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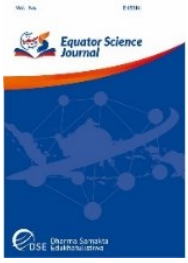

Diversity And Density of Freshwater Gastropods and Its Utilization as Learning Media in The Lake Lindu Sigi Regency

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Diversity of freshwater gastropods, Lake Lindu biodiversity, Learning media development.

ABSTRACT
Gastropods are animals that live at the bottom of waters, both fresh water and sea water. This research aims to describe the diversity and density of Gastropods as bioindicators of water quality in Lake Lindu and their use as a learning medium. This research uses the Perposive sampling method with a sampling technique using free collection with a roaming path method of 30 meters per station. Meanwhile, the data analysis technique uses quantitative descriptive. The research results showed that the Gastropod Diversity Index was obtained at Station I (1.69) and then followed by Station II (1.61) and Station III (1.67). Meanwhile, the gastropod diversity index in Lake Lindu is H'=2 and is categorized as medium level of diversity. Then the density of Gastropods in the Lake Lindu area of Sigi Regency was 11.2 ind/m2. Taking the research results as learning media in the form of a pocket book, from the validation results which include media validation, this validation, and design validation which was carried out by 3 expert lecturers and a feasibility test which was tested on 15 students obtained a percentage of 82% and is very suitable to be used as media learning.

INTRODUCTION

The gastropod class is the largest class of the phylum Mollusca which has 40,000 species or 80% of the phylum Mollusca. In Indonesia it is estimated that there are around 1,500 types of animals from this class. The Gasropoda class is more commonly known as snails or snails, and has a relatively large size. Gastropods are the most important class of the phylum Mollusca, because some of them are a source of

protein and have high economic value (Nontji, 2007). Molluscs (snails and shellfish and their relatives) are among the animals that use rice fields as a place to live. Farmers must be familiar with snails which are a type of phylum mollusca in the gastropod class which are often found in water areas, rice fields and plantations (Ikiangkringan, 2012).

Arfan et al (2020), One of the aquatic ecosystems in Central Sulawesi Province is Lake Lindu, which is the eighth largest lake in Sulawesi and in Central Sulawesi the second largest after Lake Poso. Located on the plateau, precisely 950 meters above sea level, the administrative area is in the Lindu sub-district of Sigi Regency, has an area of ± 3470.52 Ha with a depth of ± 100 m. The existence of Lindu Lake has a very important role as an aspect of the community's source of income. Geographically, Lake Lindu is in the position 1°03'-1°58' South Latitude, 119°57'- 120° 22' East Longitude. Administratively Lake Lindu is located in Lindu District, Sigi Regency, Central Sulawesi Province which is within the Lore Lindu National Park (TNLL) area. The Lake Lindu area is ecologically divided into several areas, namely inlate, middle part of the lake, settlements, livestock, plantations and outlets (Lukman, 2007). The results of observations carried out in the Lake Lindu area, especially in Tomado Village, Anca Village and Langko Village, Sigi Regency, found that there were many freshwater gastropods scattered in the lake. According to information from interviews with people in the Lake Lindu area, especially in the three villages, there are many types found and they don't know the types and benefits of these freshwater gastropods. There is a prohibition on taking freshwater Gastropods, this is because there is a public belief that there is Schistosomiasis disease if you take or consume freshwater Gastropods. Based on information and public beliefs about the disease Schistosomiasis, this has resulted in a large number of freshwater gastropods scattered in the Lake Lindu area, Sigi Regency. Apart from that, location conditions that support the life of freshwater gastropods include high rainfall, damp places and other environmental factors.

METHOD

This type of research is quantitative descriptive. Descriptive research is research that describes or illustrates existing phenomena, whether natural or the result of human engineering (Sukmadinata, 2011). Quantitative research aims to explain analytical data figures using statistics (Sugiyono 2013). The research report is described based on the results of identifying the types of Gastropods found in Lake Lindu which will be used as a recommended learning resource for students in the form of a pocket book.

This research produces learning media in the form of a pocket book which will then be validated to determine its level of suitability by a team of experts, namely content experts, media experts and design experts, then it will be tested on 15 biology education students.

Data analysis

The types of gastropods that have been identified are then calculated for their species diversity and density indices. The diversity of types or species can be measured by relative diversity which can be formulated as follows: The Shannon-Wienner diversity formula (Selvianita et al., 2024) is:

$$H' = - \sum Pi \ ln \ (Pi) \text{ Where } Pi = \sum ni/N$$

Information:

H’ = Shannon-Wienner diversity index
ni = Number of individuals of one species
N = Total number of individuals

Density of species can be measured using relative density which can be formulated as follows:
The density formula of Brower and Zar (1990) is:

$$D = \frac{\sum Ni}{A}$$

Information:
D = Number of individuals per unit area (individu/m^2)
Ni = The total number of individuals in a unit area
A = Transect Length (meters^2)

RESULTS AND DISCUSSIONS

Lake Lindu is surrounded by a number of mountains such as Mount Nokilalaki (2,357 m), Mount Lantawungu (2,270 m) and Mount Tumawu (2,120 m). There are 16 main rivers that drain water into this lake. The four largest are the Kati River, Lembosa River, Langko River and Wongkodono River. Meanwhile, the outlet of this lake is through the Rawa River which then enters the Gumbasa River, a tributary of the Palu River. Based on its geographical location, Lake Lindu is in the position 1°03'- 1°58' South Latitude, 119°57'-120° 22' East Longitude. Administratively Lake Lindu is located in Lindu District, Sigi Regency, Central Sulawesi Province which is within the Lore Lindu National Park (TNLL) area. The Lake Lindu area is ecologically divided into several areas, namely the inlate, the middle of the lake, settlements, livestock, plantations and outlets. One of the aquatic ecosystems in Central Sulawesi Province is Lake Lindu, which is the eighth largest lake in Sulawesi and the second largest in Central Sulawesi after Lake Poso. Located on the plateau, precisely 950 meters above sea level, the administrative area is in Lindu District, Sigi Regency, has an area of ± 3470.52 Ha with a depth of ± 100 m. The existence of Lake Lindu has a very important role as an aspect of the community's source of income.

Environmental Physical Conditions

Table 1. Environmental Parameters

No	Parameter	Station 1	Station 2	Station 3
1.	Temperature	27	27	29
2.	pH	7,3	7,9	7,9
3.	Salinity	27/‰	28/‰	29/‰
4.	Depth	38cm	25cm	40cm

This research was carried out by creating three different stations, there are three parameters of physical environmental conditions which can be seen in table 1.

Table 2. Gastropod Diversity Index

No	Name	Ni	Pi (Ni/N)	Ln Pi	Pi Ln Pi
1.	*Tylomelania toradjarum*	99	0.293769	-1.22496	-0.35986
2.	*Cipangopaludina chinensis*	61	0.181009	-1.70921	-0.30938
3.	*Oncomelania hupensis lindoensis*	32	0.094955	-2.35435	-0.22356
4.	*Thiara scabra*	49	0.145401	-1.92826	-0.28037
5.	*Radix rubiginosa*	18	0.053412	-2.92971	-0.15648
6.	*Anentome helena*	37	0.109792	-2.20917	-0.24255
7.	*Pila ampullaceai*	41	0.121662	-2.10651	-0.25628
	∑ Individual	337		H	2

H'= ∑ **(Pi. Ln Pi)**
H' = 2
H' = 2 (Medium Diversity Level)

Based on the table 2 of research conducted at three observation stations, 7 types of gastropods, 7 genera, 7 families and 6 orders were found.

Table 3. Gastropod Density Results

No	Name	Station			Total
		St 1	St 2	St 3	
1.	*Tylomelania toradjarum*	18	55	26	99
2.	*Cipangopaludina chinensis*	8	6	47	61
3.	*Oncomelania hupensis lindoensis*	8	18	6	32
4.	*Thiara scabra*	2	8	39	49
5.	*Radix rubiginosa*	3	10	5	18
6.	*Anentome helena*	20	10	7	37
7.	*Pila ampullacea*	5	11	25	41
	Density				**11,2**

Based on the table 3 of density research conducted at three observation stations, 7 types of gastropods, 7 genera, 7 families and 6 orders were found.

Media Validation Results

Based on validation results by content experts, it shows that the contents of the pocket book are in the appropriate category with a percentage of 77.5%. Based on the results of validation of the feasibility of learning media by media experts, it shows that the pocket book media created is in the very feasible category with a percentage of 82.85%. Based on the results of validation of learning media by design experts, it is in the very feasible category with a percentage of 82.66%. Based on the validation results of the pocket book from the three expert teams, it showed that the pocket book was suitable for testing by a group of 15 students and obtained a percentage of 82%.

The results of research conducted at Lake Lindu, Sigi Regency, found that at station one, 4 types of gastropods were found, namely *Tylomelania toradjarum, Cipangopaludina chinensis, Oncomelania hupensis lindoensis, Anentome helena.* The station is in Anca Village, a fishing area. At station two, 4 types of gastropods were found, namely *Tylomelania toradjarum, Oncomelania hupensis lindoensis, Thiara scabra, Anentome helena.* Station II is in Tomado Village, a tourist area. At station three, 6 types of gastropods were found, namely *Tylomelania toradjarum, Cipangopaludina chinensis, Thiara scabra, Radix rubiginosa, Anentome helena, Pila ampullaceal.* Station three is in Langko Village, which is an island area, this area is still less affected by community activities or the area is classified as natural. Of the three stations, the most frequently found gastropods were: *Tylomelania toradjarum* at station one as many as 18, at station two 55, and station three 26. *Cipangopaludina chinensis* at station one as many as 8, at station two as many as 6, at station three as many as 47. *Oncomelania hupensis lindoensis* at station one as many as 8, at station two as many as 18, at station three as many as 6.*Thiara scabra* at station one there are 2, at station two there are 8, at station three as many as 39. *Radix rubiginosa* at station one as many as 3, at station two as many as 10, at station three as many as 5, *Anentome helena* at station one as many as 20, at station two as many as 10, at station three as many as 7. and the last type is: *Pila ampullaceal* at station one there were 5, at station two there were 11, at station three there were 25.

The results of research conducted on the diversity of gastropod species in the Lake Lindu area of Sigi Regency, obtained a diversity index value at station one H' = 1.69. station two H' = 1.61 and station three H' = 1.67. The diversity value of Gastropods at the entire station is H'= 2. If we look at the value of H', each physical-chemical environmental condition can influence the presence of Gastropods. So the H' value is directly proportional to the physical-chemical conditions of the environment, where the lowest physical-chemical conditions of the third station are at station one. The diversity index value (H') of Gastropods in the Lake Lindu Area of Sigi Regency as a whole is H'-2 in the medium diversity level category because H'= 1<H'>3, this means that the condition of the aquatic environment can still be tolerated by Gastropods and supports to end life and reproduction.

The results of data analysis on Gastropod population density in Lake Lindu, the overall value from the station is above an average of 11.2 ind/m2. The density of Gastropods found in this study was greater at station three compared to station one and station two. The density in Lake Lindu is relatively low compared to the gastropod population density in Lake Maninjau based on research from Bahri

(2006), namely 504.34 ind/m2. The population density of an organism can be influenced by the area of the habitat and how many records are carried out in research (Suin, 2003). Based on the results of the three sampling stations, the density of gastropod species, namely the species *Tylomelania toradjarum,* was more commonly found at station two, where from all three transects at station two there were 55 *Tylomelania toradjarum*, so that at station two the density of *Tylomelania toradjarum* reached 3.3 ind/m2, for the species The second density is *Cipangopaludina chinensis* reaching 2.03 ind/m2, for the third species the density of *Thiara Scabra* reaches 1.63 ind/m2, for the fourth species the density of *ampullaceal Pila* reaches 1.36 ind/m2, for the fifth species the density of *Anentome helena* reaches 1.23 ind/m2 , the density of the six *Pleurocera acuta* species reached 1.06 ind/m2 and the lowest density, namely the *Radix rubiginosa* species, reached 0.6 ind/m2.

Learning media is said to be very feasible if the percentage value includes 81%-100%. The results of the assessment of learning resources in the form of pocket books were obtained from content experts with a percentage of 77.5%, design experts 82.66%, media experts 82.85% and tested to 15 Biology Education students with an average score of 4.28 and a percentage of 85.3%. This average value shows that pocket books are very suitable for use as learning media (Arikunto & Cepi Safruddin, 2009).

CONCLUSION AND SUGGESTION

Based on the research results that have been obtained, it can be concluded that the diversity of gastropods in the Lake Lindu Area has a moderate level of diversity with a value of H'= 2. The density of gastropods in the Lake Lindu area has an average density of 11.2 ind/m2 with a composition of Tarebia granifera species with a value of 99 individuals and the results of the assessment that have been made in the form of a pocket book, obtained 82% results which are categorized as very suitable for use as learning media.

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