

Parasite infestation patterns in nine families of coral reef fishes from Saint Martin's Island, Bay of Bengal

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Abstract

The present investigation aimed to observe the parasite infestation patterns in 9 families of coral associated fishes. A total 60 fish individuals were collected from Saint Martin's Island, preserved and investigated during the study period from June, 2024 to July, 2025. A total of 42 parasites under 8 species were collected from 17 infected fishes. Among them two species of nematode (*Camallanus intestinalis* and *Contracaecum* sp.); three species of isopod (*Anilocra* sp., *Cymothoa exigua* and *Argathona* sp.); two species of copepod (*Caligus irritans* and *Lernanthropus* sp.); and a single species of pentastomida (*Sebekia okavangoensis*) were identified. The overall prevalence and intensity of parasites infestation were 28.33% and 2.47 ± 2.4 respectively. The prevalence and intensity of ectoparasites (15%, 2.89 ± 2.8) were slightly higher than the endoparasites (13.33%, 2 ± 1.8). Comparatively higher prevalence and intensity were found in female fish (17.39%, 3 ± 2.4) than in male (10.81%, 1 ± 0) and were found to be statistically significant at $p < 0.05$ [ectoparasite ($\chi^2 = 8.89$, $p = 0.0117$); endoparasite ($\chi^2 = 6.84$, $p = 0.0327$)]. Gills and intestines were the most dominant sites where parasites live with the highest prevalence (11.67%) and intensity (3.29 ± 2.8), observed in the gills. On the other hand, the most dominant parasite species were *Caligus irritans* (21.4%), and *Contracaecum* sp. (21.4%). Among the length-weight groups of fish, the highest prevalence (100%) was observed in the length between 34.51 cm-37.50 cm, and the 151 gm-200 gm weight groups. However, the prevalence and intensity of parasite infestation in relation to the length and weight of the host fish were not statistically significant.

1. Introduction

Geographically, St. Martin's Island is positioned between latitudes 20°34'–20°39'N and longitudes 92°18'–92°21'E. It is distinguished by a nine km-wide channel from the mainland (Hossain & Islam, 2006). Coral reefs are essential ecosystems that support a vast array of marine life, especially fish. Corals, sponges, and other bottom-dwelling organisms create the complex structures with a wide range of microhabitats. Reefs are essential to the balance of the marine ecosystem because they provide fish with shelter, spawning sites, and feeding

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possibilities (NOAA, 2015). The most abundant coral reef-associated fish families, like Pomacanthidae, Holocentridae, Caesionidae, Carangidae, Chirocentridae, Siganidae, Psettodidae, Scaridae, and Terapontidae, are prominent constituents of coral reef communities, contributing to both ecological stability and fisheries productivity (Allen & Erdmann, 2012).

Parasites are ubiquitous, abundant, and diverse components of ecosystems and acknowledged to perform crucial functions in ecosystems (Mouritsen & Poulin, 2005). Parasites play important roles in the ecosystem by influencing the trophic interactions and facilitating energy transfer through parasitic relationships. Broadly, parasitism is considered one of the most widespread strategies for obtaining food among organisms in nature (Lafferty *et al.*, 2008). This coral reef associated fish species are infected by a wide array of parasites and pathogens such as cestodes, trematodes, nematodes, protozoans, acanthocephalans, and arthropods (Marcogliese, 2008). They are also recognized as valuable biological indicators of environmental factors, including food web structure, heavy metal contamination, pollution levels, climate change, and fish stock status (Bao *et al.*, 2019). The presence of parasites in fish can lead to reduced fish size, value, and quality, thereby negatively impacting their marketability (Gustilo *et al.*, 2022). More importantly, as the fish are a staple food and the region, where consumption of raw fish is common, they pose a significant risk of fish-borne parasitic diseases to human (Bao *et al.*, 2022).

Identifying fish parasites enhances research capabilities and educational programs and provides valuable information and training for scientists, veterinarians, and fishery managers. Understanding the diversity of marine life and the roles parasites play in the ecosystem is aided by their identification. The investigation of coral-associated fishes on St. Martin's Island aims to integrate parasite identification and listing with coral reef ecosystem functioning. From the economic point of view, to control the parasitic infection of fishes, it is important to know about the parasites and their way of life that they undertake to develop in the fisheries sector. A few taxonomic studies on Saint Martin's fish have been conducted, and associated parasites have been studied in different countries, but not in Bangladesh. Research on coral fish parasites would be of great importance for understanding the reef ecosystem, health implications, sustainable fisheries management, and biodiversity conservation. So, the main objective of the study was to identify the parasites and determine their prevalence, intensity and abundance in relation to sex, length groups and weight groups, and different organs of the fishes collected from the coral-associated Saint Martin's Island.

2. Materials and Methods

2.1 Sampling of fish

A total of 60 host individuals of fish among 9 families [Pomacanthidae (*Pomacanthus annularis*), Holocentridae (*Sargocentron rubrum*), Caesionidae (*Caesio cuning*), Carangidae

(*Alectis indica*), Chirocentridae (*Chirocentrus dorab*), Siganidae (*Siganus sutor*), Psettodidae (*Psettodes erumei*), Scaridae (*Scarus taeniopterus*), and Terapontidae (*Terapon jerbua*)], where each family belongs to one species of host fish were collected from the local fishermen and fish landing stations of Saint Martin's Island and examined for parasite infestation. Commercially caught dead fish is acceptable for parasitological investigations, particularly when fresh specimens were collected immediately after capture and processed appropriately. Fish samples were primarily collected directly from fishing vessels operating around Saint Martin's Island. Sampling was conducted immediately upon arrival of the vessels at the landing station. Since tourism is prohibited from April through September, samples were collected six times between October and March of each year. Hence, sample size too small in each family. Total study duration was the period from June, 2024 to July, 2025.

2.2 Measurement of length and weight and sex of host fishes

The total length and weight of individual fish were measured respectively with a centimeter scale and an extremely sensitive single-pan digital analytical balance. Sex of the host fishes was determined by locating the gonad of the fishes. The procedure was adopted to identify the sex of the host fish from the published keys (Day, 1878; Lagler, 1956; Murno, 1955; Shafi & Quddus, 1982).

2.3 Collection and preservation of parasites

To collect ectoparasites and endoparasites, all the organs of fish were examined. Using a hand lens for encysted larvae, the fish's exterior as well as the surfaces of its visceral organs, mesenteries, and body cavity were closely inspected. Each organ of the viscera, i. e. stomach, intestine, rectum, liver etc. was separated and kept in different Petri dishes containing Sodium-chloride solution (0.75% NaCl solution). An incision was made to open the stomach, intestine and rectum. The reason for this was that the parasites may adhere to the epithelium's lining. To separate the parasite, kidneys and livers were cut with forceps. Each petridish's contents were thoroughly mixed and then allowed to sink to the bottom. After some time, the sediment was first observed with the naked eye. Then, large parasites were gathered using droppers, brushes, or dissecting pins. Smaller specimens that could be invisible to the eye were examined under a 40x magnification stereoscope binocular microscope and gathered using a brush or dropper. After being gathered, the parasites were stored in 70% ethyl alcohol.

2.4 Preparation of parasites for microscopic studies and Morphological Identification

Parasites were mounted temporarily on a slide with a few drops of lactophenol, and the anterior and posterior ends were examined using the objective lens of a compound microscope. In case of permanent mounting, the parasite was stained with borax carmine. After washing off the excess stain from the parasites they were passed through graded series of alcohol and cleaned in xylene. Finally, the worms were mounted in Canada

balsam. A compound microscope was used to identify the parasites based on morphological descriptions and illustrative figures of Ahmed & Sanaullah (1976); Bunkley & Williams (1994); Dogiel (1964); & Yamaguti (1961).

2.5 Terminology used in the study

Prevalence, intensity and abundance of infection were determined by following formulae (Margolis et al., 1982).

$$\text{Prevalence of parasites} = \frac{\text{Number of infected host}}{\text{Total number of examined host}} \times 100$$

$$\text{Intensity of parasites} = \frac{\text{Total number of parasite collected}}{\text{Number of host infected}}$$

$$\text{Abundance of parasites} = \frac{\text{Number of parasite collected}}{\text{Number of host examined}}$$

$$\text{Dominance index} = \frac{\text{Number of individuals of a parasite species}}{\text{Total individual number of all species}} \times 100$$

2.6 Statistical analysis

Microsoft Excel 2010 were used to do the statistical analysis. Infection between sexes (male and female) of both ectoparasite and endoparasite, Chi-square analysis was used. Independent t-Test were done for infected fish length group and weight group. The significance level for all statistical analyses was set at 0.05.

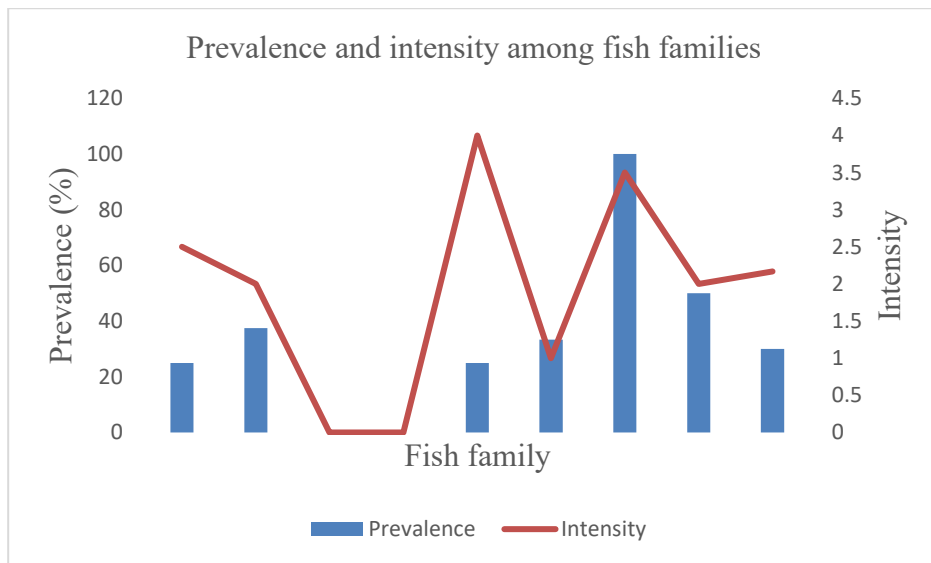
3. Results and Discussion

A total 60 fishes were examined for parasite study, among them 17 were infected with 8 species of parasites and their total number were 42. Three species of isopod (*Anilocra* sp., *Cymothoa exigua* and *Argathona* sp.); two species of copepod (*Caligus irritans* and *Lernanthropus* sp.); a single species of pentastomid (*Sebekia okavangoensis*) and two species of nematode (*Camallanus intestinalis* and *Contracaecum* sp.) were obtained from the study. The overall prevalence, mean intensity, and abundance were 28.33%, 2.47 ± 2.40 , and 0.43 respectively. Slightly higher ectoparasites prevalence (15%) and intensity (2.89 ± 2.8) were observed compared to the endoparasites prevalence (13.33%) and intensity (2.29 ± 1.9), which was statistically insignificant. The abundance (0.43) of ectoparasites is also higher than the abundance (0.26) of endoparasites (Table 1).

Table 1. Overall prevalence, intensity and abundance of parasites of host fishes

Parasites group	Examined host number	Infected host number	Prevalence %	Parasite number	Intensity (±SD)	Abundance
Ectoparasites	60	9	15	26	2.89 ± 2.8	0.43
Endoparasites		8	13.33	16	2 ± 1.8	0.26
Total		17	28.33	42	2.47 ± 2.40	0.70

The prevalence, mean intensity, and abundance of parasites varied among different fish families. In this study, total 9 families (Pomacanthidae, Holocentridae, Caesionidae, Carangidae, Chirocentridae, Siganidae, Psettodidae, Scaridae, and Terapontidae) of fish were collected. The highest prevalence (100%) were found in the Psettodidae family, while the highest intensity (4 ± 4.2) was found in the Chirocentridae family (Figure 1). Psettodid species, being predatory and bottom-dwelling, often interact with diverse prey in environments like mud flats and estuaries. These areas are rich in parasites, and the fish's feeding habits on smaller invertebrates and other bottom-dwelling organisms increase the likelihood of exposure to parasites (Kamrani et al., 2020). The lowest prevalence (25%) was observed in the Pomacanthidae and Chirocentridae families, while the lowest intensity (1 ± 0) was observed in the Siganidae family (Figure 1). The Pomacanthidae family's species live in clean, stable environments on well-maintained coral reefs. So, the habitat of pomacanthids was less prone to parasitic infestation (Gomez-Diaz & Gonzalez-Solis, 2010). As pomacanthids are herbivorous, their diet mainly consists of algae and plant materials, which reduces their chances of ingesting parasite-laden prey (Hughes, 1994).

**Fig. 1.** Prevalence and intensity of parasites among fish families.

The organ-wise distribution of parasites was examined across the gills, fins, skin, alimentary tract (buccal cavity, esophagus, stomach, and intestine), liver, heart, gall bladder, spleen, kidney, swim bladder, gonads, and urinary bladder of fish. The highest prevalence (11.67%) and intensity (3.29 ± 2.8) were observed in the gills (Figure 2). Gills in marine and freshwater fish was often the most heavily parasitized organs, particularly by ectoparasitic copepods, that feed on the mucus and blood of the host, leading to tissue damage and impaired respiratory function (Pérez-Jiménez & Mendez-Loeza, 2015). According to this investigation second-highest prevalence (8.33%) and intensity (2 ± 2.23) in the intestines (Figure 2), which supports the view that gastrointestinal parasite infestations are a common issue in fish, with potential impacts on the fish's health by impairing nutrient absorption and overall fitness. The intestine, as the second most significant organ for endoparasite infections, also supports findings from other studies. The prevalence of endoparasite infections was observed by Carlsson *et al.* (2013), particularly nematodes and cestodes. The digestive tract provides an ideal environment for these parasites due to its nutrient-rich content, which supports growth and reproduction of intestinal parasites. In contrast, the stomach and the skin showed the lowest prevalence (1.67%) and intensity (1 ± 0), indicating these were the least affected organs (Figure 2).

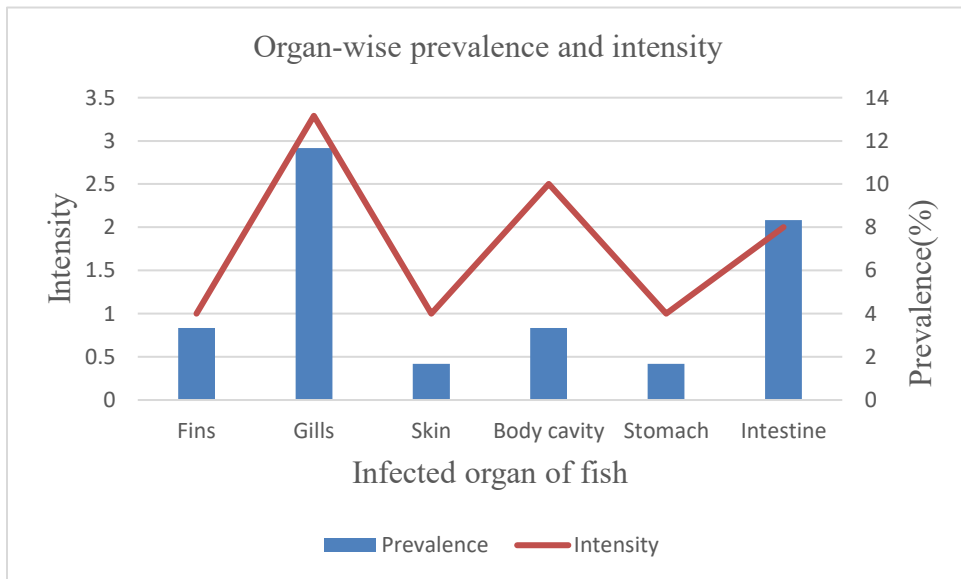


Fig. 2. Organ wise prevalence and intensity of parasites in host fishes.

The absence of parasites in the liver, gallbladder, and kidney was an interesting finding. According to other research, it implies that these organs can offer a hostile environment for parasite life. Olsen *et al.* (2014) found that, parasites, such as trematodes and cestodes, were less likely to infest the liver and kidney of fish due to their detoxification

functions and the immunological defenses associated with these organs.

Out of 60 fish individuals, 37 were male fish, of which 4 were infected, and 23 were female fish, of which 5 were infected. Both the prevalence and intensity of ectoparasites were recorded as higher in female fish (21.73%, 3.8 ± 3.4) compared to male fish (10.81%, 1.75 ± 1.5). The infestation of ectoparasites in male and female fish was found to be statistically significant (Table 2). It was also discovered that female fish (17.39%, 3 ± 2.4) have more endoparasite prevalence and intensity than male fish (10.81%, 1 ± 0). The infestation of endoparasites in male and female fish was found to be statistically significant (Table 2).

Table 2. Sex wise prevalence and intensity of parasite of host fishes

Parasite group	Sex	Examined fish number	Infected fish number	Parasite number	Prevalence %	Intensity ($\pm$ SD)	χ^2	p- value
Ectoparasites	Male	37	4	7	10.81	1.75 ± 1.5	8.89	0.0117
	Female	23	5	19	21.73	3.8 ± 3.4		
Endoparasites	Male	37	4	4	10.81	1 ± 0	6.84	0.0327
	Female	23	4	12	17.39	3 ± 2.4		

The differences in parasite intensity between male and female fish can be attributed to several factors. Ecological habitat, as well as hormonal influences, could be responsible for the increased susceptibility in females. Sex hormones are known to affect the immune system, and during reproductive cycles, female fish might experience a decrease in their immune response, making them more susceptible to infections. This can be particularly evident during gonad development, as some studies suggest that the physiological state of females during reproduction reduces their resistance to parasitic infestation. Previous research supports these findings. For instance, Eash et al. (1988) suggested that behavioral and physiological differences between sexes may contribute to variations in parasitic susceptibility. Similarly, Mercado et al. (2001); Omeji et al. (2013), noted that the reproductive cycle of female fish, particularly during gonadal development, could lead to decreased resistance to parasitic infections. Furthermore, the higher intensity of parasitism in females may also be linked to the greater energy expenditure and physiological costs associated with reproduction. Females invest more in reproductive activities, making them more vulnerable to stress, which in turn weakens their immune system. Shukerova et al. (2005) emphasized this point, noting that reproductive costs in female fish can enhance their susceptibility to parasitic infections.

Prevalence of infestation was highest (100%) in the 34.51-37.50 cm length group and lowest (29.41%) in the 16.00-19.50 cm length group. Intensity of parasites was highest (4.5 ± 3.5) in the 31.51-34.50 cm group and lowest (1 ± 0) in the 34.51-37.50 cm length group (Table 3). Abundance of parasites is highest (2) in the 25.51-28.50 cm length group and lowest (0.47) in the 16.00-19.50 cm length group. The study revealed that infestation of parasites in host

was not statistically significant on the basis of the length of host fishes (Table 3). The earlier research suggesting that larger-bodied fish harbor more parasites due to increased surface area, greater resource volume, and a higher number of ecological niches available for parasite establishment (Poulin, 1995).

The present study revealed that the highest prevalence of parasitic infestation (58.33%) in fish weighing between 151 gm–200 gm, while the lowest prevalence (1%) was recorded in the 251 gm–300 gm weight group (Table 3). These results indicate that smaller-weight fish were more susceptible to parasitic infestation than their larger counterparts. Similar findings were reported by Tasawar *et al.* (2007), who observed a higher infestation rate among fish with lower body weight. In contrast, Sehrin *et al.* (2023) documented the highest prevalence in larger-weight fish, suggesting variability in infestation patterns depending on ecological and biological factors. The prevalence and intensity of parasite infestation in relation to the fish weight was also not statistically significant (Table 3).

In this observation, the highest prevalence (5%) of ectoparasites was recorded in *Anilocra* sp., while the lowest prevalence (1.67%) was recorded in *Lernanthropus* sp., *Argathona* sp., and *Sebekia okavangoensis*. Similarly, among the endoparasites, both *Camallanus intestinalis* and *Contracaecum* sp. exhibited a prevalence of 6.67%. The intensity of infection for *Camallanus intestinalis* and *Contracaecum* sp. was 1.75 ± 1.5 and 2.25 ± 2.5 respectively. In terms of abundance, both *Caligus irritans* and *Cnotracaecum* sp. had the highest abundance (15%), while *Argathona* sp., *Cymothoa exigua*, and *Sebekia okavangoensis* had the lowest abundance (3%). According to dominance index (Kasprzak & Niedbała, 1981) only 2 subclass, the dominant class (*Caligus irritans*, *Anilocra* sp., *Lernanthropus* sp., *Camallanus intestinalis*, and *Contracaecum* sp.) with a dominance index ranging from 9.5% to 21.4% and subdominant class (*Argathona* sp., *Cymothoa exigua*, and *Sebekia okavangoensis*) with a dominance index ranging from 2.3% to 4.8% were found in this study (Table 4).

Table 3. Prevalence, intensity and abundance of parasites based on length and weight of host fishes

Length range (cm)	Examined fish number	Infected fish number	Prevalence %	Parasite number	Intensity (±SD)	t-test value	Weight range (gm)	Examined fish number	Infected fish number	Prevalence %	Parasite number	Intensity (±SD)	t-test value
16.00 - 19.50	17	5	29.41	8	1.6 ± 0.54		90 - 150	20	3	15	6	2 ± 0	
19.51 - 22.50	10	0	0	0	0		151 - 200	12	7	58.33	12	1.72 ± 1.1	
22.51 - 25.50	15	6	40	16	2.67 ± 2.65		201 - 250	5	1	20	8	8 ± 0	
25.51 - 28.50	4	3	75	8	2.67 ± 1.15		251 - 300	2	1	50	1	1 ± 0	
28.51 - 31.50	5	0	0	0	0	1.79	301 - 350	0	0	0	0	0	0.91
31.51 - 34.50	5	2	40	9	4.5 ± 3.5		351 - 400	1	0	0	0	0	
34.51 - 37.50	1	1	100	1	1 ± 0		401 - 450	5	1	20	4	4 ± 0	
37.5 - 40.5	3	0	0	0	0		451 - 500	4	1	25	1	1 ± 0	
							501 - 1000	11	3	27.28	10	3.33 ± 2.3	

Table 4. Prevalence, intensity and abundance of each species of parasite among host fishes

Group	Species name	Examined host number	Infected host number	Prevalence %	Parasite number	Intensity (±SD)	Abundance	Dominance index D (%)	Class of Dominance
Ectoparasite	<i>Caligus irritans</i>		2	3.33	9	4.5	0.15	21.42	Dominant
	<i>Argathona</i> sp.		1	1.67	2	2	0.03	4.8	Subdominant
	<i>Anilocra</i> sp.		3	5	8	2.67	0.13	19	Dominant
	<i>Cymothoa exigua</i>		2	3.33	2	1	0.03	4.8	Subdominant
	<i>Lernanthropus</i> sp.		1	1.67	4	4	0.06	9.5	Dominant
	<i>Sebekia okavangensis</i>	60	1	1.67	1	1	0.01	2.3	Subdominant
	<i>Camallanus intestinalis</i>		4	6.67	7	1.75	0.11	16.7	Dominant
Endoparasite	<i>Contracaecum</i> sp.		4	6.67	9	2.25	0.15	21.4	Dominant

4. Conclusion

In the present investigation, an attempt has been made to describe the parasites of coral fish from Saint Martin's Island, Bay of Bengal. The parasitic infestation was described in relation to sex, different organs, and the length and weight of the host fishes. From the findings, it was established that the coral fishes were infected with different ectoparasites and endoparasites. These fish have high nutritional value and can play a significant role in supplying the protein requirements of the people of our country. Though the infection rate was moderate but heavy parasite infestation can deteriorate their food value, stunt their growth, and even result in their mortality. Enhancing research on the coral fishes and their parasite communities is crucial for protecting them from infection and understanding the health status of coral reef ecosystems. Further study should be continued for better understanding the ecology of the coral fishes as they play a significant role in Bangladesh economy.

Authors' Contribution

Subrina Sehrin: Conceptualization, Writing the original manuscript, Investigation, Formal analysis, Data curation, Review & Editing. **Tania Akter:** Methodology, Data Analysis. **Aleya Begum:** Supervision, Visualization, Data curation, Review & Editing.

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