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Potential Learning Sources for the Material of Biodiversity in Grade X High School Biology at Ijo Ancient Volcano in Kulon Progo

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ABSTRACT
The environment as a biology learning source has not been broadly used by teachers in the learning process, particularly for high school students. One possible area to be used as a high school biology learning source is Ijo Ancient Volcano located in Kulon Progo and Purworejo Regencies. The purpose of this study is to identify the types of herbaceous stratum vegetation with the greatest and smallest roles based on their importance value index (IV), the diversity index of herbaceous species, relationships of measurable abiotic environmental conditions with herbaceous stand grouping patterns, and the potential of the research results as a learning source for the material of biodiversity in grade X high school biology. The method used for data collection is point intercept. The vegetation parameters measured comprise dominance, frequency, relative dominance, relative frequency, and IV. The herbaceous species diversity index was calculated using the Shannon-Wiener formula. Cluster analysis was employed to determine the relationships between measurable abiotic conditions and the clustering patterns of the herbaceous stands. A descriptive method was used to assess the potential of this study's results as a biology learning source.The results show that the herbaceous species with the greatest role by IV was *Oplismenus burmanii* (66.38%), and the smallest role was that of *Calocasia esculenta* (0.34%). The diversity index of herbaceous vegetation species ranged between 0.10 and 0.12. The grouping of herbaceous stands was dIVded into two patterns. The abiotic environmental conditions related to the stand patterns of herbaceous plants were air humidity, soil moisture, soil temperature, soil pH, and light intensity, while air temperature did not correlate with the grouping patterns of herbaceous stands. The descriptive study indicates that the results of this study have the potential to be a grade X high school biology learning source for the material of biodiversity ecosystem level.

Keywords: *Ijo Ancient Volcano, learning source, biodiversity.*

1. INTRODUCTION

Learning sources are any given objects, data, facts, ideas, people, etc. that prompt a learning process [1]. Learning sources for biology can be obtained inside or outside school. Biology learning sources outside of school enable learners to explore nature and their surrounding environment, and thus directly experience real objects that exist therein [2][3][4] When learners face objects directly, their memory of that instance lasts longer than when doing so indirectly, thereby making the learning more meaningful[5][6].

One of the learning topics in biology that can benefit from the surrounding environment as a learning source is biodiversity at the education level of high school grade X. The material of biodiversity relates to the surrounding natural environment, therefore requiring the use of learning sources that emphasize context-based learning.

According to [7][8][6] the utilization of the environment as a learning source offers several

advantages, namely growing the desire to learn, making better use of learning time, drawing interest, making learning not boring, facilitating comprehension of lessons, eliminating conceptual errors, helping learners to think critically, and increasing creativity. An environment outside school that can be used as a biology learning source is Ijo Ancient Volcano which houses various types of herbaceous plants. Research on the diversity of vegetation species there, particularly those of the herbaceous stratum, and its potential as a biology learning source for grade X of high school has never been implemented, thus underlining the need for this study to be conducted.

2. RESEARCH METHOD

This research applied an exploratory approach, which delves to the furthest possible extent into natural phenomena that generate and affect an occurrence [9]. The population of this study encompasses all species of herbaceous stratum plants on Mount Ijo. The research sample consists of herbaceous vegetation in three study areas on Mount Ijo covering a total area of 2.1 ha. The method used for data collection is the point intercept method.

This study began with observations to determine the study area and sampling to measure the parameters of the abiotic environment and vegetation. The abiotic environmental parameters gauged at each stand comprise air humidity, air temperature, soil temperature, soil acidity (pH), and light intensity. The vegetation parameters measured are dominance, frequency, relative dominance, relative frequency, and importance value index (IV). The equations used to calculate vegetation parameters [10] are as follows:

$$\text{Frequency} = \frac{\text{occurrence of species i}}{\text{number of points}}$$

$$\text{Relative frequency (RFi)} = \frac{\text{frequency of i}}{\text{total frequency}} \text{ x } 100\%$$

$$\text{Dominance (D)} = \frac{\text{occurrence of species i}}{\text{total occurrence}} \text{ x } 100\%$$

$$\text{Relative dominance (RDi)} = \frac{\text{number of points with species i}}{\text{number of points}} \text{ x } 100\%$$

Importance value index (IV) = RFi + RDi

The species diversity index (H') was calculated with the Shannon-Wiener formula:

$$H' = -\sum p_i \log p_i = -\sum\left(\frac{n_i}{N}\right) \log \left(\frac{n_i}{N}\right)$$

Note:

H'= Shannon index
n_i = importance value of each species
N = total importance value
p_i = probability of importance for each species = ni/N

The results of this research were then descriptively analyzed for the site's potential as a learning source for the biodiversity material in grade X high school biology. The study of potential biology learning sources referred to Djohar's opinion [11] 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 [12] criteria as follows:

a. Conforming to learning objectives
b. Economical
c. Practical and simple
d. Easy to obtain

3. RESULT AND DISCUSSION

3.1. Importance Value Index (IV) of Herbaceous Species in All Study Areas

Analysis results show that in all study areas, of the 26 types of herbaceous plants found, the species with the highest average IV was Oplismenus burmanii (66.38%), while the lowest IV was that of Calocasia esculenta (0.34%). The high IV of Oplismenus burmanii indicates that this species is dominant and has good adaptability, in line with [13]who state that the dominant species in an area displays better adaptability than the other species. Oplismenus burmanii belongs to the Poaceae family which has a small reproductive device that is easily carried by the wind and is able to persist in any soil condition [14]

The lowest IV of Calocasia esculenta in the three study areas pertains to abiotic environmental conditions unsuitable for its optimum growth. The abiotic environmental conditions measured in the study areas showed an average air temperature of 27.92ºC, an average soil pH of 6.30, and a C/N ratio of 13.56. Meanwhile, as stated by [13][15] the optimum air temperature for the growth of Calocasia esculenta is between 15 and 25ºC and the optimum soil pH ranges from 5.6 to 6, while good C/N ratio for the plant's growth is between 15 and 20 [16]

The occurrence of herbaceous vegetation species throughout the study areas is described by the following Venn diagram Figure 1. Venn diagram of herbaceous vegetation species throughout the study areas.

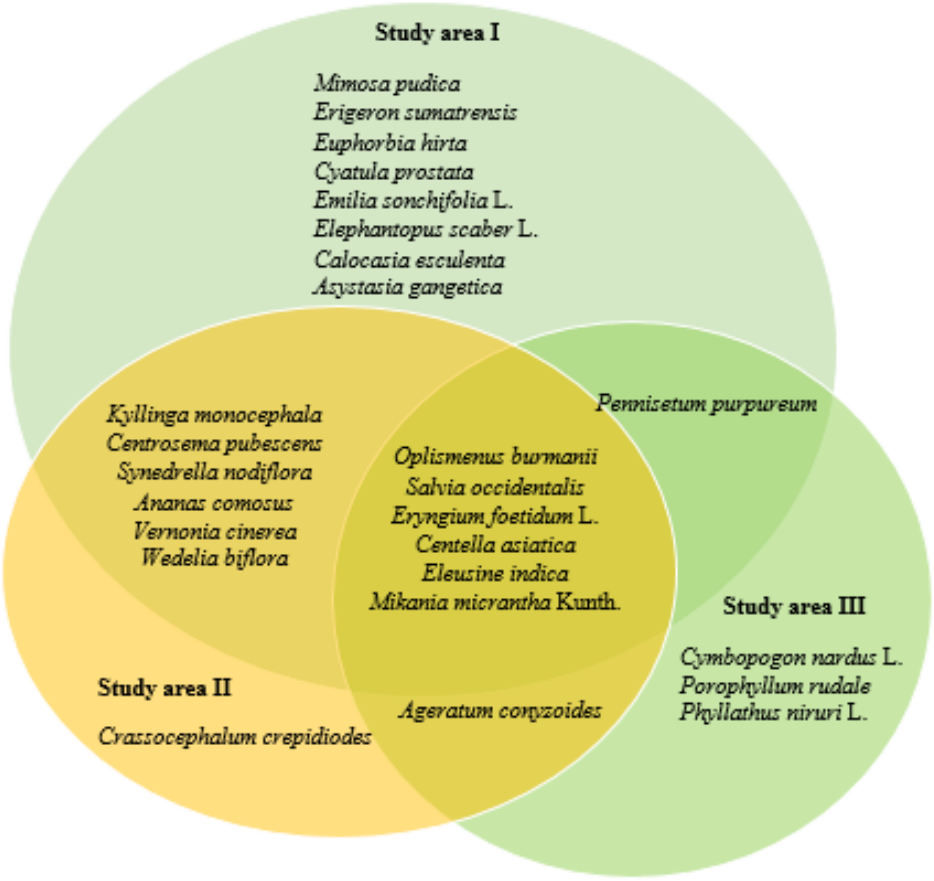

Figure 1. Venn diagram of herbaceous vegetation species throughout the study areas

The Venn diagram in Figure 1 above shows six herbaceous species that overlapped in the three study areas, namely *Oplismenus burmannii*, *Salvia occidentalis*, *Eryngium foetidum* L., *Cantella asiatica*, *Eleusine indica*, and *Mikania micrantha* Kunth. This indicates that those overlapping species have similar ecological characteristics, which in turn denote similarities in tolerance and adaptation to their abioticenvironmental condition.

3.2. Diversity Index of Herbaceous Species in All Study Areas

Based on calculations, the species diversity indices (H') of herbaceous vegetation in all study areas can be seen in Figure 2. below.

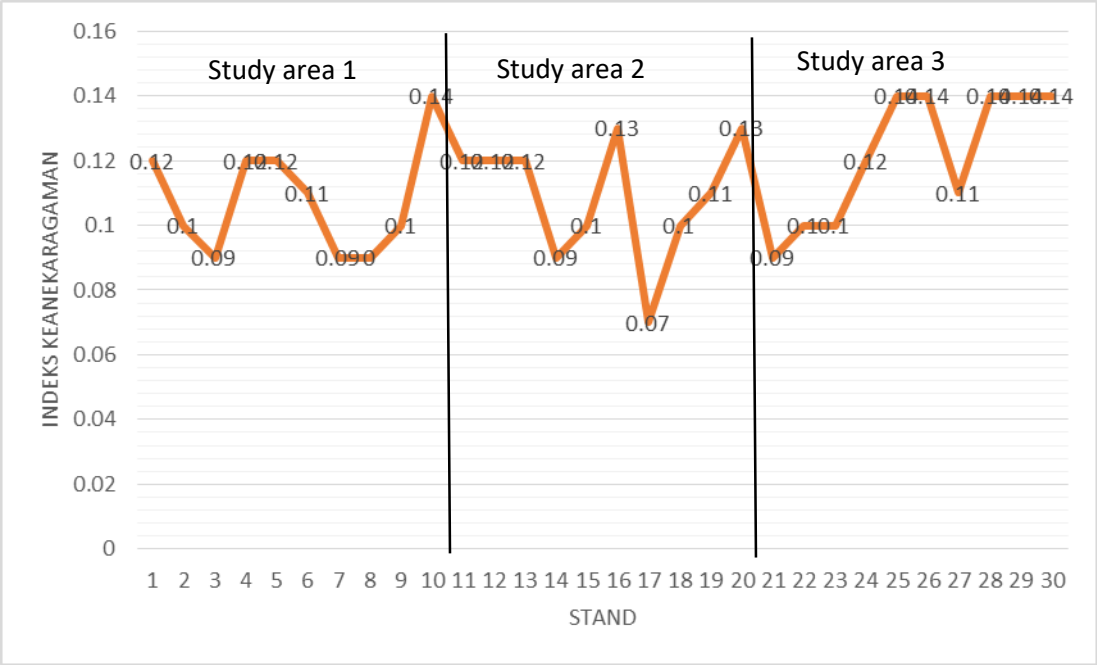

Figure 2. Average diversity indices of herbaceous vegetation species in all study areas

Figure 2 above shows that the average diversity index of herbaceous species in all study areas ranges from 0.10-0.12, signifying that the diversity index of herbaceous stratum vegetation on Ijo Ancient Volcano is relatively low. As stated by [15], the species diversity index can be classified into three categories: the value of H'>3 indicates high diversity, 1<H'<3 denotes moderate diversity, and H'<1 implies low diversity.

The low diversity indices suggest that the types of herbaceous vegetation found on Mount Ijo are not numerous and are unevenly distributed throughout the study areas. According to [17] the diversity index is a combination of species wealth and distribution. The greater the H' value, the higher the diversity of the species. Species wealth is determined by the total number of a species in a community [18]. Odum [19]asserts that species diversity is influenced by the spread of individuals from each species, in that although a community hosts many species, if the individuals are not uniformly distributed, the diversity is low.

3.2.1. Correlation between Measurable Abiotic Environmental Conditions and Stand Grouping Patterns of Herbaceous Vegetation Species on Ijo Ancinet Vulcano in All Study Areas

Cluster analysis was used to determine the relationship between measurable abiotic environmental conditions and the stand patterns of herbaceous vegetation species on Anciont Mount Ijo, with results inTable 1. as follows.

Table 1. Cluster analysis by ANOVA

ANOVA

	Cluster		Error		F	Sig.
	Mean square	DF	Mean square	DF		
Air humidity	804.805	1	97.304	28	8.271	.008

Air temperature	2.694	1	14.411	28	.187	.669
Soil moisture	364.161	1	37.724	28	9.653	.004
Soil temperature	345.774	1	6.480	28	53.358	.000
Soil pH	1.957	1	.107	28	18.368	.000
Light intensity	115070799.975	1	398488.252	28	288.768	.000

Note:
H_0 rejected (Sig.<0.05) = Correlated
H_0 accepted (Sig.>0.05) = Not correlated

The measurable abiotic environmental conditions that comprise air humidity, soil moisture, soil temperature, soil pH and light intensity had a significant value of <0.05 and thus related to the clustering patterns of herbaceous vegetation stands, while air temperature was not.

3.2.2. Analysis of Study Results' Potential as Biology Learning Source

Results of the research on the diversity of herbaceous stratum vegetation at Ijo Ancient Volcano Kulon Progo were studied descriptively for their potential as a learning source on the material of biodiversity in grade X high school biology. Djohar [11] states that something can be used as a biology learning source if it meets the following criteria: (1) clarity of potential availability of the objects and problems raised, (2) conformity with learning objectives, (3) clarity of the targeted material and its designation, (4) clarity of the information disclosed, (5) clarity of exploration guidelines, and (6) clarity of gains to be achieved.

In addition, the descriptive study refers to the opinion of [12] who explain that the selection of learning sources needs to consider several aspects, which are the extents to which the sources align with the learning objectives, are economical, practical and simple, and are easy to procure.

a. Clarity of potential availability of objects and problems raised
   Results of the study provide conspicuously existing objects with the discovery of 26 species of herbaceous stratum vegetation situated on Ijo Ancient Volcano.
   The issue raised in this study is that the biodiversity of herbaceous vegetation on Ijo Ancient Volcano in particular and its potential as a learning source for grade X high school biology have not been explored.

b. Conformity with learning objectives
   Results of the conducted research demonstrate conformity with the learning objectives of the material on ecosystem-level biodiversity in biology. The conformity in question is the partial achievement of the learning objectives in the formulation of basic competency (3.2) of high school biology in the 2013 Curriculum, namely analyzing observational data on various levels of biodiversity (gene, species, ecosystem) in Indonesia.

c. Clarity of the targeted material and its designation.
   The targeted material in this study is the ecosystem-level biodiversity material, which is designated for grade X high school students.

d. Clarity of the information disclosed
   The information clearly revealed is the fact and concept derived from the results of the study concerning herbaceous stratum vegetation on Ijo Ancient Volcano. The fact obtained in this research is the 26 types of herbaceous plants found, while the concept gained is ecosystem-level biodiversity.

e. Clarity of exploration guidelines
   This research was carried out through a clear scientific method, including determining the research site, research objects, preparation of tools and materials, work procedure, data analysis, discussion, and conclusion drawing process.

f. Clarity of gains to be achieved
   It was observed at the research site that the closest high school from there is SMAN 1 Kokap Kulon Progo. The clear gain to be achieved from the study conducted is that the results are expected to be applicable to biology learning in that high school, so as to enhance the students' abilities in the cognitive, affective, and psychomotor domains.

g. Economy
   The cost required to establish Ijo Ancient Volcano as a learning source for learners is relatively affordable. Learners can visit Ijo Ancient Volcano directly and use it as a learning source without being charged for admission into the area.

h. Practicality and simplicity
   Ijo Ancient Volcano facilitates observations and does not require complex equipment. The apparatus only consists of stationery, an observation table, a thermometer, a pH indicator, and a thermo-hygrometer, with which learners can observe various species of herbaceous vegetation directly.

i. Ease of procurement
Herbaceous stratum vegetation thrives in the area of Ijo Ancient Volcano, allowing learners to observe it directly.

3. CONCLUSIONS

From the results of this study, it can be concluded that:

1. The herbaceous plant species with the greatest role based on IV was *Oplismenus burmanii* (66.38%) while the one with the smallest was *Calocasia esculenta* (0.34%).
2. The diversity index (H') of herbaceous species in all study areas ranged from 0.10 to 0.12, indicating that the diversity of herbaceous plants on Ijo Ancient Volcano was relatively low.
3. Results of the cluster analysis were devided into two clusters: cluster 1 and cluster 2. Measurable abiotic environmental conditions correlating to the stand patterns of herbaceous vegetation on Ijo Ancient Volcano were air humidity, soil moisture, soil temperature, soil pH, and light intensity, whereas air temperature was not related.
4. According to the descriptive study, the results of research on the diversity of herbaceous stratum vegetation types on Ijo Ancient Volcano hold the potential as a biology learning source on the material of biodiversity ecosystem-level for grade X of high school.

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