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SHORT COMMUNICATION

ERGASILID COPEPOD INFESTATION ON SOME WIDELY CONSUMED FISH SPECIES IN VALAICHCHENAI LAGOON, BATTICALOA DISTRICT, SRI LANKA

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ABSTRACT

The present study was undertaken to find out the ergasilid copepod infestation on widely consumed fish species along three different locations in Valaichchenai lagoon during the Northeast monsoonal period from November 2019 to February 2020. The ergasilid copepod species namely *Dermoergasilus amplectens*, *Ergasilus sieboldi*, *Ergasilus parvitergum* and *Sinergasilus major* were recorded in the widely consumed fish species such as *Etroplus suratensis*, *Mugil cephalus* and *Leiognathus fasciatus* of Valaichchenai lagoon. The results revealed the prevalence and mean intensity in different gender of fish species for each ergasilid parasite in each location of the lagoon. *Ergasilus parvitergum* showed the maximum prevalence of 28.57%, 53.33% and 26.67% in each sampling locations of L1, L2 and L3 respectively. The highest mean intensity (14.5) was recorded in sampling location L1 for *Ergasilus parvitergum* which indicated that *E. parvitergum* is more adapted to their fish hosts when compared to other ergasilid copepod parasites found in Valaichchenai lagoon. Invasion of *Sinergasilus major* was recorded at polyhaline water (L1) in the present study. Spatial variation exists in the parasitic prevalence of *Sinergasilus major* (P = 0.00) and *E. parvitergum* (P = 0.044) between sampling locations of the lagoon. However, spatial variations do not exist the in parasitic prevalence of *Ergasilus sieboldi* (P = 0.124) and *Dermoergasilus amplectens* (P = 0.749) between the sampling locations of the lagoon. Furthermore, the overall prevalence of parasites in the host fish values were 66.67% and 33.77% in females and males respectively which shows significant differences to each other. From the present study, it can be inferred that gender influences the degree of ergasilid parasitic infestation in fish during the northeast monsoonal period.

Keywords: *Fish, Parasites, Prevalence, Valaichchenai lagoon, Water quality*

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1. INTRODUCTION

Coastal lagoons are highly productive ecosystems which support various habitat types such as saltmarshes, sea grasses and mangroves for living organisms. These ecosystems also support many valuable populations of fish and shell fish species [1]. The annual productivity of coastal lagoons generally ranges from ~50g Cm^{-2} $year^{-1}$ to >500g Cm^{-2} $year^{-1}$ [2]. Based on trophic status, coastal lagoon may be eutrophic (primary production 300 to 500 g C m^{-2} $year^{-1}$), mesotrophic (primary production 100 to 300 g C m^{-2} $year^{-1}$) and oligotrophic (primary production <100 g C m^{-2} $year^{-1}$) conditions [3]. The lagoons are the nursery ground for many fish species and it helps to complete their lifecycles [4]. Valaichchenai lagoon harbors economically important edible fin fish and shell-fish species and one of the main livelihood sources for the fishermen in this area. Most of the people who live adjacent to this lagoon prefer to consume lagoon fish species for their daily diet. More than 125 fish species were recorded in Valaichchenai lagoon among them 47 species were reported as economically important edible fish species. Apart from the increasing demand for lagoon fish species, aquaculture practices are also extended to more than 2700 hectares in Valaichchenai lagoon [5].

Parasitic conditions of fishes can be connected to specific environmental conditions and they can indicate the presence of various types of pollutants such as heavy metal, industrial and sewage pollutants, and also eutrophication elements [6]. Therefore, parasite infestation has been connected to anthropogenic effect and environmental changes in marine environments. Copepods are the common parasites in cultured and wild finfish species. Massive infection of *Ergasilus* copepod can reduce the fitness of the fish which leads to condition of asphyxia [7].

The preliminary parasitic survey of males and females of economically important food fish in Valaichchenai lagoon, Morakottanchenai region was conducted in 2013 [5]. However, the spatial variation of ergasilid copepod infestation along the lagoon remains to be determined. The present study was carried out to examine the parasitic prevalence of *Ergasilus* species on widely consumed fish species inhabiting Valaichchenai lagoon as well as to determine the mean intensity of each species.

2. MATERIAL AND METHODS

2.1 Study area

The present study was conducted in Valaichchenai lagoon, located in Batticaloa district in the east coast of Sri Lanka from November 2019 to February 2020 during the northeast monsoonal period. The lagoon started from Sittandy in the south extending up to Nasivantivu in the north between geographical coordinates of 7° 48′ 26″N, 81° 30′ 33″E and 7° 56′ 22″N, 81° 33′ 03″E. Lagoon has a single narrow bar mouth connection (about 430m length) that opens to the Vandalous Bay at Nasivantivu. This lagoon is located in the dry zone and receives annual rainfall between 1000 mm – 1500 mm from November to February by the northeast monsoon [8]. The maximum length of the Valaichchenai lagoon is 20km and the width is about 0.24 km to 1.58km and depth of this lagoon is 2m and the tidal range varies from 40cm to 60cm [9]. Freshwater inflow gradually occurs in the lagoon through the three river connections (Maduru Oya, Miyangolla Ela and Mundeni Aru).

For this study, the lagoon was divided into three salino graphical zones based on the salinity variation along the lagoon, namely oligohaline (±0.5 to ±5), mesohaline (±5 to ±18) and polyhaline (±18 to ±30) as per the prescription of Venice System (1958) from the preliminary survey of lagoon water. Based on the salino graphical zonation of the lagoon and anthropogenic activities, sampling locations were marked as, L1 (Nasivantivu), L2 (Kavathamunai) and L3 (Morakottanchenai) and Geo- coordinates of each point was obtained using a portable GPS unit (GARMIN, Taiwan). Based on of accessibility, the fish samples were collected around a 100m radius from each sampling location. The respective geographical coordinates and salino graphical zonation to each sampling location is shown in detail in Table 1 and Figure 1.

Table 1: Geographical coordinates and salino graphical zonation of sampling locations

Sampling Locations	Name of the Location	Geographical Co-ordinates		Salino Graphical zonation of Location
		Longitude	**Latitude**	
L1	Nasivantivu	81.52473 ° E	7.93560° N	Polyhaline
L2	Kavathamunai	81.51291 ° E	7.91594 ° N	Mesohaline
L3	Morakottanchenai	81.55154 ° E	7.82625 ° N	Oligohaline

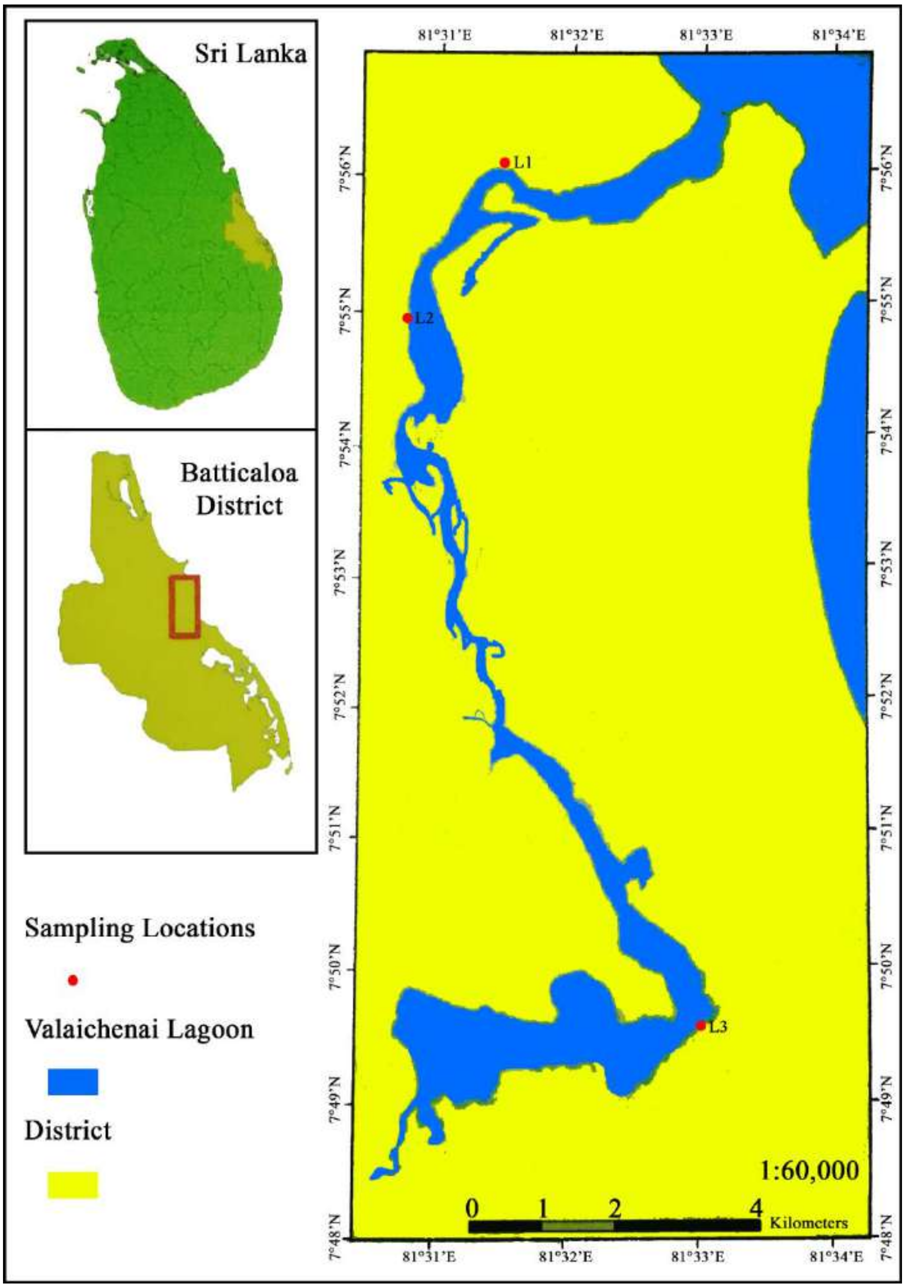

Figure 1: Map of Valaichchenai lagoon showing sampling locations

2.2 Sample collection

A total of 158 fish samples of widely consumed and commercially important fish species, namely *Etroplus suratensis* (64), *Mugil cephalus* (49) and *Leiognathus fasciatus* (45) were included in this study. Live or freshly died fish species were collected with the help of the fishermen in Valaichchenai lagoon at each sampling location with the aid of a cast net and, hook and line. The sample collection was done in the morning from 7.00am to 9.00am. The collected host fish species from the lagoon were immediately transported to the Department of Zoology Laboratory, Eastern University, Sri Lanka, for further inspection.

2.3 Fish sample examination

The morphometric measurements of host fish were taken. Length measurements were recorded as total length (TL in cm) from the tip of the snout to the end of the longer lobe of caudal fin and the measurements were taken to the nearest 0.1 cm using fish measuring board (Rulers). Fish weight was taken using a digital balance (KERN PLJ; version 2.1, USA) with an accuracy of 0.01 g. as per the prescription of Kabata (1985), Each host fish was inspected for the occurrence of ergasilid parasites [10]. To count the number of ergasilid copepod, the gills were removed from the host fish and examination was carried out under the dissecting microscope. Then cut was made along the mid-ventral line of the fish using a scalpel, thumb forceps and sharp-blunt scissors. The sex of the fish was determined by examining the gonads. Ergasilid copepods were mounted on the glass slides and stained with borax carmine, dehydrated in an alcohol series and cleared in Xylene for identification. The ergasilids were identified by the help of appropriate keys and relevant text books [11],[12] and [13]. Photographs were taken when and where necessary using Galaxy Tab A (2016) camera (SM-T285 – 5 mega pixels, South Korea). Permanent slides were made from the preserved material for future reference.

2.4 Data Analysis

The prevalence of parasites and mean intensity of infection for each fish species were determined as described by Margolis *et al.*, (1982) [14]. Prevalence denotes the percentage of each species of host infested by a specific parasite in each sample.

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

The prevalence of parasites infestation based on the sex of fish was examined by using,

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

Mean intensity is defined as the average intensity or the total number of ergasilid parasites of a particular species found in a sample divided by the number of infected hosts:

$$\text{Mean intensity} = \frac{\text{Number of particular species of parasite}}{\text{Total number of infected host}} \times 100$$

2.5 Statistical analysis

One-way ANOVA was used to compare the statistical significance among sampling sites for the prevalence of ergasilid copepods using the Minitab 17.10 version.

3. RESULTS AND DISCUSSION

The parasitic infection and unraveling ecological and evolutionary factors that influence host-parasite relationships were described using the common measure which is known as parasitic prevalence (the proportion of infected hosts). A total number of 247 ergasilid copepods were found in fish collected from all three sampling locations. Four different ergasilids species were found to be infected in widely consumed fish species collected from Valaichchenai lagoon, namely *Dermoergasilus amplectens*, *Ergasilus sieboldi*, *Ergasilus parvitergum* and *Sinergasilus major* (Figure 2). They were alive and active in the gill filaments and attached strongly. Prevalence and mean intensity of male and female fish species for each ergasilid parasite in each location were shown in Table 2 and Table 3.

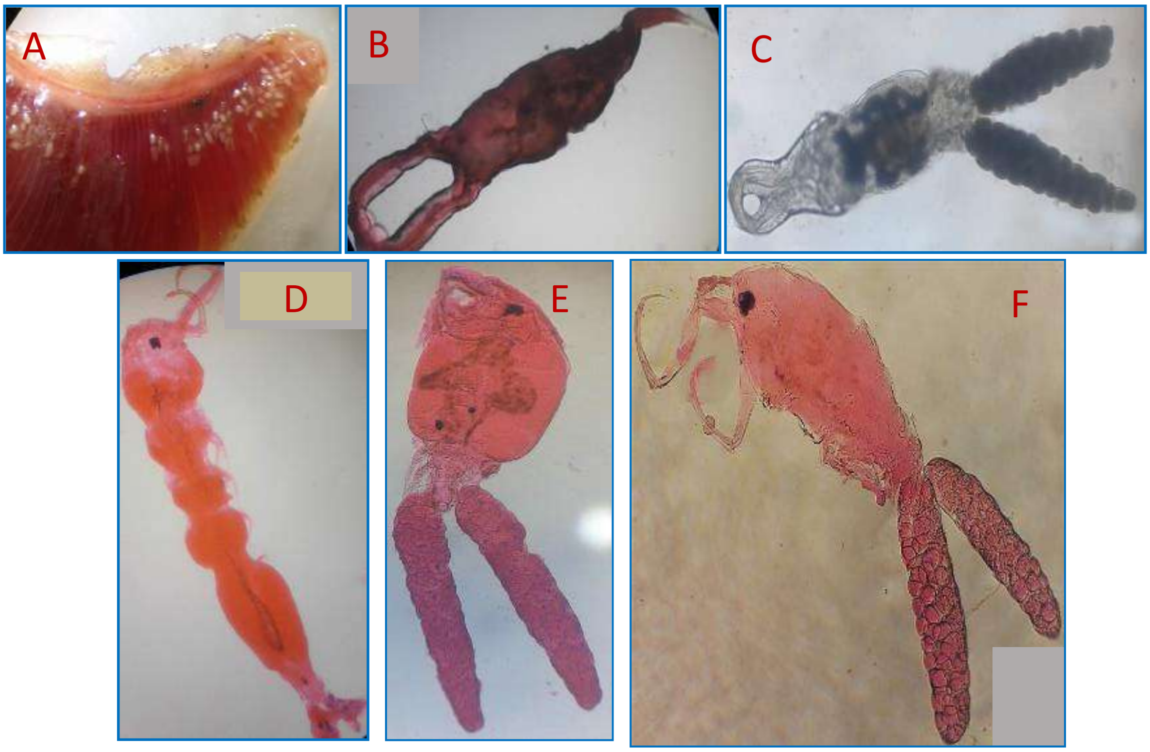

Figure 2: [Plate 1] A- Ergasilid copepod on gill, **B-** Male *Dermoergasilus amplectens* (×40), **C-** Female *Dermoergasilus amplectens* (×40), **D-** *Sinergasilus major* (×40), **E-** *Ergasilus parvitergum* (×40), **F-** *Ergasilus sieboldi* (×40)

Table 2: Parasitic prevalence and mean intensity of Ergasilid parasite in Valaichchenai lagoon

#	Host fish species	Ergasilus sieboldi		*Ergasilus parvitergum		*Sinergasilus major		Dermoergasilus amplectens	
		Prevalen-ce (%)	Mean intensity	Preval-ence (%)	Mean intensity	Prevale-nce (%)	Mean intensity	Preval-ence (%)	Mean intensity
L 1	***Mugil cephalus*** (17)	23.53	2	11.76	14.5	5.88	1.5	11.76	2.5
	Etroplus suratensis (21)	14.29	3	28.57	4.3	4.76	2	14.29	4
	Leiognathus fasciatus (17)	17.65	3	17.65	5.6	5.88	1.5	17.65	3.7
L 2	***Mugil cephalus*** (17)	17.65	2	29.41	3.8	0	0	17.65	4.67
	Etroplus suratensis (19)	21.05	3	42.11	3.25	0	0	21.05	4
	Leiognathus fasciatus (15)	13.3	2.5	53.33	3.38	0	0	13.33	3.5
L 3	***Mugil cephalus*** (15)	13.33	1.5	26.67	5.25	0	0	13.33	2
	Etroplus suratensis (24)	12.5	3.3	16.67	7	0	0	12.5	9
	Leiognathus fasciatus (13)	7.69	2	23.08	3	0	0	23.08	3.3

Sampling locations in Valaichchenai lagoon

*****Statistically significant value at 95% confidence interval (P < 0.05)

Number of parenthesis indicate the number of sampled fish

The prevalence and mean intensity of ergasilid copepod were calculated in each location for 4-month period. *Ergasilus parvitergum* showed maximum prevalence in each sampling location (L1, L2 and L3) at 28.57%, 53.33% and 26.67% respectively. The highest mean intensity (14.5) was recorded in sampling location L1 for *Ergasilus parvitergum* which indicated that *E. parvitergum* is more adapted to their fish hosts when compared to other ergasilid copepod parasites found in Valaichchenai lagoon. This is consistent with the findings of Harris and Vinobaba (2013). They reported that the *Ergasilus parvitergum* and *Ergasilus sieboldi* are more adapted to their hosts when compared to other parasites at Valaichchenai lagoon. There was no evidence for *Sinergasilus major* in sampling locations of Kavathamunai (L2) and Morakottanchenai (L3). *Ergasilus sieboldi* and *Dermoergasilus amplectens* were almost equally distributed among the sampling locations and hosts. Moreover, the highest mean intensity was reported as nine for *D. amplectens*. Based on the present survey, the sampling location L2 (Kavathamunai) showed the highest ergasilid copepod prevalence and mean intensity when compared to the other two sampling locations. According to statistical analysis, spatial variations exist in the parasitic prevalence of *Sinergasilus major* (P = 0.000) and *E. parvitergum* (P = 0.044) between sampling locations of the lagoon. However, spatial variations do not show the parasitic prevalence of *Ergasilus sieboldi* (P = 0.124) and *Dermoergasilus amplectens* (P = 0.749) between the sampling locations of the lagoon. Invasion of *Sinergasilus major* was recorded at polyhaline water (L1) in present study whereas, The World Register of Marine Species (WoRMS) in 2008 reported that *Sinergasilus major* is an oligohaline species. *Ergasilus* can occur in all salinity regimes as well as the lagoon and estuarine ergasilids generally exploit hosts which move freely between salinity regimes [15].

This study found that, male fish species were more parasitized than females. Male fish had a higher incidence rate than females of *Mugil cephalus*, *Etroplus suratensis* and *Leiognathus fasciatus*. This is consistent with the finding of Amaechi, (2015), Aloo, (2002), Biu and Nkechi, (2013), Ohaeri, (2012) and Olurin *et al*., (2012) [16],[17],[18],[19] and [20]. But not in consonance with the findings of Emere and Egbe, (2006), and Harris and Vinobaba (2013) who stated that the females have high prevalence than males [5] and [21]. The overall prevalence of parasites in the host fish values were 66.67% and 33.77% in females and males respectively which shows significant difference to each other. The highest mean intensity (6.05) was recorded in *Etroplus suratensis* for males. The differences in the incidence of infestation between male and female fish, may be due to differential feeding either by quantity or quality of feed, or as a result of different degrees of resistance to infection [22]. The major factors affecting the fish parasite burden as well as the mean intensity of ergasilid parasites include abiotic factors like water temperature, and host-related factors, such as a larger host giving a more suitable substratum when compared to a smaller one (size of the host fish), behavior, sex, age, resistance and mortality [23 and 24]. Amos *et al*., (2018) also stated that the infestation of parasite is influenced by age of fish, sex, season, stage of maturation, the fullness of the gut, type of food consumed, amount of at reserved food and degree of muscular development [22]. In some cases, the mean intensity does not depend on sex but it is noticeable that ergasilid copepod mean intensity differs strongly with different habitats from species to species.

Table 3: Prevalence and mean intensity of ergasilid copepod on Male and Female host fish

Host fish species	Sampled fish	Infected		Non-infected		Prevalence (%)		Mean intensity	
		Male	Female	Male	Female	Male	Female	Male	Female
Mugil cephalus#	49	16	7	11	15	59.26	31.82	5.69	3
Etroplus suratensis#	64	19	11	13	21	59.38	34.38	6.05	4.82
Leiognathus fasciatus#	45	19	8	3	15	86.36	34.78	3.11	5.25
		54	**26**	**27**	**51**	**66.67**	**33.77**		

 # Higher parasitic prevalence in males than females

CONCLUSION

There are four species of ergasilid copepods in three widely consumed fishes of Valaichchenai lagoon, namely *Dermoergasilus amplectens*, *Ergasilus sieboldi*, *Ergasilus parvitergum* and *Sinergasilus major*. *Ergasilus parvitergum* is the most common ergasilid copepod parasite in selected three species of fish in Valaichchenai lagoon. No statistically significant difference was found between the ergasilid copepod parasitic prevalence and sampling locations except *Sinergasilus major* and *Ergasilus parvitergum*. Invasion of *Sinergasilus major* was recorded in Nasivantivu (L1). The male fish had the highest parasitic prevalence of female fish in *Etroplus suratensis*, *Mugil cephalus* and

Leiognathus fasciatus. The mean intensity was greatest for males in *Mugil cephalus* and *Etroplus suratensis* whereas the mean intensity for females was highest in *Leiognathus fasciatus* during the northeast monsoonal period (November to February).

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RECOMMENDATIONS

Further long-term studies are necessary to find out seasonal variation of parasitic infestation on fish species along the sampling sites of the lagoon. Hence further extend these studies related to both biotic and abiotic factors of parasitic prevalence with special reference to *Sinergasilus major* also help to understand the ergasilid copepod status of the lagoon ecosystem. Study on the effect of anthropogenic activities and natural processes on Valaichchenai lagoon are necessary to make a water quality management plan by relevant authorities. In order to reduce the degree of future infestation, the relevant authorities must take the necessary steps, it is a timely need.

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