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STUDY OF NILEM FOOD HABITS IN TROPHIC LEVEL BASED CULTIVATION IN FLOATING NET CAGES

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ABSTRACT

Increasing the efficiency of feed use in fish culture in floating net cages can be done by cultivating trophic level-based fish, using nilem fish. This research is to find out the eating habits of nilem fish that are cultivated in the third net of KJA in Cirata. The study was conducted by taking samples of nilem fish from floating net cages ponds which were given various levels of feeding (0, 1, 2, 3, and 4% of body mass per day). The parameters observed include diversity, dominancy and similarity of plankton. The data obtained were analyzed in a quantitative description, by describing all the results obtained during the study with a plankton identification book. The results showed that from observations in the five treatment nets, the total number of plankton species identified in the digestive tract of cirata reservoir nilem fish were 49,227 individuals. Arcella sp had the highest number of species, with 19,163 individuals. Based on the index value of the diversity, the plankton diversity in the digestive tract of nilem fish in cirata reservoir was in the medium level category. While the dominance index and similarity index were low. Plankton diversity index values in all treatments ranged from 1.79 to 2.12. Dominancy index in all treatments ranged from 0.16 to 0.28, and similarity index ranged from 0.24 to 0.30.

Keywords : food habit, trophic level-base culture, floating net cages, diversity, dominancy, similarity, nilem

Introduction

The floating cages net (FCN) system's cultivation that are managed intensively, bring the consequences of using large amount of feeds. Generally, in lakes / reservoirs, feeding is by ad libitum system, which is by feeding that is available at any time. Some research results showed that the around 20-50% amount of feed that is not consumed or wasted at the bottom of the water by fish will be released into the water bodies as pollutants or waste. The remainder of fish feed and solid waste will decompose through the process of decomposition to form organic and inorganic compounds, such as nitrogen compounds (NH3, NO2, NO3) and phosphorus (PO4) (Juaningsih, 1997). Nitrogen (N) and phosphorus (P) compounds needed by phytoplankton and other aquatic plants. In an aquatic environment, phytoplankton are primary producers that affect the abundance of organisms. Remnants of fish food and feces from FCN act as fertilizer which can fertilize lake / reservoir waters. In a situation where hypertrophic condition occurs, an uncontrolled growth (blooming) of certain types of plankton can take place.

There must be an approach taken to overcome the deteriorating conditions of the waters, while pioneering towards the improvement of a more environmentally oriented floating net cultivation system, such as the application of trophic level-based aquaculture. The use of fish with different feeding characteristics in each layer of the net, such as a combination of main and additional commodity fish (goldfish, tilapia and nilem), respectively in the first, second and third layer of the net. In the third layer, using herbivorous fish with the aim of reducing sedimentation in the bottom of the water also utilizing organic material from the waters with the principle of bio cleaning agent. This system of layered net use in fish farming is ecologically and economically beneficial because it saves food and maintains water quality.

One herbivorous fish that can be used as a fish commodity in the lower layer of the FCN is the nilem fish (*Osteochilus hasselti*). The potential of nilem from environmental aspects acts as a cleaning biological agent because nilem is a detritus-eating fish (non-living organic matter, such as feces, deciduous leaves, and dead organisms, of all trophic levels) and periphyte (microorganisms both plants and animals that are not alive) live clinging, moving freely or attached to the surface of objects in the river such as rocks, wood, stems of aquatic plants, and so on), thus nilem fish can function as net cleaners (Jangkaru 1980). To evaluate the ability of nilem fish as cleaning agents in floating net cages, research on food and feeding habits of nilem is needed to illustrate eating preferences and the potential use of plankton as a food source.

Research Methodology

Time and Place

This research was conducted in July - October 2019 in floating net cages set up in Waduk Cirata, West Java Province. Food and feeding habits of Nilem were observed in the Aquaculture Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran.

Tolls and Materials

The fish used in this research were female Nilem fries with sizes of 3-4 cm and an average weight between 0.2-0.4 g, obtained from the Ciparanje Experiment Pond, Faculty of Fisheries and Marine Sciences Unpad. The fish was fed with feed test which contained 28% protein content. The tools used in the observation were as follows: one floating cage sized 7x7 m, twenty nets with a size of 1m x 1m x 1m each, brand AND EK-120 G digital scales with accuracy of 0.01 g, ruler with accuracy of 1 mm, brand Hanna HI-3810 pH meter with accuracy of 0.01, brand Hanna HI-3810 DO meter with accuracy of 0.1 ppm, Thermometer with accuracy of 0.1^{o}C, binocular microscope, glass object and glass cover, hand tally counter, and dissecting kit.

Research Method

This research was conducted using experimental methods. Completely Randomized Design (CRD) was used in this study. The research treatments consisted of 5 treatments and 3 replications, as follows:
Treatment A: without artificial feeding
Treatment B: fed as much as 1% of body weight per day
Treatment C: fed as much as 2% of body weight per day
Treatment D: fed as much as 3% of body weight per day
Treatment E: fed as much as 4% of body weight per day

Research Procedure

Preparation

Cultivation preparation begins with preparing tools and materials that will be used during the research, such as preparing nets for cultivation containers, and others. The nets were placed according to the treatment layout which has been randomized. Before the experiment begins, Nilem fries weight and length were measured. Then, the fish were put into the nets, with a density of 100 fish/net. The fish were vasted for 1 day and continued with 7 days of acclimatization.

Research Execution

The nilem were cultivated in one cycle of nursery period, which is 42 days. During the cultivation, feeding was done 3 times a day in accordance with the treatment given. The fish with control treatment was not given artificial feed. Feed were given every day at 08.00, 12.00 and 16.00 WIB. Observations of food and feeding habits and water quality were carried out at the start, during, and end of the study using a survey method, which consisted of 2 stages: data collection and analysis. Tika (2005) stated that survey is a research method that aims to collect large amounts of data in the form of variables, units or individuals at the same time, data collected through specific individuals or physical samples with the aim of being able to generalize the result of the study.

Observation Parameters

Plankton Diversity

Plankton diversity was calculated using the Shannon-Weinner Diversity Index According to Odum (1993):

$$H' = -\sum_{i=1}^{n} \mathbf{pi} \ln pi$$

Info:
H' = Shannon-Weinner diversity index
pi = Comparison between the number of individuals of I-type species and the total number of individuals (ni / N)
I = 1,2,3……n
N = Total number of plankton

The Shannon-Weinner H index assessment categories are as follows:
H' ≤ 1 = low diversity
1 ≤ H' ≤ 3 = medium diversity,
H' ≥ 3 = high diversity.

Plankton Dominancy

Small Similarity and Diversity Index values indicate the high dominance of a species over other species. The Simpson dominance index formula, according to Odum (1993) is as follow:

$$C = \sum_{i=1}^{n} pi^2$$

Info:
C = Dominancy Index
Pi = Proportion of individuals in fish species
I = 1,2,3……n

Index values range from 0-1 with the following categories:
0 ≤ C ≤ 0.5 = Low Dominance;
0.5 ≤ C ≤ 0.75 = Medium dominance;
0.75 ≤ C ≤ 1.0 = High dominance.

Plankton Similarity (E)

The Similarity Index illustrates ecosystem balance. Shannon-Weinner similarity index formula according to Magurran (1987):

$$E = \frac{H'}{H' max}$$

Information:
E = Uniformity Index
H ' = Diversity Index
H 'max = maximum diversity index = ln S
S = Total number of species

Uniformity index values range from 0-1 with the following categories:
0 ≤ E ≤ 0.4 = Small uniformity

$0.4 \leq E \leq 0.6$ = Medium uniformity
$0.6 \leq E \leq 1.0$ = High uniformity.

Data Analysis

In general, the analytical method used in this research is the description analysis method. The data obtained were analyzed in a quantitative description, by describing all the results obtained during the study using the plankton identification book Sachlan (1982) and Davis (1955).

Result and Discussion

Plankton Diversity

During the research on identification of the digestive tract of Nilem fish in Cirata Reservoir, as many as 49,227 plankton individuals, consisting of 31 species of plankton (Table 1) were identified in all digestive tracts of Nilem fish. Compared to other plankton species, Arcella sp was found the most abundant. The types of plankton identified during research on observation A were 10,323 individuals consisting of 30 species, B was 8,398 individuals consisting of 29 species, C was 13,143 individuals consisting of 27 species, D was 10,837 individuals consisting of 30 species, and E was 6,526 individuals which consisted of 30 species. Arcella sp was the highest number of species found, with a total of 19,163 individuals from 49,227 individuals. As for other types, they are only viewed as complementary feed due to the very large difference in number.

Table 1. Number and Types of Plankton found inside the Digestive System of Nilem Fish in Waduk Cirata

No	Species Name	Treatment					Total species
		A	B	C	D	E	
1	*Anabaena*	4	8	151	12	8	183
2	*Actinastrum*	51	5	48	5	9	118
3	*Arcella*	4037	4155	4233	4553	2185	19163
4	*Brachionus*	15	2	2	10	2	31
5	*Cyclops*	4	1	2	3	4	14
6	*Coelastrum*	46	162	215	144	223	790
7	*Cosmarium*	0	9	81	8	14	112
8	*Diatoma*	837	837	1425	1285	578	4962
9	*Diaphanosoma*	2	0	0	3	0	5
10	*Dictosphaerium*	846	765	1476	360	472	3919
11	*Denticula*	2	0	0	4	1	7
12	*Dimorphococcus*	339	289	39	930	395	1992
13	*Fragillaria*	154	2	6	46	6	214
14	*Hyalotheca*	209	33	112	96	12	462
15	*Merismopedia*	1012	639	1416	783	485	4335
16	*Navicula*	1176	666	1557	1254	785	5438
17	*Nitzchia*	63	106	272	323	333	1097
18	*Oscilatoria*	35	24	86	24	45	214
19	*Pediastrum*	4	4	8	11	5	32
20	*Pleurosigma*	9	3	3	6	6	27
21	*Peridinium*	28	3	2	2	5	40
22	*Scenedesmus*	828	204	1099	339	366	2836
23	*Spirogyra*	75	38	53	0	30	196

No	Species Name	Treatment					Total species
		A	B	C	D	E	
24	*Shirogonium*	84	125	24	84	64	381
25	*Staurastrum*	47	24	4	26	15	116
26	*Sinedra*	168	88	200	192	186	834
27	*Sphaeroplea*	50	27	0	66	93	236
28	*Surirella*	3	5	0	4	3	15
29	*Stauroneis*	4	11	39	2	4	60
30	*Tabelaria*	189	162	588	260	190	1389
31	*Treubaria*	2	1	2	2	2	9
	Total plankton	10323	8398	13143	10837	6526	49227

The amount of plankton treated at each observation shows an uneven abundance, because each station has a varied number of species and abundance. The emergence of dominant and non-dominant plankton species in an aquatic community causes the waters to become unbalanced due to pollution from sewage discharges into these waters (Soedarti et al, 2006). Comparison of the number of individual phytoplankton with zooplankton shows that the number of phytoplankton is greater. The result shows the normal situation in an ecosystem; because in a food pyramid, the primary producer is always at the bottom and occupies a larger number of rooms (Taofiqurohman et al., 2007).

There are differences in nilem food habits in different habitats due to differences in the availability of food resources in these waters. Nilem that is cultivated in the floating cages does not eat detritus, and plant parts because these food ingredients are not available. This is consistent with Effendie's (1997) statement that fish species can adapt to the availability of feed in an aquatic environment. Effendie (1997) states that the fish preference to its food is very relative, because the abundance of natural feed is not necessarily can be utilized by fish. This is due to several factors, such as the spread of organisms as feed, food availability, fish preferences, and physical factors that influence the waters.

Plankton Diversity

Diversity is the relationship between the number of species and the number of individuals of each type in a community (Kottelat et al. 1993)

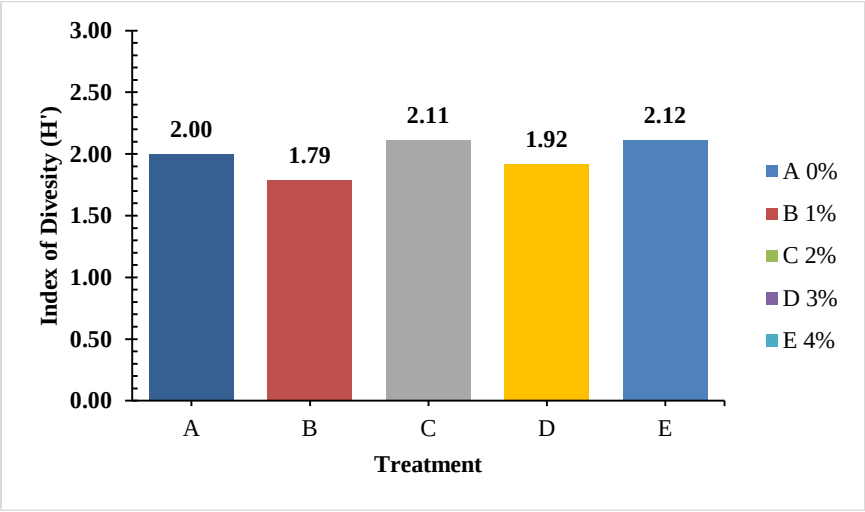

Figure 1. Plankton diversity

The highest diversity was found in treatment E, which was 2.12, which means moderate diversity. In treatment A, plankton diversity was 2.00, the diversity was moderate. Treatments B through D have a diversity value of 1.79-2.11 which indicates that diversity is of moderate criteria. In accordance with the Shannon-Weinner diversity index criteria, if $1 \leq H' \leq 3$ then the diversity index is medium. Plankton in the digestive tract of the nilem has an even distribution of species diversity, so that the diversity index value of

the A-E treatment has a moderate value. In accordance with the statement of Sriwidodo (2013) which stated that the diversity index value depends on the variation in the number of individuals of each species, then the smaller the number of species and variations in the number of individuals per species, the diversity of an ecosystem will be even lower.

Madianawati (2010) states the diversity index shows the imbalance of the aquatic environment that is characterized by the emergence of certain species that are more dominant to other species in the community. Based on the diversity index with values ranging from 1.79 to 2.12, Cirata Reservoir water quality is categorized as mildly polluted. The criteria are based on Rudiyanti (2009), which stated that the diversity value of aquatic biota with a range of 1-2 indicates that water is moderate polluted, while the value of diversity with a range of 1 - 3 indicates that the waters is mildly polluted.

Plankton Dominancy

Dominancy is the type that dominates in a community in each habitat. One type or group of species that controls a community is called the dominant group (Smith 1990).

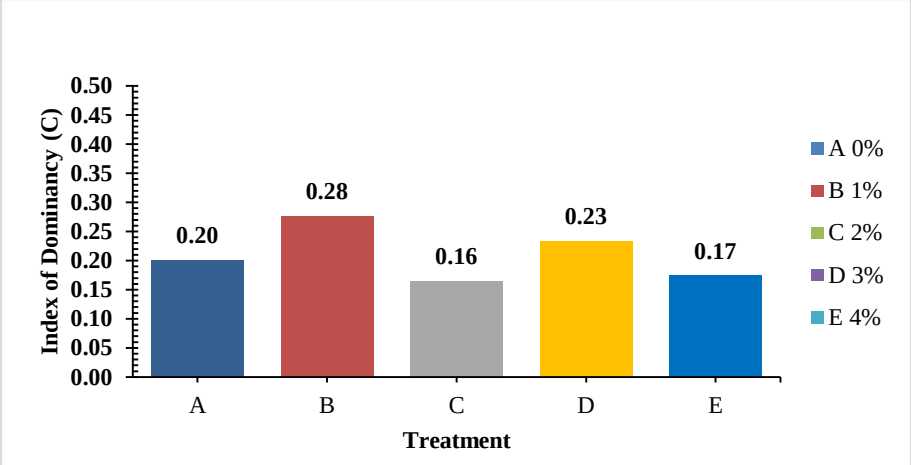

Figure 2. Plankton Dominancy

The results of the calculation of the phytoplankton dominancy index during the study ranged from 0.16 to 0.28. The dominancy index value indicates that the phytoplankton community in each treatment belongs to the category of no genus that dominates. The dominancy index value ranges from 0-0.5 indicates that there is no genus that dominates and if it ranges from 0.5-1 indicates that there is a genus that dominates (Odum 1993). Ardani and Organsastra (2009) stated that if the dominancy index is close to zero, then it is categorized as low (there is no dominating species), otherwise if the dominancy index value is close to one, then the dominancy is categorized as high (the presence of a dominating species).

Considering from the composition of the plankton type in the five treatments, the species found is quite diverse. Arcella sp has the greatest dominance among other species which leads to the population of Arcella sp being one of the natural food preferred by Nilem fish in the Cirata Reservoir.

Plankton Similarity

The similarity index (E) is the equal proportion of each type of fish in an ecosystem (Sibuea 2015).

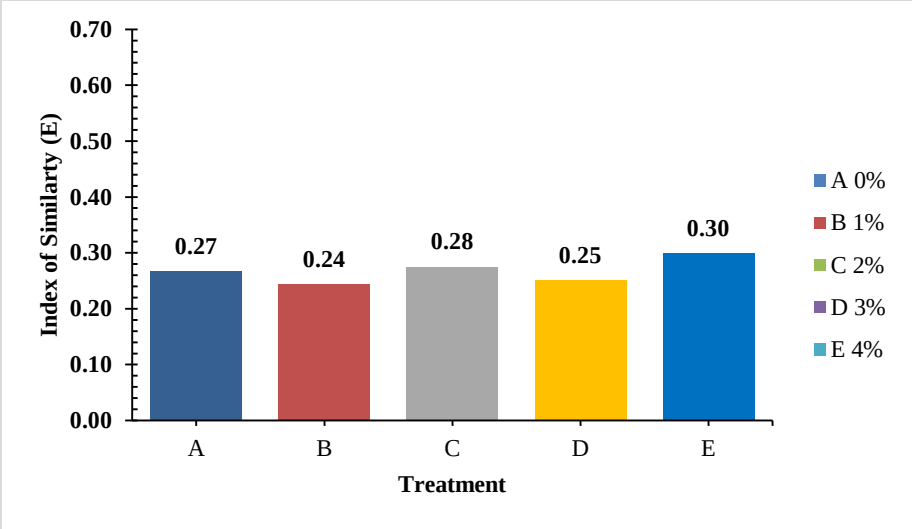

Figure 3. Plankton Similarity

Generally, the results of the similarity index calculation on the digestive tract of nilem fish from the Cirata Reservoir in the five treatments have a value of 0.24-0.30. Based on the range of similarity index values, it can be concluded that plankton in the digestive tract of nilem has a low level of similarity. Low similarity indicates that in the aquatic ecosystem as well as in the digestive tract of the nilem fish there is a tendency for species dominance caused by the unevenness of environmental factors and plankton populations (Krebs, 1989).

Yazwar (2008) deducted that the variation of value of the diversity index and similarity index in the digestive tract of Nilem is directly linked to water conditions. The varied differences are caused by the physical physics factors as well as the availability of nutrients and different nutritional uses of each individual. The ability of each type of plankton to adapt to the existing environment, coupled with the availability of nutrients such as phosphate and nitrate (Sirait 2018). Amin (2008) states that uniformity index close to zero tends to show an unstable community whereas if the value approaches one community is stable, the number of individuals between species is the same.

Conclusion

1. Plankton species were identified as many as 31 species, with a total number identified as many as 49,227 individuals.
2. Arcella sp is a plankton species that is loved by nilem fish has the most number compared to other species, with a total of 19,163 individuals.
3. Plankton diversity index has values ranging from 1.79 to 2.12 with the medium category. Plankton dominance index has a value ranging from 0.16 to 0.28 with a low category. Plankton uniformity index has a value ranging from 0.24 to 0.30 with a low category.

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