

Characterization and Inventory of Ectoparasites in Cultivated Fish at the Aquaculture Technology Development Center (BPTPB) Cangkringan, Sleman, Special Region of Yogyakarta

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ABSTRACT

Fish farming has increased significantly compared to capture fisheries due to overfishing and the excessive exploitation of wild fish resources. However, the intensification of aquaculture systems is often followed by the emergence of various diseases, including ectoparasite infestations. Ectoparasites are important pathogens that can reduce fish productivity and health status. Their presence may cause clinical symptoms such as wounds and hemorrhages on the skin and gills, respiratory disorders, abnormal swimming behavior, and even mortality in fish. This study aimed to identify and inventory the types of ectoparasites infesting cultured fish at the Center for Aquaculture Technology Development (BPTPB) Cangkringan, Sleman, Special Region of Yogyakarta, and to determine their prevalence and intensity levels. The research applied a descriptive method through field observations and microscopic examinations, with scraping techniques performed on the skin, fins, and gills of fish. A total of 85 fish samples were examined, consisting of tilapia (n=20), carp (n=21), koi (n=24), and catfish (n=20). The results revealed six ectoparasite taxa infecting cultured fish: Trichodina, Gyrodactylus, Dactylogyrus, Ichthyophthirius multifiliis, Myxobolus, and Epistylis. Among these, Trichodina showed the highest prevalence and intensity, reaching 100% prevalence with an intensity of 840.5 parasite individuals per fish. In contrast, the lowest values were recorded for Gyrodactylus, with a prevalence of 4.76% and an intensity of 1 parasite individual per fish. These findings indicate the need for effective fish health management and parasite control strategies to prevent infections that may reduce aquaculture productivity.

INTRODUCTION

Freshwater fish farming is growing as a primary alternative source of animal protein, driven by declining marine catches due to overfishing. This situation has prompted communities and governments to shift to the aquaculture sector, considered more sustainable and capable of meeting the growing demand for fish consumption annually (Nuryadin *et al.*, 2024). In addition to serving as a food source, freshwater fish farming is also developing in the ornamental fish sector, which has high economic value and contributes to increasing community income (Sumsanto *et al.*, 2024). The development of freshwater fish farming is inseparable from the challenges of ectoparasite infestation (Nisa *et al.*, 2024).

Ectoparasites in fish are organisms that live outside the fish's body and serve as hosts (Fachrussyah *et al.*, 2024). Ectoparasites infest fish on body surfaces such as the skin, fins, and gill lamellae (Ramadhani *et al.*, 2024). Several types of ectoparasites that frequently attack freshwater farmed fish include *Argulus* (fish lice), *Lernaea* (anchor worms), *Ichthyophthirius* (causing white spot), *Dactylogyrus*, and *Gyrodactylus* (Nisa *et al.*, 2024).

According to Sari *et al.* (2024), ectoparasite infestations in tilapia (*Oreochromis niloticus*) can cause up to 70% mortality in the fry stage. Ectoparasite infestations dominated by *Trichodina*, *Gyrodactylus*, and *Dactylogyrus* in early fry-stage tilapia result in a survival rate (SR) of only 30.3% in semi-intensive cultivation systems in the Klaten area, Central Java (Ramadhani *et al.*, 2024). *Trichodina* ectoparasite infestation in African catfish (*Clarias gariepinus*) was found to cause mass mortality with a prevalence of 100% in concrete ponds cultivated in Central Java (Welnando *et al.*, 2024).

Clinical symptoms of ectoparasite-infested fish include crusted skin, excessive mucus, necrosis of gill filaments, and hyperemia. Ectoparasites also cause ulcers and hemorrhages on the body surface due to parasite bites or adhesion (Sayed, 2023). Infested fish exhibit behavioral changes, including abnormal whirling swimming, rubbing against pond walls (flashing), and decreased appetite (Arsyad *et al.*, 2025). The losses caused by ectoparasite infestations in farmed fish include stunted growth, longer rearing times, high feed conversion rates, mass mortality, and decreased productivity (Febrina *et al.*, 2020).

The Center for Aquaculture Technology Development (BPTPB) Cangkringan, Sleman, Special Region of Yogyakarta, is an institution that plays a crucial role in the development of freshwater fish technology and production, encompassing research, hatchery development, and the rearing of various fish species. Based on initial observations at the center, clinical symptoms were found in fish such as increased mucus production, rubbing against pond walls, and decreased appetite, indicating ectoparasite infestation. The urgency of this research was to conduct an inventory and characterization of ectoparasites in farmed fish at the BPTPB Cangkringan, Sleman. The results are expected to inform the formulation of parasitic disease control strategies and provide scientific information regarding the diversity and level of ectoparasite infestation in freshwater fish farming systems in the region.

METHODS

Research Location and Time

This research was conducted from July 12 to September 2, 2022, at the Aquaculture Technology Development Center (BPTPB) Cangkringan, Sleman, Yogyakarta. Random sampling was used in four different aquaculture ponds. A total of 85 fish of different species were sampled. The samples included tilapia (*Oreochromis niloticus*) (n=20), carp (*Cyprinus*

carpio) (n=21), koi (*Carassius rubrofasciatus*) (n=24), and catfish (*Clarias gariepinus*) (n=20).

Ectoparasite Inspection Method

The ectoparasite inspection method used was the native (direct) method. The native method involves direct observation without staining, such as scraping the surface of the fish's body, including fins, skin, and gills. Scraping was performed gently to avoid injuring the fish. Gill examination was performed by removing the gills with tweezers and scissors. The morphological structure of the parasites found was observed using an Olympus CX23 microscope at 100x and 400x magnification.

Characterization and Inventory

The ectoparasites found were characterized based on Bykhovskaya-Pavlovskaya *et al.* (1962), Fernando *et al.* (1972), Kabata (1985), Kurniawan (2012), Olsen (1974), and Woo (2006). The inventory was conducted by calculating the prevalence and intensity of the ectoparasites found. Prevalence is the percentage of fish infected by parasites among the sampled fish examined. Intensity is the number of parasites infecting the fish compared to the total number of infected fish. According to Kabata (1985), parasite prevalence can be calculated using the following formula:

$$\text{Prevalence (\%)} = \frac{\Sigma \text{ Infected fish}}{\Sigma \text{ Fish samples examined}} \times 100\%$$

According to Kabata (1985), parasite intensity can be calculated using the following formula:

$$\text{Intensity (ind/fish)} = \frac{\Sigma \text{ Parasites found}}{\Sigma \text{ Infected fish}}$$

According to Williams & Bunkley (1996), prevalence values are described in Table 1 as follows:

Table 1. Prevalence Values

No.	Infection Rate	Information	Prevalence
1.	Always	Very severe infection	100-99%
2.	Almost always	Severe infection	98-90%
3.	Usually	Moderate infection	89-70%
4.	Frequently	Very frequent infection	69-50%
5.	Commonly	Normal infection	49-30%
6.	Often	Frequent infection	29-10%
7.	Occasionally	Occasional infection	9-1%
8.	Rarely	Rare infection	>1-0.1%
9.	Very rarely	Very rare infection	>0.1-0.01%
10.	Almost never	Never infection	<0.01%

According to Williams & Bunkley (1996), intensity values are described in Table 2 as follows:

Table 2. Intensity Values

No.	Infection Rate	(Ind/fish)
1.	Very low	<1
2.	Low	1-5
3.	Medium	6-50
4.	Severe	51-100

No.	Infection Rate	(Ind/fish)
5.	Awfully	>100
6.	Super infection	>10,000

RESULTS

Based on the results of the ectoparasite characterization, it was discovered that there are six genera of ectoparasites in the food fish group (Table 3). The ectoparasites found were *Trichodina* (Figure 1), *Dactylogyrus* (Figure 2), *Gyrodactylus* (Figure 3), *Ichthyophthirius* (Figure 4), *Epistylis* (Figure 5), and *Myxobolus* (Figure 6).

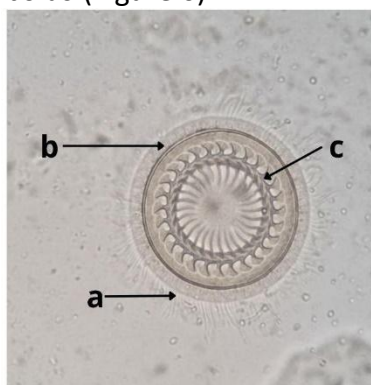


Figure 1. Observation Results of *Trichodina* at 400x Magnification; (a. Cilia; b. Border Membrane; c. Denticles)

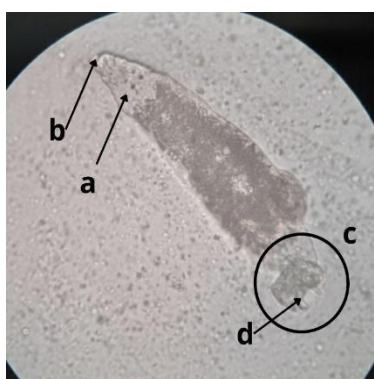


Figure 2. Observation Results of *Dactylogyrus* at 400x Magnification; (a. Eyespot; b. Lobe; c. Opisthaptor; d. Anchor)

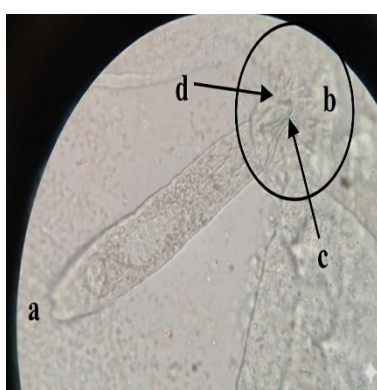


Figure 3. Observation Results of *Gyrodactylus* at 400x Magnification; (a. Lobe; b. Opisthaptor; c. Anchor; d. Marginal Hook)

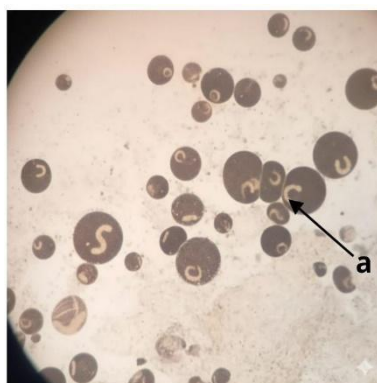


Figure 4. Observation Results of *Ichthyophthirius* at 100x Magnification; (a. Macronucleus)

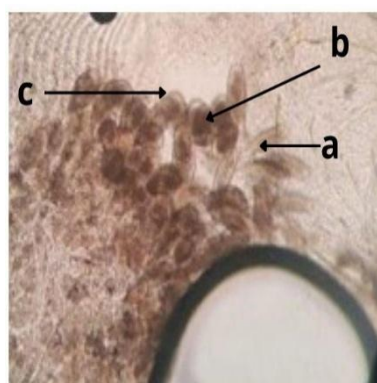


Figure 5. Observation Results of *Epistylis* at 100x Magnification; (a. Stalk; b. Vacuole; c. Cilia)



Figure 6. Observation Results of *Myxobolus* at 100x Magnification; (a. Polar Capsule)

The results of the ectoparasite inventory are as follows.

Table 3. Ectoparasite Inventory of Food Fish

Types of Fish	Types of Parasites	Prevalence (%)	Category (Williams & Bunkley-William, 1996)	Intensity (ind/fish)	Category (Williams & Bunkley-William, 1996)
Tilapia	<i>Trichodina</i>	100	Always	840.5	Awfully
	<i>Epistylis</i>	33	Commonly	62.5	Severe
	<i>Dactylogyrus</i>	45	Commonly	3.6	Low
	<i>Gyrodacrylus</i>	10	Often	1.5	Low
Catfish	<i>Ichthyophthirius</i>	45	Commonly	45.3	Medium
	<i>Dactylogyrus</i>	80	Usually	13.62	Medium
	<i>Gyrodacrylus</i>	40	Commonly	8.62	Medium

Types of Fish	Types of Parasites	Prevalence (%)	Category (Williams & Bunkley-William, 1996)	Intensity (ind/fish)	Category (Williams & Bunkley-William, 1996)
Carp	<i>Trichodina</i>	14.28	Often	26	Medium
	<i>Epystilis</i>	4.76	Occasionally	634	Awfully
	<i>Dactylogyrus</i>	9.52	Occasionally	2.5	Low
	<i>Ichthyophthirius</i>	4.76	Occasionally	2	Low
	<i>Gyrodactylus</i>	4.76	Occasionally	1	Low
Koi	<i>Myxobolus</i>	29.27	Commonly	404.7	Awfully
	<i>Trichodina</i>	50	Frequently	23.8	Medium
	<i>Gyrodactylus</i>	16.7	Often	1.75	Low

DISCUSSION

Trichodina is a type of parasite belonging to the protozoa of the Ciliata class (Yuliani *et al.*, 2023). According to Abo-Esa (2008), the classification of *Trichodina* is as follows: Phylum: Ciliophora; Class: Ciliata; Subclass: Peritricha; Order: Mobilina; Family: Trichodinidae; Genus: *Trichodina*. *Trichodina* is characterized by a circular shape surrounded by cilia, with denticles and a border membrane in the center. This is consistent with the statement by Yuliani *et al.* (2023) that *Trichodina* has round, cup-shaped cells with a diameter of 50-100 μm , equipped with vibrating hairs (cilia) surrounding the cell, and has two nuclei: a macronucleus and a micronucleus.

Fish infested with *Trichodina* exhibit dull and pale body coloration, scraggly fins, frequent swimming at the pond surface, and excessive mucus production. This is in accordance with a statement by Larasati *et al.* (2020), who stated that the clinical symptoms of fish infested with *Trichodina* include excessive mucus production and a grayish body color. Daud *et al.* (2024) added that fish infested with *Trichodina* experience skin irritation, excessive mucus production, pale gills, difficulty breathing, loss of appetite, weak movement, and a damaged, reddish caudal fin caused by ruptured capillaries.

Dactylogyrus is a type of parasite belonging to the protozoan class Monogenea (Paul & Sahoo, 2024). According to Mhaisen & Abdullah (2016), the classification of *Dactylogyrus* is as follows: Phylum: Platyhelminths; Class: Dactylogyroidea; Order: Dactylogyridea; Family: Dactylogyridae; Genus: *Dactylogyrus*. *Dactylogyrus* has four lobes on its anterior body and four eyespots. The posterior portion contains an opisthaptor containing a pair of anchors and marginal hooklets (small hooks) (Figure 2). This is consistent with Iriansyah & Budiharjo (2020) who stated that *Dactylogyrus*, a type of monogenean trematode worm, is an ectoparasite with a smaller anterior end and an elongated, transparent shape. Two pairs of eyespots at the anterior end of this parasite's body facilitate identification. The digestive tract is located posteriorly, while the mouth is near the anterior portion.

Dactylogyrus is found on the gills and body surfaces of freshwater fish such as tilapia, catfish, and carp. This statement aligns with Larasati *et al.* (2020), who stated that *Dactylogyrus* can be found on the gills as this parasite's primary habitat. *Dactylogyrus* can also be found on other organs if the infestation is severe. *Dactylogyrus* infestation is characterized by fish appearing thin and weak and producing excessive mucus (Yuliani *et al.*, 2023). Examination of *Dactylogyrus*-infested fish samples revealed pale gill color and excessive mucus production.

Gyrodactylus is a type of parasite belonging to the protozoan class Monogenea (Rahmouni *et al.*, 2023). According to Abo-Esa (2008), the classification of *Gyrodactylus* is

Phylum: Platyhelminthes; Class: Monogenea; Order: Gyrodactylidea; Family: Gyrodactylidae; Genus: *Gyrodactylus*. *Gyrodactylus* has an elongated, flat body with two lobes (protrusions) on the anterior side, and an opisthaptor on the posterior side. The opisthaptor has a pair of central hooks (anchors) surrounded by small hooks (marginal hooks) on the edges (Figure 3). This is consistent with Anshary *et al.* (2022), who stated that *Gyrodactylus* is fusiform in shape with marginal hooks at the rear. The posterior portion of *Gyrodactylus* has central and marginal hooks for attaching to the surface of fish organs.

Clinical symptoms observed in fish infested with *Gyrodactylus* include red spots on the body surface, frayed caudal and dorsal fins, excessive mucus production, and frequent swimming to the surface. This is consistent with Mishra *et al.* (2018), who reported that fish have difficulty breathing, their gills are covered by a thick layer of mucus, appear pale, and their gills fade. *Gyrodactylus* infestation on the body of fish is characterized by a bluish-gray mucus layer, frequent movement, and damage to the tissue between the fin bones.

Ichthyophthirius is a parasite of the ciliate protozoan class. According to Rahmi (2012), the classification of *Ichthyophthirius* is Phylum: Protozoa; Subphylum: Ciliophora; Class: Ciliata; Subclass: Holotrichia; Order: Hymenostomatida; Family: Ophryoglenia; and Genus: *Ichthyophthirius*. *Ichthyophthirius* is circular in shape, with a horseshoe-shaped macronucleus inside its body, making it easily recognizable upon observation. It also possesses cilia across its entire body surface (Figure 4). This is consistent with Yuliani *et al.* (2023) statement that *Ichthyophthirius* has morphological characteristics of round cells, cilia, a C-shaped macronucleus, and a darker color.

Ichthyophthirius is found in carp and catfish on the surface of the fish's body. *Ichthyophthirius* causes white spot disease and infects all freshwater fish, especially fry, and is cosmopolitan (Agustina, 2018). Clinical symptoms of *Ichthyophthirius* infestation include numerous white spots on the body, frequent rubbing of the body against the pond walls, and excessive mucus production. According to Yuliani *et al.* (2023), fish infected with the *Ichthyophthirius* parasite are characterized by excessive mucus production, the appearance of white spots on the head, frequent surfacing, and increased respiratory rate.

Epistylis is a protozoan parasite that attacks the external organs of fish. *Epistylis* has a bell-shaped body with a branched stalk, is transparent, has vacuoles, is ciliated, and lives in colonies (Figure 5). *Epistylis* is an ectoparasite with stalked zooids with cilia for locomotion and disc-shaped telotrochs. It typically infests the body surface, especially the skin of tilapia (Ageng'o *et al.*, 2024). According to Ghosh *et al.* (2021), *Epistylis* is a peritrichous ciliate that attacks ornamental fish and prefers to inhabit water with a high organic content. *Epistylis* has an inverted bell-shaped body, is transparent, ciliated, lives in colonies with non-contractile stalks, and has numerous branches on each stalk (Ummah *et al.*, 2024).

According to Abo-Esa (2008), the classification of *Epistylis* is as follows: Phylum: Ciliophora; Class: Ciliata; Order: Peritrichida; Phylum: Ciliophora; Class: Ciliata; Suborder: Sessilina; Family: Epistylidae; Genus: *Epistylis*. *Epistylis* is usually associated with gram-negative bacteria that can cause hemorrhagic lesions, edema, and ulceration in fish, resulting in damage to their scales and fin spines (Ghosh *et al.*, 2021). *Epistylis* acts as an epibiont, attaching itself to the surface of the fish's body and inducing tissue necrosis by releasing proteolytic enzymes. Transmission occurs through binary fission, where *Epistylis* reproduces, while horizontal transmission occurs between fish through the transformation of zooids into disc-shaped, ciliated telotrochs (Jawdhari *et al.*, 2024).

Myxobolus is a parasite of the protozoan sporozoan group. According to Abidi *et al.* (2015), the classification of *Myxobolus* is as follows: Phylum: Myxozoa; Class: Myxosporidia;

Order: Bivalvulida; Family: Myxobolidae; Genus: *Myxobolus*. Morphologically, *Myxobolus* is round or oval in shape and microscopic in size. Its main characteristic is the presence of two symmetrical polar capsules within its spores. These polar capsules contain polar filaments that can extend outward when the spores actively infect the host. The *Myxobolus* parasite is 12-15 µm long and 7-9 µm wide (Zulkifli & Nurekawati, 2019).

Myxobolus frequently infests carp, such as *Cyprinus carpio*. Fish infected with *Myxobolus* exhibit damage to their gill filaments. Clinical symptoms of *Myxobolus* infection include difficulty breathing and decreased activity due to impaired oxygen exchange in the gills (Batueva *et al.*, 2023). *Myxobolus*'s pathogenicity allows it to penetrate the fish's mucosal defenses, unaffected by local immune factors such as lysozyme and antimicrobial peptides. The parasite's sporoplasm attaches to the gill epithelium and then migrates to the nervous tissue and cartilage where sporogony occurs. This process causes physiological stress, decreased appetite, and impaired growth in fish (Maftuch *et al.*, 2021).

Based on the results of the ectoparasite inventory, protozoan ectoparasites such as *Trichodina*, *Epistylis*, and *Ichthyophthirius* showed relatively higher prevalence and intensity of attacks compared to Monogenea ectoparasites such as *Dactylogyrus* and *Gyrodactylus*. Protozoan ectoparasites infect fish more easily due to their small body size and rapid reproductive capacity. Protozoans generally reproduce through binary fission and conjugation, allowing their populations to increase rapidly. Furthermore, poor water quality and high fish density are environmental factors that can accelerate the spread of infection (Rasha *et al.*, 2025).

Protozoa also migrate easily in water bodies due to their free-swimming stages, such as the theront stage in *Ichthyophthirius* and the swimmer stage in *Trichodina*. The infective theront stage swims freely, then invades the gills and skin of the fish by penetrating the epithelial layer. It then develops into a trophont, which feeds on host tissue and grows into a white spot. Mature trophonts leave the fish's body and form tomonts, which then divide binary to produce many new theronts (Wang *et al.*, 2024).

Furthermore, protozoa can reproduce more rapidly in warm environments with low dissolved oxygen levels and high organic matter content, which generally supports population growth. Protozoan parasites also have a higher level of pathogenicity than helminths, with the order of damage being *Ichthyophthirius multifiliis* > *Trichodina* > *Epistylis* > *Dactylogyrus* (Jawdhari *et al.*, 2024).

CONCLUSION

Based on the results of the inventory and characterization of ectoparasites in several types of freshwater fish, it was found that the identified ectoparasites included *Trichodina*, *Epistylis*, *Ichthyophthirius*, *Dactylogyrus*, *Gyrodactylus*, and *Myxobolus*. Types of ectoparasites from the protozoan group such as *Trichodina*, *Epistylis*, and *Ichthyophthirius* showed higher prevalence and attack intensity values compared to ectoparasites from the Monogenea group such as *Dactylogyrus* and *Gyrodactylus*.

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