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Manipulation of the aquatic physical environment and its relationship with ectoparasitic infection in dumbo catfish (*Clarias sp*)

Suratno Suratno*, Suryono Suryono, Muhammad Naswir

Master of Environmental Science, Jambi University, Jambi, Indonesia

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ABSTRACT

Fish disease is an obstacle in the cultivation of Dumbo catfish (*Clarias* sp.) which can result in fish death. The need for information on how to prevent and treat fish diseases is very necessary. This study aims to determine the effect of aeration duration on water quality, ectoparasite intensity, prevalence, dominance, survival and condition factors, then correlate water quality with ectoparasite intensity. This study used a Complete Randomized Design (CRD) with five treatments and four replications. Treatment includes aeration 0 hours/day, 6 hours/day, 12 hours/day, 18 hours/day and 24 hours/day. Data analysis using ANOVA of a certain level of significance. If there is a noticeable difference from each treatment, proceed to the DUNCAN test. Test the correlation of water quality with ectoparasite intensity. The result of this study is that long aeration can increase oxygen solubility, acidity but reduce ammonia and nitrite. The correlation value of oxygen solubility in ectoparasite intensity is 0.828, acidity (pH) is 0.849, ammonia is -0.888, nitrite is -0.592. The prevalence value of P0 and P1 is 0%, P2 is 89%, P3 and P4 is 100%. The intensity of ectoparasites in Dumbo catfish (*Clarias* sp.), at P0 is 2, P1 is 13, P2 is 75, while at P3 and P4 is >100. The dominance of ectoparasites that infect is *Trichodina* sp. by 71.7-100% and *Dactylogyrus* sp. by 0-28.4%. The survival rate of fish at P0 was highest with a value of 89%, P1 at 84%, P2 at 71%, P3 and P4 rates at 0%. The value of the condition factor then P0 and P1 have a value of > 1, P2, P3 and P4 have a condition factor value of < 1. It is concluded that the longer aeration is given, the solubility of oxygen increases which results in an increase in the intensity and prevalence of ectoparasite infections, the pH of the water becomes neutral and decreases the content of ammonia and nitrite. There is a moderate to very strong correlation between water quality and ectoparasite intensity. There is an increase in the prevalence of infection, ectoparasite intensity and fish mortality so that it can reduce the survival and condition factors of Dumbo catfish (*Clarias* sp.).

Introduction

Freshwater aquaculture fish production, especially catfish farming, is an important commodity in fulfilling people's nutritional sources, especially animal protein (Suratno and Putra, 2022). Catfish farming activities certainly have obstacles and problems, namely the existence of fish disease attacks so that the fish die which results in crop failure and losses (Salsabila *et al.*, 2021). Fish disease factor is a factor that can affect the sustainability of fish farming business (Arisa *et al.*, 2021; Putra *et al.*, 2021b; Putra *et al.*, 2021c; Qing *et al.*, 2020). The need for adequate information on how to prevent and treat fish diseases is very useful in efforts to accelerate the increase in knowledge of catfish farmers (Putra, 2021a).

In some cases the death of catfish fry with a size of less than 10 cm is caused by changes in environmental conditions that cause catfish to experience stress, this occurs at the age of maintenance 1 and 2 weeks after stocking (Medinawati and Yoel, 2011). Efforts to increase catfish production have been carried out with some engineering in the aquatic environment physically. The effect of aquatic environmental engineering with the treatment of several aeration patterns on ectoparasite attacks on the maintenance of Dumbo catfish (*Clarias sp*) has never been reported. The use of several aeration patterns in the maintenance of Dumbo catfish (*Clarias sp*) can be used as an indicator of ectoparasitic infection in the body of fish because

* Corresponding author.
Email address: suratnokkp@gmail.com

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in general protozoa are obligate aerobes. Aeration is a process carried out to transfer air so that there is an increase in dissolved oxygen content (Masduqi *et al*, 2012).

The presence or absence of dissolved oxygen content will affect aquatic biota because it will create aerobic or anaerobic aquatic conditions (Astuti and Niken, 2016). In the management of liquid waste with an aerobic system through the provision of aeration will have an effect on the development of microorganime. In one study stated that there were protozoan microorganisms of *Sarcodina* sp. type from aerated rubber liquid waste and the number was highest compared to other types and several types of *Sarcodina sp* lived as parasites (Orina et al. 2016). The ability of fish to prevent disease, parasites and poor water quality can be affected by hypoxia conditions (Flint *et al*, 2015). In research on the diversity of metazoan parasites from African catfish (*Clarias gariepinus*) (Burchell, 1822) as an indicator of pollution in subtropical African river systems, namely the decrease in parasite diversity if there is an increase in organic pollution (Madanire *et al*, 2009). Raymond, *et al* (2006) stated that aquatic environments that are low in oxygen solubility will provide less habitat for organisms that are sensitive to hypoxic environments.

Infection is the attack of parasitic organisms on the host that causes disease (Kurniawan, 2012). Fish attacked by monogenea will cause fish to lose weight, jump around, mucus comes out a lot in the epidermis, the color of the fish is pale or dull than normal, fish breathing is disturbed by gasping on the surface and that the aquatic environment is one of the external factors that can trigger the emergence of disease (Rukmono, 1998).

The main purpose of this study is to analyze the engineering of the aquatic physical environment (length of aeration) on water quality then obtain the correlation of water quality to ectoparasite infection, analyze the engineering of the aquatic physical environment (duration of aeration) against ectoparasite infection including the prevalence, intensity and dominance of ectoparasites, analyze the engineering of the aquatic environment (length of aeration) on mortality patterns and survival of dumbo catfish, Analyze the duration of aeration against factors of the condition of dumbo catfish (*Clarias sp*). The benefits of this research are a reference for good and sustainable Dumbo catfish (*Clarias sp*) farming, increasing knowledge and insight into ectoparasite infections in Dumbo catfish *(Clarias sp).*

Based on the description above, it is necessary to engineer the aquatic physical environment (long aeration) to condition water quality and then correlate water quality to ectoparasite intensity through a complete randomized design experiment. The results of the experiments carried out can be recommendations and then implemented to the fish farming community.

Research Methodology

This research was carried out at the Jambi Gelam River Freshwater Aquaculture Fisheries Center from February to March 2023. Based on the description above, it is necessary to engineer the aquatic physical environment (long aeration) to condition water quality and then correlate water quality to ectoparasite intensity through a complete randomized design experiment. The results of the experiments carried out can be recommendations and then implemented to the fish farming community.

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The materials needed in this study are 4000 Dumbo catfish fry (*Clarias* sp.) measuring 3-5 cm, fish feed with > 31% protein. The equipment needed includes 100 watt aerator machine 1 piece, aeration hose 1 roll 50 m, aeration stone nosle as many as 20 pieces, plastic buckets with a capacity of 100 L as many as 20 pieces, 0.5 inch pipe faucets as many as 4 pieces, 0.5 inch T pipes as many as 4 pieces, 1 roll rope 50 m, digital scales max 50 grams as many as 1 piece, 1 ruler, 1 digital pH meter, 1 digital barometer, 1 DO meter, 1 mercury thermometer, 250 ml sample bottles, 1 binocular microscope, 1 binocular cell, 1 fish skirt

This study used a quantitative descriptive approach with a Complete Randomized Design (CRD). This experimental study used 5 treatments and 4 repeats. The treatment was carried out with a difference in the duration of aeration per day, namely P0 (Control) Treatment: without aeration, P1: aeration duration 6 hours / day, P2: aeration duration 12 hours / day, P3: length 18 hours / day and P4: aeration duration 24 hours / day.

In this study there are 2 types of variables, namely:

1. The independent variables are P0 (no aeration), P1 (6 hours aeration / day), P2 (aeration 12 / day), P3 (aeration 18 / day) and P4 (aeration 24 hours / day)

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2. The dependent variables are oxygen solubility, acidity degree, pH, ammonia, nitrite, prevalence, intensity, survival and condition factors.

There are 2 types of samples observed, namely water samples and fish samples:

1. Catfish Samples

Fish samples taken as much as 10% of the population, namely 20 heads per container, then examined the body weight of the fish, the total length of the fish body. Sampling is based on SNI No. 01-6489-2000, which is about the method of sampling fish and shrimp fry by 10% of the population. Ectoparasite examination is done by taking one by one the fish to be tested, then the fish are placed into a tray for preparation by taking mucus, fins and gills of catfish. The first preparation is done by scraping the skin of the fish from head to tail using scalpel to get mucus (mucus fluid). Then mucus is placed on top of the glass object dripped aquades, covered with a glass cover, observed under a microscope. The second preparation is the examination of ectoparasites on the tail fin and gills carried out by cutting off the tail fin and gills using surgical scissors then placed on a glass object that has been given aquades and covered with a glass cover then observed under a microscope.

2. Water Sample

Water quality measurements regarding oxygen solubility (DO), acidity (pH) and temperature are carried out every morning and evening, namely at 07.00 and 16.00 and are carried out directly in all treatments, while ammonia and nitrite measurements are carried out by taking water samples as much as 250 ml Once a week in all treatments then measurements are taken in the laboratory.

Observed parameters

Ectoparasites

Data regarding the calculation of intensity, prevalence and dominance values based on the formula from Yudhistira (2004) are:

1. *Ectoparasite intensity*

$$\text{Intensity} = \frac{\text{Number of infecting ectoparasites}}{\text{Number of fish samples attacked by ectoparasites}}$$

Prevelance of Ectoparasite

$$\text{Prevalence} = \frac{\text{Number of fish sampled}}{\text{Number of fish samples examined}} \times 100\ \%$$

2. *Ectoparasite Dominance*

$$\text{Dominance} = \frac{\text{Number of types of ectoparasites in sampled fish}}{\text{Total number of ectoparasites}} \times 100\ \%$$

Table 1. Criteria for the prevalence of parasitic infections (Williams *et al*, 1996)

No.	Prevalence (%)	Category	Information
1	100 – 99	always	Very severe infection
2	98 – 90	Almost always	Severe infection
3	89 – 70	Usually	Moderate infection
4	69 – 50	Very often	Very frequent infections
5	49 – 30	generally	Common infections
6	29 – 10	often	Frequent infections
7	9 – 1	Sometimes	Infections sometimes
8	<1 – 0.1	infrequently	Infection is rare
9	< 0.1 – 0.01	Very rare	Infection is extremely rare
10	< 0.01	Almost never	Never been infected

Table 2. Criterion of intensity of parasitic infection (Williams *et al*, 1996)

No.	Intensity (Ind/tail)	Category
1	<1	Very low
2	1 – 5	Low
3	6 – 50	Keep
4	51 – 100	Severe
5	>100	Very severe
6	>1000	Super infection

Catfish Condition (*Clarias sp*)

Data on the condition of dumbo catfish include mortality patterns, fish survival and condition factors (Effendie, 1997), namely:

1. *Fish Mortality*

Mortality is the number of deaths of individuals in a population and within a certain period of time, is calculated from the beginning of death.

$$\text{Fish mortality} = \frac{\text{Total number of dead fish}}{\text{Initial population numbers}}\ X\ 100\%$$

2. *Fish survival (SR)*

$$\text{Survival Rate (SR)} = \frac{\text{Number of live fish}}{\text{Initial population numbers}}\ X\ 100\%$$

3. *Fish condition factor (FK)*

The category of condition factor values is if the FK value > 1 then it is categorized as healthy fish while the FK value < 1 is categorized as sick fish (Effendie, 1997).

$$\text{Condition Factors (FK)} = \frac{\text{Fish weight (W)}}{\text{Body Length (TL)}^3} X\ 100\%$$

Table 3. Water Sample Test Methods

No	Variable	Operational Definition	Measuring instruments	How to measure	Measurement Results
1	Oxygen Solubility (DO)	Amount of dissolved oxygen	DO meter	SNI 06-2425-1991	mg/l
2	Acidity degree	How to test the degree of acidity (pH) using a ph meter	pH meter	SNI 06-6989.11-2004	5-9
3	Temperature	How to test temperature using a thermometer	Mercury thermometer	SNI 06-6989.23-2005	Celsius
4	Ammonia	The content of ammonia compounds contained in the test solution	Laboratory with phenate method spectrophotometrics	SNI 06-6989.30-2005	mg/l
5	Nitrite	Nitrite compound content in the test solution	Laboratory with spectrophotometrics	SNI 06-2484-2002	mg/l

Data Analysis

Anova and Duncan test analysis

The long treatment of aeration is an independent variable (x) including P0 (without aeration), P1 (aeration 6 hours / day), P2 (aeration 12 hours / day), P3 (aeration 18 hours / day) and P4 (aeration 24 / day), for bound variables (y) namely oxygen solubility, acidity degree, ammonia, nitrite, intensity, prevalence, survival and condition factors, if the results differ markedly then proceed with the Duncan test. Test anova and test duncan using SPSS application version 16.0 for windows.

Correlation test analysis

Correlation tests were performed for water quality parameters with ectoparasite intensity. The variable x includes oxygen solubility (x1), acidity (x2), ammonia (x3) and nitrite (X4), while the variable y is the intensity of ectoparasites. To get the correlation value using SPSS application version 16.0 for windows. The correlation value is then analyzed based on the correlation coefficient criteria according to Sugiyono (2021) according to Table 4, namely:

Table 4. Correlation coefficient interval (Sugiyono, 2021)

Correlation coefficient interval	Relationship Level
0,00 – 0,199	Very low
0,20 – 0,399	Low
0,40 – 0,599	Keep
0,60 – 0,799	Strong
0,80 – 1,00	Very powerful

Research Results

The results of the engineering of the aquatic physical environment and its relationship with ectoparasite infection in Dumbo catfish (*Clarias* sp.) can be seen in the following table:

Table 5. Average and standard deviation on intensity and prevalence of ectoparasitic infection after aeration

Treatment	Ectoparasite intensity (Tail)	Prevalence of ectoparasites (%)
P0	2,3±0,23a	0±0a
P1	12,6±1,00a	0±0a
P2	75±12,95a	89±0,11b
P3	344±54,23b	100±0c
P4	375,1±28,94b	100±0c

Table 6. Average and standard deviation on survival (SR) and condition factors (FK)

Treatment	Survival (SR) (%)	Condition factors (%)
P0	$89±3,66^{a}$	$1,4±0,29^{a}$
P1	$83,6±4,15^{a}$	$1,03±0,17^{b}$
P2	$71±3,11^{b}$	$0,95±0,13^{b}$
P3	$0±0^{c}$	$0,55±0,6^{c}$
P4	$0±0^{c}$	$0,58±0,10^{c}$

Different superscripts in the same column show very noticeable differences ($p < 0.01$)

Table 7. Average and Standard Deviation of Water Quality After Aeration

P	Oxygen Solubility (DO) (mg/L)	Degree of acidity (pH)	Ammonia (mg/L)	Nitrite (mg/L)
P0	1,53±0,05^{a}	6,5±0,05^{a}	0,09±0,01^{a}	0,05±0,01^{a}
P1	1,75±0,06^{b}	6,8±0^{b}	0,08±0,01^{b}	0,03±0,01^{b}
P2	2,25±0,13^{c}	7,1±0^{c}	0,07±0^{b}	0,02±0,01^{b}
P3	3.48±0.1^{d}	7.2±0.05^{d}	0,03±0^{c}	0,02±0^{b}
P4	8.08±0.05^{e}	7.6±0.05^{e}	0,03±0^{c}	0,01±0,01^{c}

Different superscripts in the same column show real different ($p < 0.05$)

Discussion

The effect of prolonged aeration on ectoparasites

Data on ectoparasites are found on target organs namely gills, fins and mucus. Data on the total number of ectoparasites found from all treatments are presented in Table 8. Table 8 explains that in the P0 treatment, Trichodina sp ectoparasites were found in fish skin/mucus organs, while in P1, P2 and P3 ectoparasites were found in gill predilection organs and skin/mucus, not found on the caudal fin, while on P4 it is found on all organs i.e. gills, mucus and caudal fin.

Table 8. Number of ectoparasites on the target organ

P	Name of the parasite	The number of parasites on the target organ (tail)		
		Gill	Fin	Mucus
P0	*Dactylogyrus*	0	0	0
	Trichodina	0	0	184
P1	*Dactylogyrus*	168	0	0
	Trichodina	319	0	520
P2	*Dactylogyrus*	1352	0	516
	Trichodina	1524	0	2611
P3	*Dactylogyrus*	1767	0	826
	Trichodina	2571	0	22388
P4	*Dactylogyrus*	1607	0	1395
	Trichodina	3865	213	22962

According to the statement of Rokhmani and Budianto (2017) that ectoparasites are a group of parasites that infect the surface of the body which are generally found on fins, operculum, scales, gills, and other organs that are directly related to the water environment.

The prevalence of ectoparasite infection was obtained from the number of individuals of Dumbo catfish (*Clarias sp*) attacked with an intensity of more than 51 heads compared to the fish population examined. The intensity of ectoparasites is obtained from the comparison between the total number of ectoparasites found with the number of fish attacked by ectoparasites. Data on the prevalence and intensity of ectoparasites are shown in Table 5.

In Table 5 that P0 and P1 have the lowest average prevalence value of 0%, so according to Williams *et al* (1996) it can be categorized almost never infected. P2 has an average prevalence value of 89% which can be categorized as moderate infection and in P3 and P4 has an average prevalence value of 100% which can be categorized as very severe infection. The average value of ectoparasite intensity in P0 is 2.3 which is categorized as low infection, in P1 it produces an average value of 12.6 which is a moderate infection, in P2 it produces a value of 75 which can be categorized as severe infection, while in P3 and P4 it has an average value of >100 which is categorized as very severe infection. The result of this study is that the longer the aeration will increase the solubility of oxygen so that there is an increase in the intensity of ectoparasites. The character of protozoan microorganisms is generally endemic in freshwater, brackish and sea so that the presence of protozoan organisms is always found in public waters. The nature of protozoan microorganisms attaches to the host or host to infest (does not cause disease) but the infestation will become an infection if the intensity conditions of microorganisms exceed the threshold so that it can result in disease and even death of the host. Nurul (2016) stated that protozoan ectoparasites such as *Trichodina sp.* attack almost all freshwater fish species and can be said to be cosmopolitic because they are found in almost all waters. This is in accordance with the statement that the emergence of fish diseases in principle does not directly attack fish but there are factors that can trigger its development, namely environmental conditions or water quality conditions, the conditions of the fish host itself and pathogenic organisms (Kordi, 2004), a statement supported by Sianturi *et al* (2022) that abiotic factors or water quality can inhibit or accelerate the development of the infection phase.

This study found two types of ectoparasites, namely *Trichodina sp* and *Dactylogyrus sp.* In this study, two types of ectoparasites were found to be dominated by *Trichodina* sp by 71.7% - 100%, then *Dactylogyrus sp.* by 0 - 28.4%. The difference in the breeding of these two types of ectoparasites that results in dominance *by Trichodina* sp because of breeding by dividing, while *Dactylogyrus sp* reproduces by laying eggs. Noga (2000) states that protozoa and monogenea are the most dominant ectoparasites infecting Dumbo catfish (*Clarias sp*). In accordance with the statement of Rokhmani and Budianto (2017) that *Trichodina sp* reproduces by dividing or binner and producing daughter cells on denticles from stem cells. *Dactylogyrus sp* lay eggs and lay on gills and substrates in the waters then the eggs will hatch into larvae within 3-5 days depending on the temperature of the waters, the optimum temperature ranges from 24-29 ^{oC,} The infective larvae that come out will form two protrusions in the interior. The hatching of eggs can be caused by pressure from within due to the development of larvae then out swimming to find a suitable host (Aryani, 2004).

The influence of prolonged aeration on the condition of fish

The effect of long aeration on fish conditions is shown in data regarding mortality patterns, fish survival (SR) and fish condition factors. Fish mortality patterns describe how long ectoparasitic infection rates occur from the beginning of fish death to the end of rearing. The sooner the time of death of fish can be concluded the presence of very severe infection by pathogenic agents. P0 and P1 found no fish mortality until the age of maintenance 21 days while in P2 found mortality of 0-3% at the age of maintenance 7 days. Aerobic conditions in P4 began to occur fish mortality at the age of maintenance 5 days which was faster in time than P3 began to die at the age of maintenance 9-10 days, in P3 and P4 treatment resulted in the highest mortality at the end of the study which was 100%. Trichodiniasis is a parasitic disease caused by *Trichodina sp* causing the body to be damaged, the skin becomes irritated, hyperplasia, degeneration and necrosis in epithelial cells, as well as proliferation of mucus cells and the host can cause death (Rokhmani *et al.* 2017; Nurrochmah *et al.* 2016). Rokhmani and Budianto (2017) that the death of fish by *Trichodina sp infection is* due to excessive mucus production in the gills so that it interferes with fish respiration, especially the exchange of oxygen and carbon dioxide in the gill lamella so that fish will experience respiratory failure which is a clinical sign of fish gasping on the surface of the water, circling and then dying. Fish survival data and condition factors are shown in Table 6.

The average survival of fish at P0 was highest with a value of 89% then P1 at 84% and P2 at 71%, at P3 and P4 fish survival (SR) was 0%. In P0, P1 and P2 hypoxia occurs in the morning, it can be concluded that catfish are able to grow well in hypoxic aquatic environmental conditions because they have additional breathing apparatus or asborescent organs, this is in accordance with Berra's statement (2001) that there is a labyrinth or *asborescent organ* In catfish can live in different areas of water oxygen deficit that is not possible for other fish. In P3 and P4 survival is low even though oxygen solubility is high above 3 mg / L which results in the development of high ectoparasites so that fish experience very severe infections resulting in fish death. Environmental conditions hypoxia has a detrimental impact on protozoan organisms, namely suppressing and inhibiting their development, but beneficial for fish that have additional breathing apparatus such as Dumbo catfish (*Clarias sp*) because the development of ectoparasites can be prevented.

The condition factor (FK) is a unit value obtained from the ratio of fish weight to fish body length (Effendie, 1997). The value of the fish condition factor can determine and distinguish healthy or sick fish, and can also be used to determine the degree of maturity of the gonads of the fish. The average value of fish condition factors in each treatment is shown in Table 6 which shows that the average value of the highest fish condition factor at P0 is 1.4, then P1 is 1.025, then P2 is 0.95, while at P3 it is 0.55 and P4 is 0.575. The value of the condition factor in P0 and P1 has a value of > 1 so it can be categorized as healthy, while in P2, P3 and P4 has a condition factor value of < 1 it can be categorized as sick fish. Ectoparasite attacks on fish will result in feed consumption, fish weight will decrease, fish quality degradation due to changes

Fish morphology, suppose the fish has abrasion wounds. Nutrients in fish blood will be sucked by ectoparasites which cause fish to experience nutritional disorders so that fish look thin (Hardi, 2015) and there is a decrease in hemoglobin and fat in the liver (Kabata, 1985). The physiological condition of Dumbo catfish (*Clarias sp*) can be distinguished between healthy fish and sick fish in Table 8.

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Table 8. Physiological differences between healthy and sick *Dumbo catfish (*Clarias sp)

	Gill	Body color	Body condition (fins, mustache and base of fins, behavior)
Healthy fish	Bright pink	The color of the fish is normal and even with the rest of the fish.	The fins of the fish are normal, the mustache is long and the base of the fins is normal, the fish is agile and active, the fish responds well to feed and is surprised there is a beat.
Sick fish	Paleness and thinning	The color of fish is darker than that of healthy fish.	Fin thinning, catfish whiskers damaged, and bleeding occurs at the base of the fins, some ventral parts of fish occur haemorraghi / bleeding, fish flock floating, do not respond to feed and beat, fish mucus is more, fish swirls.

Changes in the behavior of sick fish are characterized by reduced appetite, slow movements and floating on the surface of the water (Harianti, 2017). Body parts that ectoparasites like as predilection organs because there is a place to attach, easy to live in and available food sources to grow and develop (Rohde, 2001). Predilection organs including the surface of the skin, gills and fins are organs occupied by *Trichodina sp* (Afifah et al. 2014). The part of the body that is in direct contact with ectoparasites is the surface of the host's body so that it is a good place to live to support the growth and development of ectoparasites (Zheila, 2013). The movement of *Trichodina sp* by rotating 360o with cilia and attaching to the predilection organs which can result in damage to surrounding cells can then result in injury or irritation to the body surface (Pramono and Syakuri, 2008).

The effect of long aeration on water quality

Engineering of the aquatic physical environment with long aeration treatment obtained data on water quality in Table 7. Aeration treatment will increase oxygen solubility, increase acidity (pH) under neutral conditions, decrease ammonia and nitrite concentrations. Aeration results in direct contact between air into the water column so that oxygen will be easily bound by water which results in increased oxygen solubility, this is in accordance with Masdugi and Assomadi's (2012) statement that aeration serves to increased dissolved oxygen, supported by Scott's statement in Benefield, 1982; O'Connor in Benefield, 1982 that aeration can change the concentration of substances contained in water and the intake of oxygen from the air into solution.

Regarding the pH of water that aeration can increase the pH of water at neutral conditions. Aeration causes carbon dioxide gas to form $^{H\text{-}CO3}$ so that the pH of the water becomes neutral, this is in accordance according to Rahmayetty et al (2002) that the higher the aeration speed will increase the acidity of the pH of the water. Long aeration can reduce ammonia levels in water because the concentration of ammonia in water will be released into the air resulting in a decrease in ammonia. Marsidi and Herlambang (2002) stated that ammonia will be oxidized to nitrite then to nitrate under aerobic conditions by aerobic autotrophic microorganisms. The decrease in ammonia concentration due to the aeration process according to Latar (2015) stated that in aerobic processing of shrimp pond waste with aeration, there will be a decrease in ammonia concentration ranging from 3.09% - 93.80%. Drinan and Whiting (2001) stated that biological processes (nitrification / denitrification) or chemical processes can remove nitrogen content in wastewater and the nitrification process has two processes, namely the oxidation process of ammonium compounds into nitrites then nitrites are oxidized to nitrates. Aeration provides aerobic conditions that can increase the nitrification process in water so that nitrite concentrations decrease. Nitrifying bacteria will work optimally which will convert nitrite compounds into nitrate compounds under aerobic conditions. The nitrification process requires oxygen solubility so that the process of forming Nitrite (NO_2) to nitrate (NO_3) runs normally. Nitrites arise as a result of biochemical oxidation of ammonia or nitrate reduction and affect the workings of certain cells thereby reducing the body's resistance to disease and affecting the work of certain enzymes in the body (Sutomo, 1989).

Correlation of water quality to ectoparasite intensity

The value of the correlation coefficient describes how strong the relationship between two variables, namely variable x and variable y, so that knowing the correlation value can be used to determine and control variables for the desired purpose (Table 9).

Table 9. Coefficient Value of Water Quality Correlation to Ectoparasite Intensity

	Parameter	Value(r) correlation (x-y)
1	DO (x1)	0,828
2	pH (x2)	0,849

3	Ammonia (x3)	-0,888
4	Nitrite (x4)	-0,592

The value of the oxygen solubility correlation coefficient (DO) with ectoracyte intensity is positive 0.828 (very strong correlation) which means that the higher the oxygen solubility will cause the ectoparasite intensity to increase. The duration of aeration in the treatment will result in differences in dissolved oxygen that affect the number of obligate aerobic protozoan microorganisms. *Trichodina* sp. and *Dactylogyrus* sp. have the same character, which requires oxygen solubility to grow and develop (obligate aerobes) so that oxygen solubility is the main factor to support the continuity of these microorganisms, in an environment with high oxygen humidity above 2 ppm, the organism is easy to grow and develop, but in aquatic environmental conditions with low oxygen density or hypoxia conditions (oxygen solubility content less than 2 ppm) will inhibit the growth and development of parasitic microorganisms that are obligate aerobes. This is in accordance with the statement of Orina *et al* (2016) that the availability of oxygen through the aeration process will increase so that it helps microorganisms in liquid waste but the very low oxygen content causes aerobic microorganisms to be inhibited in degrading waste. In P0 and P1 hypoxia conditions occur that can inhibit the development of aerobic organisms, this is in accordance with the statement of Sergeva and Mazlumiyan (2015) that the aquatic environment that experiences hypoxia, many aerobic organisms have difficulty maintaining their lives, so that changes in the structure of benthic communities and reduced biodiversity in extreme conditions lead to loss of a number of aerobic benthic forms and are supported by Rodrigues et al (1998) that in active waste treatment in the aeration phase created aerobic conditions that resulted in the dominance of cilliata protozoa.

According to Sugiyono (2021), it can be concluded that the degree of acidity (pH) has a positive correlation value of 0.849 (very strong correlation) on the intensity of ectoparasites. Stable pH conditions will lead to an increase in population and support protozoan life. Ammonia content has a correlation value of -0.888 so it can be concluded that ammonia content has a very strong correlation with ectoparasite intensity. Prolonged aeration lowers the concentration of ammonia. Ammonia toxicity to aquatic organisms occurs sublethal effect (Sutomo, 1989). The toxic power of ammonia increases with increasing acidity (pH) and water temperature (Pescod, 1978 in Sutomo, 1989). Long aeration will reduce the content of nitrite compounds. Aeration can decrease the amount of nitrites. The correlation value of nitrite to ectoparasite intensity is negative 0.592 which can be concluded nitrite content has a moderate correlation to ectoparasite intensity, the lower the nitrite level, the greater the ectoparasite intensity. Nitrite is a toxic compound for aquatic organisms so the amount is limited to a maximum of 0.1 mg / L (Ginting, 2007).

Conclusion

The conclusion of this study is that the longer aeration is given, the solubility of oxygen will increase which results in an increase in the intensity and prevalence of ectoparasite infections, the pH of the water becomes neutral and decreases the content of ammonia and nitrite. There is a moderate to very strong correlation between water quality and ectoparasite intensity. There is an increase in the prevalence of infection, ectoparasite intensity and fish mortality so that it can reduce the survival and condition factors of Dumbo catfish (*Clarias* sp.).

Suggestion

Further research can be carried out on other fish commodities that have additional breathing apparatus (*Asborescent organs*) such as catfish, gourami and snakehead fish. Materials can be found and tested that can create hypoxic environmental conditions to prevent and treat catfish from ectoparasite attacks.

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