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Analysis of Plankton Abundance and Status of Water Quality Fish Cultivation "Sawah Tambak" with Overtime System in Kalitengah Subdistrict, Lamongan Regency

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Abstract. The fish cultivation system in several villages in Kalitengah District uses an *overtime* system, namely a fish cultivation system that is carried out within 1 year (12 months) without passing rice planting. The research objective was to determine the abundance of plankton and the status of water quality fish cultivation "sawah tambak" with overtime system in Kalitengah District Lamongan. This is a quantitative research using descriptive methods. Based on the plankton abundance value at Station 1,2 and 3, the waters in the overtime system of ponds are in the *Eutrooph* category, with the abundance value > 12,000 Ind / L. Meanwhile station 4,5, and 6 are included in the *Oligotrooph* category since its abundance <10,000 Ind / L. The diversity value is within the range of 0.714267-1.823 which include in the category of small diversity and low community stability because the value of 0 <H '<1.5. All stations are in a moderate level of pollution which the diversity index value is within the range of 1 <H '<3. The Dominance Index (D) is in the range 0.212-1.224, Station 1 has a high dominance value because of the dominant species, namely *Batrachospermum*. Water quality parameters at all stations such asthe temperature ranges between 28.8-34.2 ^{0}C; the pH 8.5-9.2; Dissolved oxygen 4-10.44 mg / l; ammonia 0.009-0.17 mg / l; phosphate ranges from 0.025-2.3 mg / l. From the measurement results, water quality parameters show a good value for the growth of aquatic organisms.
Keywords: plankton abundance; water quality status; sawah tambak; overtime system; lamongan

I. INTRODUCTION

The production of aquaculture in Lamongan regency reached 51,365 tons in 2016[1]. Some of the commodities that support aquaculture production such as vaname shrimp, tilapia, milkfish, and tawes are raised in pond rice fields. The potential area of pond rice in the area of Lamongan Regency is 19,485.46 hectares in 15 (fifteen) districts. The natural and technical conditions of *Sawah Tambak* are very different when compared to other areas where in the rainy season this area used for fish farming, while in the dry season it is planted with rice.

Kalitengah sub-district has the potential for *Sawah Tambak* area of 2,555.53 hectares or as much as 13.1% of the total area of *Sawah Tambak*. Kalitengah sub-district is a *bonorowo* area, part of which is prone to flooding, so that the ponds in the rainy season are often inundated and drowned. The fish cultivation system in several villages in Kalitengah sub district uses an overtime system, namely a fish cultivation system that is carried out within 1 year (12 months) without passing rice planting. The advantage of the overtime system is that it can produce fish throughout the year, but it has disadvantages, including plankton bloom, decreased water quality due to increased organic matter and reduced water sources.

Pond cultivation is strongly influenced by the fertility of the waters and pond soil [2]. Plankton density or excessive plankton bloom in pond waters is dangerous for farmed shrimp or fish because when the weather is sunny there will be excessive O_2 production through photosynthesis. O_2 levels that reach 250% saturation cause gas embolism in the gill tissue of shrimp or fish. Due to acute respiratory distress, shrimp and fish usually float on the surface of the pond water. Conversely at night, there will be a lack of O_2 due to the respiration process by plankton. Dissolved oxygen requirements for shrimp and fish ponds ranging from 3 - 10 mg /l [3].

The level of plankton production can be used to estimate the potential for shrimp and fish production, the condition of a water is stable or unstable and if the plankton population in a waters is saturated (blooming) also can be used as an indicator of biological pollution [4]. The existence of plankton species can describe the real condition of the waters [5].

From the description above, research is needed with the aim for analyzing the abundance of plankton and the status of water quality in ponds with overtime systems which have different characters from ponds in general where fresh water sources and polyculture systems are used in ponds. This research was focus on identification of plankton types; determined plankton biology index including the calculation of diversity and dominance; and determined the phsysical and chemical parameter of water quality.

II. RESEARCH METHOD

The research was conducted from May 2020 to September 2020 in the overtime system *Sawah Tambak* in 6 villages, Kalitengah Subdistrict, Lamongan Regency.

This research is quantitative research which used a descriptive method. The sampling station was determined by *purposive sampling*, namely Station I (Sugihwaras villages), Station II (Canditunggal villages), Station III (Bojoasri villages), Station IV (Tiwet villages), Station V (Somosari villages), and Station VI (Pucangtelu villages). Data collection was carried out by field observations to measure water quality and plankton sampling at each station. Measurement of water quality was also carried out at the Fish and Environmental Health Laboratory of the Fisheries Service of Lamongan District, while identification of plankton samples was carried out at the Laboratory of the Faculty of Fisheries, Lamongan Islamic University.

The tools used for the analysis of plankton abundance and the status of water quality in, namely DO meters, pH meters, refractometers, secchi disk and Hg Thermometers, while for plankton sampling and plankton identification was conducted using planktonet with mesh size 25 µm, plastic bucket volume 4-liter, plastic bottle 100 ml, trinocular microscope, SRC (Sedgewick Rafter Count), drop pipette and plankton identification book (Freshwater Algae) [6]. The material used was Lugol's Solution 4.

This research was carried out through systematic, logical and structured stages, which consisted of 3 stages, namely:

1. Plankton Identification

Prepare tools and materials in advance, namely plankton net, sample bottles, buckets, lugol and label paper. Plankton extraction can be done vertically and horizontally. The plankton sample that was filtered in the sample bottle was molded with lugol. Plankton is identified with reference [6]. Observation of plankton using a binocular electric microscope with a magnification of 10x10 = 100 times. An example of palnkton was taken with a 1 ml pipette to be observed and placed in the *Sadwich Rafter* under the microscope and then counted according to the order of the boxes in the *Sadgwich Rafter*.

2. Analysis of abundance, diversity, and plankton dominance

Plankton abundance analysis [7], plankton counting was done by calculating the number of plankton per unit volume, the density of plankton in cells or individuals per unit volume can be determined by using the following formula:

Where :

$$D = q \frac{(1)}{F} \frac{(1)}{V}$$

D: Number of plankton per unit volume (Ind / liter)
Q: Number of plankton in the subsample (Ind)
F: Fraction extracted (subsample volume per sample volume)
V: The volume of filtered water (ml) = 250 ml

The abundance of organisms in water can be expressed as the number of individuals per liter. Classify waters based on individual abundance, namely a water with an abundance <10,000 Ind / L is included in waters with a low abundance level (*Oligotrooph*), an abundance between 10,000 - 12,000 Ind / L are included in the medium level (*Mesotrooph*), and waters with an abundance of> 12,000 Ind / L are high levels (*Eutrooph*) [8]

To calculate diversity, the Shannon-Wiener diversity index [9] was used for data processing guide:

$$H' = -\Sigma \left(ni / N \right) \ln \left(ni / N \right)$$

Where :
H '= Shannon-Wienner Diversity Index
Ni = Number of individuals / species
N = total number of individuals

The dominance index is calculated using the dominance index formula from Simpson [7]:

$$D = \Sigma \left(ni / N \right)^2$$

Where :
D = Simpson Dominance Index
ni = number of individuals per species
N = number of individuals of all species

The dominance index ranges from 0 to 1, where the smaller the dominance index value, it shows that there is no dominating species, otherwise the greater the dominance, it shows that there are certain species [10]

3. T test for the relationship between physico-chemical parameters and biological parameters.

The T test was used to determine the relationship between physico-chemical parameters and biological parameters. The formula for the T test used to determine the existence of significant differences in plankton diversity [10] :

$$t = H'_1 - H'_2 / S_{H'1} - S_{H'2}$$

Where :
T : The value of t calculated is looking for
H ' : Diversity index
SH ' : Standard Deviation of Diversity

III. RESULT AND DISCUSSION

1. Plankton Identification

The results of plankton identification at 6 stations found 41 genera. The identification results can be seen in Table I below.

TABLE I
RESULT OF PLANKTON IDENTIFICATION

No	Species	Station					
		I	II	III	IV	V	VI
1	*Anabaena*	+	+		+	-	-
2	*Coelosphaeriu m*	+	+	+	-	+	+
3	*Lemanea*	+	+	+	+	+	+
4	*Myxophyta*	+	+	+	+	+	+
5	*Spirullina*	+	+	-	+	-	-
6	*Ankistrodesmus*	-	+	-	-	-	-

7	*Aulacouseira granulate*	-	+	-	-	-	-
8	*Brachinous sp*	-	+	+	-	+	+
9	*Canthocamtus sp*	-	+	-	-	-	-
10	*Ceratium*	-	+	-	-	-	-
11	*Chromulina*	-	+	-	-	-	-
12	*Dinophysis*	-	+	-	-	-	-
13	*Glenodinium*	-	+	-	-	-	-
14	*Gyrosigma frustulemarkings*	-	+	+	-	-	+
15	*Mallomonas*	-	+	-	-	-	-
16	*Nostoc*	-	+	-	-	-	-
17	*Tabellaria flucolusa*	-	+	-	-	-	-
18	*Oscillatoria rubescens*	+	+	+	+	+	+
19	*Thalassiosira weissflogii*	+	+	+	+	+	+
20	*Gyrodinium*	-	+	-	-	-	-
21	*Batrachospermum*	+	-	-	+	-	-
22	*Carteria*	+	-	-	+	-	-
23	*Euglena*	+	-	-	+	-	-
24	*Pediastrum simplex*	+	-	-	+	-	-
25	*Rizoclonium*	+	-	-	+	-	-
26	*Scytonema*	+	-	-	-	-	-
27	*Selenastrum*	+	-	-	+	-	-
28	*Stephanodiscus*	+	-	-	+	-	-
29	*Stigeoclonium*	+	-	-	+	-	-
30	*Ilothrix*	+	-	-	+	-	-
31	*Entomoneis paludosa*	-	-	-	+	-	-
32	*Diplonesfusca*	-	-	-	+	-	-
33	*Gonyaulax*	-	-	-	+	-	-
34	*Dinobryan*	-	-	+	-	+	-
35	*Eunotia arcus*	-	-	+	-	+	-
36	*Heterokontzoospore*	-	-	+	-	-	-
37	*Melosira*	-	-	+	-	+	+
38	*Monorophidium*	-	-	+	-	+	+
39	*Nielosira*	-	-	+	-	-	+
40	*Pharmidium*	-	-	+	-	+	+
41	*Nitzschia*	-	-	-	-	+	-

*** **+ Yes**

- No

2. Analysis of abundance, diversity, and plankton dominance

Diversity Index Abundance Value, and Plankton Dominance Index Can be seen in Table II below :

Station	Sampling Point	Abundance (Ind / L)	Diversity Index (H ')	Dominance Index (D)
I	IA	2.093.629	0,4739	0,8033
	IB	276.642	1,2545	0,5178
	IC	136.360	0,4144	2,3514
	Average	**835.544**	**0,714267**	**1,224**
II	IIA	420.504	1,4906	0,3672
	IIB	198.503	0,9837	0,5917
	IIC	914.717	0,91663	0,5803
	Average	**304.906**	**1,1302**	**0,513**
III	IIIA	1.046.834	0,788	0,482
	IIIB	483.979	1,59782	0,2411
	IIIC	856.997	0,2964	0,884
	Average	**795.937**	**0,894**	**0,535**
IV	IV A	180.185	1,61	0,255
	IVB	94.750	2,205	0,141
	IVC	29.460	1,654	0,257
	Average	**101.465**	**1,823**	**0,212**
V	VA	31.330	0,891	0,582
	VB	111.660	0,9768	0,604
	VC	30.042	1,485	0,287
	Average	**57.677**	**1,1176**	**0,491**
VI	VI A	37.464	1,0404	0,491
	VI B	74.031	1,1981	0,299
	VI C	15.522	1,7361	0,186
	Average	**42.339**	**1,324**	**0,325**

Based on Table 2, the highest average plankton abundance value was obtained at station 1 (Sugihwaras Village), which is 835,544 Ind / L from all stations. While the results of the calculation of the plankton diversity index mean value, the highest value was at station 4 (Bojoasri Village) which was 1.823 and the lowest was at station 1 (Ds. Sugihwars) of 0.714. The dominance index value, the highest average value at station 1 (Sugihwaras Village) was at 1.224 while the lowest value was at station 4 (Bojoasri Village) at 0.212.

The highest abundance of plankton at Station 1 was *Sawah Tambak* overtime system in Sugihwaras Village, Kalitengah Subdistrict. The number of plankton abundance average values is 123,155 Ind / L. For the type of plankton abundance the highest was from the genera *Batrachospermum* with an average abundance of 624,428

Ind / L. *Batrachospermum* is a family of red algae (Rhodopyta). Classifies waters based on individual abundance, namely a water with low abundance (*Oligotrooph*), an abundance between 10,000-12,000 Ind / L including moderate level (*Mesotrooph*) and waters with abundance. > 12,000 Ind / L, it is classified as high level. (*Eutrooph*)[8]. At Station 1, it is based on information obtained in the field that the use of water is *closed system* (water rotation) without discharging water so that it can be indicated that it is included in high level waters (*Eutrooph*) because of the abundance> 12,000 Ind / L. The abundant *Rhodophyceae* (red algae) class causes pond water to tend to be dark brown. Plankton which has the lowest abundance at Station 1 is from the genera *Thalassiosira weissflogii* with an abundance of 417 Ind / L. *Thalassiosira weissflogii* is non-toxic and very tolerant of poor water quality including being able to live in an environment with a high carbon dioxide content [11].

The diversity index of all stations is in the range 0.714267-1.823. According [12] regarding the range of diversity index (H '), all stations fall into the small diversity category and low community stability because the value of 0 <H' <1.5. The highest diversity index is 1,823 at station 4, there are no dominant genera as seen by the discovery of 19 genera at that station which have almost the same total of individuals in each genera. Stated that the diversity value in the range of 0.714267-1.823 indicates that the water is in moderate quality because it is in the value range of 1-2, while the diversity value is in the range of 1-3 indicating the water is in lightly polluted quality. Meanwhile, according to [13], all stations are in a moderate level of pollution because the diversity index value is in the range of 1 <H '<3.

The Dominance Index (D) is in the range 0.212-1.224. The highest dominance index value is 1.224 at Station 1 while the lowest dominance index is at Station 4. According to [14] [15] the dominance index ranges from 0 to 1, where the smaller the dominance index value, it indicates that no there are species that dominate otherwise if the greater the value of the dominance index, it indicates that there is dominance in certain species. At Station 1 which has a high dominance value because of the dominant species, namely *Batrachospermum*.

Measurement of water quality parameters

Temperature is one of the physical parameters of water quality which plays a very important role in controlling the ecosystem of a waters, especially pond rice fields which are freshwater waters. [9]stated that the solubility of the gases required for photosynthesis is increased by low temperatures. Based on the results of in situ (field) measurements at 6 stations, it was found that the overtime pond waters had temperatures ranging from 28.8-34.2 ^{0}C. The optimum temperature range values are 28-32 ^{0}C at Station 1 and 2, while the temperature value is above the optimum range at Station 6, namely 31.2-34.2 ^{0}C. High temperature is affected by intensity sunlight, water brightness and water depth. Temperature greatly affects the distribution, composition, and abundance of phytoplankton in the water [16]. According to [17] temperature is one of the important physical factors that affect the life of many aquatic animals and plants, one of which is plankton. According to [18] states that the optimum temperature range for phytoplankton growth in general is 20-30 ^{0}C and the temperature range for active life of marine organisms and brackish water is 0-35 ^{0}C. Phylum *Chlorophyta* will grow optimally in the temperature range 30-35 ^{0}C while for diatoms in the temperature range 20-30 ^{0}C. Based on the temperature values at all stations, it can be concluded that the temperature in the overtime pond water is still good for metabolic activity and the reproduction of organisms and biota in these waters.

The pH value of water in overtime pond rice fields ranges from 8.5-9.2. The pH value of water shows a value above the optimum value. The optimum pH value of water is 7.5-8.5. The highest pH value is at Station 5, which ranges from 9.0-9.4. At Station 5, if it is related to the water brightness value of 20.5 cm, the pH value tends to be high, which causes slow growth. The pH value of a water can change if the waters experience disturbances such as pollution and instability of the aquatic environment. Changes in the pH value of waters can be influenced by the presence of temperature, photosynthetic activity and waste disposal [16].

Based on in situ measurements for dissolved oxygen (DO) levels at all stations are above the permissible water quality criteria, namely > 3 mg /l [19]. The range of dissolved oxygen at all stations is 4-10.44 mg /l. The minimum oxygen solubility in supporting fish life is around 4 mg / l. Meanwhile, [10] states that the value of dissolved oxygen in the water should be in the range of 6.3 mg / l. The lower the dissolved oxygen value, the higher the level of pollution in an aquatic ecosystem. According to [16], plankton can live well at concentrations of more than 3 mg /l.

The difference in the amount of ammonia content as a nutrient in the form of nitrogen has a very large effect on the growth of microalgae. The utilization of nitrogen nutrients in waste in the form of ammonia will decrease along with the consumption of algae as a source of nutrition [20]. Nitrogen plays a very important role as a constituent of protein compounds in cells and is an important part of chlorophyll. The range of ammonia in laboratory measurements at all stations is 0.009-0.17 mg / l. According to [21] the ammonia content of 0.05-0.2 mg /

l affects the occurrence of growth disorders in aquatic organisms in general. Based on the results of ammonia measurements at all stations, it is still in a safe range for the growth of aquatic organisms.

The phosphate concentration at the station ranges from 0.025-2.3 mg / l. The phosphate concentrations at all stations were in a good range to support the growth of phytoplankton. According [22], it is stated that optimal growth of phytoplankton has a range of 0.27-5.51 mg / l. Referring to the aquatic fertility category, the average phosphate concentration at each station is still within the recommended limit of 0.48 mg / l.

3. Test T

Based on the results of calculations using SPSS 17 software from all stations, the following conclusions were obtained: The T test with paired sample T Test shows the abundance of Plankton from Station A to Station B, Station A to Station C, and Station B to Station C, Station C to Station D, Station E to Station F, the results are at t count <t table, At 0.05: reject Ha, accept Ho, it means that there is no significant effect between each station. So it can be stated that "there is no suitability of water quality based on plankton density" in the Sawah Tambak.

IV. CONCLUSION

Based on the plankton abundance value at Station 1,2 and 3, the waters in the overtime system of ponds are in the *Eutrooph* category, because the abundance value is> 12,000 Ind / L. Meanwhile station 4,5,6 is included in the *Oligotrooph* category because of its abundance <10,000 Ind / L. The diversity value is in the range of 0.714267-1.823 in the category of small diversity and low community stability because the value of 0 <H '<1.5. All stations are in a moderate level of pollution because the diversity index value is in the range of 1 <H '<3. The Dominance Index (D) is in the range 0.212-1.224, Station 1 has a high dominance value because of the dominant species, namely *Batrachospermum*

In measuring water quality parameters at all stations the temperature ranges between 28.8-34.2 0C, the pH value of water ranges from 8.5-9.2; The dissolved oxygen range is 4-10.44 mg / l; ammonia is 0.009-0.17 mg / l; Phosphate ranges from 0.025-2.3 mg / l. From the measurement results, water quality parameters show a good value for the growth of aquatic organisms.

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