	28	.216	.646
Air_humadity	234.388	1	13.981	28	16.764	.000
pH_Soil	.219	1	.027	28	8.025	.008

Light_Intencity	115645.125	1	2164.217	28	53.435	.000

The result obtained from the cluster analysis that the abiotic factors correlated with the stand grouping pattern of herb-strata vegetation are soil humidity, soil pH, and the light intensity with values of each are 0.00 ; 0.08 ; 0.00, respectively. The other abiotic factors such as air temperature, soil temperature, and air humidity are not correlated with the stand grouping pattern of vegetation with values of 0.348, 0.676, and 0.646, consecutively. If the significance > α (0.05) then H0 is accepted (measured abiotic factor is correlated with the stand grouping pattern) and if the significance < α (0.05) then H0 is rejected (measured abiotic factor is not correlated with the stand grouping pattern).

D. Analysis of Research Result Potential as a Biology Learning Source for First-grade High School in the Biodiversity Material.

According to Djohar (Suhardi, 2012) the Biology research result can be made as a learning source if it fulfills the requirements of a learning source. The following is an analysis of potential learning resources from the results of research on the diversity of vegetation types of herbaceous strata in the Ancient Mujil Volcano area as a source of learning biology for high school students.

1. The Clarity of potential, the availability of object and the problem which is taken
   The object used in this study is the herb-strata vegetation in Ancient Mujil Volcano Region, Kulon Progo. The reason of the choice of herb-strata plants as the objects in this research is because the plant is easy to find, be recognized, and identified based on its morphology and it is very easy to be found in the local environment. The relevance of the problem taken with its potential as a learning source of Biodiversity material is that the Ancient Mujil Volcano is not yet utilized by the nearest schools as a learning source of biodiversity material with contextual basis.
2. The suitability with the learning objective
   Learning objectives of the 2013 Curriculum is written in KD 3.2 which is to analyze the observation data regarding various level of biodiversity (genes, species, and ecosystem), which is that the students could mention the herb-strata vegetation species, students are able to mention the example of herb-strata vegetation species which has a vital role and the least important role, and also the students are able to explain the concept of biodiversity in the ecosystem level.
3. The Clarity of the material target and its subject
   The clarity of the material target in this research is the biodiversity material for first-grade high school particularly ecosystem-level diversity, while the subject target of this study is the first-grade high school students.
4. The clarity of the information explained
   Based on the research that has been done, the clarity of the information which can be explained are in form of facts and concepts. Moreover, the fact obtained is the finding of 29 plant species of herb-strata in the Ancient Mujil volcano Kulon Progo volcano region with the highest average of Importance Value Index (IV) belongs to Cynodon dactylon with 27.91%, while the herb vegetation with the lowest average of Importance Value Index is Centhotheca lappacea with 0.5%. The concept which is obtained from this study is the biodiversity especially in the ecosystem level. According to Eurika. Novy & Akhmadi. Arief.N (2016) The Curriculum analysis is done by adjusting the process and research product with the core curriculum standards in 2013. Based on the analysis of processes and products (facts, concepts, principles and procedures) study, the results of the research on attractant compound Basil flower (Ocimum basilicum) toward fruit flies can be used as a Biology learning resource of 11th grade at KD. 3.6 Curriculum 2013 vocasional hight schools.
5. The Clarity of Exploration Guidance
   According to the research result, it is required to have a clear and coherent exploration research guidance starting from the choice of study area, research object, work procedure, tools and materials, data collection, data analysis, and conclusion making. The research result can be utilized to support the achievement of KD 3.2. which is to analyze the observation data regarding various biodiversity levels (genes, species, and ecosystem) in particular on the biodiversity ecosystem material level.
6. The Clarity of the Obtained Result
   The clarity of the obtained result in the choice of learning source should be based on the objectives to be achieved in the learning process. A good learning source ideally could give a meaningful experience to the students so that it could increase the skill of students in the cognitive, affective, and psychomotic area. This can be realized through a contextual learning, in which one of them is by presenting an authentic and concrete learning source which is close to the students through the utilization of environment-based learning source in

the surrounding area. According to Najmulmunir (2010), a learning source is differentiated into 2, which are learning source which is purposely designed for learning (by design) and the learning source which are utilized. The by-design learning source is a learning source which is specifically made or developed as an instructional system to give a directed and formal facility, while the by-utilization learning source is a learning source that cannot be specifically designed for learning purpose and its existence can be found, implemented, and utilized for the learning needs. Ancient Mujil Volcano Region, Kulon Progo district is one of the local potential that can be utilized as a biology learning source for first-grade high school.

Other than the learning source requirements above according to Djohar (Suhardi, 2012), an assessment is also done regarding learnig source requirements according to Dick and Carey (Supriadi, 2015), which are explained below:

1. The availability of local sources
   The choice of learning source has to consider the availability of the local sources. It means that if a learning source is not available then it has to be bought or made. Ancient Mujil Volcano Region is a region which can be used as a learning source alternative because it provides objects such as herb-strata vegetation species which can be utilized as learning source in the material of ecosystem-level biodiversity. Ancient Mujil Volcano Region can be directly used as a learning source without any further procurement or making and can be straightly used because it is already provided by the nature.
2. The availability of fund, resources, and sufficient facility to conduct a learning source
   Costs and resources needed to use the Ancient Mujil volcano Kulon Progo Volcano Region as a learning source in Biodiversity material are relatively low. This due to the distance of the Ancient Mujil Volcano to the school area which is quite close, so that it can save costs, transportation, and resources. The facility used to support the Ancient Mujil Volcano region as a learning source is relatively simple such as gauge, thermometer, Thermohygrometer, and observation table
3. The flexibility, practicality and learning source security factors for a relatively long period.
   Ancient Mujil Volcano Region have a flexibility, practicality, and learning source security factor for a long period. This shows that this region does not need complicated process and stages to be used as a learning source and easy be observed, and also a region in which its sustainability is still preserved makes Ancient Mujil Volcano Region can be used as a learning source for a long-term period.
4. Cost effectiveness for a relatively long period
   Financing needed to make the Ancient Mujil Volcano as a learning source is relatively cheap and effective. This due to the location of Ancient Mujil Volcano that is easily accessible and its utilization as a learning source does not require a complicated process hence saving the cost needed.
5. The description above explains that the surrounding environment can have potential as a source of learning for high school students. Acording to Boleng. D.T.and Lumowa. S.V.T (2019) Most high school biology teachers (64.0%) say that natural resources available on land in East Kalimantan such as plantations can be used as learning media for senior high school biology learning. The results are potential to use as learning materials for first grade senior high school. The aspects include object availability and the issues in question; suitability with the learning objectives; aims and purposes; information clarity; exploration guidelines; and the outcome (Handayani, T & Nurhidayat. 2019; Handayani T. Moro, Hendro K.E, 2019; Handayani.T, Muhammad S. Wibowo, Sulisworo.D. 2019)

CONCLUSION

Based on the research result it can be concluded as follows:

The herb-strata vegetation species found in the Ancient Mujil Volcano Region, Kulon Progo are in total 29 species. The species with the highest Importance Value Index (IV) is Cynodon dactylon with 27.91% and the lowest IV comes from Centhotheca lappacea with 0.50%. The diversity of herb-strata vegetation species in Ancient Mujil Volcano Region, Kulon Progo is relatively low because the H' ranges between 0.11-0.14. According to the cluster analysis it is found that the stand grouping pattern is divided into two clusters such as: Cluster 1 and Cluster 2. The abiotic environment factor correlating to the stand grouping pattern of herb-strata vegetation is the soil humidity, soil pH and the light intensity, while the abiotic environment factors which are not correlated to the stand grouping pattern are air temperature, soil temperature, and soil humidity. Based on the descriptive analysis method, this process and research result are potential to be a biology learning source for first-grade high school in the biodiversity of ecosystem level material.

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