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Digenetic Parasite Diversity of the Coastal Trevally Fish, *Carangoides caeruleopinnatus*: Factors Influencing Parasitism

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ABSTRACT

Background: Carangidae is a family of ray-finned fish within the order Carangiformes which are invaded by different parasite species and the rate of parasitism changed regarding different factors. This study aimed to provide information about the relationship between fish size and sex on the parasites that infect fish within the family Carangidae in Saudi Arabia.

Methods: A total of 90 *Carangoides caeruleopinnatus* specimens were collected from the Red Sea. The size of the fish was taken in grams (for weights) and centimeters (for lengths), respectively, as well as fish sex was determined. Fish organs were examined for parasitic infection.

Result: There is a relationship between the length, weight and sex of fish hosts on the incidence of parasitic infection in the examined fish. Larger fish size is heavily parasitized than smaller ones which provide a greater surface for infection. In addition, the mean weight of uninfected samples was considerably higher than infected which suggested a weight loss because of parasitic infection. Parasitism in fish has been reported to be sex-biased, with males suffering greater susceptibility than female fish. This study reflects the rate of parasitism in the coastal trevally, *Carangoides caeruleopinnatus*, concerning fish length as well as their sex.

Key words: Carangidae, Fish, Parasitism, Red Sea.

INTRODUCTION

Fish are considered an important nutritional source among many cultures especially in coastal areas and fish are signified from other meats due to their cheap economical cost and digestibility and the fact that it contains many essential elements like proteins, phosphorus, potassium, *etc*. (Arafa and Fahmy, 2018). Fish from different water natures get an infection with different types of external and internal parasites that can be rapidly contagious due to the fish being crowded together (Alves and Luque, 2006). Eating raw or improperly cooked or processed fish is the main source of these infections for humans (Bakhraibah, 2018).

The prevalence of parasitic infection in fish varied from one study to the other (Kim *et al*., 2016). Such differences could be attributed to various factors, such as the number of fish examined, seasonal variations and hydro-biological factors that affect the transmission of parasites and the distribution of intermediate hosts (Erasmus *et al*., 2022). The temperature was found to be the most important physical environmental factor determining the seasonal population dynamics of different parasites as stated by Gehman *et al*. (2018).

Carangidae forms one of the largest families of bony fish with worldwide distribution and is represented by about 140 species belonging to 32 genera (Abbussamad *et al*., 2013). *Carangoides* Bleeker, 1851 (Carangidae, Perciformes) is a genus comprising at present 48 species of marine fish that inhabit the tropical and subtropical regions (Froese and Pauly, 2021). These fish species are of considerable economic importance and are commonly affected by several pathological problems, which can lead to mortalities and loss of production including viral, bacterial (Abbussamad *et al*., 2013) and parasitic infections (Froese and Pauly, 2021). Like other fish, carangids harbor parasites, including digenean, nematodes, cestodes, monogeneans, isopods and copepods (Barton *et al*., 2009).

Therefore, the present study aimed to describe the spatial distribution of parasite fauna concerning body size and sex of the coastal trevally (*Carangoides caeruleopinnatus*).

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MATERIALS AND METHODS

Fish samples

A total of 90 fish specimens of the coastal trevally *Carangoides caeruleopinnatus* Rüppell, 1830 (F: Carangidae) were collected from commercial fishermen in the investigated area from the Red Sea (Jeddah, Saudi Arabia), between January and December 2021. Fish were brought to the Laboratory of Parasitology Research, Department of Zoology, College of Science, King Saud University, Riyadh,

Saudi Arabia. The collected fish samples were identified using the rules of the website fishbase.org. The fish weights were taken in grams (gm) with the aid of the scale kilogram weighing balance while the standard and total length of the fish were measured in centimeters (cm) using a meter rule. The sex of each fish was determined after examination of its papillae.

Parasitological examination

Fish specimens were necropsied and their organs were examined. Internal organs were transferred to the Petri dishes with a 0.65% saline solution and examined under a stereo-dissecting microscope (Nikon SMZ18, NIS ELEMENTS software) for detection of any parasite infections (Abdel-Gaber *et al*., 2020). Parasites were removed using fine forceps and then preserved in 70% ethanol for morphological analysis. This study should be viewed as another analysis of the coastal trevally, *Carangoides caeruleopinnatus* and its digenea parasite by Abdel-Gaber *et al*. (2023); Indian Journal of Animal Research, pp. 1-9). The sites of each parasite species, as well as the number from each fish, were recorded.

Statistical analysis

ANOVA analysis was performed in one way and statistical comparisons between the size and sex of fish hosts with parasite infections were done using Duncan's test via the SPSS v.18 software program (SPSS Inc., Chicago, Illinois, USA). Values were expressed as the mean±SD, at a significance level of $p \leq 0.05$.

RESULTS AND DISCUSSION

Natural prevalence of parasitic infections

Fish are considered one of the important sources of animal protein (de Boer *et al*., 2020). Several studies have been conducted about the parasites of the Red Sea fish with digenean as the largest sector of endoparasitic species (Cribb *et al*., 2001). In total, 90 specimens of *Carangoides caeruleopinnatus* were collected, 53 (58.88%) of which were infected in the intestinal region with one acanthocolpid species having morphological features corresponding with the genus *Monostephanostomum* Kruse, 1979. The prevalence of parasitic infection for the current parasite species was 58.88%. This agreed with Madhavi (1976), Kruse (1979), Reimer (1983), Ramadan (1984), Bray and Cribb (2002), Bray and Cribb (2007) and Madhavi and Bray (2018) which documented *Monostephanostomum* digenean as intestinal parasites in marine fish. The parasite's mean intensity in each of the fish hosts does not exceed five. As a result, the recovered acanthocolpid species identified as *Monostephanostomum mesospinosum* (Madhavi, 1976) Bray and Cribb, 2002 regarding to the morphological criteria mentioned in our previous study of Abdel-Gaber *et al*. (2023).

Relationship between parasitic infection and fish host

1-Relationship between fish body length and level of parasitic infection

An increased fish size reflects length, which is usually considered a measure of age (Yalçin *et al*. 2002). The size of normal and infected fish species is grouped into three length classes which were I, II, III (*i.e*. I larger size of more than 18 cm, II medium size from 13 cm to less than 18 cm and III smaller sizes from less than 10 cm) as shown in Fig 1 and Table 1. The smallest fish was relatively less infected than the other length groups for the examined fish species and the percentage of infection increased with higher fish lengths. These results coincided with data obtained by Madanire-Moyo and Avenant-Oldewage (2013) who stated that the juvenile fish (10-24 cm) had lower prevalence values while sub-adults (23-39 cm) and adults (40-54 cm) had higher prevalence of parasitic infections. Fig 2 illustrates that there was a direct (positive) relationship between the length and intensity of infection. The high infection observed in bigger fish in this study may be because larger fish provides a greater surface for infection than smaller fish as reported by Madanire-Moyo and Avenant-Oldewage (2013).

Fig 1: Photograph of the examined fish species, the coastal trevally *Carangoides caeruleopinnatus* with different lengths and weights.

2-Relationship between fish body weight and level of parasitic infection

Table (1) showed the effect of host weight on the intensity of infection throughout the present study. The weight of the normal and infected fish is grouped into three classes which were I, II and III (*i.e*. I smaller size from less than 12 gm, II medium size from 12 gm to less than 15 gm, III larger weight more than 15 gm). The mean weight of uninfected samples was considerably higher than infected which suggested a weight loss because of infection, this coincided with Bichi and Yelwa (2010) who reported the damage inflicted by parasitic infection in the gut of *C. gariepinus*. They were found blocking and attached firmly to the intestinal lining, thus, inducing lesions at the site of attachment. This also, likely suggested the absence of infective organisms in the type of diet of the fish while it is young. In addition, Onwuliri and Mbgemena (1989), Folstad and Karter (1992), Emere (2000) and Omeji *et al*. (2013) observed that heavier fish

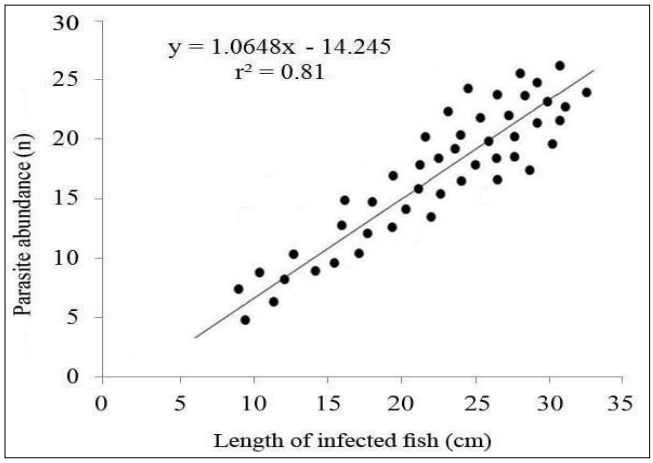

Fig 2: Relationship between the number of parasites per fish as a function of fish length.

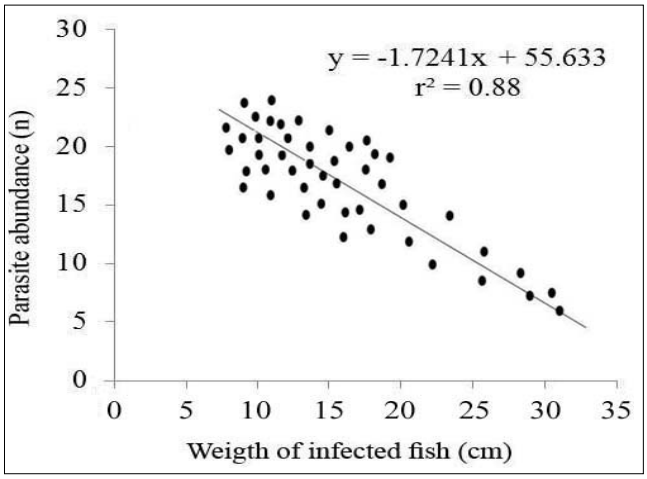

Fig 3: Relationship between the number of parasites per fish as a function of fish weight.

Table 1: Relationship between body length, weight and sex for the examined fish samples with the level of infection.

Examined	Body length (cm)		Body weight (gram)		No. of infected fish		Percentage of infection	
fish	Non-infected	Infected	Non-infected	Infected	Female	Male	Female	Male
Class I	19.1-35.6	21.9-39.4	10.20-11.70	8.76-9.64	3	24	3.75%	42.5%
(n=30)	(25.6±0.2)	(28.6±0.1)	(10.92±0.86)	(9.05±0.55)				
Class II	13.2-16.7	14.5-16.7	12.40-14.60	11.34-12.98	7	12	13.75%	25.0%
(n=30)	(14.9±0.1)	(15.1±0.1)	(14.55±0.90)	(12.12±0.97)				
Class III	7.5-9.0	8.9-10.5	33.50-58.40	16.30-27.90	2	5	10.0%	25.0%
(n=30)	(8.9±0.1)	(9.1±0.1)	(45.59±1.20)	(22.97±1.20)				

are less infected than low-weighted fish. Fig 3 illustrates that there was an indirect (negative) relationship between body weight and the intensity of infection.

3-Relationship between fish sex and level of parasitic infection

During the current study, the effect of sex for the host fish specimens on the prevalence of infection was illustrated in Table 1. Parasitism in fish has been reported to be sex-biased, with males suffering greater susceptibility. The sex ratio found in this study indicated that a higher number of parasites were found in males than in females. This sex-linked parasitism has been explained because of a difference in reproductive investment between male and female fish (Sanmartín *et al*., 2000). Immuno-suppression by steroid hormone during spawning in males has been suggested as a major factor contributing to the greater susceptibility of males to parasite invasion (Skarstein *et al*., 2001; Šimková *et al*., 2008). According to Aliyu and Solomon (2012), differences in the rates of infection between the two sexes could be due to differential feeding either by quantity or quality of food eaten and because of different degrees of resistance to infection.

CONCLUSION

This study demonstrates the relationship between the fish size and their sex on the incidence of parasitic infections. Further studies should include more environmental parameters that affect both fish health and parasite distribution.

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Data availability statement

All the datasets generated or analyzed during this study are included in this published article.

Conflict of interest

The author(s) declare that they have no conflict of interest regarding the content of this article.

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