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Research

Prevalence of Parasites in Fish from The Pelagic and Benthic Zones

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ABSTRACT

The present research is a comparative study on the prevalence of parasites in marine finfish among the two major marine zones; namely the pelagic zone and benthic zone. The objectives of the present study were to investigate the parasite prevalence in both zones, as well as to determine the effect of differing marine zones regarding the presence of parasites in fish. A total of 30 individual fish occurring in pelagic and benthic zones were randomly selected from three different fishmongers at a wet market in Bintulu, Sarawak. Both the gill and stomach content of the samples were examined to detect the presence of parasites. Nematodes and trematodes were observed in the intestinal tract of the fish, *Cymothoa exigua* was found attached to the fish tongue, and monogenean parasites were also detected on the gills. The prevalence of the parasite was roughly equal in *Setipinna breviceps*, *Ilisha megaloptera,* and *Selaroides leptolepis.* The highest prevalence of parasites (87.50%) from fish in the benthic zone based on fish size was for fish measuring between 20.1 - 30.00 cm in total length (*P*-value=0.3778), whereas for pelagic fish, the highest prevalence of parasites (100%) in fish measurements of 30.1 – 40.0 cm in total length (*P*-value=0.0044). A major factor for the diversity of marine fish parasites occurring in the different zones is the difference in feeding behavior of the hosts and depth distribution which resulted in low or high rates of parasite infestation.

Key words: Benthic, fish, marine, pelagic, parasites

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INTRODUCTION

Parasites comprise a sizeable proportion of the diversity of life on earth (Price, 1980). Parasites are organisms that are dependent on host organisms to survive; parasites can be broadly divided into ectoparasites and endoparasites (Bailey, 2017). Endoparasites are those found within the body cavity of their host whereas ectoparasites are those attached to the exterior of their hosts (Jithin *et al*., 2016). Parasitic infections in fin fishes are common and occur in both freshwater and marine environments (Campbell *et al*., 1980; Hilderbrand *et al*., 2003; Mahsol *et al*., 2014). Parasitic infestations in fish pose a serious threat to human health, aquaculture, and fisheries (Khalil *et al*., 2014). Many fish parasites are highly adapted to their fish host and require them to complete their life cycle (Klimpel *et al*., 2006). Especially in marine environments where there is a vast diversity of ecosystems, parasites have adapted to their host feeding behavior, depth

distribution, host migration patterns, and other variables inherent to their chosen environment (Klimpel *et al*., 2006). Some common parasites of fish include protozoans, flagellates, nematodes, trematodes, cestodes, and crustaceans (Klimpel *et al*., 2006), despite the abundance of fish parasites only a few species are known to be harmful to human health (Adams *et al*., 1997). According to the Food and Drug Administration, FDA (2011), larval stages of parasites occurring in uncooked or undercooked seafood have the potential to cause mild-to-moderate illness with severe reactions being a remote possibility. The most common parasites found in marine fish are nematodes (FDA 2011; 2012). Infection of mammals with fish parasites is mainly due to the consumption of infected fish (Adams *et al*., 1997). The human gastrointestinal tract is not a suitable environment for most nematodes, the majority of species do not survive more than 10 days in the human digestive system (Hilderbrand *et al*., 2003). The greatest risk factor for any fish-borne parasitic zoonosis is the consumption of raw or improperly cooked fish (Khalil *et al*., 2014). Especially in Southeast Asia where the consumption of raw fish is a regional norm, fish-borne parasites can be a major public health concern (Xayaseng *et.* al., 2013). Thus, the present study was carried out to compare the prevalence of parasites in marine finfish found within two major marine zones; the pelagic zone and the benthic zone. These fish were commercially available for human consumption at the local wet markets of Bintulu, Sarawak. The study investigated the prevalence of different species of parasites found in fish from these two marine zones.

MATERIALS AND METHODS

Fish sampling

A total of 30 fish were purchased from three different wet markets around Bintulu, Sarawak. These markets were the ABF Kidurong Market, Kampung Baru Market, and Pasar Tamu Market. Freshly landed fish were purchased randomly from vendors and their length and weight were recorded in situ. The fish samples were brought to the Aquatic Biotech Laboratory and Wet Laboratory, Academic Centre Complex, Department of Animal Science and Fisheries, Faculty of Agricultural and Forestry Sciences, Universiti Putra Malaysia Bintulu Sarawak Campus for further analysis. Subsequently, the fish samples were identified down to species level and their respective distribution zones whether pelagic or benthic. This was achieved using morphology and marine zone distribution was determined using Fishbase (https://www.fishbase.se).

Parasite samples

Parasite analysis was carried out at the Aquatic Biotech Laboratory and Wet Laboratory, Academic Centre Complex, Department of Animal Science and Fisheries, Faculty of Agricultural and Forestry Sciences, Universiti Putra Malaysia Bintulu Sarawak Campus**.** Fish samples were kept frozen in a chest freezer at -20 °C until use. Parasite samples were obtained by scraping the mucus of the fish samples' gills and gut, and by dissection of the intestines. Samples were observed under magnification using a Leica Zoom 2000 (Model, Gxm L3200) and Leica CME microscope. Collected samples were mounted on slides and observed under magnification of 4x, 10x, and 40x. Some parasites were visible to the naked while others required microscopic magnification. The number of parasites on each fish was recorded and any parasites found were identified morphologically as described by others (Woo, 1995).

Statistical analysis

All data was recorded in Microsoft Excel 2013. The data were analyzed using Analysis of Variance (ANOVA) at 5% using Statistical Analysis Software (SAS) version 9.2. The Fisher's Exact Test was carried out to determine the significance of all possible pair's treatment mean.

RESULTS

From the 30 specimens examined, 20 (66.67%) individual fish were found to be from the pelagic zone whereas 10 (33.33%) individual fish were from the benthic zone. From the analysis carried out 40% of examined fish from the pelagic zone were positive with endoparasites (Table 1). No parasitic infections were found in all samples of three species of fish (*Setipinna breviceps*, *Ilisha megaloptera,* and *Selaroides leptolepis)* examined. As shown in the following Table 1.0, 66.67% of Spanish mackerel (*Scomberomorus commerson)* samples were infected with endoparasites. Half (50%) of the Herring Scad (*Alepes vari*) samples were found to be housing endoparasites. There were no endoparasites detected on hairfin anchovy (*Setipinna breviceps*), big eye Ilisha (*Ilisha megaloptera*), and yellow strip scad (*Selaroides leptolepis*) samples. On the other hand, 100% of all samples of hardtail scad (*Megalaspis cordyla)*, mackerel tuna (*Euthynnus affinis*), and painted sweetlips *(Diagramma pictum)* were positive with endoparasites. There was no significant difference found between the species infected with parasites (*P*-value = 0.73) at a 0.05 level of significance.

Table 1. Prevalence of endoparasites among marine fish from the pelagic zone

Types of Fish (Common name/Local name/ Scientific name)	Number examined	Number positive	Prevalence (%)
Big Eye Scad /*Selar Bulat*/ *Selar crumenophthalmus*	4	1	25
Hairfin anchovy */ Empirang / Setipinna breviceps*	4	0	0
Big Eye Ilisha /*Puput*/*Ilisha megaloptera*	1	0	0
Spanish Mackerel /*Tenggiri*/ *Scomberomorus commerson*	3	2	66.67
Herring Scad /*Talam-talam*/ *Alepes vari*	2	1	50
Yellowstripe Scad /*Selar Kuning*/ *Selaroides leptolepis*	2	0	0
Hardtail Scad /*Cencaru*/ *Megalaspis cordyla*	2	2	100
Mackerel Tuna /*Tongkol*/ *Euthynnus affinis*	1	1	100
Painted Sweetlips /*Seminyak*/ *Diagramma pictum*	1	1	100
Total	20	8	40%

P-value= 0.73

In terms of fish species from the benthic region, 80% of the study samples were found to be positive with endoparasites (Table 2). However, there was no statistically significant difference found between parasite-infected benthic species in this study (*P*-value=0.4652) at a 0.05 level of significance. One out of two samples (50%) of silver pomfret (*Pampus argenteus*) were found to be infected with endoparasites whereas two out of three samples (66.67%) of black pomfret (*Parastromateus niger*) were found to be positive with parasites. All samples (100%) of both six banded grouper (*Epinephelus sexfasciatus*) and Indian Halibut (*Psettodes erumei*) were positive with endoparasites.

Table 2. Prevalence of endoparasites among marine fish from the benthic zone

Types of Fish (Common name/Local name/ Scientific name)	Number examined	Number positive	Prevalence %
Silver Pomfret /*Bawal Putih*/ *Pampus argenteus*	2	1	50
Black Pomfret /*Bawal Hitam*/ *Parastromateus niger*	3	2	66.67
Six Banded Grouper /*Kerapu Belang*/ *Epinephelus sexfasciatus*	2	2	100
Indian Halibut /*Sebelah*/ *Psettodes erumei*	3	3	100
Total	10	8	80

P-value= 0.4652

In Table 3, it was found that the prevalence of parasites in fish from the benthic zone was higher (80%) in comparison to those from the pelagic zone (40%). However, statistically, there was no significant difference in terms of parasite prevalence in terms of marine zones (*p*-value = 0.0577) at a 0.05 level of significance.

Table 3. Prevalence of parasites in fish zone

Fish Zone	Number Examined	Number Positives	Prevalence %
Pelagic	20	8	40.0
Benthic	10	8	80.0
Total	30	16	53.3

P-value =0.0577

Prevalence of parasites based on fish size

From Table 4 it is shown that all samples of fish within the size range of 30.1 – 40.0 cm were infected with parasites (100%) whereas there was no parasitic infection detected in fish within a size range of 10.1 – 20.0 cm. Finally, 50% of the fish samples with a size range of 40.1 – 50.0 cm were infected with parasites.

Table 4. Prevalence of Parasites among pelagic zones based on the sizes

Fish Sizes (cm)	Number Examined	Number Positives	Prevalence %
10.1 – 20.0	1	0	0.00
20.1 – 30.0	12	2	16.67
30.1 – 40.0	5	5	100.00
40.1 – 50.0	2	1	50.00
Total	20	8	40.00

P-value= 0.0044

From Table 5 it is shown that there was a higher prevalence of parasites on benthic fish within a size range of 20.1 – 30.0 cm (87.5%). However, no significant difference was detected in terms of the prevalence of parasites and sizes of benthic fish in this study.

Table 5. Prevalence of parasites among benthic zones based on the sizes

Fish Sizes (cm)	Number Examined	Number Positives	Prevalence %
10.1 – 20.0	2	1	50.00
20.1 – 30.0	8	7	87.50
Total	10	8	40.00

P-value= 0.3778

Distribution of parasite

The majority of endoparasites found in the present study comprised of Isopods, (Figure 1) and monogeneans (Figure 2) which were found infecting the mouth and gills of infected fish. In terms of endoparasites, trematodes (Figure 3) and nematodes were found in the gastrointestinal tract and organs of infected fish. Table 6 shows the distribution of fish parasites from the three sampling sites (wet markets) of this study as well as the site of infection found in the study samples.

Fig. 1. *Cymothoa exigua* found in *Psettodes erumei* mouth cavity.

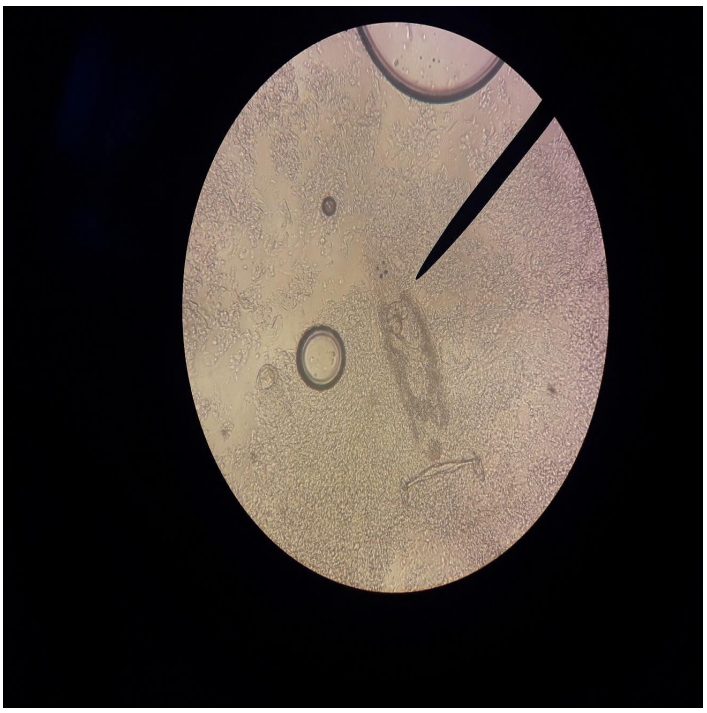

Fig. 2. Monogean found in the gills of the fish sample observed under a microscope (40x mag.).

Fig. 3. Trematodes found in *Ilisha megaloptera* intestine observed under a microscope (40x mag.).

Table 6. Distribution of fish parasites from 3 different wet markets and sites of infection in fish samples

Market	Fish species	Parasites	Site of infection
Market A	Big Eye Scad (*Selar crumenophthalmus)*	Sea lice, *Cymothoa exigua*	Mouth
	Silver Pomfret (*Pampus argenteus)*	Trematodes	Intestine
	Black Pomfret (*Parastromateus niger*)	Trematodes	Intestine
	Indian Halibut (*Psettodes erumei*)	Sea lice, *Cymothoa exigua*	Mouth
		Nematodes	Kidney
	Tenggiri (*Scomberomorus commerson*)	Trematodes	Intestine
	Mackerel Tuna (*Euthynnus affinis*)	Monogenian	Gills
	Painted Sweetlips (*Diagramma pictum*)	Trematodes	Intestine
	Hardtail Scad (*Megalaspis cordial*)	Trematodes	Intestine
	Six Banded Grouper (*Epinephelus sexfasciatus*)	Trematodes	Intestine
Market B	Herring Scad (*Alepes vari*)	Monogeneans	Gills
	Yellowstrip Scad (*Selaroides leptolepis*)	NA	NA
	Hardtail Scad (*Megalaspis cordial*)	Trematodes	Intestine
Market C	*Empirang* (*Setipinna breviceps*)	NA	NA
	Big Eye Ilisha (*Ilisha megaloptera)*	NA	NA

n= total number of parasite, NA= not applicable

DISCUSSION

In the present study, it was found that 8 out of 20 fish samples from the pelagic zone were positively infected with endoparasites. There were no parasites detected in samples of *Setipinna breviceps*, *Ilisha megaloptera,* and *Selaroides leptolepis*. For fish samples from the benthic zone, 8 out of 10 samples were positive for parasites. All study samples of *Epinephelus sexfasciatus* and *Psettodes erumei* in this study were found to be infected with parasites. The results of our study showed that there was no significant difference in the prevalence of parasites in terms of fish from both benthic and pelagic zones. These findings are contradictory to prior studies by Houston and Haedrich (1986) which showed that fish from the benthic zone had a higher prevalence of parasites (53.1%) in comparison to fish from the pelagic zone (28.9%). In contrast, Khan (2012) found that the prevalence, species, abundance, and diversity of the parasitic helminth taxa, trematodes, nematodes, and cestodes, were significantly higher in pelagic fish in comparison to mid-water-benthic fish species. The variations in findings between the present and prior studies may have been due to sample size, number and type of species sampled, method of parasite detection as well as season and sampling period (Amarante *et al*., 2015).

Our study found a relationship between fish length and parasitism with a higher prevalence of parasite infestation in fish measuring 30.1- 40.00 cm. Among benthic fish, the smaller sizes (10.1 – 20.0 cm) were found to be less infected than medium-sized fish (20.1 – 30.0 cm). In pelagic fish, the larger fish (30.1 – 40.0 cm) were highly infected with parasites in comparison to medium-sized (20.1 – 30.0 cm) and smaller (10.1 – 20.0 cm) fish. According to Hilderbrand *et al*. (2003), larger fish are often more prone to parasitic infection due to their older age and hence longer exposure to the parasite sources in comparison to smaller and younger fish. Several prior studies have found a correlation between the body length of fish about parasite diversity and prevalence (Hilderbrand *et al*., 2003; Luque *et al*., 2004). Bigger fish have a greater number of parasites as these big fish have bigger space (Luque *et al*., 2004), good nutrient content, and higher available energy to support the growth of parasite species (Griffiths, *et al*., 2017).

CONCLUSION

The findings of the present study showed that there was no significant difference found in terms of the prevalence of parasites in fish from two different marine zones. This may have been due to the limitations of the present study sampling methods as well as sample size. Future studies could increase the sample size as well as the number of sampling sites. The present study found that trematodes found mainly in the intestinal tract of fish samples were the most commonly detected parasite. Nematodes were also found in fish organs as well as monogeneans in the fish gills. Larger fish were found to have notably higher rates of parasitic infections in comparison to smaller fish. Despite its limitations, the study showed the high rate of parasitic infection of fish sold for human consumption in the local markets of Bintulu, Sarawak. Thus, the data collected will be useful, especially given the local cultural habit of consuming raw fish as part of the normal diet. Fish such as Spanish Mackerel and black pomfret with a high parasite prevalence of 66.67% in samples studied are commonly used in local raw fish dishes such as Umai (Aini *et al*., 2020). The data will be useful to formulate suitable measures that can be taken during processing or post-processing by the consumer to mitigate and reduce the risk of infection.

ETHICAL STATEMENT

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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