Profile of ectoparasites and biometric condition of snakehead (*Channa striata* Bloch 1793) collected from different habitats

Ilham Zulfahmi[1,*], Feizia Huslina[2], Rizki Nanda[3], Firman M. Nur[4], Suraiya Nazlia[5], Rian Djuanda[1], Adli Waliul Perdana[6]

[1] *Department of Fisheries Resources Utilization, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia* [2] *Department of Biology, Faculty of Science and Technology, Universitas Islam Negeri Ar-Raniry Banda Aceh 23111, Indonesia.*
[3] *Center for Aquatic Research and Conservation (CARC), Universitas Islam Negeri Ar-Raniry Banda Aceh 23111, Indonesia.*
[4] *Graduate School of Mathematics and Applied Science, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia.*
[5] *Department of Aquaculture, Faculty of Fisheries, Abulyatama University, Aceh Besar 23372, Indonesia.*
[6] *Department of Aquaculture, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia*

ARTIC LE INFO

Keywords:
Tetrahymena sp.
Prevalence
Intensity
Predilection Length-weight relationship

ABSTRACT

Studies related to the comparison of ectoparasites that infect snakehead from different habitats and their relationship to biometric conditions have not been widely studied. Thus, present study aimed to investigate the prevalence, intensity, dominance, and predilection of ectoparasites on snakehead collected from ditches, paddy fields, and swamps and correlate them with biometric conditions. In total of 90 snakehead fish were collected from ditches, paddy fields, and swamps. The observation of ectoparasites was performed on the gills, fins, and skin. The parameters measured in this study were ectoparasite profiles and biometric condition of fish. Specifically, the parameters of the ectoparasite profile included prevalence, intensity, dominance, and predilection. Meanwhile, the parameters of the biometric conditions were the length-weight relationship, the distribution of length and weight classes, and condition factors. Five species of ectoparasites that have been identified as *Tetrahymena* sp., *Epistylis* sp., *Trichodina* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp. *Tetrahymena* sp. infection in snakehead was reported for the first time. The ditch habitat had the highest prevalence and intensity, which were 76.7% and 15.4 ectoparasites/fish, respectively. *Tetrahymena sp.* and *Epistylis sp.* were detected in sneakhead from all habitats, *Trichodina* sp. was detected at ditch and paddy field habitats, whereas, *Gyrodactylus* sp. and *Dactylogyrus* sp. were only found in swamp habitats. The gill was the predilection organ that most vulnerable to ectoparasite infection. Infected Snakehead tend to have lower average weight and length than healthy snakehead. Snakehead with a weight range of 115.2-145.2 g and a length range of 258.5-268.5 mm tend to be more vulnerable to ectoparasite infection compared to other sizes.

DOI: 10.13170/depik.10.3.22492

Introduction

Snakehead (*Channa striata* Bloch 1793) is a (Chasanah *et al*., 2015). Rahayu *et al.* (2016) freshwater fish with high economic value for suggested that snakehead also contains bioactive Indonesian (Cahyanti *et al.,* 2021). In addition to the proteins that can accelerate the formation of new high selling price (from IDR 35,000 to IDR 75,000 cells during postoperative wound healing.
per kg), this fish also has a delicious taste and high Snakehead fish could live in a fluctuating nutritional content compared to other freshwater environment and distribute in almost all Indonesian fish. The nutritional content in snakehead reported waters. The natural habitat of snakehead includes consists of 19.71-19.85% protein, 0.44-

2.56% fat, paddy fields, swamps, rivers, and ditches (Dosi *et al.*, albumin, mineral, and essential amino acids 2019; Widyastuti *et al.*, 2020; Gustiano *et al.*, 2021;

* Corresponding author.
Email address: *Ilham.Zulfahmi@unsyiah.ac.id*

p-ISSN 2089-7790; e-ISSN 2502-6194
Received 1 September 2021; Received in revised from 13 November 2021; Accepted 26 December 2021
Available online 31 December 2021

Saura *et al.*, 2021). Based on its feeding habits, snakehead were categorized as carnivore, where at the larval stage, snakehead consume zooplankton, while as adults, they eat gastropods, insects, worms, and small fish (Marhana *et al.*, 2017; Arsyad *et al.*, 2018; Liana *et al.*, 2020).

Living in fluctuating environmental conditions causes snakehead fish to be vulnerable to parasites infection, both ectoparasites and endoparasites. Previous studies have disclosed parasitic infection occurrence in snakeheads from several locations in Indonesia, including Maros Regency, South Sulawesi (Harmah *et al.*, 2018), Aceh (Umara *et al.*, 2014), South Kalimantan (Sugiartanti *et al.*, 2020), and East Java (Salam and Hidayati, 2017). The species of ectoparasites that infect snakehead include *Oodinium* sp., *Trichodina* sp., *Ichthyophthirius multifiliis,* and *Epistylis* sp. (Salam and Hidayati, 2017). Meanwhile, the species of endoparasites that infect snakehead fish include *Neobenedenia pargueraenis, Diphyllobothrium latum, monogeneans*, *Mecoderus* sp., *Pallisentis Nagpurensis,* and worm larvae (*Nematoda*) (Umara *et al.*, 2014; Harmah *et al.*, 2018).

The ability of snakeheads to defend against parasites is highly dependent on their health and environmental conditions (Ode, 2014). The poor environmental condition might cause stress in fish, impacting the body's decreased defense mechanisms and being vulnerable to parasitic infections. Nova *et al.* (2015) stated that parasitic infection in fish could occur due to the interaction of three components: weak hosts, virulent pathogens, and poor environmental quality.

According to Mulia (2007), ectoparasite infection can traverse to an acute death without preceding symptom. Besides, ectoparasite infection is also one of the predisposing factors for other more lethal organisms. The chronic level of ectoparasite infection irritates external organs such as the gill and skin. The alteration of fish gill due to ectoparasites infection causes a disturbance in respiration and osmoregulation processes. In addition, ectoparasites infection on the skin has decreased the fish immunity and led to the intrusion of other parasitic organisms. If this condition continues, it will adversely impact the lower growth rate, even death (Mood *et al.*, 2011).

To date, studies related to the comparison of ectoparasites that infect snakeheads from different habitats and their relationship to biometric conditions have not been optimally investigated. Paddy fields, swamps, and ditches are habitats for snakeheads that have different characteristics. Specifically, the swamp has puddle fluctuating conditions for a certain period, and the paddy field has streams/puddles that have been mixed with agricultural fertilizers and pesticides. At the same time, a ditch is identically used as a place for waste disposal, especially household waste. Thus, this present study aimed to investigate the prevalence, intensity, dominance, and predilection of ectoparasites on snakehead fish collected from ditches, paddy fields, and swamps and correlate them with biometric conditions. This study has provided valuable information as a part of the preventive and responsive efforts to monitor snakehead health.

Materials and Methods Location and time of research

This research was conducted from April to June 2021. The sampling of snakehead was carried out in paddy fields, swamps and ditches within the Aceh Besar Regency, involving Kajhu Village of Baitussalam Subdistrict (N 5°35'51.11" E 95°22'32.30"), Limpok Village of Darussalam Subdistrict (N 05°33'43.88" E 095°22'27.56"), Cot Keung Village of Kuta Baro Subdistrict (N 5°33'19.54" E 95°24'10.49"), Samahani Village of Kuta Malaka Subdistrict (N 5°26'39.73" E 95°24'11.16") and Mata Ie Village of Montasik Subdistrict (N 5°28'23.51" E 95°23'52.40") (Figure 1). The process of identifying ectoparasites and measuring related parameters was performed in Multifunctional Laboratory at Universitas Islam Negeri Ar-Raniry, Banda Aceh.

Fish sample preparation and ectoparasite identification

A total of 30 samples of snakehead fish were collected from each habitat through direct purchases from local fishermen. The fish samples were kept in labeled plastic and then transported into the laboratory for further identification. The physicochemical parameters of water in each habitat were measured, including temperature, pH, dissolved oxygen, and ammonia. The temperature and dissolved oxygen were measured using DO meter (Lutron YK-2005WA; Taiwan), and pH was measured using the digital pH meter (ATC pH2011; Romania). Ammonia was measured using Wastewater Treatment Photometer (HANNA HI-83214; United States of America).

The observation of ectoparasite was carried out in the skin, fins, and gill of snakehead based on Fautama *et al.* (2019) protocol. Briefly, the fish was sacrificed by pinning with a needle in the neurocranium part of the fish. The mucus from the lateral body of the fish was taken by using a scrapping method. In addition, ectoparasites in the fins were observed by placing a slice of the fish fin (dorsal, caudal, ventral, and pectoral fin) into an object-glass that has been dripped with distilled water. The observation of ectoparasites in the gill was performed after separating the gill filament from the operculum. Ectoparasites were observed under a light microscope with a slight magnification (40x) to a large magnification (100x). The identification of ectoparasites found was done by comparing the similarity of ectoparasite morphology with several related references such as Kabata (1985), Noble and Noble (1989), and Nurcahyo (2014).

Research parameters

The parameters observed in this research were ectoparasite profile and biometric condition of fish. The ectoparasite profile parameters included prevalence, intensity, dominance, and predilection of organ.. Meanwhile, the parameters of the biometric conditions were the length-weight relationship, the distribution of length and weight classes, and condition factors. The prevalence, intensity, and dominance were calculated as follow (Kabata, 1985):

$$\text{Prevalence } \% = \frac{\text{Total number of infected fish}}{\text{Total number of examined fish}} \times 100$$

$$\text{Intensity (ectoparasite/fish)} = \frac{\text{Total number of ectoparasite found}}{\text{Total number of infected fish}}$$

$$\text{Dominance } \% = \frac{\text{Total number of each ectoparasite species}}{\text{Total number of ectoparasite found}} \times 100$$

The length-weight relationship and condition factor of fish were measured with Linear Allometric Model (LAM) approach based on Effendie (1997) as follow:

$$W=aL^b$$

W is the weight of fish (g), L is the total length of fish (mm), a is constant, and b is an exponential expressing the relation between length and weight. The condition factor (K) was measured based on the following formula (Okgerman, 2005):

$$K=\frac{W}{aL_b}$$

Data analysis

The data were separated based on the habitat and condition of fish (healthy fish, infected fish, and total fish). The infection and infestation level (prevalence dan intensity) of parasites in each habitat was determined based on Williams and Williams (1996). Besides, the biometric condition was analysed descriptively.

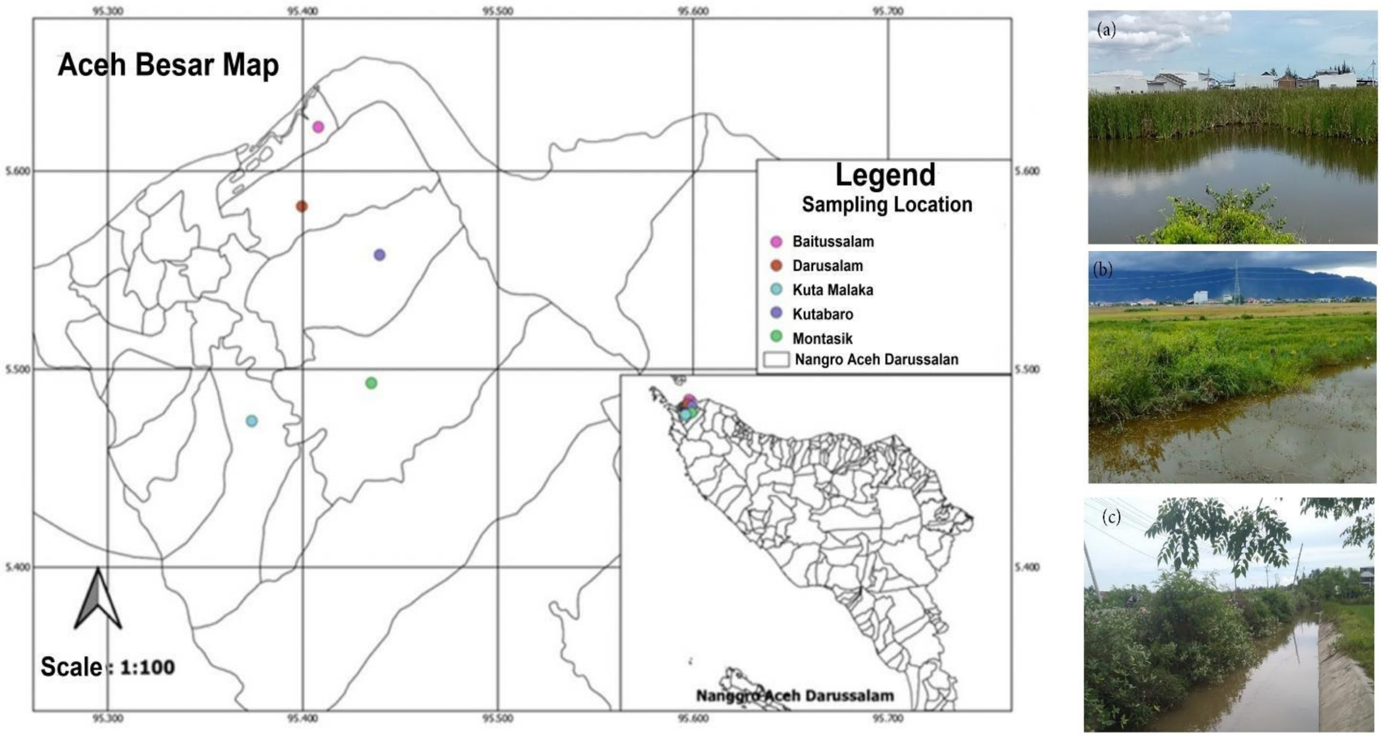

Figure 1. Snakehead Fish Sampling Location Map. Swamp at Kajhu Village (A). Paddy field at Samahani Village (B). Dicthes at Limpok Village (C).

Results Ectoparasites profile

Five Species of ectoparasites were identified up to the genus level, including *Tetrahymena* sp., *Epistylis* sp., *Trichodina* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp. (Figure 2). Taxonomically, the ectoparasites found are divided into two phyla (Platyhelminthes and Protozoa), two classes (Trematoda and Ciliata), four orders (Gyrodactylidea, Dactylogyridea, Petrichida, and Hymenostomatida), and five familiae (Gyrodactylidae, Dactylogyridae, Trichodinidae, Tetrahymenidae, and Epistylidae). *Tetrahymena* sp. is an ectoparasite included in ciliated protozoa. This parasite possesses an oval body shape surrounded by cilia that are helpful in movement. The body is transparent so that the cell organelles are easily visible (Figure 2A). Ectoparasite *Epistylis sp.* is a protozoan with a cylindrical shape, like stemmed bell, and a transparent body (Figure 2B). *Trichodina* sp. has a perfectly round transparent body shape like a plate that constantly rotates in the middle and is filled with serrations. The outermost layer of the body of *Trichodina sp.* is filled with cilia (Figure 2C). *Dactylogyrus sp.* is an ectoparasite included in *Platyhelminthes*. It possesses a round, flat and elongated body shaped. It has a plate at the posterior used to attach to the host and has a sucker located near the anterior end. (Figure 2D). *Gyrodactylus* sp. was found to have a body shape identical to *Dactylogyrus sp.* But, *Gyrodactylus sp.* has hooks on the anterior part, which attach themselves to the host (Figure2E).

Figure 2. Ectoparasites that infect snakehead at each habitat. *Tetrahymena* sp. (A). *Epistylis* Sp. (B). *Trichodina* sp. (C). *Dactylogyrus* sp. (D). *Gyrodactylus* sp. (E). 400X magnification for A, B and C; 100X magnification for D and E.

Prevalence and intensity of ectoparasites based on the habitat

The total ectoparasites infecting snakehead in the three habitats amounted to 573 individuals. The ditch habitat has the highest prevalence value by 76.7%, while paddy field habitat has the lowest prevalence value by 53,3% (Table 1). Based on the criteria of ectoparasite prevalence level referring to Williams and Williams (1996), ditches and swamps habitat are in moderate infection and infestation (70-89%). Meanwhile, the paddy field habitat is classified as the most frequent infection and infestation (50-69%).

Ectoparasites intensity values in the three habitats range from 5.75 ectoparasites/fish up to 15.4 ectoparasites/fish. Ditch habitat has the highest intensity value, followed by swamp habitat and ditch habitat, which are 15.4, 6.05, and 5.75 ectoparasites/fish, respectively, as shown in Table 1 below. Nevertheless, based on the criteria for the intensity level of ectoparasites infection, Williams and Williams (1996) suggest ditch and swamp habitats are within the moderate infection category (6 – 55 ectoparasites/fish). In contrast, the ectoparasite infection at paddy field habitat is within the low category (<6 ectoparasites/fish).

Table 1. Prevalence and intensity of ectoparasite that infect snakehead at each habitat.

Habitat	Infected Fish (Ind)	Examined Fish (Ind)	Number of Parasites (Ind)	Prevalence (%)	Intensity (□ ectoparasite /fish)
Ditch	23	30	354	76.7	15.4
Paddy Field	16	30	92	53.3	5.75
Swamp	21	30	127	70	6.05

Dominance of ectoparasites based on the habitat

Of the five identified ectoparasites, four were found in swamp habitats, while only three species were found in ditch and rice field habitats. *Tetrahymena* sp. and *Epistylis* sp. ectoparasites were detected in all habitats. *Trichodina* sp. ectoparasite was detected at ditch and paddy field habitats, while, *Gyrodactylus* sp. and *Dactylogyrus* sp. ectoparasites were only found in swamp habitat. The highest dominance of ectoparasites in each habitat included *Tetrahymena* sp. in ditch and swamp habitats and *Epistylis* sp. in the paddy field habitat. In the ditch habitat, the highest ectoparasite species dominance was 85.59%. Meanwhile, in the paddy field and swamp habitat, the dominance value was under 50%, which were 34.78% and 49.61%, respectively (Table

2).

Table 2. The dominance of ectoparasites that infect snakehead fish at each habitat.

Habitat	Dominance of Ectoparasites (%)				
	Trichodina sp.	*Tetrahymena* sp.	*Epistylis* sp.	*Gyrodactylus* sp.	*Dactylogyrus* sp.
Ditch	7.06	85.59	7.35	-	-
Paddy Field	20.65	34.78	44.56	-	-
Swamp	-	49.61	19.69	12.6	18.12

(skin, fins, and gills).

Biometric condition

A total of 60 (66.7%) snakehead examined was infected with ectoparasites. The average weight and length of infected snakehead fish were 161.9±31.3 g and 250.33±52.5 mm, respectively. While, for the healthy snakehead fish were 165.3±36.8 g and 251.28±63.3 mm. Healthy and infected snakehead had almost identical condition factor values, which were 1.006 and 1.011, respectively (Table 4). All snakehead collected from various habitats (both healthy and infected) had negative allometric growth

Table 4. Biometric condition of health snakehead fish and infected snakehead.

Fish Condition	N	Weight Range (g) Length Range (mm)	Average Weight (g)	Average Lenght (mm)	a	b	K	R^2
Healthy Fish	30	84.2- 289.5 188.5-303.5	165.3±36.8	251.28±63.3	0.0002	2.458	1.011	0.93
Infected Fish	60	85.2-264.6 191.4-299.4	161.9±31.3	250.33±52.5	0.0004	2.342	1.006	0.90

Table 5. Physico-chemical parameters of water at each habitat.

Parameter	Unit	Result			Tolerance Range for Snakehead
		Ditch	Swamp	Paddy Field	
Temperature	°C	32.3±0.2	30.5±0.3	31.9±0.5	26.0-32.0*
pH	-	8.2±0.15	7.6±0.1	6.9±0.15	5.2-7.8*
Do	mg/L	2.2±0.15	4.3±0.2	4.5±0.1	>3**
Ammonia	mg/L	1.05+0.05	0.64±0.01	0.5±0.01	0.54-1.57***

*Hidayatullah *et al.* (2015), ** Fariedah and Widodo (2016), ***Extrada *et al.* (2013)

Based on total weight and length distribution, the snakeheads with a weight range of 115.2-145.2 g highest ectoparasite infection was observed on and a length range of 258.5-268.5 mm, namely 23

Predilection of ectoparasites

Out of the three organs observed, the gill was the most vulnerable organ. All types of ectoparasites were detected to infect the gill. In comparison, the skin and fin were only infected by two species of ectoparasites, namely *Tetrahymena* sp. and *Dactylogyrus* sp. (infecting skin) and *Trichodina* sp. and *Epistylis* sp. (infecting fins). *Tetrahymena* sp. became the most dominant ectoparasites attacking the gills and skin, with 270 and 128 individuals, respectively. Likewise, *Epistylis* sp. ectoparasite became the most dominant ectoparasite attacking the fins (Table 3). *Dactylogyrus* sp. ectoparasites were the fewest found, as many as four individuals. There were no ectoparasites that simultaneously infected the three organs observed

patterns ($b<3$). However, in general, infected snakehead had a lower b coefficient value. Only infected snakehead fish from ditch habitats have a coefficient b value identical to healthy snakehead. The coefficient b value of healthy snakehead fish ranged from 2.321 to 2.537. Whereas, the coefficient b value of snakehead infected with ectoparasites was in the range of 2.163 - 2.535. The lowest b coefficient value of snakehead infected with ectoparasites was observed in the paddy field habitat, which was 2.163. In contrast, the highest b coefficient value of the healthy snakehead was observed in the swamp habitat, which was 2,535.
(Figure 3).

Table 3. Ectoparasite predilection of organ in infected snakehead

Organ Predilection	Number of Ectoparasites that Infect (ind)				
	Trichodina sp.	*Tetrahymena* sp.	*Dactylogyrus* sp.	*Epistylis* sp.	*Gyrodactylus* sp.
Skin	-	128	-	-	4
Fins	13	-	25	-	-
Gill	31	270	67	16	19

and 15 individuals, respectively (Figure 4B-D). The lowest number of infections was obtained in snakehead with a weight range of 177.2-207.2 g and a length range of 188.5-198.5 mm. Similar results were also recorded in each habitat where snakehead with a weight range of 115.2-145.2 g had the highest infection rate compared to other weight size ranges. The predominat snakehead infected with ectoparasites in paddy field was in the length range of 258.5-268.5 mm, while in ditch and swamp habitats were in the range of 218.5-228.5 mm (Figure 4A-C).

Physical and chemical parameters of waters

The analysis of physico-chemical parameters of the waters showed that temperature, pH, dissolved oxygen, and ammonia content in the three habitats were respectively in the range of 30.5±0.3-32.3±0.2^{o}C, 6.9±0.15-8.2±0.15, 2.2±0.15-4.5±0.1 mg/L, and 0.5±0.01-1.05±0.05 mg/L. Three of four parameters of the waters measured in the ditch habitat have exceeded the tolerance range for snakehead, including temperature, pH and dissolved oxygen. Meanwhile, in the paddy field and swamp habitats, there are no parameters were exceeded the ideal value range (Table 5). The highest values of temperature, pH, ammonia and lowest dissolved oxygen levels were detected in the ditch habitat, which was 32.3±02^{o}C, 8.2±0.15, 1.05±0.05 mg/L, and 2.2±0.15 mg/L, respectively.

Discussion

Five species of ectoparasites identified in this study (*Tetrahymena* sp., *Epistylis* sp., *Trichodina* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp.) were also reported to infect various freshwater fish, brackish water fish to seawater fish. Several of them were catfish (*Clarias gariepinus*) (Fautama *et al*., 2019), panga (*Pangasius hypophthalmus*) (Islami *et al*., 2017), goldfish (*Carassius auratus*) (Anshary, 2008), nile tilapia (*Oreochromis niloticus*) (Rahmi, 2012), milkfish (*Chanos chanos*) (Riko *et al*., 2012) and tiger grouper (*Epinephelus fuscoguttatus*) (Siswoyo and Hendrianto, 2011). Hardi (2015) asserts that several factors affecting the abundance and diversity of parasites in the waters include poor water quality, carrier vectors, and unhealthy cultivation media management. From the five ectoparasites identified, four of them (*Trichodina* sp., *Dactylogyrus* sp., *Epistylis* sp. and *Gyrodactylus* sp.) were also reported to infect snakehead fish in many regions in Indonesia. *Trichodina* sp. also infected snakehead fish from irrigation habitat in Aceh Besar Regency (Umara *et al*., 2014). *Dactylogyrus* sp. and *Gyrodactylus* sp. infested snakehead from paddy fields, swamps, and cultivation media in Yogyakarta area (Fitriani *et al*., 2019). *Epistylis sp.* ectoparasite had been found in snakehead from tributary habitats in Sidoarjo area (Salam and Hidayati, 2017). Only *Tetrahymena sp.* have not been previously reported to infect snakehead from other regions in Indonesia. However, this ectoparasite has been reported to infect several different fish species, such as tiger grouper (*Epinephelus fuscoguttatus*) and goldfish (*Carrasius auratus*) (Siswoyo and Hendrianto, 2011; Haryono *et al*., 2016). In this study, *Dactylogyrus* sp. and *Gyrodactylus* sp. are only recorded at swamp habitat. Consequently, swamp habitats have a higher diversity of ectoparasites compared to other habitats. Several studies inform that monogenean parasites are more commonly found in wetland areas (including swamps) with still water and low pollution levels (Krause *et al*. 2010; Morales-Serna *et al*., 2019). Ansyari *et al*. (2020) also revealed a similar result where *Dactylogyrus* sp. was only observed in swamp areas compared to other sampling locations such as a river. This might occur due to stream water conditions in, rivers and ditches, while the swamp has a stagnant water condition.

To date, studies related to ectoparasites in snakehead fish, mainly from Indonesia's territory, are still limited. Thus, this opens up opportunities for the discovery of various other types of ectoparasites. *Tetrahymena* sp. has a high potential to infect snakehead fish due to its wide distribution and breed rapidly. In this study, the presence of *Tetrahymena* sp. is suspected to be caused by environmental factors that support their proliferation and growth. Moreover, *Tetrahymena* sp. became the dominant ectoparasite infecting snakehead from ditch and swamp habitats with values of 85.59% and 49.61%, respectively.

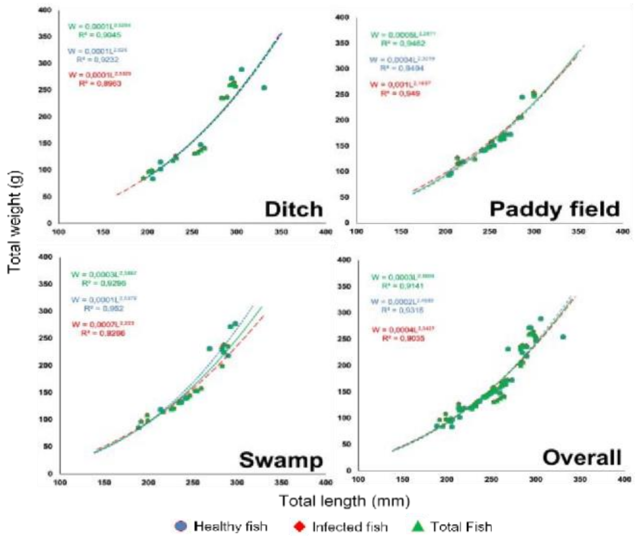

Figure 3. Length-weight relationship of healthy fish and infected fish at each habitat.

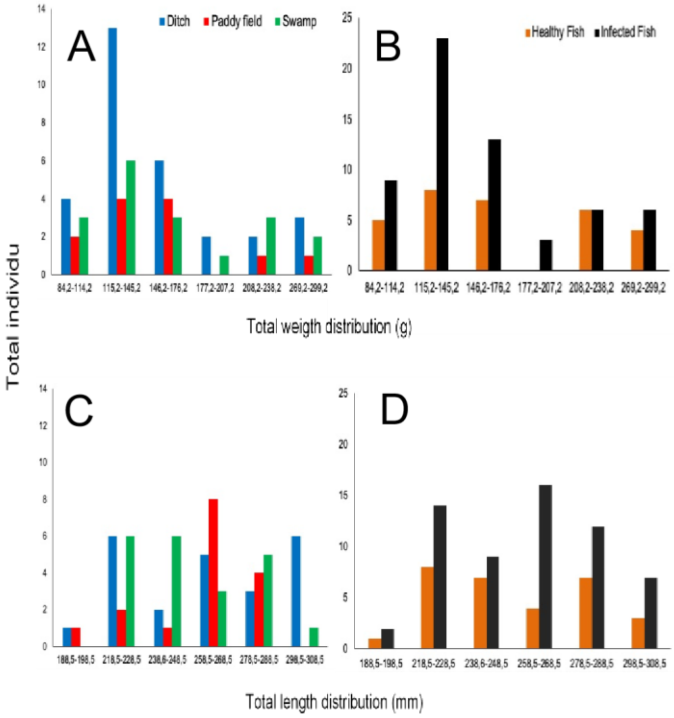

Figure 4. Total weight and length distribution of infected snakehead based on their habitat (A-C). Total weight and length distribution of healthy and infected snakehead (B-D).

The ditch habitat had a higher prevalence and intensity of ectoparasites than other two habitats. This is assumed to be highly correlated with the value of water's physical and chemical parameters in the ditch habitat. Ditch habitats have temperatures, pH, dissolved oxygen levels exceeding the optimum snakehead survival and growth range. The poor quality of water in the ditch is strongly affected by household waste input. According to Sumantri and Cordova (2011), household waste originating from cleaning materials such as detergents, soaps, and shampoos contains inorganic nitrogen (NH_3, NH_4OH, NO_2, NO_3), which can be a source of ammonia in the waters. Therefore, high levels of ammonia can increase the pH value and decrease the dissolved oxygen value (Monalisa and Minggawati, 2010).

Leibowitz *et al.* (2005) revealed that poor water quality can improve the susceptibility of fish to parasitic infections. High ammonia content can reduce fish immunity, while the high content of organic matter becomes nutrients for parasites growth. The study by Faggio *et al.* (2014) and Dawood *et al.* (2021) proves that exposure to ammonia can decrease the value of blood protein, albumin, and globulin, affecting the decrease of fish immunity levels. In fact, low immunity is one factor that facilitates the parasite to infect fish.

Furthermore, snakehead gills are the most vulnerable organs to ectoparasite infection compared to fins and skin. Similarly, it was also reported in catfish (*Clarias gariepinus*) and hairtail fish (*Trichiurus lepturus*)(Fautama *et al.* 2019; Rahmat *et al.*, 2020). This might occurs due to several factors, including 1) Gill is one organ with great contact with the environment. 2) During the respiration process, the gills actively filter water that enters the oral cavity so that it has the potential to attach to ectoparasites. 3) In the gills, there are blood vessels that become a source of nutrition for ectoparasites. On the one hand, ectoparasite infection caused gill degeneration characterized by hemorrhage, excessive mucus production, and histopathology (Iwanowicz, 2011; Suliman *et al.*, 2021). Additionally, gill morphological changes due to infection of ectoparasites can disturb the respiration's performance, adversely impacting fish growth (Nisa *et al.*, 2021).

Infected snakehead tend to had a lower average weight and length value than healthy snakehead. Based on habitat, swamps had more parasites species with moderate infection rates. Therefore the negative effect of parasitic infection on the growth coefficient of snakeheads was more visible than normal fish. To date, studies related to the impact of parasites infection on fish growth coefficients are still rare. This study indicates that besides the intensity rate, the type of parasite that infects might also affect fish's growth rate. Based on their size, snakehead fish with low weight and longer size tends to be more vulnerable to ectoparasite infection compared to other sizes. This is also in line with the finding of Finley and Forrester, 2003; Muchlisin *et al.*, 2014, where *Coryphopterus glaucofraenum* fish with lower weight and *Tor tambra* fish with longer size were also most infected by ectoparasite. In addition, Hardi (2015) stated that fish that have not yet reached the adult stage (generally identical to low body weight) have an immature immune system, so they are more susceptible to ectoparasite infection. Adversely, in terms of length, ectoparasite infection probably correlates with the attachment area on the fish body, where longer fish provides more space for parasites to infect (Alifuddin *et al.*, 2003).

Conclusion

A total of 573 ectoparasites were detected infecting snakehead from the three habitats. Of the five types of ectoparasites that have been identified as *Tetrahymena* sp., *Epistylis* sp., *Trichodina* sp., *Dactylogyrus* sp., and *Gyrodactylus* sp, *Tetrahymena* sp. infection in snakehead fish was firstly reported. The ditch habitat had the highest prevalence level by 76.7%, whereas the paddy field habitat had the lowest one by 53.3%. The ectoparasite intensity values in the three habitats were ranging from 5.75 to 15.4 ectoparasites/fish. Ditch habitat had the highest intensity value, followed by swamp habitat and ditch habitat. The ectoparasites of *Tetrahymena* sp. and *Epistylis* sp. were detected in all habitats. Ectoparasite of *Trichodina* sp. detected at ditch and paddy field habitats. In contrast, *Gyrodactylus* sp. and *Dactylogyrus* sp. were only found in swamp habitats. All types of ectoparasites were detected to infect the gills, while the skin and fins were only infected by each of the two types of ectoparasites. Regression analysis showed that infected snakehead tend to have a lower growth coefficient compared to healthy snakehead. Snakehead with a weight range of 115.2-145.2 g and a length range of 258.5-268.5 mm tend to be more vulnerable to ectoparasite infection compared to other sizes. Further research related to the impact of ectoparasite infection on physiological performance and its relationship to snakehead growth is highly recommended.

Acknowledgments

We thank collaboration with the Center for Aquatic Research and Conservation (CARC), Universitas Islam Negeri (UIN) Ar-Raniry, for facilitating and supporting this research. Thanks to Dina Meltia, Nurliza Zaiyana, dan Mawardi for helping during fish and water sampling.

References

Alifuddin, M., Y. Hadiroseyani, I. Ohoiulun. 2003. Parasit pada ikan hias air tawar (ikan cupang, gapi dan rainbow). Jurnal Akuakultur Indonesia, 2(2): 93-100

Anshary, H. 2008. Tingkat infeksi parasit pada ikan mas koi (*Cyprinus carpio*) pada beberapa lokasi budidaya ikan hias di Makassar dan Gowa. Jaringan Sains dan Teknologi, 8(2): 139-147.

Ansyari, P., Slamat, Ahmadi. 2020. Food habits and biolimnology of snakehead larvae and fingerlings from different habitats. AACL Bioflux, *13*(6): 3250-3251

Arsyad, R., Asriyana, N. Irawati. 2018. Variasi ontogenetik makanan ikan gabus (*Channa striata*) di perairan Rawa Aopa Watumohai Kecamatan Angata Kabupaten Konawe Selatan. Jurnal Manajemen Sumber Daya Perairan, 3(2): 143-149.

Cahyanti, W., A. Saputra, A.H. Kristanto. 2021. Performa reproduksi dan larva ikan gabus (*Channa striata* Blkr) dengan beberapa teknik pemijahan. Jurnal Riset Akuakultur, 16(2): 99-106.

Chasanah, E., M. Nurilmala, A.R. Purnamasari, D. Fithriani. 2015. Komposisi kimia, kadar albumin dan bioaktivitas ekstrak protein ikan gabus (*Channa striata*) alam dan hasil budidaya. JPB Kelautan Dan Perikanan, 10(2): 123-132.

Dawood, M.A., M.S. Gewaily, M.N. Monier, E.M. Younis, H. Van Doan, H. Sewilam. 2021. The regulatory roles of yucca extract on the growth rate, hepato-renal function, histopathological alterations, and immune-related genes in common carp exposed with acute ammonia stress. Aquaculture, 534: 736287.

Dosi, E.M., A.A. Tuen, I.C. Yaman. 2019. Fishes of a conserved peat swamp forest in an oil palm plantation. *Oil Palm Bulletin,* 78: 1-5.

Effendie, M.I. 1997. Metode Biologi Perikanan. Yayasan Dewi Sri. Bogor.

Extrada, E., H.T. Ferdinand, Yulisman. 2013. Survival and growth rate of snakehead juvenile (Channa striata) at different levels of water elevation on rearing media. Indonesian Swamp Aquaculture Journal, 1(1): 103-114.

Faggio, C. 2014. Haematological and biochemical response of Mugil cephalus a er acclimation to captivity. Cahiers de Biologie Marine, 55: 31-36.

Fariedah, F., M.S. Widodo. 2016. Effect of different feed on the growth of snake head fish (Channa striata). El-Hayah, 5(4): 153158.

Fautama, F.N., I. Zulfahmi, M. Muliari, A.A. Anas. 2019. Prevalence and intensity of ectoparasites on *Clarias gariepinus* from aquaculture pond in Aceh Besar District, Indonesia. Jurnal Biodjati, 4(1): 58–67.

Finley, R.J., G.E. Forrester. 2003. Impact of ectoparasites on the demography of a small reef fish. Marine Ecology Progress Series, 248: 305-309.

Fitriani, E.N., M. Arief, H. Suprapto. 2019. Prevalence and intensity of ectoparasites in gabus fish (*Channa striata*) at Cangkringan Fishery Cultivation Technology Development Center, Sleman, Yogyakarta. In *IOP* Conference Series: Earth and Environmental Science, 236(1): 012095. IOP Publishing.

Gustiano, R., K. Kurniawan, I.I. Kusmini. 2021. Bioresources and diversity of snakehead, *Channa striata* (Bloch 1793): a proposed model for optimal and sustainable utilization of freshwater fish. In IOP Conference Series: Earth and Environmental Science, 762(1): 012012. IOP Publishing.

Hardi, E.H. 2015. Parasit Biota Akuatik. Mulawarman University Press. Samarinda.

Harmah, Darsiani, I.S. Arbit. 2018. Prevalensi endoparasit pada lambung dan usus ikan gabus (*Channa striata*). Jurnal Ilmiah Samudra Akuatik, 2(2): 1-8.

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.

Hidayatullah, S., Muslim, Taqwa, F.H. 2015. Rearing of snakehead larvae (*Channa striata*) in plastic lined pond with different stocking density. Journal of Fisheries and Marine Science, 20(1): 61-70.

Islami, H., S. Prayogo, 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): 1-8.

Iwanowicz, D.D. 2011. Overview on the effects of parasites on fish health. *Proceedings of the Third Bilateral Conference between Russia and the United States*, 12–20 July 2009, held in Shepherdstown, West Virginia. 176-184.

Kabata, Z. 1985. Parasit dan penyakit ikan yang dibudidayakan di daerah tropis. Taylor dan Frances. London dan Filadelfia. 318.

Krause, R.J., D. McLaughlin, D.J. Marcogliese. 2010. Parasite fauna of Etheostoma nigrum (Percidae: Etheostomatinae) in localities of varying pollution stress in the St. Lawrence River, Quebec, Canada. Parasitology research, 107(2): 285-294.

Leibowitz, M.P., R. Ariav, D. Zilberg. 2005. Enviromental and physiological conditions affecting *Tetrahymena* sp. infection and pathology of infected fish. Journal of Fish Diseases. 32: 846-855.

Liana, Asriyana, N. Irawati. 2020. Kebiasaan makanan ikan gabus (*Channa Striata*) di Perairan Rawa Aopa Watumohai, Desa Pewutaa Kecamatan Angata Kabupaten Konawe Selatan. Jurnal Manajemen Sumberdaya Perairan, 5(3): 148-156.

Marhana, W.O., Asriyana, Kamri, S. 2017. Kelimpahan dan distribusi ikan gabus (*Channa striata*) di perairan Rawa Aopa Watumohai Desa Pewutaa Kecamatan Angata Kabupaten Konawe Selatan. Jurnal Manajemen Sumber Daya Perairan, 2(3): 225-234.

Monalisa, S.S., I. Minggawati. 2010. Kualitas air yang mempengaruhi pertumbuhan ikan nila (*Oreochromis* sp.) di kolam beton dan terpal. Journal of Tropical Fisheries, 5(2): 526-530.

Mood, S.M., P. Shohreh, J. Sahandi. 2011. A survey on ectoparasite fauna of cold-water fish farms in Mazandaran Province, Iran. Human and Veterinary Medicine, 3(3), 246-251.

Morales-Serna, F.N., M.A. Rodríguez-Santiago, R. Gelabert, L.M. Flores-Morales. 2019. Parasites of fish Poecilia velifera and their potential as bioindicators of wetland restoration progress. Helgoland Marine Research, 73(1): 1-8.

Muchlisin, Z.A., A.M. Munazir, Z. Fuady, W. Winaruddin, S. Sugianto, M. Adlim, N. Fadli, A. Hendri. 2014. Prevalence of ectoparasites on mahseer fish (*Tor Tambra* Valenciennes, 1842) from aquaculture ponds and wild population of Nagan Raya District, Indonesia. Human and Veterinary Medicine, 6(3): 148152.

Mulia, D.S. 2007. Tingkat infeksi ektoparasit protozoa pada benih ikan nila (*Oreochromis niloticus*) di Balai Benih Ikan (BBI) Pandak dan di Balai Benih Ikan (BBI) Sidabowa Kabupaten Banyumas. Sain Akuatik, 10(1).

Nisa, M., G. Mahasri, L. Sulmartiwi. 2021. Gill and skin pathology of hybrid grouper (*E. fuscoguttatus* x *E. lanceolatus*) infested *Zeylanicobdella arugamensis* worms in different infestations degree. In *IOP Conference Series: Earth and Environmental Science,* 679(1): 012006. IOP Publishing.

Noble, E.R., G.A. Noble.1989. *Parasitologi*. Gadjah Mada University Pres. Yogyakarta. pp.178 183; 288-294,909-939

Nova, L., Y. Fahrimal, R. Daud, Rusli, D. Aliza, M. Adam. 2015. Identifikasi parasit pada ikan nila (*Oreochromis nilloticus*) di irigasi Barabung Kecamatan Darussalam Aceh Besar. Jurnal Medika Veterinaria, 9(2): 101-103.

Nurcahyo, W. 2014. Parasit Pada Ikan. UGM Press. Yogyakarta.

Ode, I. 2014. Ektoparasit pada ikan budidaya di perairan Teluk Ambon. Jurnal Ilmiah Agribisnis dan Perikanan, 7(1): 66-72.

Okgerman, H. 2005. Seasonal variation of the length weight and condition factor of rudd (*Scardinius erythrophthalmus* L.) in Spanca Lake. International Journal of Zoological Research, 1: 6-10.

Rahayu, P., F. Marcelline, E. Sulistyaningrum, M.T. Suhartono, R.R. Tjandrawinata. 2016. Potential effect of striatin (DLBS0333), a bioactive protein fraction isolated from *Channa striata* for wound treatment. Asian Pacific Journal of Tropical Biomedicine, 6(12): 1001-1007.

Rahmat, H., P.S.J. Gde, W.E. Suryaningtyas. 2020. Prevalensi dan intensitas parasit pada ikan layur (*Trichiurus lepturus*) di Pasar Ikan Kedonganan, Bali. Current Trends in Aquatic Science, 3(1): 4753.

Rahmi. 2012. Identifikasi ektoparasit pada ikan nila (*Oreochromis niloticus*) yang dibudidayakan pada tambak Kabupaten Maros. Jurnal Ilmu Perikanan, 1(1): 19-23.

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

Salam, B., D. Hidayati. 2017. Prevalensi dan intensitas ektoparasit pada ikan gabus (*Channa striata*). Jurnal Sains Dan Seni ITS, 6(1): 1-4.

Saura, R.B., G. Falcasantos, R.J. Andante, L. Munda, M. Alimorong, B.J. Hernando. 2021. Evaluation of fluctuating asymmetry and sexual dimorphism of Channa striata using landmark-based geometric morphometric analysis from Agusan Marsh and Lake Mainit in Caraga Region, Philippines. Nusantara Bioscience, 13(1): 100-110.

Siswoyo, B.H., D.A. Hendriyanto. 2011. Infestasi ektoparasit pada kerapu macan (*Epinephelus fuscoguttatus*) ditinjau dari beberapa kualitas air. Warta Dharmawangsa, 21-46.

Sugiartanti, D., R. Damayanti, R. Tiffarent, F. Ramadhani. 2020. Deteksi penyakit bakteri dan parasit pada ikan gabus (*Channa striata*) di Lahan Rawa Kalimantan Selatan. In Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner*,* 20(20): 789-802.

Suliman, E.A.M., H.A. Osman, W.A.A. Al-Deghayem. 2021. Histopathological changes induced by ectoparasites on gills and skin of *Oreochromis niloticus* (Burchell 1822) in fish ponds. Journal of Applied Biology & Biotechnology*,* 9(1): 68-74.

Sumantri, A., M.R. Cordova. 2011. Dampak limbah domestik perumahan skala kecil terhadap kualitas air ekosistem penerimanya dan dampaknya terhadap kesehatan masyarakat. Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan (Journal of Natural Resources and Environmental Management), 1(2): 127-127.

Umara, A., M. Bakri, Hambal. 2014. Identification of parasites in snakehead fish (*Channa striata*) in Meunasah Manyang Village Lhoknga Subdistrict Aceh Besar. Jurnal Medika Veterinaria, 8(2).

Widyastuti, Y.R., T.H. Prihadi, I. Taufik, B.A. Pamungkas, SK. Das. 2020. Increasing productivity of snakehead fish (*Channa striata*) juvenile in ponds with different bottom substrates. IOP Conference Series: Earth and Environmental Science, 521(1).

Williams, E.H.J., L.B. Williams. 1996. Parasites of Offshore Big Game Fishes of Puerto Rico and The Western Atlantic. Departement of Natural and Environmental Resources. University of Puerto Rico, Puerto Rico.

How to cite this paper:
Zulfahmi, I., F. Huslina, R. Nanda, F.M. Nur, S. Nazlia, R. Djuanda, A.W. Perdana. 2021. Profile of ectoparasites and biometric condition of snakehead (*Channa striata* Bloch 1793) collected from different habitats. Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan, 10(3): 284-292.