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Prevalence, intensity, and dominance of ectoparasites in the gourami (*Osphronemus goramy* Lacepède, 1801) reared in the floating net cage in Cirata Reservoir, West Java, Indonesia

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ABSTRACT

Ectoparasite is one of the main problems in aquaculture. Parasitic infection can cause fish growth and health to be impaired. Gourami *Osphronemus goramy is one of the popular cultured freshwater fish that culture extensive and intensively in Indonesia. The aimed of the study was to determine the prevalence, intensity, and dominance of ectoparasites that infected gourami (Osphronemus goramy) which cultivated in floating net cages in Cirata reservoir, West Java. Present results showed that there were 22 gouramis infected with ectoparasites from 30 observed fish. The ectoparasites (Prevalence, Intensity and Dominance) found were Trichodina sp. (13.33%, 8.15 & 32.62%), Ichthyobodo sp. (3.33%, 1.00, 0.31%) Microsporadia (6.67%, 1.00, 0.31%), Carchesium granulatum (6.67%, 34.00, 20.92%), Cichligogyrus sp. (3.33%, 7.00, 2.15%), Dacthylogyrus sp. (20.00%, 2.00, 3.69%), Centrocestus sp. (6.67%, 3.00, 1.85%), Argulus sp. (56.67%, 6.94, 36.31%), Lerneae sp. (3.33%, 3.00, 0.92%), Gnatia sp. (3.33%, 1.00, 0.31%) and Hatschekia sp (3.33%, 1.00, 0.31%). The Argulus sp. had the highest prevalence with a percentage of 73.33% and becames the most dominant species with a percentage value of 36.31%. Meanwhile, Carchesium granulatum was an ectoparasite species that demonstrated the highest intensity of 34. Based on the diversity of ectoparasites, it was found as positive case that gourami cultivated in the Cirata reservoir have been infected with ectoparasites, especially from the species Argulus sp. The highest prevalence were found in the Argulus sp. while the highest intensity was Carchecium granulatum.*

Introduction

Gourami (*Osphronemus goramy* Lacepède, 1801) is one of the consumption fish that is most in demand from other species of freshwater consumption fish because it has a delicious taste (Martawijaya, 2020) and has a higher nutritional content, for example fat 2.20-2.79%, protein 10.67-18.71 % (Fasya and Nabila, 2020) carbohydrate 8.05% and fiber 3.3% (Azrita, 2020). The gourami is also the main commodity of Indonesian fisheries. To meet the consumer demand, gourami production need to be increased (Fasya and Nabila, 2020). In addition, the gourami production from 2014 was 0.68% and reached 0.86% in 2018 (KKP, 2020).

Gourami is a slow growth fish group (Saparinto, 2008), and the aquaculture biotechnology development has been widely used to manipulate its growth, either through feed or directly giving hormones to fish (Fitriadi *et al*., 2014). Apart of the slow growth, another problem is the presence of parasites that are affected by water quality. Moreover, poor water environment quality causes more types of parasites to live and reproduce. Besides water quality, weather, climate, and high stocking density (Anshary, 2016) can affect the level of parasite spread in fish.

The climate in an area determines which parasites are endemic to the area, while the weather also determines the prevalence level of parasites that infect fish (Lianda *et al*., 2015). In addition, high stocking density makes the fish stress, affecting the fish are more susceptible to parasites (Anshary, 2016). Followed by the emergence of pathogens,

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either parasites or other types that can damage and interfere with the growth of fish, can also cause death in these fish (Anshary, 2016).

The parasites which is found in fish are very diverse and parasitic infection that is more severe in an organism can occur because of ectoparasite infection. However, fish that have been infected with ectoparasites are more susceptible to other diseases caused by wounds or a decreased immune system. Furthermore, the fish that have experienced a decrease in metabolism, shows some clinical symptoms in accordance with the ectoparasites that attacked these fish (Fidyandini and Subekti, 2012) causing disrupted fish growth an death (Nurcahyo, 2018). Previous research by; Riko and Herawati (2012) regarding the identification and prevalence of ectoparasites in milkfish (*Chanos Chanos*) in floating net cages in Cirata reservoir, West Java, Indonesia have been performed. The result found the ectoparasites on milkfish (*Chanos chanos*) namely *Trichodina* sp., *Trichodinella* sp., *Chilodonella* sp., and *Ichthyopthirius* sp. In addition Muchlisin *et al.* (2014) has been reported the infestation of extoparasite in mahseer fish (*Tor tambra*) in aquaculture pond. However, there was no research that identifies parasites in gourami cultivated in the Cirata reservoir, West Java, Indonesia. Therefore, it is necessary to conduct a study on the identification of ectoparasites gourami.

The purpose of this study was to determine the types of ectoparasites which infected the gourami in the Cirata reservoir, West Java, Indonesia, and to determine the prevalence, intensity, and dominance values of ectoparasites. The results of the study can be used as a reference for fish farmers in the Cirata reservoir that can take early detection of the parasite infection. Further, the prevention of the parasites spreading to other fish and the public as consumers can be more take into attention to the condition of the fish consumed.

Materials and Methods

Study site

The study was conducted at Cirata Reservoir, West Java, Indonesia. At the coordinate point 06 ° 48.387 'LS 107 ° 13.905' East Longitude (Figure 1). The ectoparasite analysis was carried out at the PT Suri Tani Pemuka Laboratory, Cikijing, West Java. Cirata Reservoir is one of the reservoirs used for freshwater fish cultivation using the Floating Net Cage method which is managed by the Public Aquatic Fisheries Conservation Agency (BPPPU). Cirata Reservoir located in Cianjur Regency, West Java.

Fish preparation

A total of 30 gourami (*Osphronemus goramy* Lacepède, 1801) were used. The fish was classified into three groups based on their body weight (>300g, 300-400g, <400g). The gourami were collected randomly from 16 ponds. The gourami collection was carried out periodically for 3 months (March – May 2018) with total of 8 collections. The gourami were taken from the same pond using same plastic packing to be brought to the laboratory. First, the plastic fish was given water before putting the fish followed by oxygen and closed tightly. After arriving at the laboratory, the fish were transferred to a large Styrofoam and given an aerator. Furthermore, ectoparasite identification were carried out in the laboratory.

Ectoparasite identification

Fish were weighted (g) using an analytical electronic balance (Electronic Balance CHQ-DJ series DJ 2002A). The observation of fish ectoparasites was performed on the fish's body from the presence of parasites visible macroscopically. The observation of ectoparasites in fish was also done by mucus identification by scraping the mucus with an object glass and closed with a cover and observed using a microscope (40, 100 and 400 Magnification). Furthermore, observation was also performed in fish gills. The fish gills were cut using scissors, placed on the petri dish, and observed under a microscope. The, ectoparasites were also observed in fish fins starting from the pectoral fin, anal fin, dorsal fin , ventral fin and caudal fin using a microscope (Anshary, 2016).

After the discovery of ectoparasites attached to the parts of the fish, the number of parasites was counted and then photographed using a camera and identified using the book *Parasitologi Ikan: Biologi, Identifikasi dan Pengendaliannya* and the book Foundation of Parasitology (Schmidt and Robert, 1996) then entered the observation table. The microscope used was a Yazumi brand microscope XSZ-107BN.

Figure 1. Study location at Cirata Reservoir, West Java, Indonesia.

Environmental factors

Data on environmental factors of Cirata reservoirs such as DO, temperature, pH, Nitrite, Total Ammonia Nitrate (TAN) and water transparency were measured using. DO meter brand Incoporated YSI 550A number 937.76.7241 for DO data and water temperature. Meanwhile pH were determined using Lutech Instruments pH meter serial number 2135539. Nitrite and TAN measurements were evaluated by taking a 5 mL water sample added the Sera test solution then adjusting the color change of the water sample to the existing parameters and for water brightness using secci disk in centimeters.

Environmental factors was carried on every gourami were taken in Cirata reservoir. Water brightness DO and water temperature it was repeated 3 times in the morning (06.00 am), midday (12.00 am) and the afternoon (17.00 pm).

Data analysis

The method used is purposive random sampling to obtain facts and data. Primary data obtained by direct observation of fish samples. Primary data collected were the type and number of fish ectoparasites and calculated the prevalence, intensity and dominance of ectoparasites (Islami *et al*, 2017).

The prevalence value of intensity and dominance were calculated using Microsoft Excel 2016 using the following formula (Hadiroseyani *et al.*, 2006) :

> Prevalence Value (%) = $\frac{\text{the number of infected fish}}{\text{the number of fish examined}}$ x 100

> Intensity = $\frac{\text{thenumberofparasites}}{\text{thenumberofinfectedfish}}$

> Dominance (%)= $\frac{\text{the number of infecting ectoparasites}}{\text{the total number of ectoparasites infecting the sample}}$ x 100

Results

There were some ectoparasites infection that was found on body part of the gourami namely *Trichodina* sp., *Ichthyobodo* sp., *Microsporadia*, *Carchecium granulatum*, *Cichlidogyrus* sp., *Dacthylogyrus* sp., *Centrocestus* sp., *Argulus* sp., *Lernaea* sp., *Gnathia* sp. And *Hatschekia* sp. (Table 1 and Figure 2) and related to the body weight. The results indicated that 6 small gouramis with a body weight of <300g, infected with 78 ectoparasites (24%) on the skin, 1 ectoparasite (0.3%) on the gills and 7 ectoparasites (2.15%) on the fins. Meanwhile, in medium gourami with a body weight of 300 - 400g, there were infected14 fish with 68 ectoparasites (20,10%) on the skin, 5 ectoparasites (1,54%) on the gills and 71 ectoparasites (21,85%) on the fins. Further, 10 large gouramis with body weight>400g were also infected with 80 ectoparasites (24,60%) on the skin while, 15 ectoparasites (4,60%) on the fins. Thus, it can be seen that there was an influence of the body location of infection and body weight of the fish on the ectoparasite infection (Figure 3).

Furthermore, it was shown that *Argulus* sp. has the highest prevalence and dominance values of 56.67% and 36.31% (Table 2), indicating that almost half of the gourami population examined were infected with *Argulus* sp. Meanwhile, the highest ectoparasite intensity (34.00) was found as *Carchecium granulatum*.

In addition, the quality of water environment in the Cirata reservoir was in a good condition, according to the Government Regulation of Indonesia (PPRI) No. 82 of 2001 (Table 3). Apart from measuring water quality, water quality can also be seen visually from the state of the waters. During the research, the waters of Cirata reservoir experienced a blooming of hyacinth (*Eichhornia crassipes*) (Figure 4) where this plant is a bio-indicator of dirty waters.

Table 1. Ectoparasites found in Gourami (*Osphronemus goramy* Lacepède, 1801) at Cirata reservoir, West Java, Indonesia.

No	Ectoparasites	Found in-			Amount
		Skin	Gill	Fin	
1	*Trichodina* sp.	106	0	0	106
2	*Ichthyobodo* sp.	1	0	0	1
3	*Microsporadia*	1	0	1	2
4	*Carchecium granulatum*	0	0	68	68
5	*Cichlidogyrus* sp.	0	0	7	7
6	*Dacthylogyrus* sp.	10	0	2	12
7	*Centrocestus* sp.	6	0	0	6
8	*Argulus* sp.	102	1	15	118
9	*Lernaea* sp.	0	3	0	3
10	*Gnathia* sp.	0	1	0	1
11	*Hatschekia* sp.	0	1	0	1
Total		226	6	93	325

Table 2. Value of Ectoparasites Prevalence, Intensity and Dominance.

Ectoparasites	Number of infected fish	The number of infecting	Prevalence (%)	Intensity	Dominance (%)
Trichodina sp.	13	106	43.33	8.15	32.62
Ichthyobodo sp.	1	1	3.33	1.00	0.31
Microsporadia	2	2	6.67	1.00	0.62
Carchecium granulatum	2	68	6.67	34.00	20.92
Cichlidogyrus sp.	1	7	3.33	7.00	2.15
Dacthylogyrus sp.	6	12	20.00	2.00	3.69
Centrocestus sp.	2	6	6.67	3.00	1.85
Argulus sp.	17	118	56.67	6.94	36.31
Lernaea sp.	1	3	3.33	3.00	0.92
Gnatia sp.	1	1	3.33	1.00	0.31
Hatschekia gracilis	1	1	3.33	1.00	0.31

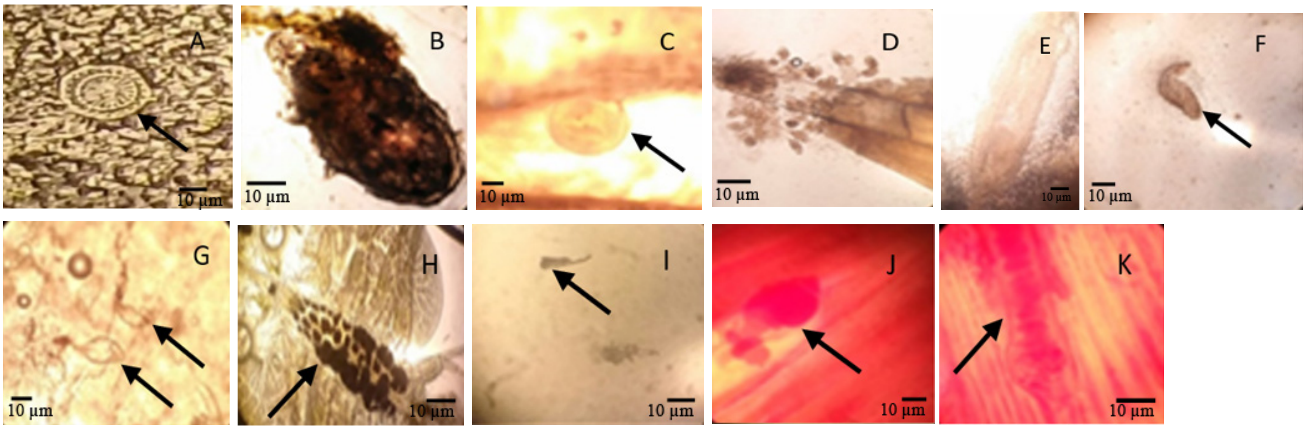

Figure 2. (A) *Trichodina* sp. (40 x 10*), (B) *Ichthyobodo* sp. (4x10*), (C) *Microsporidia* (10x10*), (D) *Carchesiumgranulatum* (4x10*), (E) *Cichlidogyrus*sp. (10x10), (F) *Dactylogyrus* sp. (10x10), (G) *Centrocestus* sp. (4x10), (H) *Argulus* sp. (4x10), (I) *Lernaea* sp. (4x10), (J) *Gnathia* sp. (4x10), (K) *Hatschekia* sp. (4x10). * = Light microscope magnification.

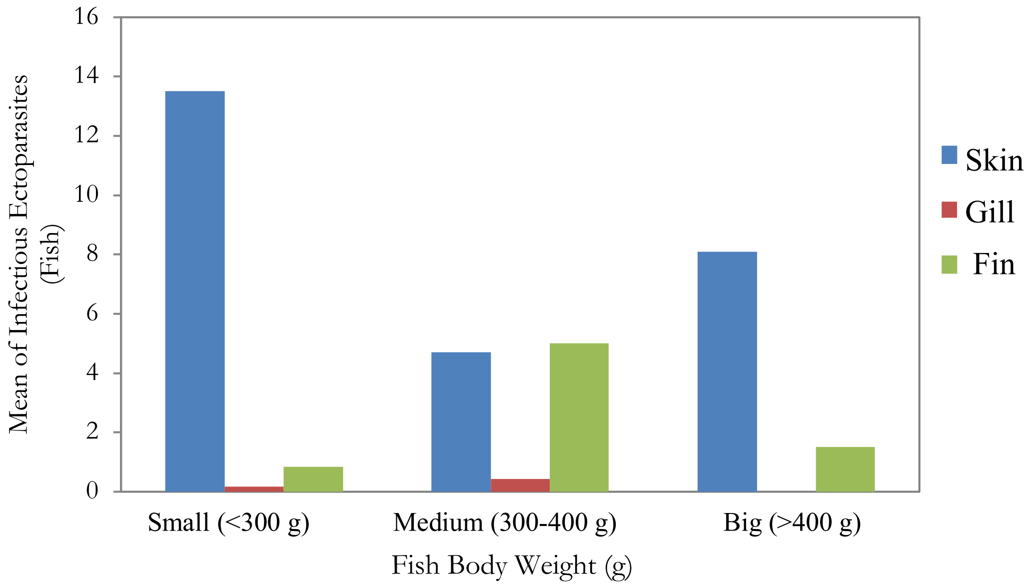

Figure 3. Ectoparasites infection on the gourami (*Osphronemus goramy* Lacepède, 1801) based on body weight.

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Table 3. Water environmental quality value at Cirata reservoir, West Java, Indonesia during observation.

Parameters	Mean	Quality Standards (PPRI No. 82)
pH	7.3	6 – 9
Nitrite (mg/L)	0	0.06
Total Ammonia Nitrate (mg/L)	0.31	0.1
Dissolve Oxygen (mg/L)	2.45	3
Temperature (°C)	31	±30
Brightness (cm)	124.38	-

Figure 4. Blooming of Hyacinth (*Eichhornia crassipes*) in Cirata Reservoir.

Discussion

The observations of ectoparasites that infected gourami which cultivated in floating net found 11 species of ectoparasites with 325 individuals. The ectoparasites obtained (Table 1) are divided into three groups, namely Protozoa, Platyhelminthes and arthropods according to Anshary (2016). The protozoa group was identified as *Trichodina* sp., *Ichthyobodo* sp., *Microsporadia* and *Carchecium granulatum*. There were also three namely species of Platyhelminthes, namely *Cichlidogyrus* sp., *Dacthylogyrus* sp. and *Centrocestus* sp., in the cercaria phase. Meanwhile, the *Arthropod* group was found as *Argulus* sp., *Lernaea* sp, *Gnatia* sp., and *Hatschekia* sp. It was also observed that ectoparasites were found more in the fish's skin bodies than in the fins and gills of fish with 226 individuals. According to Salam and Hidayati (2017), ectoparasites are found more in the skin than in the gills because the skin layer is the outermost layer of the body which directly contact to the outer environment, while the gills is located inner on the covers gill cover called the operculum.

It can be seen from the Figure 3 that mostly ectoparasites infected small gourami because of the low fish's body defenses (Anisah *et al.*, 2017). Present finding was in line with previous study by Haryono *et al.* (2016), revealed that in adult fish, the fish body's immune system is completely formed, while young fish still have low immune system, causing parasites easier to infect the young fish. In contrast, the results of Argiono (2012), mentioned that parasites are more common in fish that have a larger body or at an older age. This is because the parasites that live in the fish's body increases and multiply in the fish's body itself.

Furthermore, the highest prevalence (56.67%) and dominance (36.31%) are found in the species *Argulus* sp. The prevalence value is a the level of ectoparasites that can attack fish by counting ectoparasites identified in the number of fish samples observed in the laboratory (Yuli and Harris, 2017). Meanwhile, the dominance was carried out to determine the type of ectoparasite that infected the most identified fish. Thus, it can be explained that *Argulus* sp. were the ectoparasite species that infected fish most easily and have an even distribution. Present results is in contrary with Eliyani (2018) study who also conducted in the Cirata reservoir in 2017, stating that the *Argulus* sp. infection was not found, but the highest prevalence was found in the species *Trichodina* sp. While the dominance was *Dactylogyrus* sp. The difference in current results can be due to differences of several factors, for example in stocking density, handling of fish seed transfer or

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environmental factors (Aalberg *et al.*, 2016). Reference to environmental data from the Meteorological, Climatology and Geophysics Agency (BMKG, 2021), there was a difference in rainfall, in August 2017 was lower (11.43 mm) than in the period March – May 2018 (13.01 mm).

Meanwhile, the highest intensity value (34.00) was obtained in the calculation of *Carchecium granulatum*. Intensity is a description of the abundance of one type of parasite in a population (Yuli and Harris, 2017). Thus, it can be stated that the *Carchecium granulatum* species has a very high infection rate in one individual fish. Generally, *Carchecium granulatum* is a species that lives in colonies and infects the fin of the fish, causes death, especially in giant prawn seeds (Handayani and Adiputra, 2014). The discovery of various types of ectoparasites in this study can occur because the cultivation does not do spawning or take seeds from other places, so it has the potential to bring parasite seeds from their place of origin. This is because of an epizootic event in fish that adapt to new places (Haryono *et al.*, 2016).

Besides from the fish adaptation factor or the stocking density carried out in the cultivation, environmental factors also play an important role in the growth and reproduction of parasites that live in the waters of the Cirata reservoir. The results of quality measurements carried out in Table 3, revealed that the quality of the waters of the Cirata Reservoir from pH, nitrite, TAN, DO, temperature, and water transparency were still classified as normal according to PPRI No. 82. However, it shown in Figure 4, that the Cirata reservoir had experienced a blooming of hyacinth (*Eichornia crassipes*), covering the entire surface of the water and this was one of the main problems faced by fish cultivators and the community around the Cirata reservoir (Nurhayati and Nurruhwati, 2019). Past research by Handayani and Adiputra (2014), regarding the abundance of hyacinth in the Cirata reservoir, stated that a relative abundance index value of hyacinth was 20.1%, indicating a high abundance of hyacinth in Cirata reservoir. In addition, past study by Nastiti *et al.* (2018) also found that the water quality index value of Cirata Reservoir was 14.431, revealing that the water quality was categorized as heavily polluted, which may experience an environmental pollution.

Blooming Hyacinth as an indicator of bad water and explains that was a paradigm imbalance between the host, parasites and the environment (Nurcahyo, 2018). Hyacinth was a solid or substrate that can be host the storage of parasite eggs in the waters until the eggs hatch (Aalberg *et al.*, 2016). Thus, the presence of water hyacinth blooms can be a factor in the number of parasites reproducing in the waters.

Conclusions

This study indicated that there are 11 species of ectoparasites found in Gourami (*Osphronemus goramy*), namely *Trichodina* sp., *Ichthyobodo* sp., *Microsporadia*, *Carchecium granulatum*, *Cichlidogyrus* sp., *Dacthylogyrus* sp., *Centrocestus* sp., *Argulus* sp., *Lernaea* sp, *Gnatia* sp., and *Hatschekia* sp. The highest prevalence (56.67%) and dominance (36.31%) were found in the *Argulus* sp. while the highest intensity (34.00) was *Carchecium granulatum*.

References

Aalberg, K., L. Koscova, L. Smiga, Kosuth, P. Kosco, M. Oros, D. Barcak, P. Lazar. 2016. A study of fish lice (*Argulus* sp.) infection in fresh water food fish. POlia Veterinaria, 60(3):54-59.

Anisah, N., R. Rokhmani, E. Riwidiharso. 2017. Intensitas dan variasi morfometrik *Trichodina* sp. pada benih ikan gurami (*Osphronemus goramy* Lacepede) pendederan i yang dijual di pasar ikan Purwonegoro Kabupaten Banjarnegara. Majalah Ilmiah Biologi BIOSFERA: A Scientific Journal, 33(3):134-141.

Anshary, H. 2016. *Parasitologi ikan: biologi, identifikasi, dan pengendaliannya*. Deepublish, Makassar.

Argiono, S.F. 2012. Inventarisasi parasit pada benih ikan gurame dalam kolam terpal di Kecamatan Pengasih Kabupaten Kulon Progo Yogyakarta. Skripsi.

Azrita. 2020. Gurami sago (*Osphronemus goramy* Lac.): komoditi keunggulan perikanan air tawar untuk pangan dan ikan hias. *LPPM Universitas Bung Hatta*

BMKG. 2021. Laporan Iklim Harian.

Eliyani, Y. 2018. Sebaran infeksi ektoparasit pada ikan mas di jaring apung jatiluhur, Cirata, Saguling, Jatigede, Darma, Provinsi Jawa Barat. Jurnal Penyuluhan Perikanan dan Kelautan, 12(1):33-46.

Fasya, A. H., H. Nabila. 2020. Hubungan antara umur dan fekunditas telur ikan gurame (*Osphronemus Gouramy*). Journal of Aquaculture Science, 5(1):31-37.

Fidyandini, H.P., S. Subekti. 2012. Identifikasi dan prevalensi ektoparasit pada ikan bandeng (*Chanos Chanos*) yang dipelihara di karamba jaring apung upbl situbondo dan di tambak Desa Bangunrejo Kecamatan Jabon Sidoarjo. Journal of Marine and Coastal Science, 1(2):91-112.

Fitriadi, M.W., F. Basuki, R.A. Nugroho. 2014. Pengaruh pemberian recombinant growth hormone (rGH) melalui metode oral dengan interval waktu yang berbeda terhadap kelulushidupan dan pertumbuhan larva ikan gurame var bastard (*Osphronemus goramy* Lac, 1801). Journal of Aquaculture Management and Technology, 3(2):77-85.

Hadiroseyani, Y., P. Hariyadi, S. Nuryati. 2006. Inventarisasi parasit lele dumbo *Clarias* sp. di Daerah Bogor. Jurnal Akuakultur Indonesia, 5(2):167-177.

Handayani, R., Y.T. Adiputra. 2014. Identifikasi dan keragaman parasit pada ikan mas koki (*Carrasius Auratus*) dan ikan mas (*Cyprinus carpio*) yang berasal dari Lampung dan luar Lampung. AQUASAINS (Jurnal Ilmu Perikanan dan Sumberdaya Perairan)

Haryono, S., M. Mulyana, M.A. Lusiastuti. 2016. Inventarisasi ektoparasit pada ikan mas koki (*Carrasius auratus*) di Kecamatan Ciseeng–Kabupaten Bogor. Jurnal Mina Sains, 2(2):71-79.

Islami, H., S. Prayogo, and T. Triyanto. 2017. Inventarisasi ektoparasit pada ikan patin (*Pangasius hypophthalmus*) yang diberi pakan day old chick di Sungai Kelekar Desa Segayam. Jurnal Ilmu-Ilmu Perikanan dan Budidaya Perairan, 12(2)

KKP. 2020. Produktivitas perikanan indonesia. www.kkp.go.id (Accessed 02 Oktober 2020).

Lianda, N., Y. Fahrimal, R. Daud, R. Rusli, D. Aliza, M. Adam. 2015. Identifikasi parasit pada ikan nila (*Oreochromis niloticus*) di irigasi barabung Kecamatan Darussalam Aceh Besar. Jurnal Medika Veterinaria, 9(2)

Martawijaya, E. I. 2020. *Bisnis pembenihan ikan gurame dalam galon*. PT Elex Media Komputindo, Jakarta.

Muchlisin, Z.A., A.M. Munazir, Z. Fuady, W. Winaruddin, S. Sugianto, M. Adlim, N. Fadli, A. Hendri. 2014. Prevalence of ectoparasites on mahseer sh (*Tor tambra* Valenciennes, 1842) from aquaculture ponds and wild population of Nagan Raya District, Indonesia. HVM Bioflux, 6(3): 148-152.

Nastiti, A.S., S.T. Hartati, B. Nugraha. 2018. Analisis degradasi lingkungan perairan dan keterkaitannya dengan kematian massal ikan budidaya di Waduk Cirata, Jawa Barat. BAWAL Widya Riset Perikanan Tangkap, 10(2):99-109.

Nurcahyo, W. 2018. Parasit pada ikan. *Gadjah Mada University Press*

Nurhayati, A., I. Nurruhwati. 2019. Penyuluhan pemanfaatan tanaman air di perairan umum Waduk Cirata Kabupaten Cianjur Provinsi Jawa Barat. Media Kontak Tani Ternak, 1(1):17-25.

Riko, Y.A., T. Herawati. 2012. Intensitas dan prevalensi ektoparasit pada ikan bandeng (*Chanos chanos*) dalam karamba jaring apung (KJA) di Waduk Cirata Kabupaten Cianjur Jawa Barat. Jurnal Perikanan Kelautan, 3(4)

Salam, B., D. Hidayati. 2017. Prevalensi dan intensitas ektoparasit pada ikan gabus (*Channa striata*) dari tangkapan alam dan budidaya. Jurnal Sains dan Seni ITS, 6(1):E1-E4.

Saparinto, C. 2008. *Panduan Lengkap Gurami*. Penebar Swadaya Grup, Jakarta.

Schmidt, D.G., L.S. Robert. 1996. Foundation of parasitology. Edisi ke-5. *Wm. C. Broen. University of Winconsin*

Yuli, S., H. Harris. 2017. Tingkat serangan ektoparasit pada ikan patin (*Pangasius hypopthalmus*) yang dibudidayakan dalam keramba jaring apung di Sungai Musi Palembang. Jurnal Ilmu-Ilmu Perikanan dan Budidaya Perairan, 12(2)