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Correlation between water quality and prevalence on Koi (*Cyprinus carpio*) which infested by *Argulus* in Mungkid Subdistrict and Muntilan Subdistrict, Magelang Regency, Central Java

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Abstract. Koi (*Cyprinus carpio*) has an interesting added value which one of the most famous freshwater ornamental fish. There are a lot of factors which have to be faced when we were trying to cultivate or culture Koi; one of those factors is the disease. Ectoparasite is one factor that can be the decline on koi selling because the ectoparasite can reduce the selling point caused by the effect on koi. One of ectoparasite known as attack koi is *Argulus*. The purpose of this research to determine relations between water quality and the prevalence of *Argulus* on Koi (*Cyprinus carpio*). The research was conducted at Magelang, Central Java (on Mungkid's and Muntilan's region). Measurement of water quality was temperature, pH, DO, and ammonia. This research use survey method and take the sample with random sampling. The result of this research shown that the prevalence of Koi that infested by *Argulus* in Mungkid subdistrict are 30.77 %, and in the Muntilan sub-district are 55.17%. There was a positive correlation between water quality and the prevalence of *Argulus* especially at the temperature, which has a significant correlation. Higher temperatures will also increase the *Argulus* prevalence.

1. Introduction

The current fishery business has developed rapidly, especially in ornamental fish which is in great demand both on the national and international markets. One commodity of freshwater ornamental fish that is much in demand by the public is koi fish. The main types of ornamental fish in Central Java are arowana, koi, goldfish, and koi. Viewed from a number of regencies in Central Java, Magelang Regency is the most potential area because it has the most koi fish farming households, namely 86 households [1].

The main causes of disease are poor aquatic environmental conditions, fish density, and stress [2]. The problem that is often faced in fish farming is disease, this can cause a decrease in the level of fish production and the sale value of fish. Disease can be caused due to feed quality and poor environmental conditions. Environmental conditions that support the occurrence of disease are changes in water quality in a short time, pollution, and overcrowding in ponds. Production failure can be caused by a pathogenic outbreak of fish disease both from parasites, fungi, bacteria and viruses.



One of the parasites that often attacks koi fish is the Argulus parasite. According to data obtained from the research of [3], *Argulus japonicus* infested 14 out of 100 samples of koi fish seeds (*Cyprinus carpio*) with a prevalence rate of 14%. According to the results of research conducted [4] in Mungkid Subdistrict, Magelang District, the Argulus prevalence was 4.16%, while the prevalence in Kemloko Village, Blitar Regency was reported as 11%. The prevalence of *Argulus japonicus* in koi fish in Bangoan Village, Tulungagung Regency has been reported by [5] as much as 10.7%.

Parasites can cause stunted growth and even death, causing a decrease in production and quality of ornamental fish, which results in economic losses for farmers [6]. Water quality that is not suitable for koi and sudden water quality fluctuations when the transitional season becomes very vulnerable for koi fish to be infested with Argulus. The quality of water used for koi fish in Magelang is the main factor that will be used as a theoretical basis for the prevalence of Argulus so that correlation is found. Prevention of Argulus infestation that can be done is to treat fish well by paying attention to the water quality that is suitable for koi fish.

2. Materials and method

2.1 Place and time

The study was conducted on 29 February - 7 March 2016, fish sampling in two districts, which contained koi fish measuring 5-15 cm, namely Mungkid and Muntilan Districts, Magelang District, Central Java.

2.2. Research equipment and materials

The equipment used in this research consists of fishing net, section set, meter, camera, ruler, magnifying glass. Tools used to measure water quality are pH meter, DO meter (measuring DO and there is a temperature gauge) and ammonia test kit. The used fish is koi fish (*Cyprinus carpio*) originating from Kec. Mungkid and Muntilan with a size of 5-15 cm.

2.3. Research methods

This research was conducted by survey method. The data presentation used a descriptive method, which is to make a description of a particular situation or event [7]. The description of the occurrence of this study is the prevalence of Argulus in koi fish which will be correlated with the water quality in Mungkid and Muntilan Districts, Magelang Regency, Central Java.

2.4. Water quality measurement

Water quality parameters of temperature and DO are measured using a DO meter to get accurate results. Then the pH was measured using a pH meter to be more specific, and the measurement of ammonia using the ammonia test kit.

2.5. Sampling and separation of parasites

This research was conducted by taking 10% of fish from the population. Intake in Muntilan Subdistrict in the first pool was taken 20 tails with a population of 194 tails and the second pond was taken nine tails with a total population of 90 tails. Sampling in Mungkid District totaled six out of 63, and seven from a population of 70 in the pond. All koi fish samples were 42 fish.

2.6. Research Parameters

The independent variables that will be used as this research are temperature, pH, DO, and ammonia. The dependent variable is Argulus prevalence. Prevalence calculations can be calculated based on the formula [8].

$$\text{Prevalence} = \frac{\text{Number of infested fish}}{\text{The number of fish examined}} \times 100\%$$

Table 1. Categories parasitic infestation by Williams and Williams [9].

Category infestations	Range Value (%)
Almost never	<0.01
Very rarely	<0.01-0.1
rarely	<0.1-1
Occasional	1-9
Often	10-29
Commonly	30-49
Frequently	50-69
usually	70-89
Almost always	90-98
Always	99-100

2.7. Data analysis

The relationship of water quality and prevalence of *Argulus* using regression correlation calculation to determine the quality of water affects the prevalence *Argulus*. Correlation stated degree of relationship between variables and variables into a regression to measure the presence or absence of correlations between variables.

3. Results and discussion

3.1. Prevalence of *Argulus*

The results showed that *Argulus* infested koi fish in Mungkid Subdistrict as many as four positive fish from 13 samples examined, the prevalence of fish infested with *Argulus* was 30.77% so it was included in the common category. Examination of koi fish in two different ponds in Muntilan District showed a prevalence of 16 positive *Argulus* infested fish from 29 examined fish samples so that the prevalence was 55.17% and included in the frequent category.

3.2. Correlation regression calculation of water quality on the prevalence *Argulus*

The results of the calculation of average temperature with a prevalence *Argulus* on a Koi fish were examined in Muntilan district and Mungkid ie $R = 0.996$. The graph shows the magnitude of regression correlation can be seen in Figure 1.

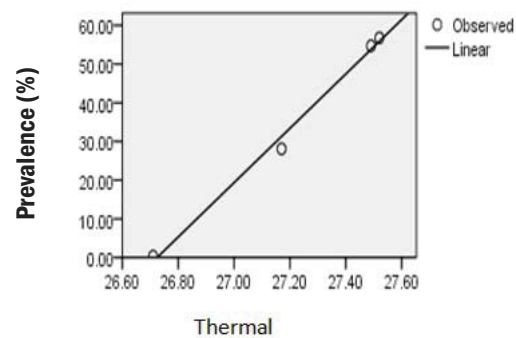


Figure 1. Regression correlation of temperature with koi fish infested prevalence Argulus

The result of the calculation of the average DO prevalence Argulus on a Koi fish were examined in Muntilan district and Mungkid ie $R = 0.329$. The graph shows the magnitude of regression correlation can be seen in Figure 2.

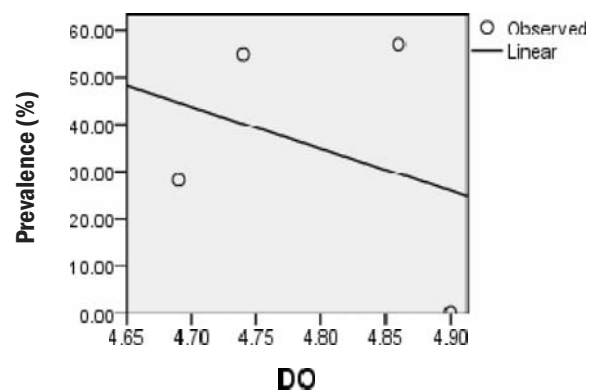


Figure 2. Regression DO correlation with koi fish infested prevalence Argulus

The result of the calculation of the average pH of the prevalence of Argulus on a Koi fish were examined in Muntilan district and Mungkid ie $R = 0.446$. The graph shows the magnitude of regression correlation can be seen in Figure 3.

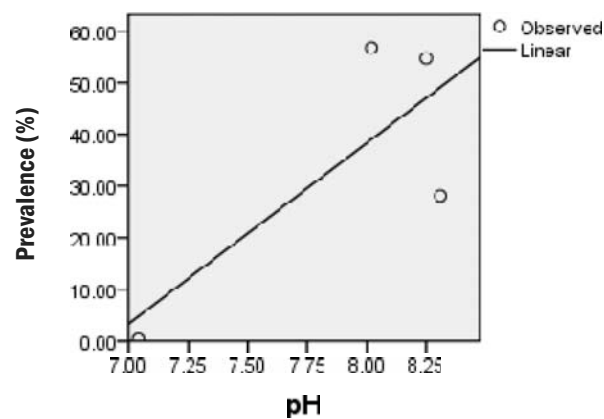


Figure 3. Regression correlation of pH with koi fish infested prevalence Argulus

The result of the calculation of average ammonia prevalence Argulus on a Koi fish were examined in Muntilan district and Mungkid ie $R = 650$. The graph shows the magnitude of regression correlation can be seen in Figure 4.

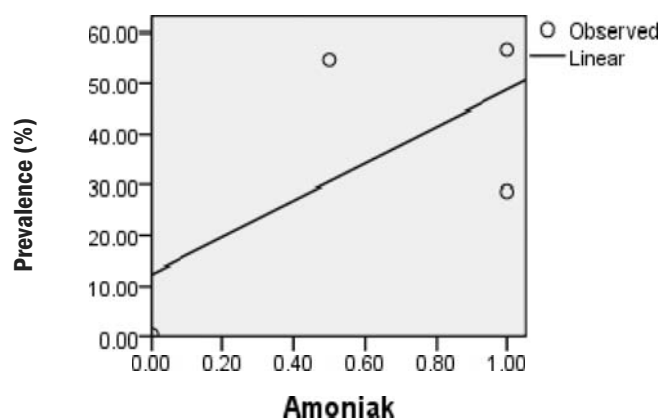


Figure 4. Regression correlation prevalence of ammonia with koi fish infested Argulus

Temperature is influenced by several factors, namely latitude (where the location is towards the sun's circular line), altitude (where the height is from sea level), season, weather, shade, time of measurement, and water depth. The sun's light entering the water undergoes absorption and changes into heat energy. This light absorption process takes place intensively in the upper layer so that the upper layer of water has a higher temperature and a smaller density than the lower layer. Increased temperature results in viscosity, chemical reactions, evaporation and volatilization. The results of the average pH measurement had a slight difference, in Mungkid Subdistrict the first pool had a normal

pH of 7.04 while the second pool had a higher pH of 8.25. The pH measurement in Muntilan Subdistrict in the first pond was lower compared to the second pond, 8.02 (first pool) and 8.31 (second pool). The range of water quality that can still be tolerated by aquatic organisms, where in general aquatic organisms can live well in the pH range 6-8 [10]. Slightly excessive pH can trigger stress in fish due to inappropriate environmental conditions.

Dissolved oxygen contained in the two Districts did not have a significant difference, in District Mungkid in the first pool the dissolved oxygen was 7.04 mg / l and in the second pool it was 4.74 mg / l. dissolved oxygen in the first pool in the district of Vomilan which is 4.86 mg / l and the second pool has dissolved oxygen of 4.69 mg / l. Oxygen content varies, depending on time and weather, water depth and currents. In the morning the oxygen range is rather low and rises towards noon and decreases again this afternoon, one of the causes is phytoplankton photosynthesis activity associated with sunlight. Ammonia measurements were made at the beginning and end of sample measurements. Ammonia levels in the two Sub districts in two different ponds also have different ammonia, in the Mungkid Sub district the first pond has an ammonia level of 0, while in the second pool the ammonia level is 0.5 mg / l. In contrast to ammonia levels in Muntilan Sub district, the measurement of ammonia in two ponds has the same result which is 1 mg / l. According to [11], maintenance water quality can decrease rapidly due to residual feed, feces and waste metabolites. This is evident from the decline in water quality due to an increase in water pH that is too fast and high levels of ammonia during maintenance. The water quality causes poisoning or lack of oxygen and accelerates the development of germs.

3.3. Correlation between water quality and argulus prevalence

The coefficient value between temperature and the prevalence of fish infested with Argulus is $R = 0.996$, which is a positive correlation approaching number one, this indicates a very strong significant relationship between temperature and the prevalence of fish infested with Argulus. Significance value of 0.03 so that it is smaller than 0.05 then H_0 is rejected which shows a correlation between temperature and the prevalence of koi fish infested with Argulus. The more temperature higher, then higher the prevalence of fish infested with Argulus. If the temperature higher, then higher the prevalence of Argi infested koi. The result of the average temperature in Mungkid and Muntilan which is 27.2°C allows Argulus eggs to hatch with a high percentage even though the hatching time is longer. This is in accordance with [12] which states that Argulus eggs hatch at 32°C for 10 days with a hatching percentage of 60%. At 28°C , Argulus eggs hatch for 15 days with a 75% hatching percentage. At 15°C the incubated Argulus eggs do not show any development, but when brought back to room temperature ($25\text{--}28^\circ\text{C}$) these eggs hatch within 20 days with a 30% hatching percentage.

The coefficient value between pH and the prevalence of fish infested with Argulus is $R = 0.446$, which is a positive correlation but shows the level of relationship in the medium category. T test results are used to determine the effect of pH on the prevalence of Argulus infested koi fish that is $T_{\text{count}} < T_{\text{table}}$ ($793 < 0.816$) then H_1 is rejected which indicates that pH does not affect the prevalence of Argulus infested koi. The overall test results indicate that the actual pH and prevalence of Argulus infested koi fish have a relationship but pH does not affect the prevalence of Argulus infested koi. This situation occurs because of the measurement factors carried out during the transition season so that pH fluctuations are erratic.

The coefficient value between DO and prevalence infested with Argulus is $R = 0.329$, which is a negative correlation but shows the level of relationship that is included in the low category. T test results are used to determine the effect of DO on the prevalence of Argi-infested koi fish, namely $T_{\text{count}} < T_{\text{table}}$ ($0.533 < 0.816$), then H_1 is rejected, indicating that DO has no effect on the prevalence of koi infested with Argulus. The overall test results show that DO and the prevalence of Argulus infested koi fish have a relationship but DO has no effect on the prevalence of infested koi. This situation is possible because of the presence or absence of wind that affects DO fluctuations.

The coefficient value between ammonia and prevalence infested with Argulus is $R = 0.650$, which is a positive correlation and indicates a relationship that is included in the category of strong

relationship, but the value of the coefficient of determination shown is 0.423 (42.3%) and the remaining 0.577 (57.7%) due to other factors not examined. T test results used to determine the effect of pH on the prevalence of Argulus-infested koi fish, that is $T_{count} < T_{table}$ ($0.558 < 0.816$), then H_1 is rejected, which indicates that ammonia has no effect on the prevalence of Argi-infested koi. Overall testing results indicate that the ammonia and the prevalence of koi infested with Argulus have a relationship but the ammonia has no effect on the prevalence of infested koi. This situation occurs because of the different levels of fish density so that many feces and food scraps accumulate into ammonia.

According to [13] states that the interpretation value of the correlation coefficient 0.00-0.19 belongs to the very low interpretation category, 0.20-0.39 belongs to the low category, 0.40-0.59 belongs to the medium category, 0.60-0.79 into the strong category, 0.80-1.00 into the very strong category.

4. Conclusion

The prevalence of Argulus infested koi in Mungkid Subdistrict in the first pond is 0% which is in the almost never category and the second pond is 66.67% which is included in the frequently (often) category while the prevalence in Muntilan Subdistrict is 70 % are included in the always category and 22% are included in the often category, so Argulus infest more koi fish in Muntilan District than Mungkid District. Based on the correlation regression analysis, the more temperature, pH and ammonia higher, then higher the prevalence of Argulus infested koi fish, and the lower DO, then higher the prevalence of Argulus infested koi, but the high/low pH, DO and ammonia do not affect the prevalence of fish the koi infested with Argulus. Water quality control and change of water should often be carried out, so that the pool remains clean of residual impurities and the possibility of spreading disease germs, especially ectoparasites and to immediately take preventive and treatment efforts.

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