Original article DOI: 10.19027/jai.21.2.152-160

Identification and prevalence of ectoparasites and endoparasites in kerandang fish *Channa pleurophtalma* and catfish *Clarias batrachus* captured from Sebangau River

Identifikasi dan prevalensi ektoparasit dan endoparasit pada ikan kerandang *Channa pleurophtalma* dan ikan lele *Clarias batrachus* yang tertangkap di Sungai Sebangau

Infa Minggawati[1], Frid Agustinus[1*], Tania Serezova Augusta[1], Candra Putra Pahawang[2], Toto Francisco[3]

[1]Aquaculture, Faculty of Fisheries, Palangka Raya Christian University
[2]Aquaculture, Graduate School, Palangka Raya Christian University
[3]Fish Quarantine, Quality Control, and Safety Station, Palangka Raya
*Corresponding author: fridagustinus24@gmail.com

ABSTRACT

This study aimed to determine types, prevalence, and intensity of ectoparasites and endoparasites that infect kerandang fish *Channa pleurophtalma* and catfish *Clarias batrachus*. Sampling was carried out in Sebangau River, while identification was carried out at the Fish Quarantine, Quality Control, and Safety Station, Palangka Raya. Examination of ectoparasite infection included bilateral body mucus, caudal fin, and gills. Endoparasite examination was done by observing the fish organs, such as liver, blood, meat, intestines, and stomach. The parasite analysis was determined by calculating the prevalence and intensity. In kerandang fish, the ectoparasites were identified as *Trichodina* sp., *Gyrodactylus* sp., *Epistylis* sp., *Dactylogyrus* sp., while the endoparasites were *Camallanus* sp. and *Neoechinorhyncus*. In catfish, the ectoparasites were identified as *Trichodina* sp., *Dactylogyrus* sp., *Myxobolus* sp., and *Costia* sp., while the endoparasites were *Camallanus* sp. Dominant ectoparasite that infected fish was *Dactylogyrus* sp. on fish gills. For endoparasites, the dominant endoparasites were identified as *Neoechinorhyncus* in kerandang fish and *Camallanus* sp. in catfish. The highest prevalence was found in *Dactylogyrus* sp. at 27%. The prevalence was categorized as a frequent infection. The highest ectoparasite intensity level was obtained from *Trichodina* sp. at 20.3 ind/fish in kerandang fish and *Dactylogyrus* sp. at 12.2 ind/fish in catfish. This intensity level is categorized in a medium intensity.

Keywords: *Channa pleurophtalma*, *Clarias batrachus*, ectoparasites, endoparasites

ABSTRAK

Penelitian ini bertujuan untuk mengetahui jenis ektoparasit dan endoparasit yang menginfeksi ikan kerandang *Channa pleurophtalma* dan ikan lele *Clarias batrachus* serta prevalensi dan intensitas parasitnya. Pengambilan sampel dilakukan di sungai Sebangau sedangkan identifikasi dilaksanakan di Stasiun Karantina Ikan, Pengendalian Mutu dan Keamanan Hasil Perikanan Palangka Raya. Pemeriksaaan infeksi ektoparasit meliputi; lendir tubuh bilateral, sirip ekor, dan insang. Pemeriksaan endoparasit dilakukan dengan cara mengamati bagian organ tubuh ikan seperti hati, darah, daging, usus, dan lambung. Untuk mengetahui tingkat serangan parasit pada ikan dianalisis dengan menghitung prevalensi dan intensitas. Pada ikan kerandang parasit yang teridentifikasi ektoparasit adalah *Trichodina* sp., *Gyrodactylus* sp., *Epistylis* sp., *Dactylogyrus* sp., dan endoparasit adalah *Camallanus* sp., dan *Neoechinorhyncus*. Pada ikan lele parasit ektoparasit yang teridentifikasi adalah *Trichodina* sp., *Dactylogyrus* sp., *Myxobolus* sp., dan *Costia* sp., sedangkan pada endoparasit adalah *Camallanus* sp. Ektoparasit yang dominan menginfeksi kedua ikan ini adalah *Dactylogyrus* yang terdapat pada insang. Sedangkan untuk endoparasit, pada ikan kerandang endoparasit yang dominan adalah *Neoechinorhyncus* dan endoparasit pada ikan lele adalah *Camallanus* sp. Prevalensi tertinggi pada ikan kerandang dan ikan lele adalah *Dactylogyrus* yaitu masing-masing 27%. Berdasarkan hasil prevalensi parasit pada ikan kerandang dan ikan lele termasuk kedalam kategori infeksi sering. Intensitas tertinggi pada ikan kerandang adalah *Trichodina* sp. dengan nilai 20.3 ind/ekor dan pada ikan lele adalah *Dactylogyrus* sp. dengan nilai intensitas 12.2 ind/ekor. Dari hasil intensitas parasit pada kedua ikan tersebut termasuk dalam kategori intensitas sedang.

Kata kunci: *Channa pleurophtalma*, *Clarias batrachus*, ektoparasit, endoparasit

INTRODUCTION

Sebangau River is one of the rivers in Central Kalimantan with peat water characteristics originated from peat forest. Peat water has high acidity level (pH of 3-5), low suspended particle level, and high brownish red intensity level due to high organic matter contents (Welsiana *et al*., 2012; Suherman & Sumawijaya, 2013). Kerandang fish *Channa pleurophtalma* and catfish *Clarias bathracus* are two potential fish in Sebangau River, Central Kalimantan (Aryani *et al*., 2019). Both fish are the most consumed fish by local people as animal protein source. According to Agustinus & Minggawati (2021), local fish culture effort requires a further attention as most culture fish are introduced fish, compared to local fish that continue to be extinct.

The first component to conduct a local fish culture is domestication. According to Augusta (2016), domestication is an effort to prevent extinction in a threatened species population. Fish culture activities originated from nature requires an adapatation process as basic knowledge and behavior should be studied further (Hasanah *et al*., 2019).

A main problem in the domestication of kerandang fish and catfish is wild fish adaptation to the culture environment, whereas these fish are still wild fish with many parasites attacking them. A condition that determines the fish culture business success is pest and disease control. Gradual infection incident in fish body will affect the fish growth and productivity (Hasnidar, 2021). The parasitic infection in fish causes tissue damage, connective layer breaking, immune system disruption, and weight reduction, which can even cause death and economical loss. Moreover, the presence of parasites in fish will also impact on humans, whereas nematode, cestode, and trematode parasites can infect humans after consuming raw or imperfectly-cooked fish (Abdan *et al*., 2020).

Agustinus & Gusliany (2020) reported that ectoparasites attacked on Kapar fish *Belontia hasselti* as Sebangau River Fish were *Dactylogyrus* sp., *Myxobolus* sp., *Vorticella* sp. However, no reports on parasite types and distribution have not yet been reported in kerandang fish and catfish captured from Sebangau River. Therefore, the fish health status in area or region is an important information for disease handling and culture development.

MATERIALS AND METHODS

This study was performed for three months on February – April, 2022. Sampling was performed in Sebangau River, while identification was performed in Fish Quarantine, Quality Control, and Safety Station, Palangka Raya.

Procedures

Total kerandang fish and catfish used were 60 samples. Samples were taken directly from Sebangau River and brought to the laboratory for parasite examination. Fish samples were measured their total length (cm) and weight (g), then the ectoparasite examination included: bilateral body, caudal fin, and gill mucus taken by sterile scalpel. Furthermore, mucus sampling in fish body was performed by scrapping the fish body surface, placing the mucus on the object glass, dropping the aquadest and NaCl, closing the mucus with cover glass, and observing the mucus under the microscope. The fish fins were observed by placing the caudal and pectoral fins on object glasses, dropped with aquadest and NaCl, and closing with cover glass. This procedure was also applied in gills.

Endoparasites were examined by observing the fish body organs, such as liver, blood, meat, intestine, and stomach. Fish endoparasites were examined by surging the stomach part to take the gastrointestinal, mucus, and stomach entrail, then being taken and placed on object glasses. Furthermore, samples were dropped with aquadest or water and closed with cover glass. Parasites were observed with binocular microscope and identified by guide books (Kabata, 1985).

Data analysis

Ectoparasites and endoparasites found after sample examination were recorded for further calculation in the total ectoparasite and endoparasite types. For determining the attacking level of parasites in fish, prevalence and intensity levels were calculated under the following formula, based on Kabata (1985):

$$P = N/n \times 100\%$$

Note:
P = Prevalence
N = Total infected samples
n = Total observed samples

Intensity was calculated using the following formula:

$$I = P / N$$

Note:
I : Parasite attacking intensity (ind/fish)
P : Total infecting ectoparasites (ind)
N : Total infected samples (fish)

Prevalence and intensity levels were analyzed using the criteria based on William & Bunkley (1996) in Maulana *et al*. (2017), as presented on the following table:

RESULTS AND DISCUSSIONS

Results

The identification results of ectoparasites and endoparasites in kerandang fish and catfish obtained several samples infected with parasites. In kerandang fish, 27 of 60 fish were infected with parasites. Meanwhile, 32 of 60 catfish were infected with parasites. During the sampling examination, ulcers were presented. Parasites infested kerandang fish and catfish were composed of single and combined infestations. In detail, 1-3 parasites were found in a fish during observation.

From the analysis results, there were several parasites found in kerandang fish. The number of kerandang fish to examine parasites were 60 fish with 65-250 g weight and 16-25 cm length. Ectoparasite and endoparasite types in kerandang fish can be seen in Table 3 and 4.

Ectoparasites in kerandang fish were composed of four parasites identified as *Trichodina* sp., *Dactylogyrus* sp., *Epistylis* sp., dan *Gyrodactylus* sp. Based on the observational results, *Trichodina* sp. in kerandang fish were discovered in fins, scales, and gills. The parasites were abundantly

Table 1. Prevalence criteria.

No	Attacking level	Note	Prevalence
1	Constantly	Very severe infection	100 - 99%
2	Almost constantly	Severe infection	90 - 99%
3	Frequently	Intermediate infection	89 - 70%
4	Very frequently	Very frequent infection	69 - 50%
5	Commonly	Normal infection	49 - 30%
6	Often	Frequent infection	29 – 10%
7	Sometimes	Gradual infection	9 – 1 %
8	Rarely	Rare infection	>1 – 0.1%
9	Very rarely	Very rare infection	>0.1 – 0.01%
10	Almost never	Almost no infection	>0.01%

Table 2. Intensity criteria.

No	Attacking level	Intensity
1	Very low	<1
2	Low	1 – 5
3	Middle	6 – 55
4	Severe	51 – 100
5	Very severe	>100
6	Super infection	>1000

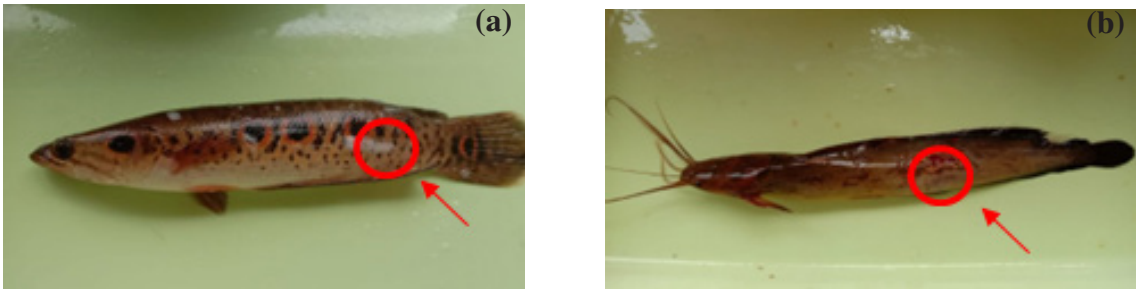

Figure 1. Infected kerandang fish (a) and infected catfish (b).

found in gills. *Dactylogyrus* sp. parasites were only found in kerandang fish gills. *Epistylis* sp. parasites were only found in kerandang fish fins. *Gyrodactylus* sp. parasites were only found in kerandang fish fins. The observational results of kerandang fish endoparasites can be shown in Table 4.

Meanwhile, endoparasites in kerandang fish were composed of two parasites identified inside the fish body, namely *Camallanus* sp. and *Neoechinorhyncus*. *Camallanus* sp. in kerandang fish was found in intestine and stomach. *Neoechorhyncus* in kerandang fish was only found in intestine. For kerandang fish endoparasites, the dominant parasite infecting kerandang fish is *Neoechorhyncus* in intestine. Prevalence and intensity levels of parasites in kerandang fish can be seen Table 5 and 6.

Ectoparasite and endoparasite prevalence calculation results present different values. The prevalence of *Trichodina* sp. was 11%, *Gyrodactlylus* sp. was 11%, *Dactylogyrus* sp. was 27%, *Epistylis* sp. was 8%, *Camallanus* sp. was 11%, and *Neoechinorhyncus* was 16%. From these values, the highest prevalence value of ectoparasites is observed in *Dactylogyrus* sp. at 27%. Meanwhile, the highest prevalence value of endoparasites is observed in *Neoechorhyncus* at 16%, which was different from *Camallanus* sp. with the prevalence value of 11%. This condition occurs as various parasitic worms that live in an organism will be limited by other parasites in their microhabitat. Based on the prevalence value, *Trichodina* sp., *Gyrodactylus* sp., *Dactylogyrus* sp., *Camallanus* sp., and *Neoechorhyncus* parasites are in a frequent infection category.

Table 3. Ectoparasites of kerandang fish.

No	Parasites	Fins	Scales	Gills	Total
1	*Trichodina* sp.	2	3	7	12
2	*Dactylogyrus* sp.	-	-	16	16
3	*Epistylis* sp.	5	-	-	5
4	*Gyrodactylus* sp.	7	-	-	7

Table 4. Endoparasites of kerandang fish.

No	Parasites	Intestine	Stomach	Liver	Meat	Total
1	*Camallanus* sp.	5	2	-	-	7
2	*Neoechinorhyncus*	10	-	-	-	10

Table 5. Prevalence of kerandang fish parasites.

No	Parasites	Observed fish	Infected fish	Prevalence
1	*Trichodina* sp.	60	7	11%
2	*Gyrodactylus* sp.	60	7	11%
3	*Dactylogyrus* sp.	60	16	27%
4	*Epistylis* sp.	60	5	8%
5	*Camallanus* sp.	60	7	11%
6	*Neoechinorhynchus*	60	10	16%

Table 6. Intensity of ectoparasites and endoparasites in kerandang fish.

No	Parasites	Total infecting parasites	Total infected samples	Intensity (ind/fish)
1	*Trichodina* sp.	142	7	20.3
2	*Gyrodactylus* sp.	48	7	6.8
3	*Dactylogyrus* sp.	107	16	6.6
4	*Epistylis* sp.	87	5	17.4
5	*Camallanus* sp.	18	7	2.5
6	*Neoechinorhynchus*	16	10	1.6

For *Epistylis* sp., the infection is categorized as a gradual infection.

The intensity level of ectoparasites and endoparasites in kerandang fish comprises *Trichodina* sp. at 20.3 ind/fish; *Dactylogyrus* sp. at 6.6 ind/fish, *Gyrodactylus* sp. at 6.6 ind/fish, *Epistylis* sp. at 17.4 ind/fish, *Camallanus* sp. at 2.5 ind/fish, and *Neoechinorhyncus* at 1.6 ind/fish. From these values, the highest intensity level of parasites in kerandang fish is obtained from *Trichodina* sp. High intensity level of *Trichodina* sp. may be caused by the water pollutions due to household waste exposure. Water environmental pollution can cause water quality change and elevate the number of pathogens including parasites (Handayani & Siswanto, 2022). Moreover, stress condition in fish and poor water condition become the supporting factors of this parasite development (Umara *et al*., 2014). Also, this parasite attacks in the water with less than 4 ppm dissolved oxygen, more fluctuative water temperature, and higher organic matter contents (Hassan, 1999 in Hoar, 2020). According to Rico *et al*. (2012), this parasite is commonly found in freshwater fish. According to Untergasser (1989) in Windarto *et al*. (2013), *Trichodina* sp. in less numbers causes no serious impact, but severe infection will cause scars outside of the fish body. The second highest intensity level is observed in *Epistylis* sp. This parasite is much easier to proliferate in poor water quality (Elfachmi & Muliati, 2018), related to waters rich in organic matters that can often be found in scaled-wild fish (Akbar & Fran, 2013). Intensity level of ectoparasites and endoparasites in kerandang fish is still included in an intermediate category.

Based on the observation results of ectoparasites and endoparasites in catfish *Clarias bathracus*, 60 catfish were examined with 40-120 g weight and 15-25 cm length. During observation, several parasites were identified as ectoparasites and endoparasites, presented in Table 7 below.

The results of ectoparasite observation in catfish showed several parasites infesting the outer body part of catfish, such as *Trichodina* sp., *Dactylogyrus* sp., *Myxobolus* sp., and *Costia* sp. *Dactylogyrus* sp. parasite becomes the most dominant parasite during observational period of ectoparasites in catfish. Specifically, *Dactylogyrus* sp. parasites only infest on gills and are absence on other body parts.

Based on the observation results, a parasite that infected the inner body part of catfish was *Camallanus* sp. that could be found in the intestine with 8 individuals and stomach with 6 individuals. Therefore, the total endoparasites in catfish is 14 individuals. Also, *Camallanus* sp. becomes the most dominant parasite in catfish, based on the endoparasite observational results. The study results present different prevalence and intensity levels of ectoparasites and endoparasites that can be seen in Table 8 and 9.

From the prevalence of parasites in catfish, *Trichodina* sp. obtained a value of 11%, *Dactylogyrus* sp. was 27%, *Myxobolus* sp. was 6%, *Costia* sp. was 5%, and *Camallanus* sp. wasa 16%. The results indicate the highest prevalence level in catfish as *Dactylogyrus* sp. with the prevalence level of 27%. This condition was occurred as *Dactylogyrus* sp. belongs to a fast-spreading parasite from one host to another. Based on this prevalence values, *Trichodina* sp.,

Table 7. Ectoparasites in catfish.

No	Parasites	Fins	Scales	Gills	Total
1	*Trichodina* sp.	-	4	7	11
2	*Dactylogyrus* sp.	-	-	16	16
3	*Myxobolus* sp.	-	-	4	4
4	*Costia* sp.	-	-	3	3

Table 8. Prevalence of parasites in catfish.

No	Parasites	Observed fish	Infected fish	Prevalence
1	*Trichodina* sp.	7	60	11%
2	*Dactylogyrus* sp.	16	60	27%
3	*Myxobolus* sp.	4	60	6%
4	*Costia* sp.	3	60	5%
5	*Camallanus* sp.	10	60	16%

Dactylogyrus sp., and *Camallanus* sp. are included in a frequent infection category. Meanwhile, *Myxobolus* sp. and *Costia* sp. are categorized as gradual-infecting parasites.

From the intensity level of ectoparasites and endoparasites in catfish, *Trichodina* sp. were found at 6.1 ind/fish; *Dactylogyrus* sp. were found at 12.2 ind/fish, *Myxobolus* were found at 8.5 ind/fish, *Costia* sp. were found at 11.6 ind/fish, and *Camallanus* sp. were found at 2.5 ind/fish. The highest intensity level during parasite observation was *Dactylogyrus* sp. with the intensity level of 12.2 ind/fish. Ectoparasites in catfish are categorized as intermediate intensity. Meanwhile, endoparasites in catfish were categorized as low intensity. High prevalence and intensity of *Dactylogyrus* sp. were caused as this parasite is hermaphrodite and oviparous that can lay at least ± 100 eggs by attacking fish gills (Sachlan, 1972 in Amirullah *et al*., 2012). According to Haryono *et al*. (2016), gills are vital organs in fish for respiration process. Gills are formed as pink and moist sheets. The outer part of gills is associated with water, while the inner part is associated with blood capillaries. As related to water, gills can be easily infected by parasites. Gills are soft tissue that causes the living pathogens to inhabit on them, then gaining oxygen and food supplies (Usman, 2007 in Juwahir *et al*., 2016). This parasite attacks gills as food source suppliers in the form of blood and proper media for *Dactylogyrus* sp. to reproduce maximally, which can be used as an indicator for organic matter pollution exposed by domestic, industrial, and fertilizer wastes (Amirullah *et al*., 2012).

Discussions

The local fish culture effort, mainly during wild fish adaptation process in the culture media requires a special attention for parasites that infect fish. Therefore, this information will suggest an initial prevention and environmental adjustment. In this study, ectoparasites and endoparasites in kerandang fish and catfish are captured from Sebanagau River. In ectoparasite and endoparasite observation, there are infesting fish hosts in single and combined infestations, whereas single infestation is a single parasite infestation, while combined infestation is two different parasite infestations in fish host. These parasites can attack fish either directly or indirectly. In direct way, a direct contact can occur between health and infected fish, while indirect way occurs due to immune system decrease caused by stress, which allows parasite to attack fish.

Dactylogyrus sp. was observed either in kerandang fish and catfish, specifically in gills. *Dactylogyrus* sp. is an ectoparasite that attacks peat water fish, such as kapar fish, climbing perch, and giant snakehead (Agustinus &

Table 9. Intensity of ectoparasites and endoparasites in catfish.

No	Parasites	Total infecting parasites	Total infected samples	Intensity (ind/fish)
1	*Trichodina* sp.	43	7	6.1
2	*Dactylogyrus* sp.	195	16	12.2
3	*Myxobolus* sp.	34	4	8.5
4	*Costia* sp.	35	3	11.6
5	*Camallanus* sp.	25	10	2.5

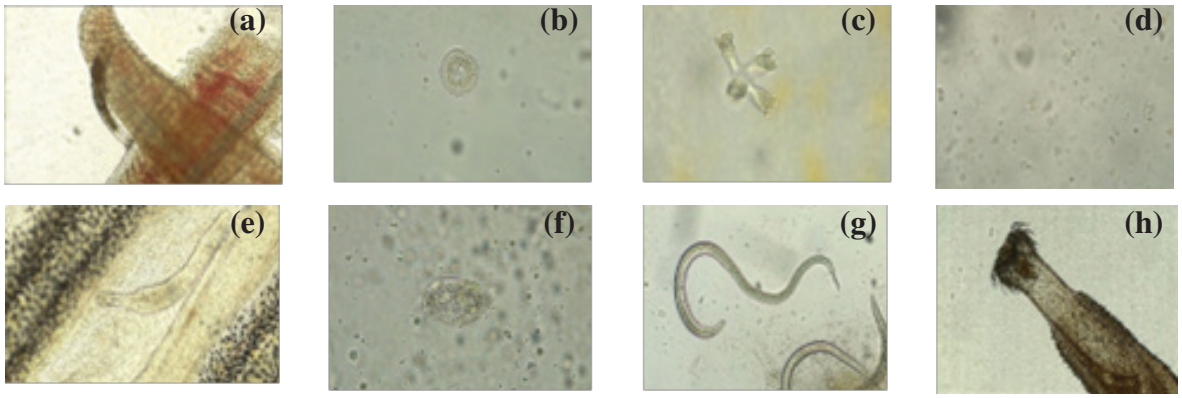

Figure 2. Ectoparasites and endoparasites found in kerandang fish and catfish. (a) *Dactylogyrus* sp.; (b) *Trichodina* sp.; (c) *Epistylis* sp.; (d) *Myxobolus* sp.; (e) *Gyrodactylus* sp.; (f) *Costia* sp.; (g) *Camallanus* sp.; (h) *Neoechinorhynchus.*

Gusliany, 2020; Maulana *et al.*, 2017; Herlina, 2021). This parasite has a pair of hooks on its posterior body, surrounded by smaller 14 suckers called opisthaptor (Puspitasari, 2013). According to Kusumah (1976) in Lianda *et al*. (2015), *Dactylogyrus* sp. is a gill-attacking parasite. This parasite takes nutrients from host by hooks and suckers. High *Dactylogyrus* sp. value refers to ectoparasite attacking area mainly in fish gills as respiratory organs that filters water. Juwahir *et al* (2016) stated that gills are fish body organs related to environment. Yuli & Harris (2017) stated that high occurrence of parasites in gills is caused by direct contant in waters. A similar condition was also found by Gusriyanti & Sarita (2016), that gill place and gill work by filtering the oxygen in the water can cause gills are severely susceptible to the environmental condition change. Acute *Dactylogyrus* sp. infection can also cause mass mortality (Subekti & Mahasri, 2012).

Meanwhile, endoparasites found in both fish were *Camllanus* sp. and *Neoechorhyncus*. These parasites were emerged due to imbalance condition of fish, environment, organis, and host. Moreover, age, sex, and body immune system determine the total parasitic worms that infect hosts (Rahayu *et al*., 2013). The *Camallanus* sp. parasites have no specific host found in various fish species with different water condition, such as seawater and freshwater fish (Maulana *et al*., 2017).

Ectoparasite and endoparasite infestations in kerandang fish and catfish were caused by water quality factor in Sebangau River. Whereas, many household wastes become a place for parasite proliferation and several pathogen-remains are decomposed in open water. This condition occurs as ectoparasite and endoparasite can swim freely in the water to find new hosts. According to Inel *et al*. (2022), water quality in Sebangau River was remained at a temperature of 29.71-29.93 ^{o}C, dissolved oxygen (DO) of 3.29-5.66 mg/L, peat water pH of 4.05-4.66, and depth of 1.0-3.4 meter. Environmental pollution will cause water quality change and increase the number of pathogens such as parasites, which cause fish stress and imbalance of fish, environment, and pathogen (parasite). Therefore, fish will be easily infected by parasites (Maulana *et al*., 2017).

Based on the visual condition of Sebangau River, there are inhabitants around the river watershed as a household waste source. Also, Sebangau River has one water canal that connects directly to the river. In water canal, there are many household wastes thrown directly to the canal, which are carried by water flow and piled up on the river downstream. A problem occurred until now is the slow development of water waste management facilities and less community anticipation on the environmental condition of Sebangau River.

CONCLUSION

In kerandang fish, the identified ectoparasites were *Trichodina* sp., *Gyrodactylus* sp., *Epistylis* sp., and *Dactylogyrus* sp., while identified endoparasites were *Camallanus* sp. and *Neoechinorhyncus.* In catfish, identified ectoparasites were *Trichodina* sp., *Dactylogyrus* sp., *Myxobolus* sp., and *Costia* sp., while identified endoparasite was *Camallanus* sp. The most dominant ectoparasite in both fish is *Dactylogyrus* sp. found in gills. For endoparasite, the most dominant parasite in kerandang fish is *Neoechorhyncus* and in catfish is *Camallanus* sp.

The highest prevalence level in kerandang fish and catfish is obtained from *Dactylogyrus* sp. at 27%. Based on the prevalence level in kerandang fish and catfish, this prevalence level is included in a frequent infection. The highest parasite intensity level in kerandang fish can be found in *Trichodina* sp. at 20.3 ind/fish and in catfish can be found in *Dactylogyrus* sp. at 12.2 ind/fish. These intensity levels both found in kerandang fish and catfish are included in an intermediate category.

ACKNOWLEDGMENTS

We would like to thank the Fish Quarantine, Quality Control, and Safety Product Station, who have assisted our project mainly by providing the laboratory and other facilities.

REFERENCES

Abdan M, Batubara AS, Nur FM, Yulianto D, Sugito S, Muchlisin ZA. 2020. Intensity and prevalence of ectoparasites and endoparasites on Largescale *mullet* Liza *macrolepis* (Smith, 1846) in the West-South coast of Aceh. Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan 9: 484–491

Agustinus F, Gusliany. 2020. Identification of ectoparasites in kapar fish (*Belontia hasselti*) reared in plastic lined pond. Jurnal Ziraa'ah 45: 103–110.

Agustinus F, Minggawati I. 2021. Domestication of kapar fish (*Belontia hasselti*) caught in the Sebangau river. Jurnal Ziraa'ah 46: 363–370.

Aryani, Eddy S, Budi SB, Hardoko. 2019. Secondary metabolite screening in charcoal from waste of kerandang fish (*Channa pleurophthalma* BLKR) originated from Central Kalimantanese. Russian Journal of Agricultural and Sociology 10: 3–6.

Augusta TS. 2016. Domestication effort of tambakan (*Helostoma temminckii*) caught from Sebangau river. Jurnal Ilmu Hewani Tropika 5: 82–87.

Akbar J, Fran S. 2013. Fish health management. Banjarmasin : P3AI Universitas Lambung Mangkurat Banjarmasin.

Amirullah S, Dhahiyat Y, Rustikawati I. 2012. Intensity and prevalence of ectoparasites from fish in the upstream of Cimanuk river. Jurnal Perikanan dan Kelautan 3: 271–282.

Elfachmi, Muliati. 2018. Inventory of ectoparasites of siamese gouramy fish (*Trichogaster pectoralis*) in Sirah Pulau Padang sub-district, Ogan Komering Ilir district, Sumatera Selatan. Fiseries 7: 1–7.

Gusriyanti IN, Sarita AH. 2016. Inventory parasities in groupers sunu (*Plectropomus leopardus*) reareddon floating net cage. Jurnal Media Akuatika 1: 15–26.

Haryono S, Mulyana, Lusiastuti MA. 2016. Inventory of ectoparasites on goldfish (*Carrasius auratus*) in District Ciseeng Bogor Regency. Jurnal Mina Sains 2: 71–79.

Hasanah N, Robin, Prasetiyono E. 2019. Survival rate and growth performance of selincah fish (*Belontia hasselti*) with different pH. Jurnal Akuakultur Rawa Indonesia 7: 99–112.

Handayani L, Siswanto. 2022. Disease diagnosis and analysis of water quality for the health of tilapia (*Oreochromis niloticus*) raised in floating cages. Jurnal Budidaya Perairan 10: 177–190.

Hasnidar H. 2021. Identification and prevalence of ectoparasites and endoparasites in grouper (*Epinephelus tauvina*) in Talawi sub-district, Batu Bara district. Jurnal Budidaya Perairan 17–25.

Herlina S. 2021. Ectoparasite infection rate in toman fish (*Channa micropeltes*). Jurnal Ziraa'ah 46: 393–397.

Hoar Y, Salosso Y, Santoso. 2020. Identification of vibrio parasites and bacteria in blood shells (*Anadara granosa*) in Tanah Merah, Central Kupang District. Jurnal Akuatik 3: 57–66.

Inel L, Minggawati I, Ardianor. 2022. Study of aquatic biota and riparian vegetation in the Sebangau river, Central Kalimantan. AACL Bioflux 15: 1293–1301.

Juwahir A, Ya´la ZR, Rusaini. 2016. Prevalence and intensity of ectoprasites of carp fish (*Cyprinus carpio* L) in Sigi district. Jurnal Agrisains 17: 62–69.

Kabata Z. 1985. Parasites and diseases of fish cultured in the tropics. London : Taylor and Prancis.

Lianda N, Fahrimal Y, Daud R, Rusli, Aliza D, Adam M. 2015. Identification of parasites on nile tilapia (*Oreochromis niloticus*) fish collected from Barabung irigation Darussalam Aceh Besar. Jurnal Medika Veterinaria 9: 101–103.

Maulana DM, Muchlisin ZA, Sugito S. 2017. Intensity and prevelency of parasites on climbing perch fish (*Anabas testudineus*) from inland waters of Northern Region of Aceh Province. Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah 2: 1–11.

Puspitasari S, Mukono J. 2013. Correlation between bacteriology quality of well and health behavior with waterborne disease incidence in Tambak Sumur Village, Waru, Sidoarjo. urnal Kesehatan Lingkungan 7: 76–82.

Rahayu FD, Ekastuti DR, Tiuria R. 2013. Infestation of parasitic worm at mujair's gills (*Oreochromis mossambicus*). Acta Veterinaria Indonesia 1: 8–14.

Rico YA, Rosidah, Herawati T. 2012. Intensity and prevalence of ectoparasites in milkfish (*Chanos chanos*) in floating net cages (KJA) in Cirata reservoir, Cianjur district, Jawa Barat. Jurnal Perikanan dan Kelautan 3: 231–241.

Subekti S, Mahasri G. 2012. Textbook of fish parasites and diseases (*Trematodiasis* dan *Cestodiasis*). Surabaya : Global Persada Press.

Suherman D, Sumawijaya N. 2013. Removing colour and organic content of peat water using coagulation and floculoation method in basaltic condition. Jurnal Ris.Geo.Tam 23: 127–139.

Umara A, Bakri M, Hambal M. 2014. Identification of parasites in snakehead fish (*Channa striata*) in Meunasah Manyang Village Lhoknga subdistrict Aceh Besar. Jurnal Medika Veterinaria 8: 110–113.

Welsiana S, Yulintine L, Septiani T, Wulandari L, Trisliana, Yurenfrie, Limin SH, Haraguchi A. 2012. Composition of macrozoobenthos community in the Sebangau river basin,

Central Kalimantan, Indonesia. Tropics 21: 127–136.

Windarto R, Adiputra YT, Wardiyanto, Efendi E. 2013. Diversity of morphological characters between *Trichodina nobilis* dan *Trichodina reticulata* of comet fish (*Carrasius auratus*). Jurnal Rekayasa dan Teknologi Budidaya Perairan 1: 117–126.

Yuli S, Harris H. 2017. Level of ectoparasite attack on catfish (*Pangasius hypopthalmus*) cultivated in floating net cage at Musi river Palembang. Jurnal Ilmu-Ilmu Perikanan dan Budidaya Perairan 12: 50–57.