

Development of Invertebrate Zoological Learning Videos for Students Based Ecological Aspects of Macrozoobentos in the Toaya River Waters

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Abstract

*Macrozoobenthos as basic organisms in relatively sedentary habitats. This study aims to describe the development of invertebrate zoological learning videos based on aspects of macrozoobenthic ecology in Toaya river waters and the results of the research can be made into videos about the types of Macrozoobenthos as a media for learning biology. The method used is a descriptive method with purposive sampling technique. The results of the research have been developed as learning media in the form of videos with a percentage value of 78% for content experts, 80% for design experts, and 77% for media experts. Meanwhile, there were 20 student trials, the percentage reached 87%. This shows that the video made is suitable for use as a learning medium. The number of Macrozoobenthos found were 4 *Macramia magnifica*, *Bellamyia javanica*, *Faunus ater*, and *Ocypoda stimpsoni*. The diversity of macrozoobenthos in the waters of the Toaya river, Sindue District, Donggala Regency is low, for very abundant abundance, high density, and low frequency, very high dominance, and low diversity. The most distribution patterns are at stations IV and III which are inhabited by *Ocypoda stimpsoni* species.*

Keywords:

Macrozoobentos, streams, vidios.

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Introduction

Video is an electronic medium that can combine audio and visual technology to produce a dynamic and attractive presentation. Videos can be packaged in the form of VCD and DVD so they are easy to carry everywhere, easy to use, can reach a wide audience, and are interesting to ask questions (Yudianto, 2017).

Video media can attract attention and direct audience concentration on video material. The effective function, namely the video media can arouse the emotions and attitudes of the audience. According to (Sudjana & Rivai, 1992). The benefits of video media are: (1) Can foster motivation (2) The meaning of the message will be clearer so that it can be understood by students and allows for mastery and achievement of the objectives of delivering instructional videos that are shown to make it easier for students to understand lesson materials not always according to needs and the wishes of students. Video media is very important in everyday life because it can provide more Sophisticated and fast information. In addition to providing information and entertainment, videos can also be used as learning media.

So many terms and memorization characteristics of each animal group make this science quite difficult for students. As a result, the final results and this course tend to be unsatisfactory.

Efforts to balance the demands of the learning aspects in the invertebrate zoology learning material, it is not sufficient to use one type of teaching media. Therefore, it is necessary to try the use of media in the form of videos during lectures and practicum. This is intended to help students see more concretely the description and characteristics of each identified animal type.

One of the sub-materials that will be developed in the instructional media for invertebrate Zoology video is the ecological aspects based on macrozoobenthos. The choice of macrozoobenthic material is because this material is difficult for students to understand, especially its classification and ecological aspects.

Therefore, this research will be conducted on the development of invertebrate Zoology learning videos for students based on macrozoobenthic ecological aspects in the waters of the Toaya river. The results of research on the development of invertebrate Zoology learning videos for students based on macrozoobenthic ecological aspects in Toaya river waters.

Makrozobentos live relatively sedentary, so it is good to use as an indication of environmental quality because it is always in contact with the waste that enters its habitat. This group of animals can better reflect changes in environmental factors from

time to time because these animals are in water whose quality changes (Zulkifli & Setiawan, 2011).

Macrozoobenthos are organisms that live on the bottom of the waters and are part of the food chain whose existence depends on a population of lower organisms (Pealeu, 2018).

Macrozoobenthos as basic organisms in relatively sedentary habitats. Changes in water quality and the substrate in which it lives greatly affect its composition, abundance, and diversity. Diversity is a trait that involves the level of diversity in the types of organisms that exist. Macrozoobenthos are groups of invertebrates that live at the bottom or stick to the substrate at the bottom of water bodies. Generally, these organisms are relatively sedentary or can move but very slowly (Furaidah et al., 2013).

The existence of macrozoobenthic animals in waters is greatly influenced by various environmental factors, both biotic and abiotic. Biotic factors that influence are producers who are a source of food for macrofauna and species interactions and life cycle patterns of each species in the community. While the abiotic factors are Physico-chemical water, including temperature, current, dissolved oxygen (DO), biological oxygen (BOD), and chemical (COD) requirements, as well as nitrogen (N) content, water depth, and basic substrate. Characteristics of chemical physics parameters can affect the density, productivity type composition, and population physiological conditions (Tatangindatu et al., 2013).

The habitat of macrozoobenthos is relatively fixed because this group of animals is an organism that occupies the bottom of the water. With this nature, changes in water quality and the substrate in which it lives greatly affect the existence of macrozoobenthos depending on their tolerance or sensitivity to environmental changes. Each community responds to changes in habitat quality by adapting to the community structure. In a relatively stable environment, the diversity of macrozoobenthos is relatively constant (Rahmawaty, 2011).

The river is water that flows because the quality of the water always changes from time to time or is dynamic. "Freshwater ecosystems have very significant importance in human life because freshwater ecosystems are the most practical and inexpensive source to meet domestic and industrial interests.

The river is a type of public aquatic ecosystem that plays a role in biota and human needs, for various activities such as agriculture and industry which are influenced by many factors, both by natural activities and human activities (Salmin, 2005).

Water territory is a medium that is susceptible to pollution. Various types of pollution both from housing, industrial, natural phenomena, and so on enter many water bodies. After accumulating, pollution will directly or indirectly

affect water quality. One of the indicators that can be used to see water quality is macrozoobenthos. (Suwondo et al., 2004).

The river is one of the lotic types of fresh water and is one of the natural resources that can provide value to human life. One of the uses of this ecosystem is for fast-water fish cultivation. In mountainous areas that have very good water quality, especially water physics variables, water is used as a source of meeting the needs for clean water, including as a source of drinking water. This condition is very possible considering that environmental parameters related to the feasibility of water as a source of clean water are still in the lower range value than the water quality standard as a source of clean water (Rachman et al., 2016).

The upstream is characterized by shallow, narrow river bodies, steep and high cliffs, clear water, and fast-flowing, and has a small population (both in type and number) of biota. The downstream rivers are generally wider, the cliffs are steep or sloping, the water bodies are deep and cloudy, the water flow is slow, and the water biota population in them is large, but the types are less varied. While the estuary is the part of the river bordering the sea. This part of the river, has shallow and gentle cliffs, the body of water is deep, cloudy, and flows slowly. At high tide, river water flows upstream. The height of the water bodies is greatly influenced by the tides and ebbs of seawater. The water population is relatively large because several types of marine fish can enter the dry river (Kawuri et al., 2012).

The main component contained in a river is very necessary for the survival of an organism because most of the body of an organism consists of water as a constituent of the protoplasm and as a medium to help speed up the course of chemical reactions in the organism's body. Besides, water also functions as a universal solvent, therefore there is no water and pure natural water but in it, there are other compound elements. The people of the river, they play an important role in life, including household needs, fisheries, agriculture, and even as a means of transportation. The utilization of rivers as above greatly affects the physical and chemical conditions of the aquatic environment, if it does not pay attention to the stability of the ecosystem (Ratih et al., 2015).

One of the rivers in Sulawesi, which is located in Donggala Regency, Sindue Induk sub-district is the Toaya River, geographically the position of this river stretches out, the length of the river is approximately 9 km stretching from Sumari Village as Hulu and Toaya Village as the river mouth.

Based on the description above, it is necessary to research the development of invertebrate zoology learning videos for students based on macrozoobenthic ecological aspects in Toaya village waters. The existence of the Toaya river is very important for the life of the Toaya people and its surroundings for use (MCK) and even a source of

clean water for some people who consume the river water. The need for the existence of the river has been carried out by the community for years, of course, this activity will have a big influence on the life of river biota, especially the macrozoobenthos in these waters.

With the activities of the Toaya village community such as washing, bathing, and other activities in household needs, fisheries, agriculture, and even as a means of transportation, can affect macrozoobenthic activity in the waters of Toaya village then whether macrozoobenthos based on ecological aspects can be developed in video form.

This research has benefits in providing information about the development of invertebrate zoology learning videos for students based on the ecological aspects of macrozoobenthos in Toaya village waters. As information material for researchers in developing knowledge and skills in research, is a scientific contribution to Tadulako University for the development of the implementation of the Tri Dharma of Higher Education, and as basic data for local governments and related agencies in the context of optimal river management. Especially in Toaya Village, Sindue District, Donggala Regency.

Materials and Method

This research is joint research where this researcher uses 2 methods (multimedia), namely descriptive analysis and development methods, descriptive analysis is used in ecological studies to obtain the results of macrozoobenthic ecological research, and to make videos the development method is used.

Population A group of Tadulako University students, especially Biology students. And all types of macrozoobenthos live in the river area of Toaya Village, Sindue District, Donggala Regency.

The sample in this study was 20 students of Tadulako University. And the types of river macrozoobenthos are sampled at each predetermined station. The technique used in this study is a sampling technique that determines the number of samples according to the sample size that will be used as the actual data source.

The determination of the station was done by purposive sampling with consideration of environmental baseline and community activities along with the river flow. Based on this, there are 4 stations placed; Station I Part of the river water around the natural forest, station II part of the river water around the cocoa plantation area, station III part of the river water around residential areas, and Station IV part of the river estuary.

At each station, 3 transect lines are placed, namely 1 transect and 1 transect on the left and right banks in the middle of the river. The length of the transect is 150 m so that it can represent the area of the observation, and the distance between the transects is 1.5 m. Each transect has placed a plot

measuring 1x1 m, with a distance between the plots of 5m.

Sample Analysis

a) Population density (K)

$$K = \frac{\text{Number of individuals of a kind}}{\text{Surber Net area}}$$

b) Frequency of attendance (FK)

$$K = \frac{\text{Number of repetitions occupied a species}}{\text{Total number of repetitions}} \times 100\%$$

(Romadhon, 2008).

c) Diversity

Macrozoobenthic diversity can be calculated using the diversity index type according to Shannon-Winer (Odum, 2008) with the formula:

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

Information:

$$P_i = n_i/N$$

n_i = number of individuals of one kind

N = total number of individuals

Umar (2013) states that the diversity index of H' 's consists of several criteria, namely:

$H' > 2.0$ = High Diversity

$H' 1,6-2,0$ = Medium diversity

$H' 1,0-1,5$ = Low diversity

$H' < 1,0$ = Very low diversity

d) Abundance

Haryono (2004) states that the calculation of the abundance of identified individual starfish can be used the formula:

$$K = \frac{n_i}{St}$$

St

K = abundance

n_i = number of individuals of type i

St = The number of stations occupied by type i

Abundance level criteria:

0 = nothing

1-10 = less

11-20 = enough

> 20 = very much (Michael (1994)

e) Unidirectional distribution/pattern

$$I\delta = n \frac{\sum X^2 - N}{N(N-1)}$$

$I\delta$: Spread Index

N : The total number of individuals obtained

X : The number of individuals per station

n : Number of stations

f) Dominance

$$D = \sum_{i=1}^n \frac{P_i^2}{1} = \sum_{i=1}^n \left(\frac{n_i}{N}\right)^2$$

Where:

D = dominance index

n_i = the number of individuals i-th

N = total number of individuals

The greater the dominance index (D), the greater the tendency for certain types to dominate g. and Inequality is denoted by:

1. < (smaller

2. \leq (less than or equal to)

3. > (bigger)

4. \geq (greater than or equal to)

Table 1. Results of measurements of the physical and chemical conditions of the Toaya river waters

No	Station	Parameter					
		Temperature (°C)	Salinity (PPM)	Dissolved oxygen (mg/L)	pH	Substrate	Strong currents (sec/m)
1	Station I	31	0.3	0.2	7.80	Sandy	3
2	Station II	32	0.3	1.3	7.80	Stony	9
3	Station III	31	0.3	3.3	7.62	Muddy sand	5
4	Station IV	32	0.5	2.4	7.0	Sandy mud	7

Results and Discussion

Based on the validation results of the Learning video development. Content expert lecturers obtained 78%, design experts 80%, and media experts 77%. While there were 20 student trials, the percentage reached 87%. This shows that the videos made are suitable for use as learning media.

Based on the measurement of the abiotic factors of river waters, it was found that the physical-chemical conditions were different in each measurement at the observation station, station I had a temperature ranging from 29-30 C, salinity ranged from 0.2 to 0.3 ppm, dissolved oxygen ranged from 4.2 -8.7 mg/L pH range 7.0-7.80 assisted substrate, current strength 3 seconds/1m, then station II has a temperature ranging from 29-30 C salinity ranges from 0.1 -0.3 ppm dissolved oxygen ranges 2.3-3.3 mg/L, pH range 7.0-7.80 substrate muddy sand, strong current 9 sec/1m then station III has a temperature of 29-31 °C, the salinity of 0.3-0.4 ppm of dissolved oxygen ranging from 2.3 to 3.3 mg/L pH range from 7.50 to 7.62, sandy substrate, 4 sec/1m, and the last is station IV has a temperature ranging from 30-32 C, salinity 0.4-0.5 ppm, dissolved oxygen 2.3-2.4 mg/L, pH 6.9 -7.0 type of sludge substrate sandy and strong currents 7 sec/1m. These conditions are by the station where the macrozoobenthic is located, this is because the river water ecosystem is an integrated set of abiotic (physical-chemical) and biotic (living organisms) components that are related to each other and interact to form a functional structure, changes of one of the components, Of course, this will affect the entire life system in it, whereas according to (Oktarina et al., 2015).

With the occurrence of changes in physical-chemical and biological factors, the types of aquatic biota that have high tolerance will experience an increase and widespread. A tolerant organism can grow and thrive in a range of environmental conditions of even poor quality. On the other hand, intolerant aquatic biota will be scattered in certain waters.

Based on the results of the overall analysis, it shows that the abundance level of macrozoobenthos refers to the abundance criteria, this shows that the abundance conditions are very much, this is because the habitat where its survival is very supportive and still maintained. This is because these conditions are by the station where the macrozoobenthos is river

water ecosystems are an integrated set of abiotic (physical-chemical) and biotic (living organisms) components that are related to each other and interact with each other to form a functional structure, changes in one of these components will certainly affect the entire living system in it. Meanwhile according to (Farianita 2006). With the change in physical-chemical and biological factors, the types of aquatic biota that have high tolerance will experience an increase and a widespread., and the diversity refers to very low criteria this is because abundance and diversity are very inversely proportional to a stable system in terms of the resistance of disturbance or pollutants may have low or high diversity, this depends on the function of the energy flow contained in these waters.

Abiotically, environmental factors that have the presence of animals, especially the macrozoobenthos that are in river waters, are the physical-chemical factors of the aquatic environment, among them; light penetration affects water temperature, the basic substrate, the content of chemical elements such as dissolved oxygen, current strength, and what is related to all of these conditions is the pH value or the degree of acidity or wetness of water further (Darojat et al., 2020).

States that tolerance the pH of water organisms varies, this depends on water temperature, dissolved oxygen, and the substrate content of the river waters.

Density and frequency analysis shows that the frequency level of the macrozoobenthic type is very low because the density of macrozoobenthos is very high, almost all types of density are very high and the most dominant density is in the Ocy-poda stimpsonian type. Life in it, whereas according to (Izmiarti 2010). With changes in physical-chemical and biological factors, the types of aquatic biota that have high tolerance will experience an increase and a widespread.

Very low diversity, while at very high dominance, is because there are only four types in macrozoobenthos, based on the table above, the level of diversity is very low, referring to the Diversity criterion, that the macrozoobenthos level of equality is very <Small This is because river according to (Ekaningrum et al., 2012). Water ecosystems are an integrated set of abiotic (physical-chemical) and biotic (living organisms) components that are related to each other and interact with each other to form a functional structure, changes of one

of these components will certainly affect the entire living system.

This is according to (Hadikusumah 2008) with the change in physical-chemical and biological factors, the types of aquatic biota that have high tolerance will experience an increase and a widespread. A tolerant organism can grow and thrive in a range of environmental conditions of even poor quality. On the other hand, intolerant aquatic biota will be scattered in certain waters.

While the distribution pattern is based on the station the distribution pattern level is mostly at Station IV and then Station III, which is inhabited by *Ocypoda stimpsonies* and at Station I and II is very low, we can see that the environmental climatic conditions are very supportive for the continuity of the organisms according to (Haryono 2004). With changes in physical-chemical and biological factors, the types of aquatic biota that have a high tolerance will experience an increase and a widespread, we can see that the environmental conditions are very supportive for the continuity of organisms according to Rauf, (2019) with the occurrence of changes in physical-chemical and biological factors, the types of aquatic biota that have high tolerance will experience an increase and a widespread.

Conclusions

The development of Invertebrate Zoology learning videos with the topic macrozoobenthos is suitable for use as a learning medium. The ecological aspects of macrozoobenthos found in the Toaya Village River, Sindue District, Donggala Regency consist of 4 types. These types are, *Macramia magnifica*, *Bellamyia javanica*, *Faunus ater*, *Ocypoda stimpsoni*. Meanwhile, the diversity of macrozoobenthos in the waters of the Toaya river, Sindue District, Donggala Regency is classified as lace, and for very abundant abundance, high density, low frequency, very high dominance, and low diversity. The most distribution patterns are at Stations IV and III, which are inhabited by *Ocypoda stimpsonies*.

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