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The influence of physical and chemical parameters on the extinction of the god fish (*Tor duoronensis*) species: case study in Balong Dalem Kuningan district

The influence of physical and chemical parameters on the extinction of the god fish (*Tor duoronensis*) species: case study in Balong Dalem Kuningan district

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Abstract. *Tor douronensis* (God Fish) species are endemic freshwater fish that only live in Kuningan District. Originally these fish scattered in the pool Cigugur, Cibulan, Balong Kambang, Darma Loka and Balong Dalem. However, since 2006 the god fish that existed in Balong Dalem extinct. This study aims to analyze the possible factors causing extinction of the god fish in situ Balong Dalem. The study was conducted during May 2017. The results showed that there were 11 phytoplankton and 13 genera of Gomphonema, Stigeoclonium, Desmidium, Closterium, Navicula, Spirulina, Phormidium, Melosira, Gloeotrichia, Oedogonium, Hyalodiscus, Moscocrocis and Cladophora. While zooplankton found 3 genus of Cyclops, Rotifera and Tanypus. The results showed that the abundance, diversity and uniformity of zooplankton correlated positively with pH, temperature, DO and water flow but not with others. Condition of water quality (physical-chemical parameter) Balong Dalem in bad condition, low productivity and labile. Condition of substrate base there Balong Dalem in the form of sand and fine mud. All of these conditions caused the extinction of *Tor douronensis* in situ Balong Dalem.

1. Introduction

Tor douronensis (god of fish) is an endemic freshwater fish that lives only in the vicinity of Mount Ciremai District Kuningan West Java. There are five places occupied by *T. douronensis* fish that is Balong Dalem, Darma Loka, Cigugur, Cibulan and Bale Kambang. Since 2006 *T. douronensis* who live in Balong Dalem extinct while on the other four still exist to this day. *T. douronensis* is a fish that is rescued by the surrounding population so that no one dares to consume or interfere with his life. This study attempts to analyze the possible causes of *T. douronensis* extinction by comparing the physical, chemical and biological factors of Balong Dalem with other situations still suffered by *T. douronensis*.

The Genus Tor is a fish that lives extensively in tropical and sub-tropical fresh waters and they low mountainous waters. Especially for species *Tor duoronensis* and *Tor tambroides* (synonymous *Tor tambra*) inhabit Java waters Tor plays an important role in ecology as they feed on wild fruits, reflecting their status as key consumers in complex river food webs. In addition, Tor is associated with

rivers and streams, preferring clear and swift waters on rocky, gravel and rocky grounds, thus becoming one of the non-polluted river bioindicators [1].

The extinction of a freshwater fish species is generally caused by overfishing and other human activities that lead to a decrease in the abundance and diversity of a species. Plankton (phytoplankton and zooplankton) are the main sources of nutrients for fish that affect the survival, abundance and diversity of fish. Physical-chemical parameters affect the productivity of phytoplankton which in turn affects the population dynamics of zooplankton and fish [2]. Based on this, physics-chemical changes in a waters will affect the quality of the waters which in turn affect the survival of fish. In relation to that matter, to know factor causing *T. douronensis* annihilation from there Balong Dalem needs to be analyzed condition of chemical physics and plankton in situ Balong Dalem. It is important to do as input for the management of Balong Dalem's place to be back inhabited by *T. douronensis* and can preserve *T. douronensis* which has been tried many times to breed it but failed. Of course if this effort will successfully increase the attraction of tourists to visit Balong Dalem.

2. Methods

The research was conducted in May 2017 in the waters of Balong Dalem (BD), Dharma Loka (DL) and Bale Kambang (BK), each at five stations, namely station I which is located in the inflow, station II on the edge where there is exposure, Station III in the center and IV station on the edge of location and station V at outlet. Samples of Situ Darma Loka and Bale Kambang were taken with the aim of comparing the situation still inhabited by *T. douronensis* with Balong Dalem uninhabited by *T. douronensis*.

Sampling time is conducted between 09.00-13.00 WIB. Water samples are taken passively by using 5 liter bucket of 100 liters and filtered with plankton net. The filtered water of the sample is then fed into the sample bottle and preserved with 4% formalin. Observation of plankton samples using 10x40 magnification binoculars enlargement in the laboratory of University of Kuningan Biology. Calculation of plankton by using haemocytometer by combing all the haemocytometer boxes then calculating the plankton counted in haemocytometer. Identification of plankton species using standard literature [3,4].

Measurement of chemical physics parameters is done in insitu and exsitu. Exsitu analysis is done in the laboratory of Biology University of Kuningan. Physical parameter measurements were performed at the time of sampling which included light intensity (LI) using luxmeter, current velocity (CV) using the time of the table tennis ball when following the water flow within one meter, the temperature (T) using the thermometer, and the clarity / transparency using Secchi discs. Chemical parameters measurements were performed in the laboratory of University of Kuningan Biology covering the degree of acidity (pH) using pH meter, DO (Dessolved Oxygen) using DO meter, and BOD (Biochemical Oxygen Demand) using DO meter. For the measurement of DO and BOD the sample water was inserted into the Winkler bottle and incubated in the incubator at 20°C for 5 days, then measured the dissolved oxygen using a DO meter. The BOD value is obtained through the DO difference measured on the first day minus the DO value after 5 days incubated in the incubator.

The Shannon-Wiener equation is used for the diversity index: H H = - $\sum_{i=1}^{s}(P_i)\left(\log_2 p_i\right)$ H '= Shannon-Wiener diversity index, S = Number of species, Pi = The proportion of the number of individual types i to the total number of individuals; Uniformity index: E = H '/ H max where H = Shannon-Wiener and Hmax diversity index = Maximum diversity index; Dominance Index: D = Σ [ni / N] 2 where ni = Number of individual species i and N = number of individuals of all species [5]. The abundance index = N = nx Vr / Vo x 1 / Vs where n = Number of cells observed (individual), Vr = Volume of filtered water (ml), Vo = observed water volume (ml) and Vs = Filtered Water Volume ml). Further data were analyzed by multiple regression test using SPSS version 17

3. Result and discussion

The very different physical parameters are seen at higher current velocities so that the plankton quickly comes out of it following the flow of water (Table 1). The results [6] show that water flow

affects fish abundance. The intensity of light is also lower than the other two places, indicating that Balong Dalem has more depth than the other two places. Light is a limiting factor in the productivity of situ. DO in situ Balong Dalem in the middle (3.8) is much lower than the other two places. The DO requirement for fresh water for fish is ≥ 7. This indicates that the middle is not good for organism metabolism and less good as the habitat of the organism. BOD data support the assertion that the central part of Balong Dalem is not good for organism habitat because BOD Balong Dalem is higher than the other two sites. A good BOD requirement for fresh water for fish is ≤ 3. Similarly, water pH is more acidic than the other two sites [7]. The pH required by *Tor duorenensis* ranges from 7.7 to 8.7. pH is a factor inhibiting growth and plankton proliferation [8]. Based on this, the waters of Balong Dalem less optimal for the growth of phytoplankton and zooplankton when compared with Bale Kambang and Darma Loka.

Table 1. Physical-chemical parameters

Station	Physical-Chemical Parameters																	
	Temperature (°C)			Current velocity (m/det)			Light intensity (lux)			DO (ppm)			BOD (ppm)			pH		
	BD	BK	DL	BD	BK	DL	BD	BK	DL	BD	BK	DL	BD	BK	DL	BD	BK	DL
I	24	24	24	0.26	0.3	0.02	200	294	300	8.2	7.4	5.3	3.1	4.3	2	7	7	7.1
II	25.5	25	-	0.03	0.01	-	300	684	-	7.3	8.4	-	3.2	2.4	-	6.5	7	-
III	24	24	25	0.02	0.34	0.01	200	282	300	3.8	8.3	5.1	3.9	2.6	3.2	6.5	7	7.2
IV	25	24	-	0.02	0.38	-	250	376	-	6.7	8.4	-	3.9	3.3	-	6.5	7	-
V	24.5	24	24	0.52	0.01	0.33	200	694	280	8.7	6.1	5.2	3.0	2.7	2.1	6.5	7	7.1

The phytoplankton diversity index is lower than the other two sites (Table 2), as well as the dominant index and its abundance indices except for higher similarity indexes. Almost at all research stations, the low phytoplankton diversity index H '<1. This indicates that the waters of the Balong Dalem have very low productivity as an indication of severe stress and unstable ecosystems. The low dominance index indicates that in Balong there is no dominant species. Similarity index value below 1 means the condition of waters situ Balong Dalam in unstable condition. The value of the index of abundance in Balong Dalem far below the two other sites indicates that the quality of waters Balong Dalem less optimum in supporting the survival of microorganisms. Samples are taken during the rainy season so that the existing diversity as in Table 2 is likely when samples taken during the dry season will be higher in diversity [9].

Table 2. Phytoplankton biological parameters

Station	Biological Indexes											
	Diversity			Dominance			Similarity			Abundance		
	BD	BK	DL	BD	BK	DL	BD	BK	DL	BD	BK	DL
I	0.83	2.40	2.15	0.009	0.12	0.15	0.755	0.71	0.61	16	1191	117
II	0.79	0.33	-	0.070	0.13	-	0.855	0.69	-	80	767	-
III	0.99	2.33	2.26	0.002	0.14	0.23	0.762	0.78	0.65	10	623	156
IV	0.94	2.43	-	0.002	0.13	-	0.858	0.72	-	10	683	-
V	0.94	2.55	2.18	0.009	0.11	0.22	0.677	0.76	0.69	27	994	320

As with the phytoplankton biological indexes, the zooplankton biological indexes of Balong Dalem also have smaller indices except in the larger dominant index (Table 3). This indicates that the condition of waters situ Balong Dalem tainted or less good than the other two situ. Table 3 shows that there are variations in diversity index, dominance, similarity and zooplankton split between stations in one place and inter-situ situations between them. The results of the study [10] show that the variation

of zooplankton depends on the condition of physical chemical parameters. As with phytoplankton, zooplankton in the dry season shows a higher abundance in the rainy season [11].

Table 3. Zooplankton biological parameters

Station	Biological Indexes											
	Diversity			Dominance			Similarity			Abundance		
	BD	BK	DL	BD	BK	DL	BD	BK	DL	BD	BK	DL
I	0.14	2.09	0.76	0.66	0.15	0.23	0.30	0.75	0.18	19	227	79
II	0.06	2.15	-	0.60	0.14	-	0.12	0.78	-	17	204	-
III	0.12	2.39	0.91	0.62	0.12	0.19	0.24	0.86	0.13	8	298	99
IV	0.11	2.19	-	0.64	0.16	-	0.23	0.79	-	17	230	-
V	0.11	2.05	0.88	0.34	0.11	0.25	0.23	0.87	0.09	20	334	101

Based on the results of phytoplankton studies found in five stations, namely: Chlorophyta, Cynophyta, Charophyta, Bacillariophyta, and Cyanobacteria with 13 genera namely Gomphonema, Stigeoclonium, Desmidium, Closterium, Navicula, Spirulina, Phormidium, Melosira, Gloeotrichia, Oedogonium, Hyalodiscus, Moscocrocis and Cladophora. This result is similar to other studies [12].

Of the total types of zooplankton found there are 8 ordo: Podocopida, Copepoda, Diplostraca, Cladocera, Ploima, Amphipoda, Bdelloida, and Cyclopoida; This is in accordance with the results of Ruttner's research that in Java, Sumatra and Bali the zooplankton groups often found are Rotifera, Cladocera and Copepoda. The results of the study in India are also similar [13;14]. Among them many cause poisoning in fish / vertebrates [15].

The number and type of plankton in Bale Kambang more than Darma Loka, as well as the number of god fish at Bale Kambang (2.400) more than Darma Loka (2.000). This means the number of god fish is related to the number and number of plankton species [8].

Results of multiple regression analysis found there is a very close relationship between physical parameters with phytoplankton abundance (R^2 = 0.895) with regression equation Y = 1262.942 – 67.360 T+1.755 LI+112.474 CV; Chemical parameter with phytoplankton abundance (R^2 = 0.966) with regression equation Y = 24.080 +4.319 DO + 6.230 BOD -8.972 pH; Physical parameters with zooplankton abundance (R^2 = 0.696) with regression equation Y = 14.398 – 0.879 T+0.086 LI+21.830 CV; Chemical parameters with zooplankton abundance (R^2 = 0.979) with regression equation Y = -12.666 + 2.471 DO + 0.136 BOD + 1.642 pH. Based on the calculation R^2 value is generally close to 1, it means there is a relationship between abundance and diversity of phytoplankton and zooplankton with physico-chemical factor with a strong level of relationship. This is in accordance with the results of previous studies [16, 17]. This means that the existence of the god fish is indirectly related to the physics-chemical condition of the waters [18]. There is an interaction between phytoplankton and Zooplankton, where the zooplankton regulates the phytoplankton cycle [7]. The results showed that the abundance, diversity and uniformity of zooplankton correlated positively with pH, temperature, DO and water flow but not with others.

Based on the above data there appears to be abitotic and biotic variations between research stations within a site, and between one site and another. This is in accordance with the results of the study [19] which shows the variation of biotic and abitotic factors that are equitable and time consuming in terms of species richness and diversity of fish.

Based on the above data analysis, water quality conditions (physical-chemical parameters) Balong Dalem affect the survival of plankton, so that the extinction *T. douronensis* likely caused by poor water quality, low productivity. And unstable. Among the physico-chemical factors that are the key factor of extinction of *Tor duoronensis* in situ Balong Dalem is low DO factor (2.8 ppm) because with low DO is very difficult for *T. douronensis* to breed. Another factor is the condition of substrate Balong Dalem, which is in the form of fine sand and silt, in contrast to the other four locations that have a rock bottom substrate [13]. The basic substrate of rock is highly favored by *T. douronensis* for

spawning and picking up the moss attached to the rocks. This is evidenced by repeatedly tried to spread *T. douronensis* in Balong Dalem taken from other places still can not breed. This means that the Balong Dalem ecosystem has undergone a change and can not be inhabited by *T. douronensis* unless there is an improvement in in situ conditions. The loss of *Tor duoronensis* affects marine ecosystems in Dalem [21]. Balong Dalem changes that caused the extinction of *T. douronensis* due to human activities that damage the environment. Until now the extinction of *Tor duoronensis* in Balong Dalem is unknown because the threat status to freshwater is not as clear as that of marine fish species. However, it does not rule out the extinction of *Tor duoronensis* due to the exploitation of consumption by humans because *Tor duoronensis* is one type of fish that can grow large which has the risk of extinction. When viewed in terms of geographical location compared to other situations that still exist *T. douronensis*, Balong Dalem closer to the top of Mount Ciremai. This means that Balong Dalem is closer to the forest, where it is close to the forest has low productivity [22].

4. Conclusion

The waters of Balong Dalem have poor quality, low productivity and labile so less optimum for plankton growth which resulted in the extinction of *Tor duoronensis*. This is shown by data of research result, that is low BO that is 3.8 (DO requirement for fresh water for fish is ≥ 7); High BOD ie> 3.0 (BOD good condition for fresh water for fish is ≤ 3); low pH of <7.0 (pH needed by *T. duorenensis* ranged from 7.7 to 8.7) and high current velocity. The waters in this Balong Dalem have very low productivity because it has a low phytoplankton diversity index H '<1; in a volatile state because the uniform index value is below 1; and low quality because it has a low biological index. Another factor is the condition of the substrate base situ Balong Dalem in the form of sand and fine mud, a substrate that is not favored by *T. Douronensis.*

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