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Diversity of Fish Species in Cilodong Lake

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Abstract. Fish provides many benefits for humans, such as food and ornamental fish. Lake fish in West Java is increasingly threatened due to environmental degradation. This study aimed to record the diversity of fish species and it's potency in Cilodong Lake, Depok. The parameters measured were the diversity of fish species by Shannon Wienner index, and the physical chemical of water quality that were pH, DO, BOD, COD, TOM, temperature, brightness, and depth. This research found 12 species consumption fishes, and 5 species of ornamental fishes. Four most common species found were Oreochromis mossambicus (cichlids/mujair), Oreochromis sp., Hypostomus sp. (ikan sapu-sapu), and Dermogenys pussil (julung-julung). The Pearson correlation analysis results showed that all physical chemical parameters of water correlated inversely with the diversity of fish species. Parameters that had very strong correlation with the species diversity in Cilodong Lake were the water depth, temperature, and COD.

Keywords: Species Diversity, Fish, Lake Cilodong

I. INTRODUCTION

Fish is a cheap and easy source of animal protein (Omar, 2012). The diversity of fish species in an ecosystem is largely determined by the carrying capacity of the habitat, and the water condition. The diversity of fish species in 11 lakes in West Indonesia, and Sulawesi known as 69 species from 22 families (Wargasasmita, 2000). Changes in the watershed conditions, and intensive use of areas around the lake can alter the ecological balance of lakes, including the diversity of fish species.

Morphological characterization is one of the easy ways to identify fish species. It because the differentiation of morphological characters that occur in a species due to their adaptation to the environment, can lead to morphological changes and survival (Bhagawati et al. 2012).

Until now there is no information about the diversity of fish species in Cilodong Lake, while fishing and lake pollution continues. Based on this, research needs to be done to determine the diversity of fish species and their potential, also to evaluate the ecological use of Cilodong Lake, Depok.

II. RESEARCH METHODS

The research took place in August-September 2015 at Cilodong Lake, Depok. Fish sampling and physical chemical parameter measurements were carried out at 3 stations, that were the inlet, outlet, and vegetated areas in the lake, sizes 2x2m^2 each. Sampling has done once a week, during six weeks investigation.

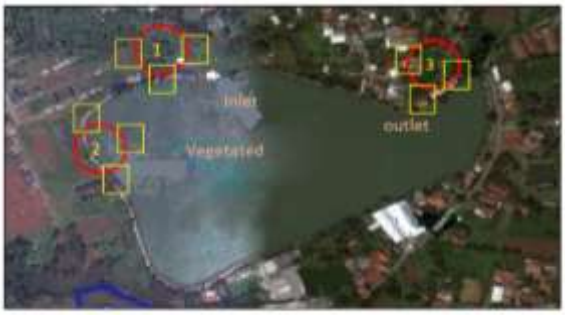

Figure 2. Research location at Cilodong Lake (Source: Google maps 2015)

Fish sampling was used 2 mm net, captured fish then kept in stored boxes, and transported to the laboratorium. The identification of fish species based on Kottelat et.al. (1993) done at the Laboratory of Biology in Faculty of Mathematic and Natural Sciences, Pakuan University. After measurement and identification, fish samples then soaked in 4% formalin for 24 hours. The specimens then washed in running water, transferred to 70% alcohol, and labeled with species names, locations, and sampling dates.

The physical parameters such as pH, brightness, depth, dissolve oxygen (DO), and water temperature were measured directly at the

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study site. The water chemical parameters that were biological oxygen demand (BOD), chemical oxygen demand (COD), and total organic matter (TOM), were analyzed at the Laboratory of Environmental Productivity in the Faculty of Fisheries and Marine Sciences, Bogor Agricultural University.

The diversity of fish species analysis based on Shannon-Wienner diversity index (Latupapua, 2011), as follow :

$$H' = -\sum_{i=1}^{s} pi.\ln pi$$

which :

$$Pi = \sum \frac{n_i}{N}$$

H'= Shannon-Wienner diversity index
Pi = sum of ratio of the individual number in a species to the total number of species.
n_i = number of individual in species *i*
N = total number of individuals

The index value obtained (H ') is then interpreted as follows:

H'> 3 means high degree of species diversity.
1< H'< 3 means moderate deeree of species diversity
H'< 1 means low degree of species diversity.

The Pearson correlation analysis measured the strength and the form of relationship between two variables with the results of a quantitative nature. This analysis was used to determine the correlation between the diversity of fish species and physical chemical of water parameters in Cilodong Lake. The formula of Pearson correlation coefficient (r) as follow (Usman, 2013):

$$r = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{\{n\Sigma x^2 - (\Sigma x)^2\}\ \{n\Sigma y^2 - (\Sigma y)^2\}}}$$

which :

n	=	number of data pairs X and Y
Σx	=	total amount of variable X (fish species diversity)
Σy	=	total amount of variable Y (physical/chemical parameter of water)
Σx^2	=	square of total number of variables X
Σy^2	=	squares of total number of variables Y
Σxy	=	multiplication result of total number of variable X and variable Y

The results of Pearson analysis interpreted as follows:

– If the correlation coefficient value approaches +1 (positive one) means data pair of variable X and variable Y have a strong positive linear correlation.
– If the correlation coefficient value is close to -1 (negative one) means data pair of variable X and variable Y has a strong negative linear correlation.
– If correlation coefficient value is close to 0 (zero) means data pair of variable X and variable Y have very weak correlation, or possibly uncorrelated.

The secondary data was collected through questionnaires asked to the people live near the lake. The questions asked among others were commonly caught fish species, kind of fishing gear, and the type of bait that usually they use.

III. RESULTS AND DISCUSSION

The diversity of fish species

Based on the identification of fish results there were 17 fish species from 11 families found in Cilodong Lake (Table 1). The most number of species were found at the vegetated area (station II), that were 12 species with 105 individuals, or 53% of the total fish species obtained. The lowest number of fish species were found at the outlet area which were 7 species with 30 individuals, or 15% of the total fish obtained. From the lake inlet area we obtained 10 species with 62 individuals, or 32% of the total fish obtained.

There were four species that had been found in all observation stations, and their numbers are relatively numerous, they were *Oreochromis mossambicus* (mujair), *Oreochromis sp*. (red tilapia), *Dermogenys pussila* (julung-julung), *Hypostomus sp*. (sapu-sapu). Those species, specially *Oreochromis mossambica* (mujair), and *Oreochromis sp*. (sepat), are well known by the Indonesian people, especially in West Java province, as the consumption fish that have relatively high economical value.

Some of species found in Cilodong Lake are introduced fish species, among others were *Cyprinus carpio (common carp/ikan mas), Oreochromis mossambicus (cichlids/mujair), Clarias gariepinus (lele dumbo).* There are at least 17 species of introduced fishes in West Java and Banten region (Rachmatika & Wahyudewantoro, 2006). Generally introduced fishes have a preference for living in an environment where habitat quality has generally declined. The success of introduced fish occupies a new habitat because it is able to occupy a habitat with a wide range of salinity and water temperatures, also has high colonization power in new habitats.

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Table 1. Diversity of fish species found in Cilodong Lake, Depok.

No	Family	Species	Number of fish (individu)			Total (individu)
			I	II	III	
1	*Belontiidae*	*Trichogaster tricopterus*		3		3
		Trichopsis vittata		1		1
2	*Channidae*	*Channa striata*	1			1
3	*Cichlidae*	*Oreochromis mossambica*	8	14	3	25
		Oreochromis niloticus		11	3	14
		Oreochromis sp.	11	16	5	32
4	*Clariidae*	*Clarias gariepinus*		1		1
5	*Cyprinidae*	*Cyprinus carpio*	1			1
		Osteochilus haselti		1		1
		Rasbora lateristriata	2			2
		Rasbora argyrotaenia	1		1	2
6	*Eleotridae*	*Oxyeleotris marmoratus*		4		4
7	*Gobiidae*	*Brachygobius xanthomelas*	8	12		20
8	*Hemiramphidae*	*Dermogenys pussila*	14	19	10	43
9	*Loricariidae*	*Hypostomus sp.*	9	22	5	36
10	*Pangasiidae*	*Pangasius humeralis*		1		1
11	*Poeciliidae*	*Poecilia reticulata*	7		3	10
∑	11 families	17 species	62 10 species	105 12 species	30 7 species	197

Note: I = inlet area, II = vegetated area , III = outlet area

The analysis of fish species diversity in Cilodong Lake found that the species diversity index was moderate, according to Shannon-Wienner index (H '= 2.16). This value indicated that the condition of Cilodong Lake at present has little disturbance (Prianto & Husnah, 2013). Several external factors could influenced and threatened the lake quality. The increase of population and peoples activities around the lake, the rapid rate of urban growth, and the conversion of land use around the lake, could decreased the lake water quality, especially dissolve oxygen concentration due to water silting.

Physical chemical condition of lake waters

In general, the physical chemical parameters of Cilodong Lake waters was still sufficient to support fishes life, referring to goverment rule PP. No. 82 Year 2001 about the water quality requirements for fisheries (Effendi, 2003). The water in Cilodong Lake had water temperature ranged 29.2-29.8^{o}C; water depth 40.4-114.8 cm; brightness 37.2-79.2 cm; pH 7,4-7,7; DO 4,3-6,6 mg/L; BOD 2,9-3,3 mg/L; COD 35.8-36.5 mg/L; and TOM ranged from 14.8 to 21.7 mg/L.

Correlation of water parameters with the diversity of fish species

The Pearson correlation analysis results showed that all parameters of water quality have negative linear correlation with the level of fish species diversity in Cilodong Lake. There were three parameters that have strong negative correlation with the diversity of fish species, namely water temperature, COD, and water depth.

The water temperature is an important factor for fish, since as poikilothermic animals their body temperature is easily affected by the changes in ambient temperature. An increase in ambient temperature will increase the rate of fish growth, until a certain extent. The increasing of water temperature will increase the fish metabolic rate, thereby it increasing the need of oxygen from the environment. As the consequences, when water temperature increase, the concentration of DO water decrease. If the need for oxygen exceeds the availability of oxygen in waters, fish will experience physiological disorders, even can lead to death (Sastrawijaya, 2009).

The water temperature in Cilodong Lake that ranged from 29.2-29.8^{o}C and DO level which ranged between 4,3-6,6 mg/L, are suitable enough for fisheries purposes, according to PP No. 82 year 2001. The DO levels that below the minimum limit will inhibits the process of fish respiration. The oxygen availability in water for fish to grow and develop, must at least 3 mg/L (Rahardjo et.al., 2011).

The COD level ranged 35.8-36.5 mg/L found in the study site was appropriate enough for fisheries. The COD value is a measure for the condition of water pollution by organic substances, which can naturally be oxidized through microbiological processes (Walukow, 2011). The process of oxidizing organic compounds chemically caused decreasing of DO content, while the availability of oxygen in water is very urgent for fish. The value of COD in uncontaminated waters is usually less than 20 mg/L (UNESCO/WHO/UNEP, 1992 *in* Efendi, 2003).

The concentration of COD in water must meet the established quality standards so it will not contaminate the environment. Waters with high COD level is not suitable for fishery purposes because it reduce DO level. The concentration of DO depends on physical, chemical and activity biochemistry in water. The condition of oxygen in water is an indicator of water quality, the decrease in DO concentration is an early indicator of change water conditions (Omar, 2012).

The diversity of fish species in Cilodong lake tends to decline as water depth increases. The deeper the waters, the dissolved oxygen supply diminishes as the

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water pressure gets higher, so oxygen is difficult to reach the bottom of the water. This phenomenon has an effect on the distribution of fish, the deeper the waters of the lake, the presence of fish become more rare, both in species and numbers (Rahardjo et.al., 2011).

Potential fish in Cilodong Lake

Cilodong Lake area is 10 hectares and lay close to the highway. Cilodong Lake waters look greenish due to the phytoplankton in lake waters (Walukow, 2011). A total of 12 species, or 70% from total fish species caught in this study, were fish consumption (Prianto & Husnah, 2013). Those species namely *Channa striata*, *Oreochromis mossambica*, *Oreochromis niloticus*, *Oreochromis sp*., *Cyprinus carpio*, *Trichogaster tricopterus*, *Clarias gariepinus*, *Pangasius humeralis*, *Oxyeleotris marmoratus, Osteochilus haselti, Rasbora argyrotaenia, Rasbora lateristriata*.

Among those 12 species, there were 7species that have high economic potency, and easily cultivated, namely *Cyprinus carpio* (common carp), *Trichogaster tricopterus* (sepat), *Channa striata* (gabus), *Oreochromis niloticus* (red tilapia), *Oreochromis mossambica* (mujair), *Clarias gariepinus* (catfish), *Osteochilus haselti* (nilem). There were also found five species that potential as the ornamental fish, namely *Brachygobius xanthomelas*, *Poecilia reticulata*, *Dermogenys pussila*, *Trichopsis vittata*, *Hypostomus sp*. The study results about the diversity of fish species in Cilodong Lake found that it has great potential to be developed and utilized by the surrounding community, but it needs good management in order to maintain its sustainability

Community activities around Cilodong Lake

Secondary data collected through questionnaires found that fish generally caught by people from Cilodong Lake were mujair, red tilapia, gabus, sepat, and nilem. Most of the fish caught by comunity is used for consumtion or cultivated. Peoples mostly using the fishing rods and several kinds of live baits, such as rangrang ants to catch wader stingrays, earthworms to catch gabus fish, and tiny shrimp for catching mujair, and red tilapia. Different baits have different impact on fish catched (Takapaha et.al., 2010).

IV. CONCLUSION

This investgation found 17 fish species from 11 families in Cilodong Lake, most of them (12 species) are the consumption species, and 5 species are ornamental fish species. The level of fish species diversity was moderate, based on the Shannon-Wienner index. The quality of the physical chemical water of Lake Cilodong in general is still appropriate to support fisheries. The level of fish species diversity were negatively correlated to the water temperature, depth, and COD value.

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