

Metazoan Parasites of Tuna Fish Species: Bullet Tuna (*Auxis Rochei*) and Frigate Tuna (*Auxis Thazard*) in Local Fish Markets of Davao City

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Abstract

This study was conducted to determine the metazoan parasites of commercially significant fish species, particularly bullet tuna (*Auxis rochei*) and frigate tuna (*Auxis thazard*) collected from major fish public markets in Davao City using descriptive statistics research method. Results showed that the examined fishes from the markets were infected with different kinds of parasites. Based on comparisons, Site C market had the greatest parasitic community. Moreover, the fish species with the greatest number of parasitic community and greatest number of parasitic individuals was *A. rochei* with five distinct species namely *Caligus quadratus*, *Anisakis simplex*, *Rhadinorhynchus pristis*, Monogenean trematodes, and *Dinurus scombri*. The parasites that were observed to be the most prevalent, most abundant, and with the highest mean density value were the acanthocephalans (*R. pristis*). A higher magnification of the microscopes for better focus on the parasites is recommended particularly in identifying the proboscis of acanthocephalans. The scale on the photograph is needed to determine the size of each specimen. The number of fish to be examined could be increased for more valid results. Further longer-term investigations are needed, include investigation of fish parasites as it provides information useful for the determination of specific precautionary measures in handling, preparing, and cooking to avoid parasitic infestation and infection. Thus, public health awareness of fish parasites is important.

Keywords: Health, Tuna Parasites, Descriptive, Davao City

1. Introduction

One of the rapidly emerging field of aquatic science is marine fish parasitology. Among the reasons of its rapid progress is that marine aquaculture is of great importance and concerns on the effects of pollution on fish health has generally become of increased attention in marine environmental biology and public health significance of marine fish parasitology (Noga, 2011; Rueckert, et. al., 2009). Thus, the identification of parasite species infecting and infesting tuna species will broaden the emerging information in fish parasitology and in the field of aquatic science.

Fish parasites are significant disease-causing agents of fishes both in freshwater and marine environments. They contribute to marine biodiversity and consist of almost 100,000 species (Jakob & Palm, 2006) while others are still unidentified and waiting to be discovered. Parasites have been reported from 172 of the more than 2,030 species of marine and freshwater fish occurring in Philippine waters and from another 17 species of freshwater aquarium fish, examined in the Philippines, but not found in natural waters. As of 1997, there were 201 named species of parasites that have been reported from Philippine fishes. These include (1) Apicomplexa, (16) Ciliophora, (2) Mastigophora, (1) Microspora, (9) Myxozoa, (90) Trematoda, (22) Monogenea, (6) Cestoda, (20) Nematoda, (5) Acanthocephala, (1) Mollusca, (2) Branchiura, (21) Copepoda, and (5) Isopoda (Arthur & Lumanlan-Mayo, 1997).

Fish is an important group of vertebrate. Fisheries sector is a significant mover of livelihood and income for the substantial portion of the country. Davao City Fish Port Complex, the largest fish port complex

in the city, is a primary source of marine fish in Region XI. The fish port complex is composed of several local fishermen with various sizes of fishing vessels. Majority of their catch are from the marine waters of Davao Gulf. Fish species from Davao City are distributed throughout all local markets (Tabay, et. al., 2006). Region XI is among the top regions in the Philippines that has foremost fish production. The region produced 293,000 tons of fish, and exported 84,288 tons in 2003; 77,356 tons in 2004; and 54,708 tons in 2005. Species landed included the *Auxis rochei* and *Auxis thazard*, locally known as “pirit”. The two species were considered as one of the important tuna species (Alcala, et. al., 2009).

The research will provide the status of metazoan parasite community and can be used in assessing the condition of marine environmental biology of these fish species. These parasites are natural component of the environment and may be viewed as indicators of the relative condition of an ecosystem. It can make their hosts less resilient to environmental stresses. Some are excellent and proficient of regulating host populations and they can make community structure poor through their unbeneficial effects. They can decrease market value of their fish host, while others are of public health significance. Those which are hazardous parasites tend to have complex life cycles which involve more than one type of host for development, and can include human as host (Vijayakumar & Veerappan, 2012). And due to the growing significance of marine aquaculture, apprehensions on pollution effects on fish health a generally increasing attentiveness in marine environmental biology and public health significance of marine fish parasitology (Moller & Anders, 1986).

A. rochei and *A. thazard* are endemic in the waters of Davao Gulf. Most fishermen capture these fish species from different districts of Davao City that are engaged along the coast of Davao Gulf. Tuna fish species, such as bullet tuna and frigate tuna, are the most dominant marketable fish in local and public markets. Several catch of these fish species can reach immediate provinces outside the city, which make them commercially important in Davao Region (Tabay, et. al., 2006). Consequently, parasitological study in primary marine fish will help post appropriate public health concerns.

This study aimed to determine the metazoan parasites of commercially significant fish species, particularly bullet tuna (*A. rochei*) and frigate tuna (*A. thazard*) collected from major fish public markets in Davao City, specifically this study aimed to answer the following questions:

1. What are the parasite communities of bullet tuna (*A. rochei*) and frigate tuna (*A. thazard*)?
2. What is the most observed parasite species in *A. rochei* and *A. thazard*?
3. What is the prevalence, abundance, and mean densities of parasite individuals found in infected hosts?
4. What public market establish most parasitic community?
5. What fish species harbor most parasite community?
6. What fish species harbor most parasite individuals?

2. Methodology

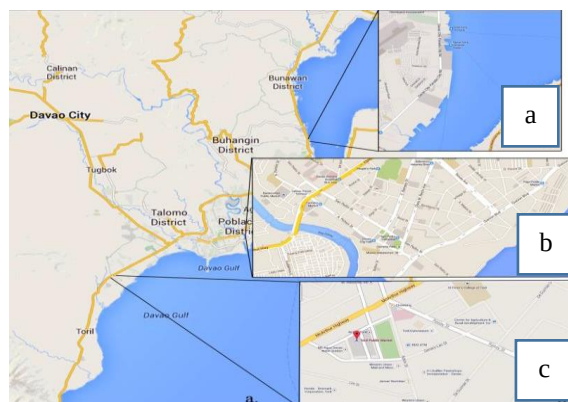
2.1. Research Design

Parasite individuals typically exhibit an aggregated distribution among host individuals; most hosts harbor few if any parasites and a few hosts harbor most of them. Descriptive statistics was used to describe parasitic infection of a single sample of hosts and to compare parasitic infections between two samples of hosts.

2.2. Research Locale

Fresh fish samples were collected from three markets of Davao City: Site A Public Market, Site B Public Market, and Site C Public Market. Fish samples were collected early in the morning from a trusted fisher folk seller posting in each market and examined it in the Laboratory.

Figure 1. Fish Sample Sources



The dissection and identification of fish parasites was conducted in the month of October 2019 to January 2020 at the Davao Doctors College (DDC) Laboratory, General Malvar Street, Davao City, Philippines.

2.3. Research Sampling

Three samples of *A. rochei* and *A. thazard* were collected from three different markets. Samples collected had a fork length range of 250mm to 400mm, and a weight range of 1.0 kg to 1.5 kg. The fish samples were stored in a tightly covered container and maintained frozen, to maintain freshness. Samples were delivered immediately to a Laboratory.

Table 1. Fish Sampling

	Site A			Site B			Site C		
S1	I1	I2	I3	I1	I2	I3	I1	I2	I3
S2	I1	I2	I3	I1	I2	I3	I1	I2	I3
*S1: sample 1 (<i>A. rochei</i>), S2: sample 2 (<i>A. thazard</i>)									
*I1, I2, I3: individuals per sample									

Fish samples biometrics were recorded (Table 2 and 3). External surface of the fish was observed for any visible pathogens and ectoparasites. Fish biometrics included the following parameters: body depth, eye diameter, head length, fork length, total length, and weight. Unit of measurement was in millimeter and ruler was used as measuring tool; gram was used for weight measurements and a triple-beam balance was used as a device for measurement. Body depth of the fish covers across the body, from the base of dorsal fin to the base of pelvic fin. Diameter of the eye was recorded. Head length is from tip of the stout to the tip of fish operculum. Fork length is from the tip of fish stout unto the lowest point of the caudal fin. Total length of the fish is from the tip of stout into the distal part of the caudal fin. Lastly, weight was recorded (Aloo, et.al, 2004).

Table 2. Biometrics of *Auxis rochei*

Fish location	Eye diameter	Head length	Fork length	Total length	Body depth	Weight
Sasa Market						
1	20mm	105mm	390mm	470mm	115mm	1.5kg

2	22mm	110mm	390mm	470mm	110mm	1.5kg
3	20mm	117mm	402mm	482mm	110mm	1.5kg
Toril Market						
1	17mm	104mm	351mm	397mm	104mm	1.2kg
2	14mm	83mm	288mm	328mm	73mm	1kg
3	13mm	90mm	315mm	363mm	45mm	1kg
Bankerohan Market						
1	15mm	81mm	316mm	363mm	72mm	1kg
2	16mm	92mm	337mm	389mm	90mm	1kg
3	18mm	92mm	344mm	396mm	80mm	1.2kg

Table 3. Biometrics of *Auxis thazard*

Fish location	Eye diameter	Head length	Fork length	Total length	Body depth	Weight
Sasa Market						
1	20mm	131mm	423mm	487mm	110mm	1.5kg
2	19mm	126mm	419mm	483mm	107mm	1.3kg
3	20mm	130mm	430mm	500mm	110mm	1.5kg
Toril Market						
1	18mm	112mm	398mm	453mm	89mm	1.3kg
2	16mm	102mm	350mm	395mm	85mm	1.3kg
3	13mm	93mm	328mm	369mm	74mm	1.1kg
Bankerohan Market						
1	20mm	91mm	311mm	362mm	84mm	1.5kg
2	17mm	96mm	293mm	338mm	73mm	1.4kg
3	16mm	81mm	290mm	340mm	78mm	1.3kg

Dissection followed where fish species were opened dorso-ventrally, and exposing their gut and digestive tract to their gills. Stainless scissors and blade were used for cutting and forceps for holding. While opening the fish, it was recommended to drop saline solution from time to time into the exposed internal organs of the fishes, to prevent dehydration of tissues and to preserve the morphology of parasites, if they were present (Aloo, et.al, 2004).

Figure 2. Body Cavity and Internal Organ Parasitological Examination



a. Preparing the fish for biometrics b. Examining the fish for ectoparasites



c. Parasitological examination of the gills



d. Fish dissection

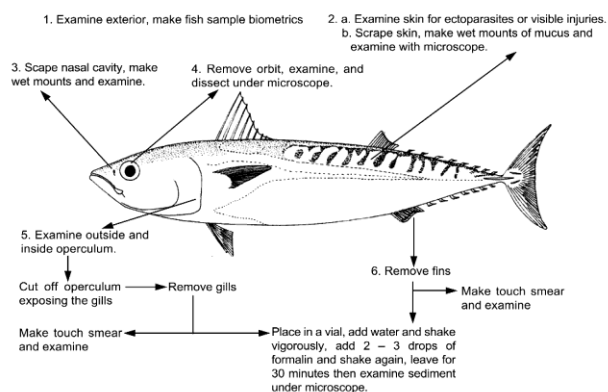


e. Examining the fish for endoparasites

2.4. Fish Parasitological Examination

First, each fish was examined for the presence of ectoparasites (Figure 3). The external part of each fish samples was examined for potential abnormalities caused by parasitic infection and infestation. Each fish sample was opened dorso-ventrally. Endoparasitic examinations were conducted and internal organs were examined for parasites. The entire digestive system was removed and placed in a Petri dish with physiological saline and the gut was divided into sections for further examinations of macroscopic parasites. Parasitological examination was aided with microscope for parasite description and identification (Aloo, et.al, 2004).

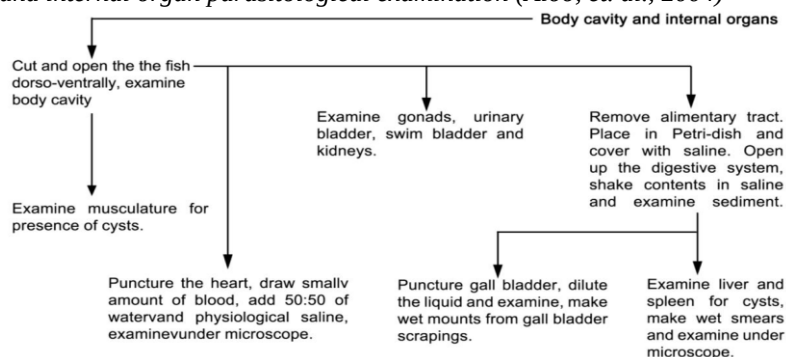
Figure 3. Fish ectoparasite examination (Aloo, et. al, 2004)



Internal organs, such as gonads, urinary bladder, swim bladder, and kidneys were punctured, diluted in liquid, and examined under microscope. Wet mounts of scrapings from the walls of the gut were obtained and view under microscope. Musculatures were scanned for possible presence of parasite cysts forms. Heart

was punctured and drawn in a vial with 50:50 solutions of water and physiological saline, and examined under microscope (Aloo, et. al., 2004).

Figure 4. Body cavity and internal organ parasitological examination (Aloo, et. al., 2004)



Parasites were treated as follows: Nematodes were boiled in water and straightened for measurement and taxonomic identification. Cestodes were placed in distilled water inside vials and left overnight in a refrigerator for determination the scolex morphology at its taxonomic importance. Trematodes were pressed between two microscope glass slides with glacial acetic acid which rendered transparent and allowed the internal organs visible and easy to examine. A 10% formalin fixative in water was used as overall fixative for suspected ova and cysts that preserved their internal morphology. Each parasite was further examined for morphological description and identification (Aloo, et. al., 2004).

2.5. Statistical Tools for Parasitic Infection

The number of observed and collected parasite species were counted and recorded for *A. rochei* and *A. thazard*. Parasites recovered were noted. Their number on each species was recorded, also location of infection on the host was noted. The prevalence, density, and mean abundance were determined. Prevalence is computed by dividing the total number of infected fishes with the total number of fish host examined and multiplied with 100. Abundance is the total number of parasites recovered divided by the total number of fish hosts examined. Mean density is equal to the total number of parasites recovered divided by the total number of infected fishes (Akter, et. al., 2007).

Figure 5. Statistical tools (Akter, et. al., 2007)

$$\begin{aligned}
 \text{Prevalence} &= \frac{\text{Total number. of infected fishes}}{\text{Total number of fishes hosts examined}} \times 100 \\
 \text{Abundance} &= \frac{\text{Total number of parasites recovered}}{\text{Total number of fish hosts examined}} \\
 \text{Mean density} &= \frac{\text{Total number of parasites recovered}}{\text{Total number of infected fishes}}
 \end{aligned}$$

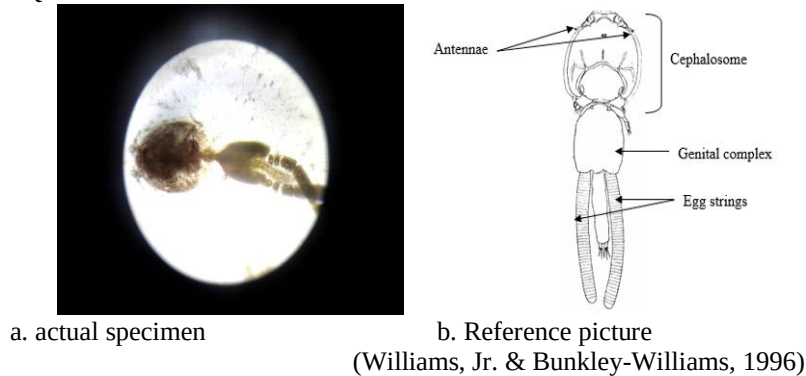
3. Results and Discussion

3.1. Identification of Parasites

Parasites that are common in fishes include helminthes, protozoans, and some crustaceans (Chandra, 2006). Ectoparasites inhabit the skin or outgrowths of the skin of another organism and may be detrimental. Endoparasites are internal parasites causing diseases to fish host which may result to low body gain and high mortality. They mostly inhabit the digestive tract and other organs of the fish (Eissa, et. al., 2011).

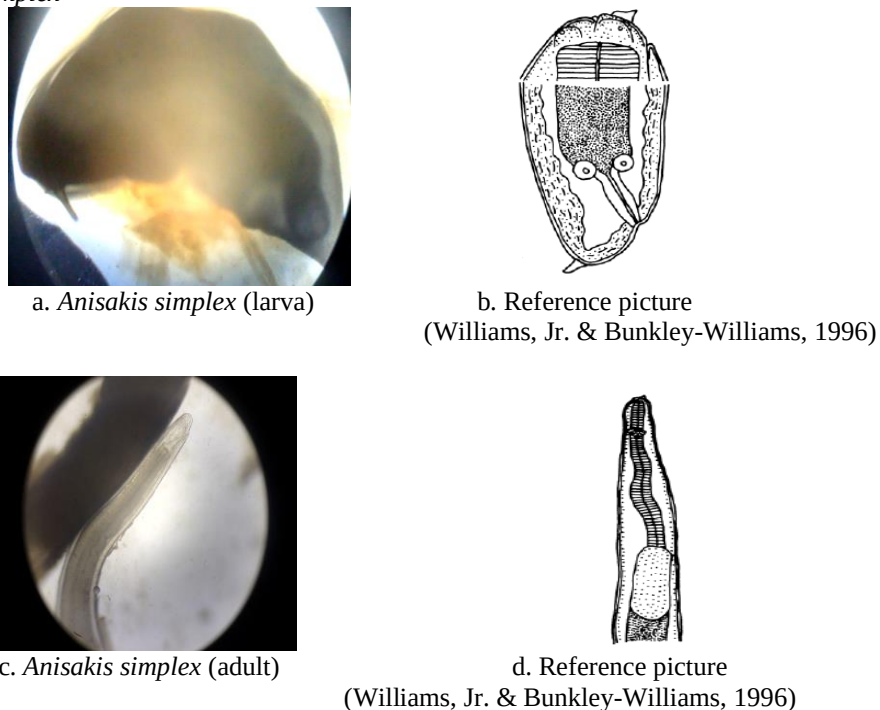
Out of 18 fish examined, all *A. rochei* from Site A public market were infected with copepods, *Caligus quadratus*, found inside the mouth (Figure 5).

Figure 5. *Caligus Quadratus*

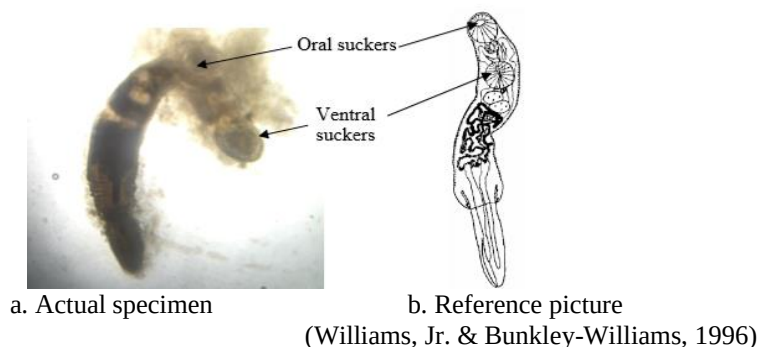


Out of 18 fish studied, all *A. rochei* from Site A public market were infected with larva and adult nematode, *Anisakis simplex* (Figure 6) in their mesenteries surrounding the gut and internal organs whereas larval nematodes were found invading the flesh of the fish.

Figure 6. *Anisakis Simplex*

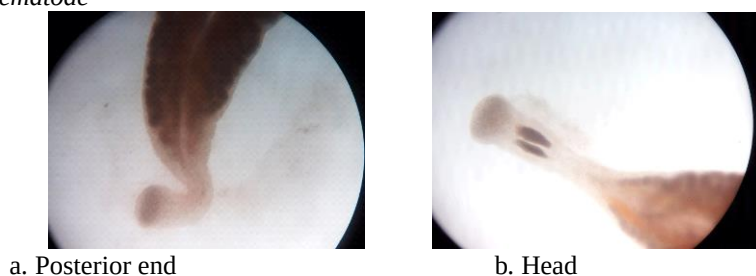


One *A. rochei* from Site C public market was infected with trematodes, *Dinurus scombri* inside the stomach (Figure 7).

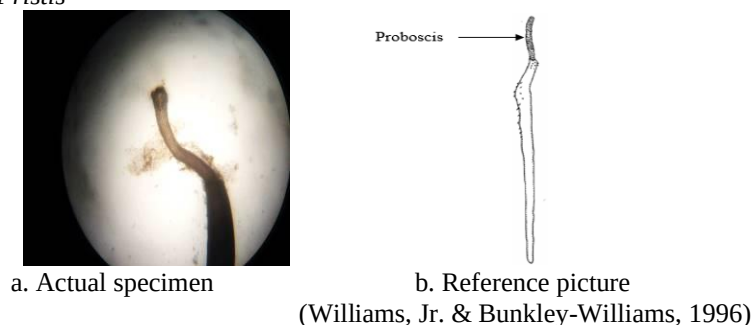
Figure 7. *Dinurus Scombri*

Another trematode species was found in the gills on two *A. rochei* from Site B public market (Figure 8), and identified as a Monogenean trematode.

Figure 8. Monogenean Trematode



All *A. rochei* collected from Site A public market and Site C public market and all *A. thazard* from Site C public market and one *A. thazard* from Site C public market were infected with acanthocephalans, *Rhadinorhynchus pristis* (Figure 9) found in large number in fish intestines and few in stomach.

Figure 9. *Rhadinorhynchus Pristis*

3.2. Prevalence, Abundance, and Mean Densities of Parasites

A. rochei were found to be infected with five different species of parasites. In Site A market, *C. quadratus*, *A. simplex*, and *R. pristis* (100%) were the most prevalent. In Site B market, only monogenean trematodes were found with 67% prevalence value. Lastly, in Site C market, *R. pristis* (100%) was the most

prevalent and this was followed by *D. scombri* (33%). Overall, the most prevalent parasites in *A. rochei* are *C. quadratus*, *A. simplex*, and *R. pristis*. They were present in all examined *A. rochei*. They were followed by the unidentified monogenean trematode. *D. scombri* was the least prevalent parasite found in *A. rochei*. On the other hand, only *R. pristis* was found to infect *A. thazard*, which were obtained from the three markets. *R. pristis* was most prevalent in Site A market and Site B market with a prevalence value of 100% whereas in Site C market, its prevalence value was only 33%.

Abundance of parasites was also calculated. In Site A market, the most abundant parasite of *A. rochei* was the *A. simplex* with an abundance value of 30.67. This was followed by *R. pristis* which was 20.67 and *C. quadratus* which was 5.00. Moreover, only monogenean trematodes were found to infect *A. rochei* with an abundance value of 1.00. In Site C market, the most abundant parasite found on *A. rochei* was *R. pristis* (41.33) and followed by *D. scombri* (2.67). Generally, the most abundant parasites of *A. rochei* was *R. pristis*, with a total abundance value of 62.00, followed by *A. simplex*, *C. quadratus*, and *D. scombri*. The least abundant parasites were the monogenean trematodes. In contrast, *R. pristis* found in *A. thazard*, which were obtained from Site C market was the most abundant (26.67). This was followed by *A. thazard* bought from Site B market (8.33) and the least abundant was in *A. thazard* from Site A market (5.67).

Mean densities of parasites were also computed. In Site A market, *A. simplex* isolated from *A. rochei* had the highest mean density value (30.67), followed by *R. pristis* (20.67). *C. quadratus* had the lowest mean density value (5.00). Furthermore, in Site B market, monogenean trematodes had a mean density value of 1.50. Lastly, in Site C market, the parasite with the highest mean density value was *R. pristis* (41.33) and the parasite with the lowest mean density value was *D. scombri* (8.00). Overall, *R. pristis* had the highest mean density value from *A. thazard* bought from the three markets with a total mean density value of 62.00, followed by *A. simplex*, *C. quadratus*, and *D. scombri*. Monogenean trematodes were the parasites of *A. rochei* with the lowest mean density value. On the other hand, *R. pristis* isolated from *A. thazard* from Site C market had the highest mean density value (80), followed by *R. pristis* isolated from *A. thazard* from Site B market (8.33). *R. pristis* obtained from *A. thazard* from Site A market got the lowest mean density value (5.67).

Based on the results, it was Site C market had the greatest parasitic community with a total number of 212 parasites. Moreover, the fish species with the greatest number of parasitic community was *A. rochei* with a total number of 304 parasites and the fish species with the greatest number of parasitic individuals was *A. rochei* with five distinct species namely *C. quadratus*, *A. simplex*, *R. pristis*, monogenean trematodes, and *D. scombri*.

Table 4. Prevalence, Abundance, and Mean Density of Parasites

Species	Location	# of fish examined	# of fish infected	# of parasites	Isolated parasites	Prevalence %	Abundance	Mean Density
<i>A. rochei</i>	Site A	3	3	15	<i>C. quadratus</i>	100	5.00	5.00
			3	92	<i>A. simplex</i>	100	30.67	30.67
			3	62	<i>R. pristis</i>	100	20.67	20.67
	Site B	3	2	3	Monogenean trematode	67	1.00	1.50
	Site C	3	3	124	<i>R. pristis</i>	100	41.33	41.33
			1	8	<i>D. scombri</i>	33	2.67	8.00
<i>A. thazard</i>	Site A	3	3	17	<i>R. pristis</i>	100	5.67	5.67
	Site B	3	3	25	<i>R. pristis</i>	100	8.33	8.33
	Site C	3	1	80	<i>R. pristis</i>	33	26.67	80

The abundance and occurrence of the parasites directly links to the distribution, migration patterns and population biology of their hosts and can be used for stock identification and even risk assessment of fish food-borne zoonoses (Palm, 2011). Furthermore, the major factors to determine fish parasite fauna and prevalence of infestation in marine environments include: diet of the host, lifespan of the host, the mobility of

the host throughout its life as well as the variety of habitats it encounters, its population density and the size attained, with large hosts providing more habitats suitable for parasites than small ones. Prevalence was correlated with the size of the fish host. One major reason for this observation is that as the fish grows, the quantity of food it consumes increases. Bigger fishes have the tendency to cover wider areas in search of food. Thus, they take more food than smaller ones and these expose them more to parasite infestation (Aloo, et. al., 2004; Omeji, et. al., 2013). In this study, *A. rochei* was observed to have the richest metazoan parasite community and it was also observed that *A. rochei* had greater size than *A. thazard*. Moreover, from all the locations where the fishes were brought, it was in Site A market where the fishes acquired various species of parasites. This is possibly due to the effect of pollutants from some factories located nearby, which might stress the fish and at the same time enhance the increase in parasite population. On the other hand, fishes bought from Site C market acquired the greatest number of parasites with a total of 212 parasites. This is certainly due to the presence of residents inhabiting near the marine environment and their activities. Fish in polluted waters tended to harbor more parasites than those from less polluted environments. Therefore, high infestation in these fishes could be attributed to the sanitary condition and location of the marine environment from residential areas, number and class of people visiting the marine environment, and their purposes (Omeji, et. al., 2013).

In this study, the parasites that were observed to be the most prevalent, most abundant, and with the highest mean density value were the acanthocephalans (*R. pristis*). Pathogenicity of acanthocephalans is primarily initiated by two factors: density of worms and depth of parasite penetration into the host tissues. Recently, laboratory researches confirmed that infections with acanthocephalans can lessen heavy metal burdens in the host when comparing uninfected fish with infected conspecifics. As a result of their vast accumulation capacity, parasites such as acanthocephalans can concentrate toxic chemicals, such as heavy metals, even though the ambient concentrations are far below the detection limits – this is beneficial particularly in some less polluted environments or for substances in very low concentration ranges (Sanil, et. al., 2010; Nachev, 2010).

4. Recommendations

Based on the findings of this study, the following were recommended for further consideration for future studies:

- A higher magnification of the microscopes for better focus on the parasites, especially SEM pictures is highly recommended particularly in identifying acanthocephalans, so that the hooks on the proboscis can be counted. The hooks are important in identifying acanthocephalan species.
- Most importantly, a scale on the photograph is highly needed to determine the size of each specimen; thus it is suggested to use a scale bar or ocular micrometer.
- The number of fish to be examined could be increased to obtain reliable results. Hence, further longer-term investigations are needed.
- Further investigation of fish parasites is significant as it provides information for the health safety of the consumers, particularly precautionary measures in handling, preparing, and cooking to avoid parasitic infestation and infection. Although majority of parasites existing in the fish are not exceedingly hazardous to human health, but humans are accidental hosts and become infected by ingesting raw or improperly cooked fish dishes. Thus, public health awareness of fish parasites is important.

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