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PREVALENCE AND INTENSITY OF ECTOPARASITES IN GOLDFISH (*Carassius auratus*) AT MAJU MAPAN FARM, MAGELANG REGENCY

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ABSTRACT

Goldfish (*Carassius auratus*) at Maju Mapan Farm is one of the leading ornamental fish commodities with a high mortality rate due to disease. For this reason, this research aims to know about the type, prevalence, and intensity of ectoparasites at Maju Mapan Farm. The method in this research was random sampling for fish sampling 30 fish/pond. The type of parasites, prevalence, and intensity were analyzed descriptively and described in figures, tables, or graphs. This observation and identification showed that ectoparasites infected by goldfish at Maju Mapan Farm consisted of 3 types: *Trichodina* sp, *Dactylogyrus* sp, and *Gyrodactylus* sp. The types of ectoparasites that dominated both were *Trichodina* sp (96.11%), *Dactylogyrus* sp (3.61%), and *Gyrodactylus* sp (0.28%). Prevalence of ectoparasites was *Trichodina* sp (83.33%), *Dactylogyrus* sp (43.33%), and *Gyrodactylus* sp (6.67%). The intensity of ectoparasites were *Trichodina* sp (129 ind/fish), Dactylogyrus sp. (9 ind/fish), and *Gyrodactylus* sp (4 ind/fish). *Trichodina* sp. and *Gyrodactylus* sp. were commonly found in mucus, while *Dactylogyrus* sp. only infected goldfish in the gill organ. Prevalence and intensity of ectoparasites were found in goldfish with medium-stage infection at Maju Mapan Farm. The result of measuring water quality parameters was not optimal, causing ectoparasites to infect and multiply rapidly in goldfish at Maju Mapan Farm.

Keywords: Ectoparasite, Intensity, Goldfish, Prevalence

1. INTRODUCTION

The development trend of ornamental fish cultivation is increasing yearly because ornamental fish is one of several fish commodities with economic value[1]. Ornamental fish cultivation does not require large areas of land (aquarium), does not require special skills, or large capital. Also, the selling price of ornamental fish tends to be stable and increases in the market compared to the consumption of fish[2]. The regency and city of Magelang, which are topographically located between mountains and hills, have great potential for the freshwater ornamental fish farming sector due to the abundant freshwater sources. One of the freshwater ornamental fish cultivators in Magelang Regency that is successful in exploiting this potential is Maju Mapan Farm.

Maju Mapan Farm is a place for cultivating freshwater ornamental fish and freshwater consumption fish located in Ngluwar District, Magelang Regency. The main ornamental fish commodity from Maju Mapan Farm is goldfish (*Carassius auratus*) because the production is carried out continuously, and the market demand is high. The high demand for goldfish is because goldfish have several advantages, such as having a unique and attractive body shape and colour, not being too difficult to care for, and the selling price of fish tends to be stable[3].

Fish farming business activities at Maju Mapan Farm, especially ornamental fish, have problems regarding pests and

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diseases based on initial observations carried out in January-February 2022. Evidence of pest and disease attacks on ornamental fish at Maju Mapan Farm can be seen from the fish's high mortality rate, especially in goldfish, many snails and dragonfly larvae that enter the fish pond, and found velvet fungal disease and *Lernea* sp. The existence of these pests and diseases is thought to be caused by some things, namely the absence of biosecurity in the fish farming area at Maju Mapan Farm; disease control and prevention is only done manually. It is less sterile, and fish are often exposed to diseases in the form of parasites and fungi due to erratic weather changes.

Ectoparasites are one type of infectious disease in fish. Ectoparasites are parasites that stick (live) on the outside/surface of the host's body, such as skin, scales, and gills[4]. Ectoparasites in fish are often found on the outside/surface of the fish body, such as scales, skin, mucosa, fins, operculum, gills, eyes, and nose[5]. Prevalence is the disease frequency at a certain time in a population[6]. Intensity is the result of the interaction of the degree of susceptibility and virulence of the host's pathogen (disease), which is influenced by many factors[7].

For this reason, this research aims to know the type, prevalence, and intensity of ectoparasite infections in goldfish at Maju Mapan Farm. This is expected to contribute in the form of identification results, prevalence, and intensity of parasites and can assist in preventing and controlling fish diseases, especially ectoparasites in goldfish, to prevent losses in fish farming activities.

2. RESEARCH METHOD

Time and Place

This research was carried out from 31 October to 28 November 2022 in three places: Maju Mapan Farm fish farm as the sampling location Laboratory Faculty of Agriculture, Tidar University, and UPT Health Laboratory of Magelang City as the sample identification site.

Method

The method in this research was random sampling for fish sampling. As many as 30 individuals took samples of goldfish from goldfish ponds at Maju Mapan Farm for each sample pond with 5-8 cm fish lengths.

Procedure

Retrieval of Ectoparasites

The physical appearance of the fish was measured, and then the goldfish's total length, standard length, and weight were measured. Using a loop, examined ectoparasites outside the fish's body, such as integuments, eyes, and fins. Take mucus liquid from the surface of the fish's body using a scalpel, then apply it to the object's glass. Then, the object glass is dripped with physiological NaCl covered with a cover glass and observed under a microscope with a zoom of 10 x 10 mm or 40 x 10 mm. Cut each part of the fish's fin small, put it on an object glass, and observe it under a microscope.

Examined fish gills by cutting the fish operculum, taking filaments from fish gills, and making observations under a microscope. Identification of ectoparasites was found in an identification book entitled Fish Parasitology: Biology, Identification, and Control[8]. Ectoparasites that have been identified are then counted and recorded.

Calculation of Prevalence and Intensity Ectoparasites

According to Kabata *in* Putri & Fauziah[9], the prevalence and intensity of ectoparasites in goldfish can be calculated using the formula:

$$\text{Prevalence } (\%) = \frac{\sum \text{Parasites infected fish}}{\sum \text{Sample fish}} \text{ x } 100\%$$

$$\text{Intensity } \left(\frac{\text{ind}}{\text{fish}}\right) = \frac{\sum \text{Parasites founded}}{\sum \text{parasites infected fish}}$$

Criteria for the prevalence and intensity of ectoparasite attacks refer to William & Bunkley *in* Batubara et al.[10], presented in Table 1 and Table 2.

Table 1. Criteria for the prevalence of parasite infection

No	Attack Rate	Information	Prevalence
1	Always	Very severe infection	100 - 99%
2	Almost always	Severe infection	98 - 90%
3	Usually	Moderate infection	89 - 70%
4	Very often	Very frequent infections	69 - 50%
5	Generally	Common infection	49 - 30%
6	Often	Frequent infections	29 - 10%
7	Sometimes	Infection sometimes	9 - 1%
8	Rarely	Rare infection	>1 - 0,1%
9	Very rarely	Infections are very rare	>0,1- 0.01%
10	Seldom	Never infection	>0.01%

Source: William & Bunkley *in* Batubara et al.[10].

Table 2. Parasites infection intensity criteria

No	Infection Rate	Intensity (ind/fish)
1	Very low	< 1
2	Low	1 - 5
3	Medium	6 - 55
4	Severe	51 – 100
5	Awfully	>100
6	Superinfection	>1000

Source: William & Bunkley *in* Batubara et al.[10].

Data Analysis

The data analysis method in this research uses a descriptive method with a quantitative approach. Analysis used quantitative methods based on the results of calculations from the prevalence (%) and intensity (ind/fish) of ectoparasites. The results of observations in the form of parasite type, parasite prevalence, and parasite intensity were analyzed descriptively and described in the form of pictures, tables or graphs.

3. RESULT AND DISCUSSION

Identification of Ectoparasites

Three types of ectoparasites have been identified in Maju Mapan Farm goldfish: *Trichodina* sp, *Dactylogyrus* sp, and *Gyrodactylus* sp. The number of ectoparasites that infected goldfish can be seen in Table 3.

Table 3. Number of ectoparasites

Type of Ectoparasites	Number of Ectoparasites (Ind)	Average (Ind)
Trichodina sp.	6.462	129
Dactylogyrus sp.	243	9
Gyrodactylus sp.	18	4

***Trichodina* sp**

Based on the results of observations and identification of ectoparasites during this research, *Trichodina* sp. was identified as having a flat round body shape like a disc ring, slightly brownish white, and having vibrating hairs or *cilia* all over its body surface. Based on the results of observations using a microscope with a zoom of 10 x 10 mm, *Trichodina* sp. runs by rotating, and the disc (adhesive disk) on *Trichodina* sp. serves to attach to target organs (Figure 1). The results of observation and identification of the ectoparasites *Trichodina* sp following the opinion of Yulianti et al.[11], namely *Trichodina* sp. is an ectoparasite originating from the protozoa phylum which has locomotion in the form of *cilia* (vibrating hairs).

Trichodina sp morphologically has a flat round body shape that resembles a saucer when flying, has a transparent colour, has a bell shape on the lateral side of the body, and is surrounded by cilia (vibrating hairs) on both sides of the cell. According to Riwidiharso et al.[12], *Trichodina* sp. will rotate 360° and

stick to the surface of the host's body. The body parts of *Trichodina* sp. are adhesive disks, denticle rings, radial pins, blades, border membranes, and ciliary rings[11]. The adhesive disk has an organelle in the form of a denticle ring, which functions as an attachment or attachment tool and facilitates the movement of *Trichodina* sp. on the surface of the host's body[13].

Figure 1. *Trichodina* sp
Source: Observation Results

***Dactylogyrus* sp**

Based on the results of observations and identification of ectoparasites during this research, *Dactylogyrus* sp, which was identified with the help of a light microscope with a zoom of 4 x 10 and 10 x 10 mm, has a long, flat body shape, has two eye spots with a transparent head. In contrast, on the sides of its body, there is an organ that looks like a rounded anchor (Ophisthaptor) (Figure 2).

In addition, *Dactylogyrus* sp was found only in the gill organs in this research. *Dactylogyrus* s. has an elongated flat body shape and, on the anterior part of the body, has four protrusions. Body parts of *Dactylogyrus* sp, namely on the anterior part of the body, there is one pair of eye spots (eye spot) and mouth (sucker) as a means of sucking blood. On the posterior part of the body, there is an Ophisthaptor equipped with two pairs of anchors (hooks) with 14 marginal hooks[14]. The function of the Ophisthaptor is to attach and help move the fish's gills[13].

Based on the results of observation and identification, *Dactylogyrus* sp is found only in the gill organs. *Dactylogyrus* sp most infects the gills of fish as many as 243 individuals. In the opinion of Irwandi et al.[14], *Dactylogyrus* sp is one of the ectoparasites that infects hosts on specific organs, namely the gills, so *Dactylogyrus* sp only infects the gills of fish and is not found in other organs. Gills have many blood capillaries on filaments that are directly related to gas exchange in the gills[15]. Blood capillaries in the filaments provide lots of nutrition for *Dactylogyrus* sp when the eggs hatch, so *Dactylogyrus* sp infects fish gills[14].

Figure 2. *Dactylogyrus* sp
Source: Observation Results

***Gyrodactylus* sp**

Based on the results of observations and identification of ectoparasites during this research, goldfish at Maju Mapan Farm were also infected with *Gyrodactylus* sp, which was identified to have an oval body shape that is slightly flattened and elongated and has a round sucking organ on the sides of its body. Observations of *Gyrodactylus* sp using a light microscope with a zoom of 10 x 10 mm, the movement of *Gyrodactylus* sp walking and sucking, namely utilizing the Ophisthaptor which attaches to the target organ then the mouth of *Gyrodactylus* sp eat food essences (Figure 3).

Observation and identification results of *Gyrodactylus* sp. This follows the opinion of Yulianti et al.[11], which stated that *Gyrodactylus* sp. has a body shape that is flat and elongated and has two antennae on the anterior part of the body. The body parts of *Gyrodactylus* sp, namely in the anterior part of the body, there is a mouth (sucker) and pharynx. Meanwhile, on the

posterior part of his body, there is an Opisthaptor.

Figure 3. *Gyrodactylus* sp.
Source: Observation Results

Ophisthaptor on *Gyrodactylus* sp, there is one pair of anchors (*hooks*) with 16 marginal hooks[14]. The function of the Ophisthaptor on *Gyrodactylus* sp is to help the parasite attach to the surface of the host's body. The difference between *Gyrodactylus* sp and *Dactylogyrus* sp is located in the eye spot and Ophisthaptor. *Gyrodactylus* sp. has no eye spots on its body and only has two protruding lobes on the anterior part of its body[16]. Based on the results of observation and identification, *Gyrodactylus* sp is found in mucus, fins, and gills of fish. The identification results also showed that *Gyrodactylus* sp infected goldfish as many as 18 individuals.

Prevalence and Intensity of Ectoparasites

Prevalence and intensity of ectoparasites in goldfish at Maju Mapan Farm, which have been identified and analyzed, show various results based on the infecting ectoparasites. The prevalence of ectoparasites was 88.33%, which means that the level of ectoparasitic attack on goldfish found was "usually", meaning that goldfish infected with ectoparasites in a pond are in the medium infection *stage*. Meanwhile, the intensity of ectoparasites was 112 ind/fish, which means that the level of ectoparasitic infection found in goldfish was high.

The prevalence of *Trichodina* sp. was 83.33%, which shows a value close to severe infection but still in the attack level stage, usually with moderate infection (medium stage). At the same time, the intensity *of Trichodina* sp. was 129 ind/fish, which shows the intensity of *Trichodina* sp. at awful infection rates (Table 4). The high prevalence and intensity values of *Trichodina* sp. in this research are caused by the fast reproduction of parasites, and they are always actively moving[17]. *Trichodina* sp. also dominates the parasites in each pond, with a very high number of parasites, more than 2,000 individuals per pond.

Table 4. Prevalence and intensity of ectoparasites in goldfish at Maju Mapan Farm

Types of Ectoparasites	Number of Infected Fish (fish)	Number of Ectoparasites (Individual)	Number of Total Samples (fish)	Prevalence (%)	Information (Attack Rate)	Intensity (Ind/fish)	Information (Infection Rate)	Ectoparasite Infected Organs
Trichodina sp.	50	6,462	60	**83,33**	Usually	**129**	Awfully	Mucus, Fins, Integuments, Gills
Dactylogyrus sp.	26	243	60	**43,33**	Generally	**9**	Medium	Gills
Gyrodactylus sp.	4	18	60	**6,67**	Sometimes	**4**	Low	Mucus, Fins, Gills
Total	**53**	**6,723**	**60**	**88.33**	**Usually**	**112**	**Awfully**	**Mucus, Fins, Integuments, Gills**

The high prevalence and intensity values of *Trichodina* sp. are caused by less than optimal water quality in fish ponds, especially high ammonia, which exceeds the quality standard. In addition, the high prevalence and intensity of *Trichodina* sp. is allegedly caused by a lack of cleanliness of the pond and biosecurity that needs to be implemented properly in the cultivation environment. The results of environmental observations in all fish farming areas at Maju Mapan Farm show that the cleanliness of the ponds and the cultivation environment is not well maintained, which is indicated by the cloudy colour of the pond and lots of moss and pests (snails) that

enter the pond. Inappropriate biosecurity, such as the use of pond tools such as seser and cleaning tools (brooms, pool brushes, boots) that are used interchangeably between one pond and another, placement of pond equipment and feed that is not up to standard, fishing those who enter the cultivation pond is not quarantined first. Several types of fish are cultivated in the same pond.

Trichodina sp. was able to attack the host in a short and fast time in fish reared in less than optimal environmental conditions[18]. *Trichodina* sp. is one of the opportunistic (facultative) ectoparasites, which means *Trichodina* sp. can live without a host and can infect and cause disease in the host if conditions are favourable, such as fish stress, the host's immune system decreases, or environmental conditions that support the development of pathogens such as high organic matter content and low dissolved oxygen in water[5]. The high or low prevalence and intensity of *Trichodina* sp. are influenced by organic matter content. High organic matter in a pond can cause a high number of diseases (pathogens), so fish will secrete excess mucus as antibodies and cause damage to the fish's skin so that ectoparasites are more easily infected[12].

The prevalence value of *Dactylogyrus* sp is equal to 43.33% with a general attack rate, meaning that the infection is moderate and ordinary. The intensity value of *Dactylogyrus* sp was 9 ind/fish, indicating a medium level of infection. High levels of ammonia cause moderate prevalence and intensity values for Dactylogyrus sp and have exceeded a predetermined threshold. *Dactylogyrus* sp is also an opportunistic parasite, just like *Trichodina* sp, which infects when the environmental conditions of the waters are unfavourable for fish.

Dactylogyrus sp only infects the gills of fish because fish gills have blood capillaries in the branchial filaments, which are rich in nutrients, so it is very good for the breeding of parasitic organisms such as *Dactylogyrus* sp[19]. Therefore, *Dactylogyrus* sp is a worm from the Trematoda class, sub-class Monogenea, nicknamed the gill worm. In addition, gills are in direct contact with water and air for gas exchange within the body, so *Dactylogyrus* sp. more infects fish gills[15].

The prevalence value of *Gyrodactylus* sp is equal to 6.67%, which shows the attack rate sometimes with occasional infections. The intensity value of *Gyrodactylus* sp was 4 ind/fish, indicating a low infection rate. The prevalence and intensity values of *Gyrodactylus* sp were classified as low because the *Trichodina* parasite dominated more than 90% of the fish samples identified and analyzed. In addition, the water quality measured during the study showed a less-than-optimal value for the growth of *Gyrodactylus* sp. *Gyrodactylus* sp is a type of monogenean ectoparasite that, at high temperatures of 30-32°C, will produce more eggs, and at low temperatures, the development of *Gyrodactylus* sp is slower[14]. Apart from temperature, egg reproduction from *Gyrodactylus* sp is also influenced by dissolved oxygen; at low dissolved oxygen levels, the number of eggs produced will increase[20]. The study's water quality measurements showed an average temperature ≤32°C and dissolved oxygen ≥5 mg/L.

The emergence of disease attacks is principally due to inappropriate interactions between 3 main factors, namely host conditions (fish), environmental conditions (water quality), and disease (pathogens)[21]. Ectoparasites can develop in poor or non-optimal aquatic environmental conditions, characterized by high levels of ammonia and nitrite and fluctuations in temperature, pH, and dissolved oxygen. Temperature fluctuations and low dissolved oxygen can weaken fish immunity, and they are easily infected by parasites[20]. In addition, in the opinion of Riwidiharso et al.[12], the factors that affect the high prevalence and intensity of parasites result from high fish densities,

lack of fish nutrition, and poor water quality. The higher the population in the pond, the greater the fish will rub against each other, and parasite transmission can occur directly or as a result of friction between fish, which can cause injuries so that parasites can easily enter the fish's body.

Water Quality

Water quality measurements during this research showed results that could have been more optimal regarding temperature, pH, dissolved oxygen, and ammonia parameters, as seen in Table 5.

Table 5. Water quality measurement result

Water Quality Parameters	Measurement results	Average	Optimal Water Quality	Category
Suhu (°C)	24,85 – 30,20	26,68	20 – 25[26]	Not optimal
pH	5,75 – 9,52	7,87	6,5 – 8,5[26]	Not optimal
DO (mg/L)	5,26 – 11,30	8,08	3 – 7[22]	Not optimal
Amoniak (mg/L)	0,22 – 0,81	0,41	0,12[27]	Exceeding Threshold

According to Effendi *in* Hamuna et al.[22], increasing water temperature would increase the decomposition of organic matter by microbes. Higher temperatures also cause certain parasites to grow and develop quickly. pH that is not optimal, the fish will maintain its metabolism, thereby reducing the level of fish immunity. If the pH is too acidic or alkaline, the fish will become easily stressed, and their immune system will decrease. As a result of decreased fish immunity, fish are easily infected with parasites, and parasites are easy to increase in population[21]. Dissolved oxygen concentrations that are too low can force fish to adapt, weakening fish and eventually making fish susceptible to disease. In addition, oxygen concentrations that are too low cause asphyxia in fish, so fish become weak and easily infected with parasites[23].

Meanwhile, according to Weitkamp & Katz[24], concentrations of DO that are too high cause chronic exophthalmia (gas bubbles), which causes secondary effects such as bleeding in the fish's circulatory system. Levels of free (non-ionized) ammonia in waters can cause negative effects for fish, including damage to fish gills, lowering the level of ammonia excretion in the fish's body so that ammonia levels in fish blood will rise and reduce the ability of blood to transport oxygen, fish are susceptible to attack. Disease and can inhibit growth (Hargreaves & Tucker *in*[25])

Based on the results of water quality measurements, physical and chemical parameters, namely temperature, pH, and dissolved oxygen (DO), were not optimal results, and ammonia exceeded the threshold for goldfish survival. The non-optimal quality of the water during the study led to many ectoparasites that infected and grew rapidly, especially *Trichodina* sp, which infects goldfish at Maju Mapan Farm.

4. CONCLUSION

The results showed that three types of ectoparasites infected goldfish at Maju Mapan Farm: *Trichodina* sp, *Dactylogyrus* sp, and *Gyrodactylus* sp. The highest prevalence of ectoparasites was *Trichodina* sp at 83.33%, and the highest intensity was *Trichodina* sp as many as 129 in/fish, both found in the mucus of the goldfish. At the same time, the lowest prevalence and intensity is *Gyrodactylus* sp, which is 6.67%, as many as 4 in/fish found in the gills of goldfish. The results of measuring the parameters of temperature, pH, DO, and ammonia showed values that were not optimal and caused ectoparasites to infect goldfish and reproduce rapidly.

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