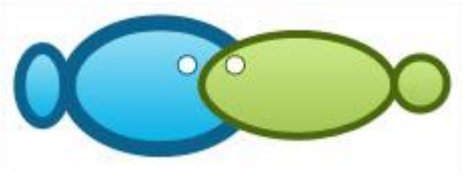

Parasite infection, prevalence, intensity, and dominance in climbing perch (*Anabas testudineus*) in Sebangau River, Central Kalimantan, Indonesia

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Abstract. This study aims to identify the parasites and to assess their prevalence, infection intensity, and dominance in climbing perch (*Anabas testudineus*). Fish samples were collected using a scoop net and line fishing from Sebangau River, Palangka Raya, Central Kalimantan. The total samples of 90 fish were collected from 3 stations, Mandi Kapau, Awang Bangkal, and Tambela. Results found six types of ectoparasites in the climbing perch, namely *Trichodina* sp., *Oodinium* sp., *Vorticella* sp., *Chilodonella* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp. and two types of endoparasites, *Camallanus* sp. and *Procamallanus* sp. The highest prevalence of the ectoparasite was found in *Trichodina* sp., 91%, with a criterion of severe infection. The highest intensity was also recorded in *Trichodina* sp., 23 ind fish^{-1}, with moderate infection and dominance of 83%. The endoparasite had the highest prevalence in *Procamallanus* sp., 25%, with a criterion of frequent infection and dominance of 68.18%, whereas the highest intensity was found in *Camallanus* sp., 7 ind fish^{-1} with a moderate infection.
Key Words: ectoparasite, endoparasite, infection, purposive sampling.

Introduction. Climbing perch *Anabas testudineus* is a freshwater fish interested for consumption (Fitriani et al 2011) due to its good taste. This species is also highly tolerant to water quality variations so it has potential to be developed as culture fish (Akbar 2012; Muchlisin 2013; Helmizuryani & Muslimin 2019). However, disease infections are often problems affecting the cultured fish production. These can be caused by viruses, bacteria, fungi, and worms. Infections can result in fish mortality up to 80% and make a big economic loss for the fish farmers. Parasite identification is an early prevention effort of fish health management to minimize the risk and economic loss from disease infections (Rokhmani & Utami al 2017).

Until now there is little information on these issues on the climbing perch in Sebangau River, Central Kalimantan. So far, information on parasite infection focuses on snakeheads with the most infection of *Dactylogyrus* sp. with a prevalence of 70% and intensity of 2.14 ind fish^{-1}, *Henneguya* sp., with a prevalence of 20% and intensity of 7.68 ind fish^{-1}, and *Trichodina* sp., with a prevalence of 10% and intensity of 4.29 ind fish^{-1}, whereas the endoparasites infecting the intestine were *Camallanus* sp. with a prevalence of 20% and intensity of 3 ind fish^{-1}, and *Procamallanus* sp., with a prevalence of 10% and intensity of 2 ind fish^{-1} (Maryani et al 2022; Sembiring et al 2022). This study aims to identify the parasites and analyze their prevalence, intensity, and dominance in climbing perch in Sebangau River, Central Kalimantan.

Material and Method

Time and place. This study was carried out for one month, from January 3rd to February 3rd, 2022. Samples were collected from Sebangau River, Palangka Raya. Fish samples were collected using a scoop net and line fishing in 5 sampling points. Parasite identification was

conducted in the technical implementation unit of the Laboratory of Fish Quarantine Center, Quality and Security Control of Fisheries Products, Palangka Raya City, Central Kalimantan.

Observation procedures. The body total length and weight of fish samples were recorded, then the fishes were placed on a tray and their heads were stabbed to inactivate the brain nerve. The ectoparasites were obtained by scrabbing the mucus on the fish skin and cutting parts of the gill lamella and fin tissues. The parasite was placed on an object glass, dropped with distilled water, and observed under a microscope.

Endoparasite examinations were carried out through body dissection. The fish was placed on the board and the dissection was done in several steps: 1) from the anus toward the pelvic fins; 2) from the anus to the abdominal cavity; 3) from the ventral base toward the anterior. The skin and tendon covering the abdominal cavity were also removed and the target organ was taken out using a pinset. The target organs were then placed on the cutting board, scrabbed, placed on an object glass for microscopic observations. All parasites were identified, counted, and photographed.

Data analysis. The type and number of parasites found were recorded, descriptively analyzed, and presented as figures and tables. Table 1 and Table 2 show respectively the prevalence and intensity of ectoparasites and endoparasites infecting the climbing perch.

The estimation of parasites prevalence followed the formula of Kabata (1985):

$$\text{Prevalence (\%)} = \frac{\text{No. infected fish}}{\text{No. checked fish}} \times 100$$

Table 1

Parasites prevalence categories

No	*Prevalence (%)*	*Category*	*Remarks*
1	100-99	Always	Heavy infection
2	98-90	Nearly always	Bad infection
3	89-70	Usually	Moderate infection
4	69-50	Very often	Very often infection
5	49-30	Common	Common infection
6	29-10	Often	Frequent infection
7	9-1	Sometimes	Occasional infection
8	< 1-0.1	Rare	Rare infection
9	< 0.1-0.1	Very rare	Very rare infection
10	< 0.01	Almost never	Never

Intensity rate. The intensity describes the average number of parasites infesting each climbing perch (Table 2):

Table 2

Parasites intensity categories

No	*Intensity (ind fish^{-1})*	*Category*
1	< 1	Very low
2	1 – 5	Low
3	6 – 50	Moderate
4	51 – 100	Poor
5	> 100	Very poor
6	> 1000	Overinfected

The intensity of the parasite was assessed using the following formula (Noble et al 1989):

$$\text{Intensity (ind fish}^{-1}) = \frac{\text{No. parasites found}}{\text{No. infected fish}}$$

Dominance. The dominance of parasites was estimated using the following formula (Noble et al 1989):

$$\text{Dominance } (\%) = \frac{\text{No. parasites infecting the fish sample}}{\text{Total no. parasites infecting the fish sample}} \text{x } 100$$

Results and Discussion. The present study found 6 genera of ectoparasites in the climbing perch, namely *Trichodina* sp., *Oodinium* sp., *Vorticella* sp., *Chilodonella* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp., and 2 genera of endoparasites, namely *Camallanus* sp. and *Procamallanus* sp. (Table 3).

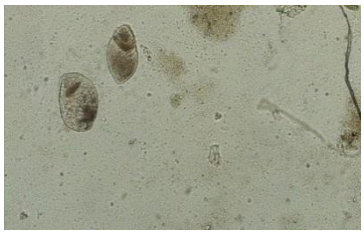
Table 3

Parasites infection in the climbing perch *A. testudineus*

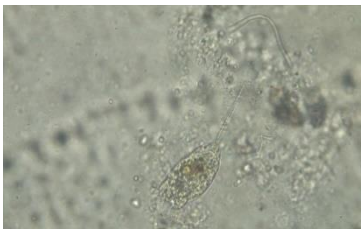
Genus	*Group*
Ectoparasite	*Trichodina* sp.
	Vorticella sp.
	Chilodonella sp.
	Dactylogyrus sp.
	Gyrodactylus sp.
	Oodinium sp.
Endoparasite	*Camallanus* sp.
	Procamallanus sp.

Ectoparasite infection. Ectoparasites infect the external parts of the fish body. Based on the results of the study, 6 types of ectoparasites were found, namely *Trichodina* sp., *Dactylogyrus* sp., *Chilodonella* sp., *Oodinium* sp., *Vorticella* sp., and *Gyrodactylus* sp. (Figure 1) and there were four major body parts infected in the climbing perch (Table 4).

Trichodina sp.

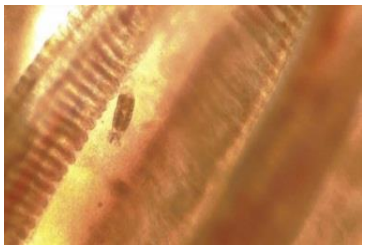


Oodinium sp.



Vorticella sp.

Chilodonella sp.



Dactylogyrus sp.

Gyrodactylus sp.

Figure 1. Ectoparasites found on the climbing perch in Sebangau River.

Table 4

Microscopic identification of ectoparasites in the climbing perch *A. testudineus*

Ectoparasite	*No. of infections*				*Total*
	Scales	*Tail*	*Gills*	*Mucus*	
Trichodina sp.	151	61	382	80	674
Dactylogyrus sp.	24	7	83	4	118
Chilodonella sp.	0	0	3	0	3
Oodinium sp.	5	1	0	1	7
Vorticella sp.	4	0	0	0	4
Gyrodactylus sp.	0	0	0	6	6
Total (ind fish^{-1})	184	69	468	91	812

Table 4 demonstrates that total number of ectoparasites found in the climbing perch is 812 ind $fish^{-1}$, 184 ind $fish^{-1}$ on the scales, 69 ind $fish^{-1}$ on the tail, 468 ind $fish^{-1}$ in the gills, and 91 ind $fish^{-1}$ in the mucus, with the highest number in the gill, 468 ind $fish^{-1}$.

The most vulnerably infected organ is gill. It could result that gills are a respiratory organ directly contacted to the surrounding environment. Gills also filter the dissolved substances, food, and bind the oxygen. It is in line with Juwaihir et al (2016) that gill position, structure, and contact mechanism with the environment make the gill highly vulnerable to the environmental changes and becomes an appropriate site for infection by the pathogenic organisms, such as parasites.

As a whole, the highest number of ectoparasites in climbing perch was *Trichodina* sp., 674 ind $cell^{-1}$ followed by *Dactylogyrus* sp., and the lowest in *Chilodonella* sp., only 3 ind $cell^{-1}$ collected from 4 target organs. Gills are mostly occupied and tails are the least selected (Table 4). High intensity of *Trichodina* sp. is due to its fast breeding stimulated by declined water quality. This high intensity can cause stress and mortality. A severe infection of *Trichodina* sp. can result in the lesion of the fish body that could work as a vector for more dangerous pathogen. Besides, the infected fish could look pale and have low appetite that could cause a high mortality (Rustikawati et al 2004; Hadiroseyani et al 2006).

Trichodina sp. is a disc-shaped parasite generally infecting the external parts, such as skin, fins, and gill, so this group is known as ectoparasite. Nevertheless, this genus often infects the internal organs, such as the urinary tract, rectum, and cloaca. About 112 *Trichodina* sp. are identified from fish and generally cause nearly similar problems. *Trichodina* sp.-infected fish is indicated with white grey spots and increased mucus production (Basson 2010; Rahmi 2012; Munawwaroh & Rahayu 2017; Rokhmani & Utami 2017).

Trichodina sp. belongs to phylum Protozoa as fish parasites (Klinger & Floyd 2003; Anshary 2008). This genus can also cause damage to the fish morphology. According to Fernando (1972), each type of parasite has different organ targets as habitat, but some parasites can attack two or more body organs; for instance, *Trichodina* sp. can infect the scales, skin, fins, and gills. Kabata (1985) added that parasites can infect and breed in certain habitats of the host body organ and the infection could occur in two or more host organs. The present study found that *Trichodina* sp. preferred to occupy the body surface. This is in line with Munawwaroh & Rahayu (2017) that this parasite group could cause damage to the skin tissue, fins, and gills. High number of *Trichodina* sp. on the body surface could result from the fact that the skin is the widest area of the body parts and has a higher possibility for infection, and it has direct contact with the environment (Jeronimo et al 2011; Valladao et al 2013). It is also in agreement with Asmat (2001), Horiguchi & Ohtsuka (2001), Alifuddin et al (2003), Rahmi (2012), Hardi (2015), and Salam & Hidayati (2017) that the bigger the surface area of the host the higher the number of parasites.

Dactylogirus sp. is a parasite often infecting the gills. This parasite stays on the fish body during its life and will only leave the host if the host dies, then hundreds of larvae hatch and look for new hosts. The dangerous impact of *Dactylogirus* sp. infection is when the parasite infects the gills using its hook. Bleeding could occur with the damage of gill lamella, and the blood clots which disrupts the respiration (Borji et al 2012; Gérard et al 2016; Harahap et al 2018).

Ectoparasite prevalence. Based on Table 5, the highest prevalence of ectoparasite in the climbing perch was recorded in *Trichodina* sp. (91%), and the lowest was recorded in *Chilodonella* sp. (3%). The prevalence of *Dactylogyrus* sp. is also high, namely 63%.

Sebangau River is a part of the peat swamp forest ecosystem which is a natural habitat for various fish species. However, changes in this ecosystem impact the fish population. Peat swamp containing a high number of organic substances is vulnerable to forest fires which can cause fish habitat damage due to declined water quality, dissolved oxygen, and increased organic substances (Barchia 2006). The high prevalence of *Trichodina* sp. and *Dactylogyrus* sp. in Sebangau River could result from an increase in organic substances in the water which promotes parasite breeding. It is in agreement with Nicolau et al (2005) that high-organic substance water highly supports the parasite occurrence.

Table 5

Ectoparasite prevalence in climbing perch

Genus	*No. of parasites*	*No. of fish samples*	*No. of infected fish samples*	*Prevalence (%)*	*Criterion*
Trichodina sp.	674	32	29	91	Severe
Dactylogyrus sp.	118	32	20	63	Highly infected
Chilodonella sp.	3	32	1	3	Rarely infected
Oodinium sp.	7	32	2	6	Rarely infected
Vorticella sp.	4	32	2	6	Rarely infected
Gyrodactylus sp.	6	32	2	6	Rarely infected

A decline in water quality conditions could also have a deleterious impact on the climbing perch, such as low appetite and low endurance, so the host becomes vulnerable and easy to be infected. Environmental pollution could also make the immune response tend to decline (Khan et al 2003; Sari & Ekawaty 2016).

Ectoparasite intensity and dominance. The intensity and dominance data of the ectoparasites in the climbing perch are presented in Table 6.

Table 6

Ectoparasite intensity and dominance in climbing perch

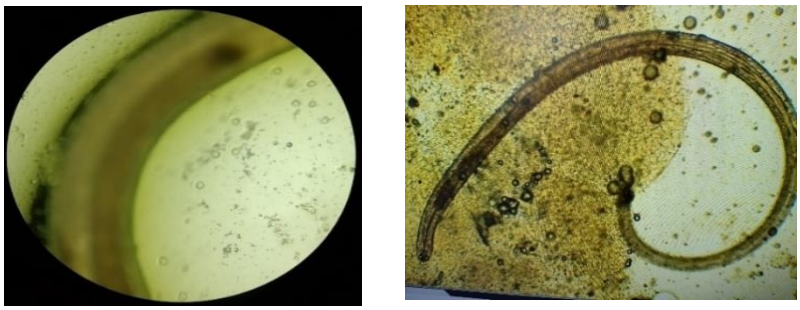
Genus	*No. fish samples*	*No. infected samples*	*No. parasites*	*Intensity (ind fish^{-1})*	*Declined infection rate*	*Dominance (%)*
Trichodina sp.	32	29	674	23	Moderate	83.00
Dactylogyrus sp.	32	20	118	6	Moderate	14.53
Chilodonella sp.	32	1	3	3	Low	0.37
Oodinium sp.	32	2	7	4	Low	0.86
Vorticella sp.	32	2	4	2	Low	0.49
Gyrodactylus sp.	32	2	6	3	Low	0.74

The infection intensity ranged from low to moderate. The highest infection intensity was recorded in *Trichodina* sp. and the lowest in *Vorticella* sp. The highest dominance also occurred in *Trichodina* sp. (83%) and the lowest in *Chilodonella* sp. (0.37%).

Dominance can be related with parasite prevalence and intensity, and it can be influenced by internal and external factors. The former could be the easiness of fish to be infected by diseases, whereas the latter could be uncertain water quality fluctuations (Maulana et al 2017; Wahyuni et al 2017; Roaita 2022). Moreover, the infection rate could be dependent on the type and number of microorganisms attacking the fish (Munajat & Budiana 2003; Maulana et al 2017; Makmur et al 2023).

The appearance and progression of fish disease are determined by the relationship between the pathogen, host, and environment. Stressful conditions, including high population density, change in temperature, and hypoxia, can hasten the spread of pathogenic bacteria and result in major disease outbreaks (Kordi 2004). Poor water quality conditions could result in stress to the fish so they are easily infected. Stress from poor environmental conditions could reduce the immune response to pathogenic organisms (Scarola et al 2019). Declined water temperature will cause an increase in oxygen solubility, but a decrease in the metabolism rate, appetite, growth, and immune system activity, causing the fish to be weak and disoriented, which can lead to mortality (Noga 2010; Kordi 2004). Despite that, when water temperature rises, the body temperature, metabolism rate, and oxygen consumption also increase so that the dissolved oxygen content declines but the toxicity of chemicals and some pathogens rise, and the fish are easily exposed to diseases and die. Declined water temperature can cause immunosuppression, whereas increased temperature can cause hormonal stress so that the pathogen can quickly enter the fish body (Noga 2010; Abbink et al 2012).

Endoparasite infection. There were two endoparasites recorded in the present study, *Camallanus* sp. and *Procamallanus* sp. (Figure 2); the target organs we investigated were the intestines, stomach, and liver (Table 7).



Camallanus sp. *Procamallanus* sp.

Figure 2. Endoparasite recorded in climbing perch in Sebangau River.

Table 7

Microscopic identification of endoparasites in climbing perch

Endoparasites	*No. fish infected*			*Total*
	Intestine	*Stomach*	*Liver*	
Procamallanus sp.	14	1	0	15
Camallanus sp.	7		0	7
Total	21	1	0	22

Table 7 shows that total endoparasites found in climbing perch were 22 ind cell^{-1} in fish with mean body total length of 11.7 cm and weight of 25.1 g. The highest infection was in intestine and the lowest in stomach, with no infection in liver. The endoparasite more often found in climbing perch was *Procamallanus* sp.

Camallanus sp., in general, infects the intestine, pilorus, and cecum (Adji 2008). Worms *Camallanus* are often called gastrointestinal parasites as well and live in a colony. *Camallanus* infections do not show clinical symptoms, but severe infections of this worm could make the fish weak, causing lesions in the intestine, anemia, and emaciation (abnormally thin or weak body) (Rigby 1997; Rigby et al 1998).

Procamallanus sp. has a blackish-brown body color, posterior tip narrowed, radially symmetrical body with a length of ±17 mm. This morphology is in accordance with the description of Moravec et al (2006), that the nematodes *Procamallanus* sp. have a brown color, an elongated body with a length of 16.32-18.54 mm and 408-517 µm wide and generally narrowed posteriorly.

According to Molnar et al (2006), a high investment of *Camallanus* sp. and *Procamallanus* sp. can cause perforation on the intestinal wall. *Procamallanus* sp. and *Camallanus* sp. use their buccal capsule to absorb food needed by the host, damage cell layers on the intestinal wall, and suck the host blood. Usually the investment locality has local haemorrhages. Thatcher (1991) reported that nematodes can cause anemia because they suck blood. Severe investment in small fish can reduce growth and clot in the intestine.

Endoparasite prevalence. Table 8 demonstrates that the prevalence of endoparasites in the climbing perch ranges from 3 to 25% with the highest in *Procamallanus* sp.

Table 8

Endoparasite prevalence in climbing perch

No.	*Genus*	*No. parasites*	*No. fish samples*	*No. infected samples*	*Prevalence (%)*	*Criterion*
1.	*Camallanus* sp.	2	32	1	3	Rare infection
2.	*Procamallanus* sp.	15	32	8	25	Frequent infection

Endoparasite intensity and dominance. The intensity of endoparasites in climbing perch is categorized as low to moderate infection rates, with the highest intensity in *Camallanus* sp., but the highest dominance was recorded in *Procamallanus* sp. (Table 9).

Table 9

Endoparasite intensity and dominance in climbing perch

Genus	*No. fish samples*	*No. infected fish*	*No. parasites*	*Intensity (ind fish^{-1})*	*Infection rate*	*Dominance (%)*
Camallanus	32	1	7	7	Moderate	31.82
Procamallanus	32	8	15	2	Low	68.18

Camallanus sp. found in the gastric tract of the climbing perch was mostly present in the intestine. *Camallanus* is a non-specific host parasite since they can live in various fish species at different water conditions. Siahaan et al (2013) found that this worm infected manfish, cychlids, guppies, swordtails, and other freshwater fish species. The first infection is usually marked with red color and the worm comes out from the anus. These endoparasites are permanent in that they live in the host body for their entire life, and at a certain time they can move to another host. *Camallanus* sp. does not directly invade the host but it needs an intermediate host (Eira et al 2009; Muchlisin et al 2014; Pudjiastuti & Setiati 2015; Maryani et al 2022).

The fish gastric tract is the organ mostly infected by worms *Procamallanus* sp. and *Camallanus* sp. The small intestine provides a nutrition source for the nematodes, such as blood, tissue cells, body fluids, and food smell contained in the lumen of the small intestine. The intestinal structure and physiology (parasite microhabitat) can affect the parasite occurrence and numbers (Muttaqin & Nurlita 2013; Novita et al 2016).

A high intensity of parasites will be detrimental to the fish, even in a limited area. In addition, parasites can cause reduced body weight, changes in the body shape, decreased body resistance, facilitation of secondary infection for other pathogens (fungi, bacteria and viruses) and ultimately death (Riko et al 2012; Umara et al 2014; Hardi 2015; Fahrurrozi & Linayati 2022).

Conclusions. Parasites in the climbing perch *Anabas testudineus* could be identified through a microscopic method. Two types of parasites were recorded in this fish species, ectoparasites and endoparasites. The former was *Trichodina* sp., *Oodinium* sp., *Vorticella* sp., *Chilodonella* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp. The latter was *Camallanus* sp. and *Procamallanus* sp. The highest prevalence, intensity, dominance of ectoparasites were found in *Trichodina* sp. with a severe infection category and moderate infection rate. The highest prevalence of endoparasites was recorded in *Procamallanus* sp. with frequent infection criteria, whereas the highest intensity was recorded in *Camallanus* sp. with a moderate infection rate.

Conflict of interest. The authors declare that there is no conflict of interest.

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