

THE TYPES, MORPHOLOGY AND POPULATION PATTERNS OF  
METAZOAN PARASITES OF *AMBLYGASTER CLUPEOIDES* IN  
SRI LANKA

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**Abstract**

The present investigation is a survey of endo- and ecto-parasites of the marine fish *Amblygaster clupeioides*, Gal Hurulla, from Trincomalee.

The scope of the survey is to record the types of parasites found in *A. clupeioides*, to describe their morphology for identification purposes and to analyze the population dynamics of the endo-parasites.

Nine different parasitic types, both ecto-parasites, (caligids, copepods, gastropods and isopods) and endo-parasites (mites, trematodes and nematodes) are recorded from this nine-month survey. Morphological features of the parasites are described in detail for identification purposes. Finally, the population patterns of the endo-parasites were analyzed.

This survey reveals that the parasites of *A. clupeioides* are quite diversified. The commonest parasite is *Hemiurus* Sp. where 1,242 organisms were found. The second most abundant parasite is a trematode parasite belonging to the sub-order Prosostomata. Other parasitic types were observed only in low numbers.

**Introduction**

Parasitological studies on fishes have the world over gained much momentum in recent years, (Robotham & Thomas, 1982; Goven & Amend, 1982; Radhakrishnan & Nair, 1980; Watson & Dick, 1979) but records on fish parasites of Sri Lanka are limited (Crusz et al, 1964; Gussev, 1963; Fernando, 1964). Some information exist on a survey of parasitic copepods of fish in Sri Lanka (Kirtisinghe, 1964). Also various other aspects of fish parasites are recorded. For example, physiological aspects (Llewellyn, 1956; Bauer, 1958; Larue, 1951); biological aspects (Canon, 1973; Ginetsinskaya, 1958); ecological aspects (Dogiel, 1958; Polyanski, 1958); and pathological aspects (Roberts et al, 1970; Bursey, 1982).

However, no recorded information is available on the parasites of Gal Hurulla — *Amblygaster clupeioides* upto 1967 in Sri Lanka. Some information exist on parasites of Clupeoid fishes on various other aspects (Bennet, 1965; Blaxter & Honter, 1982; Lazarus, 1978; Mackenize, 1975; Edwin, 1984; Moores & Winters, 1984; Aneer et al, 1982; Whitehead, 1973).

*Amblygaster clupeioides* (Bleeker, 1849) is a marine bony fish. It belongs to the order Clupeiformes and family Clupeidae (Munro, 1955). Fishes of the family Clupeidae are found in very large numbers in the Sri Lankan coastal waters throughout the year (Joseph, 1974; Joseph 1975). Due to its ready availability, its tastiness and low price, it is popular in the diet of Sri Lankans. Therefore, a survey of this sort is important to study the parasites of *Amblygaster clupeioides* because parasites may affect the fish populations by causing mechanical injury such as irritation, tissue damage etc. Also it may cause parasitic infections in human beings or may act as vectors of other pathogens.

The scope of this study is to,

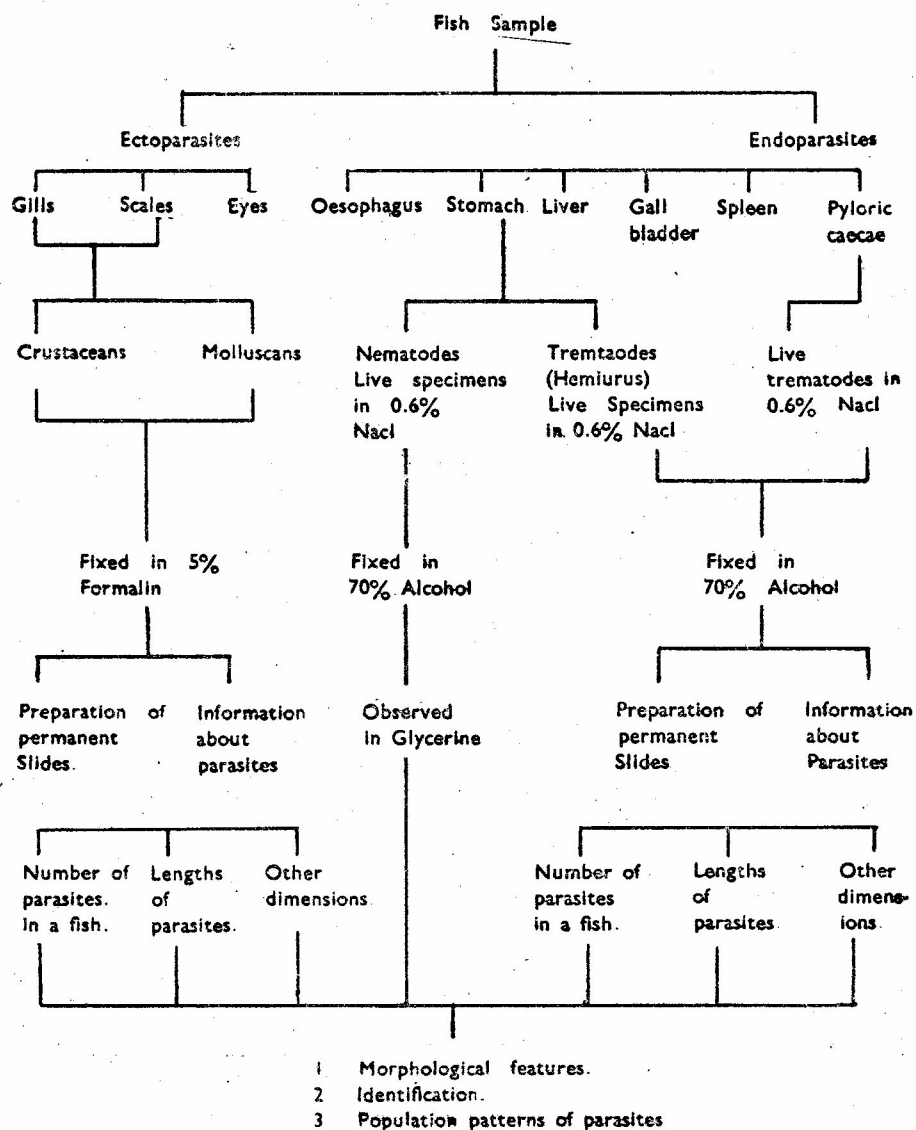
- (a) record the types of parasites found in *A. clupeioides*,
- (b) describe the morphological features of parasites for identification purposes, and
- (c) analyze the population patterns of the metazoan parasites.

#### Materials and Methods

A sample (about 25 fish) of fresh herring fish (*Amblygaster clupeioides*) brought to the market from Trincomalee were examined weekly for ecto- and endo-parasites. The standard length, total length and sex of each fish were noted and then they were examined for ectoparasites on the skin, fins, gills, buccal cavity and eyes (Fig. 1). Fish were then dissected and all internal organs esophagus, stomach liver, gall bladder, spleen, pyloric caecae, gonads, small intestine, large intestine, rectum and kidney were removed from the body and examined for endoparasites in invertebrate saline (0.6% NaCl) (Arulpragasam & Attapattu, 1970) to observe live parasites. The number, position of attachment and orientation of the parasites and external lesions at the point of attachment were observed and recorded. The ecto- and endo-parasites were fixed in the relevant fixatives. The trematodes were fixed in 70% alcohol (Lincoln & Sheals 1976). The nematodes, molluscs and crustaceans were also fixed in 70% alcohol (Lincoln & Sheals, 1976) and examined in glycerine. Nematodes, crustaceans and molluscs were observed straight away without staining.

Trematodes fixed in bouin's fluid were flattened between two slides and stained using single staining procedure (Gray, 1958). These preparations were used to describe the morphological features of the parasites for identification purposes. Sections of some trematodes (T.S. & L.S.) were taken and used to study their internal morphology.

To study the morphological aspects of trematodes, the total length, fore body length, width, diameter of suckers, distance between two suckers of each parasite were measured. Presence or absence of eggs, operculum, the striations on fore body and other important morphological features were recorded.



A Schematic diagram of methodology.

Fig. 1. The schematic diagram of Methodology. This indicates the procedure followed in analysis of samples and collection of data during the investigation.

Finally diagrams were drawn to illustrate the morphological features of all the parasites by using a camera lucida attachment (SHIMADZU KALNEW Type).

### Results

#### Types of parasites

There are two major digenetic trematodes found in *A. clupeioides*. The *Hemiurus* species in the stomach and a trematode of the sub-order Prosostomata (Table 1) in the pyloric caecae of the host. The third group of parasites found in appreciable numbers in the stomach of the host are the nematodes.

Apart from these, the ecto-parasites recorded in the survey are *Bopyrus* species, two species of *Caligus*, gastropod species and parasitic copepod species. These were attached to the gills of the host.

Also, some mites were found attached to the surface of *Hemiurus* Sp. inside the stomach of the host.

Table 1

The numbers of parasitic types found in about 600 herrings examined over a Period of nine months

Figure	Type	No. of parasites
2 A ...	... <i>Caligus</i> sp. (1) ...	01
2 B ...	... <i>Caligus</i> sp. (2) ...	02
2 C ...	... <i>Bopyrus</i> sp. ...	02
2 E ...	... Gastropods ...	02
2 D ...	... Copepod species ...	04
3 A ...	... <i>Hemiurus</i> ...	1242
3 B ...	... Prosostomata ...	168
3 C ...	... Nematoda ...	23
3 D ...	... Mites ...	many (uncounted)

#### Morphological features

##### The Ecto-parasites :

Parasites of The Genus *Caligus* are ectoparasites belonging to The Order Caligoida and Family Caligidae (Kirtisinghe, 1964). These *Caligus* species were found attached to the gills of *A. clupeioides* (Fig. 2 A).

Their body consists of three parts; head, thorax and abdomen. These regions are covered by a rigid chitinous exoskeleton. They have five pairs of appendages on the head and a pair of sucker-like organs at the anterior-most end of the body which is used to attach to the host tissue. It has a neck



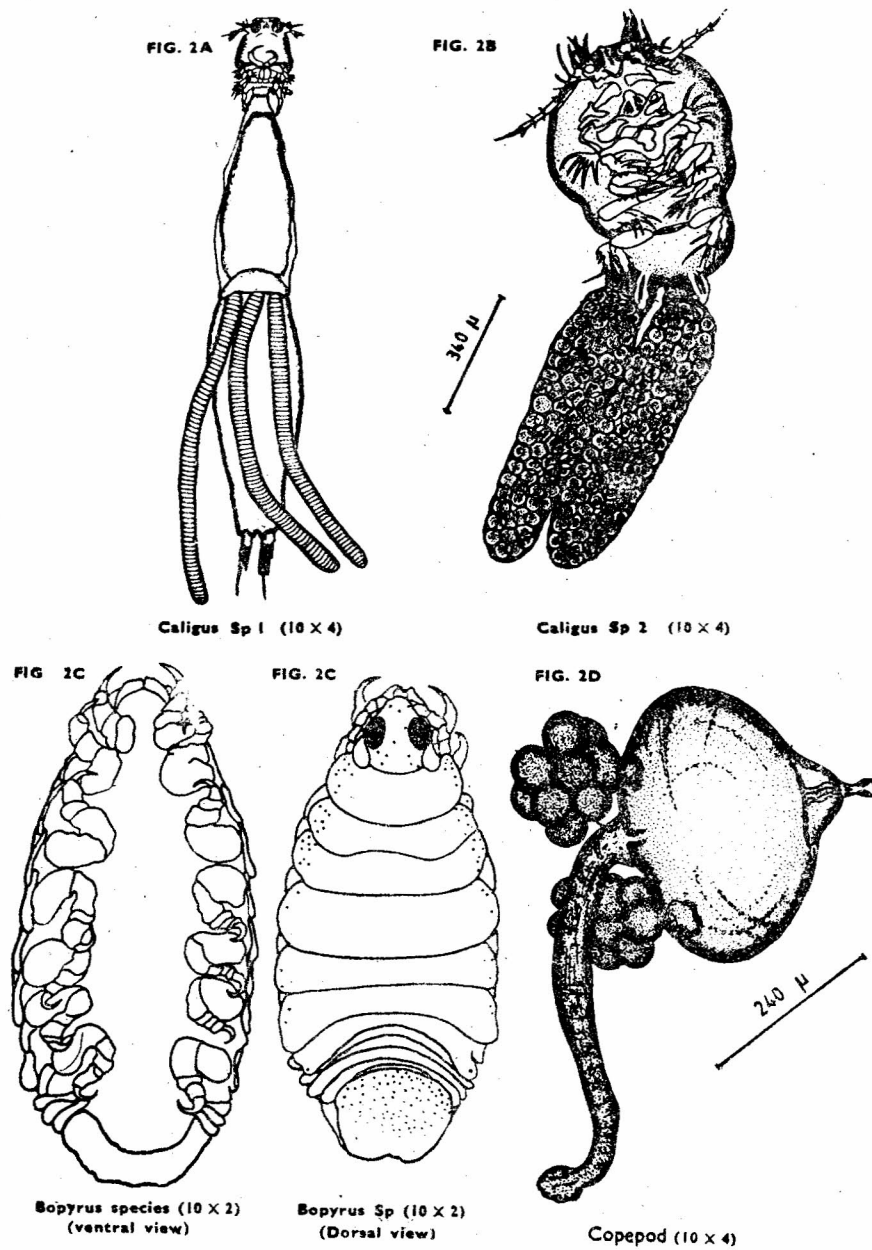


Fig. 2. Morphology of Ectoparasites found in the survey. All these parasite; A - D, the *Caligus* sp. 1, *Caligus* sp. 2, *Bopyrus* sp. & the copepod were found attached to the gills of *A. clupeioides*.

region in between head and thorax. The lines of division between the body segments are commonly fused. At the posterior-most end of the abdomen a pair of appendages are present. No males were found in this survey and in the females three egg sacs were present between thorax and abdomen. These are long and unsegmented.

The body dimensions of this *Caligus* sp. is 10–15 mm in length and 2–3 mm in width.

The body of the second *Caligus* sp. consists of two parts; the cephalothorax and abdomen (Fig. 2 B). The body is covered with a chitinous skeleton. The most anterior part of the body consists of a pair of sucker-like organs used to attach to the host tissues. Females possess two egg sacs at the posterior end of the body. The eggs are oval in shape. The mean length of the parasite is about 2–3 mm and width about 0.5–1.0 mm.

The *Bopyrus* sp. found attached to the gill chambers of *A. clupeioides* (Fig. 2 C) belongs to the Order Isopoda, Sub-Order Epicarida and Family Bopyridae.

It possesses a rudimentary pair and anterior thoracic limbs and seven pairs of abdominal limbs which are plate like and branchial in function.

The Copepod species (Fig. 2 D) were found attached to the gills of the host. The body of this parasite is highly specialized due to a parasitic mode of life and consists of two major parts; the cephalothorax which is oval in shape and bears a crown like appendages at its most anterior point and a tail-like projection at the posterior extremity of the body. Two egg sacs are present at each side of the body laterally at the junction of tail and cephalothorax. No thoracic appendages are observed in these organisms. The mean length of the parasite varies from 0.5 to 1.0 mm and the width varies from 1.0 to 1.25 mm.

The molluscs found attached to the gills of the herring, belong to the Class Gastropoda. The shell is clock-wisely rotated and the size is approximately 2 mm long and 2–3 mm wide.

### The Endo-parasites

*Hemiurus* sp. is a distome trematode parasite belonging to the Order Digenea, Sub Order Prosostomota, Family Hemiuridae and Sub-Family Hemiurinae (Dawes, 1956).

The body of *Hemiurus* sp. is elongated (Fig. 3 A). Its body consists of two parts; the soma ("fore body") and the ecsoma ("hind body") covered with a cuticle. Ecsoma when fully extended is about three quarters of the length of the soma. The largest population of the parasites belong to the

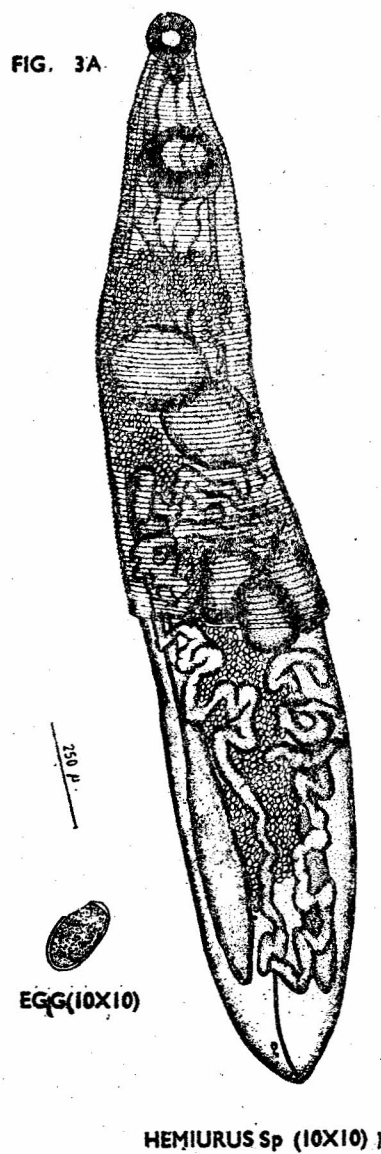
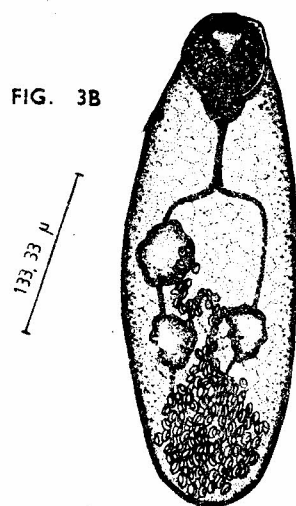


Fig. 3. Morphology of endoparasites found in the survey.  
A. *Hemiurus* sp.



TREMATODE Sp 2

(10X10)

FIG. 3C

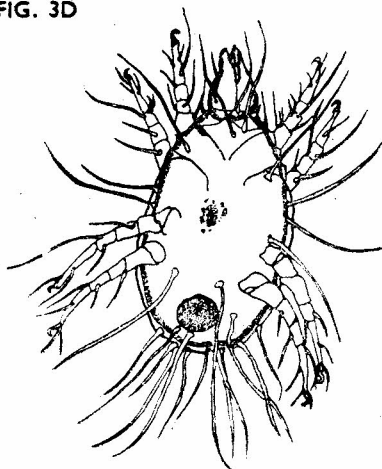


POSTERIOR



NEMATODE Sp (10 X 20)

FIG. 3D



MITE (10 X 4)

C. Nematode sp. & D the Mite were found inside the stomach of the Host. The trematode sp 2 (Fig. 3B) was found inside the gut caecae of the host.

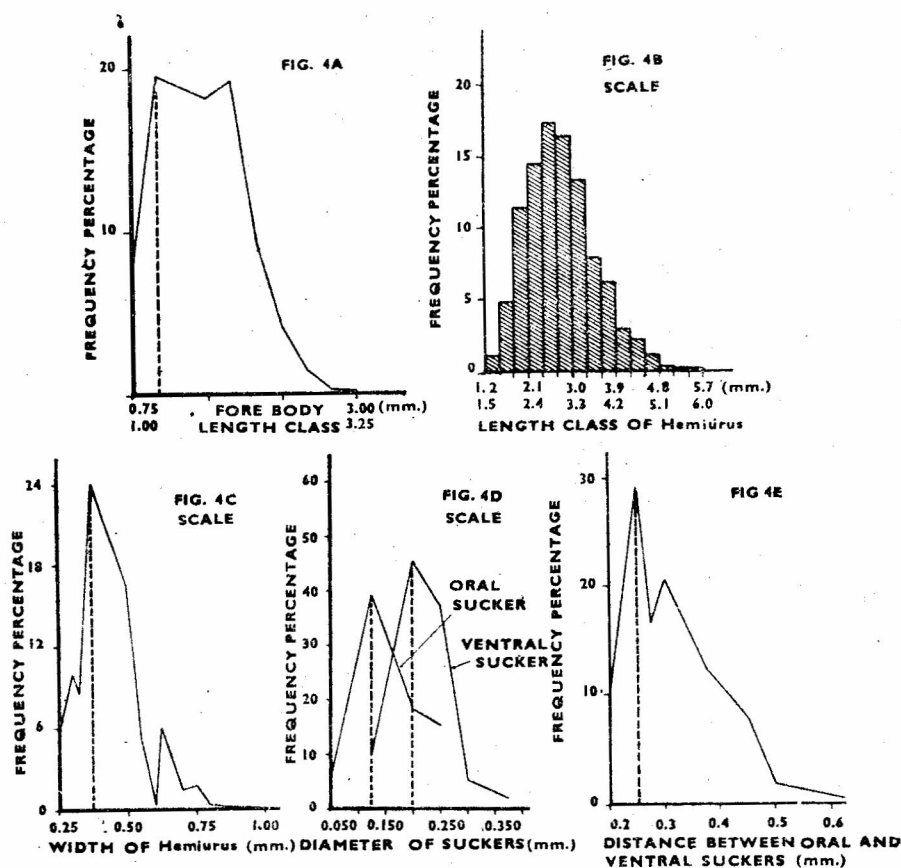


Fig. 4. The relationship between frequency percentage *versus*

- A. Fore body length class
- B. Length class
- C. Width
- D. Diameter of suckers and
- E. the Distance between "Oral & ventral suckers of the *Hemiurus* sp.

This indicates that the highest population of the *Hemiurus* sp. belongs to 1.0—1.25 mm fore body length class 2.4 — 2.7 mm length class 0.375 mm width class 0.125mm & 0.20 mm oral & ventral sucker diameters & 0.25 mm distance between the two suckers.

1.0–1.25 mm fore body length class (Fig. 4 A). Fore body or the soma is annulated to the level of the ovary. The vitellaria are compact and irregularly rounded and are paired organs lying close to the ovary. The limbs of the uterus extend into the ecsoma and are almost coextensive with the caeca.

The frequency percentage values for the length classes of *Hemiurus* sp. indicate that the largest percentage of its population belongs to the 2.4–2.7 mm length class (Fig. 4 B) and 0.375 mm width class (Fig. 4 C).

The ventral sucker is about twice as large as the oral sucker and lies close behind it. The largest parasitic population consists of individuals whose oral and ventral sucker diameters are 0.125mm and 0.20mm, respectively (Fig. 4 D). Also the distance between the two suckers of the largest number of parasites is 0.25mm. (Fig. 4 E).

The eggs are oval in shape and their size is 0.010 mm–0.015 mm.

The digenetic trematode species of the Sub Order Prosostomata (Fig. 3 B) have oval shaped bodies. The Cuticle is smooth and transparent. There are spines or striations present on the body surface. They have only a single sucker which is the anterior or oral sucker.

The largest population of this species belongs to the 1.3–1.6mm length class and 0.25mm width class. (Fig. 5 A & 5 B). Their oral sucker diameter belongs to the 0.125mm size class (Fig. 5 C).

Their eggs are oval in shape and size is 0.020–0.025 mm.

The nematodes found inside the stomach of the host, are filiform organisms and 7–15 mm long. No distinct buccal capsule is present. The oesophagus is cylindrical and the posterior part of it is dark in colour and looks like a glandular portion. There are striations on the cuticle. (Fig. 3 C).

The mites observed in this survey were numerous (Fig. 3 D) and were found attached to the bodies of *Hemiurus* sp. or to the stomach wall of *A. clupeioides*. Their body length is about 0.25–0.35 mm and width about 0.15 mm. The body is oval in shape. They have four pairs of limbs which terminate in a single claw. They possess a thin soft integument. Chelicerae are usually scissor — like with strong chelae probably adapted for chewing. Their integument and limbs possess hair which may be used for attachment.

The main characteristics of the parasites and their habitats are summarized in Table 2.

Table 2

## Main characteristics of the parasites and their habitats

<i>Name of the parasite</i>	<i>Habitat</i>	<i>Main characteristics</i>
<i>Hemiurus</i> sp.	... stomach	... Distome digenetic trematode and about 1.2–5.7 mm long and 0.25–0.95 mm in width. Fore body is longer than hind body and is about $\frac{2}{3}$ of the total body length. Two suckers, oral and ventral or acetabulum present. Diameter of oral sucker is 0.05–0.25 mm and remainder is 0.125–0.375 mm. The acetabulum is about twice as large as the oral sucker. Distance between the two suckers is about 0.2–0.625 mm. Striations occur only on the fore body. Eggs are oval in shape and size is 0.015–0.010 mm. Paired vitellaria, paired testis and a single ovary present.
Trematode belonging to Sub Order Prosostomata	pyloric caecae	Monostome digenetic trematode. Their body is about 1.0–2.1 mm long and 0.25–0.3 mm in width. Cuticle smooth and transparent. Only one sucker, the oral sucker present whose diameter is about 0.075–0.20 mm. About posterior half of the body filled with eggs. Eggs are oval in shape and size is 0.025–0.020 mm. Paired testis and a single ovary present
Nematode species	... Stomach	... Filiform and length is about 7–15 mm and 0.1–0.5 mm in width. No distinct buccal capsule. Oesophagus cylindrical and posterior part of it is dark in colour; looks like a glandular portion. Cuticle is simple

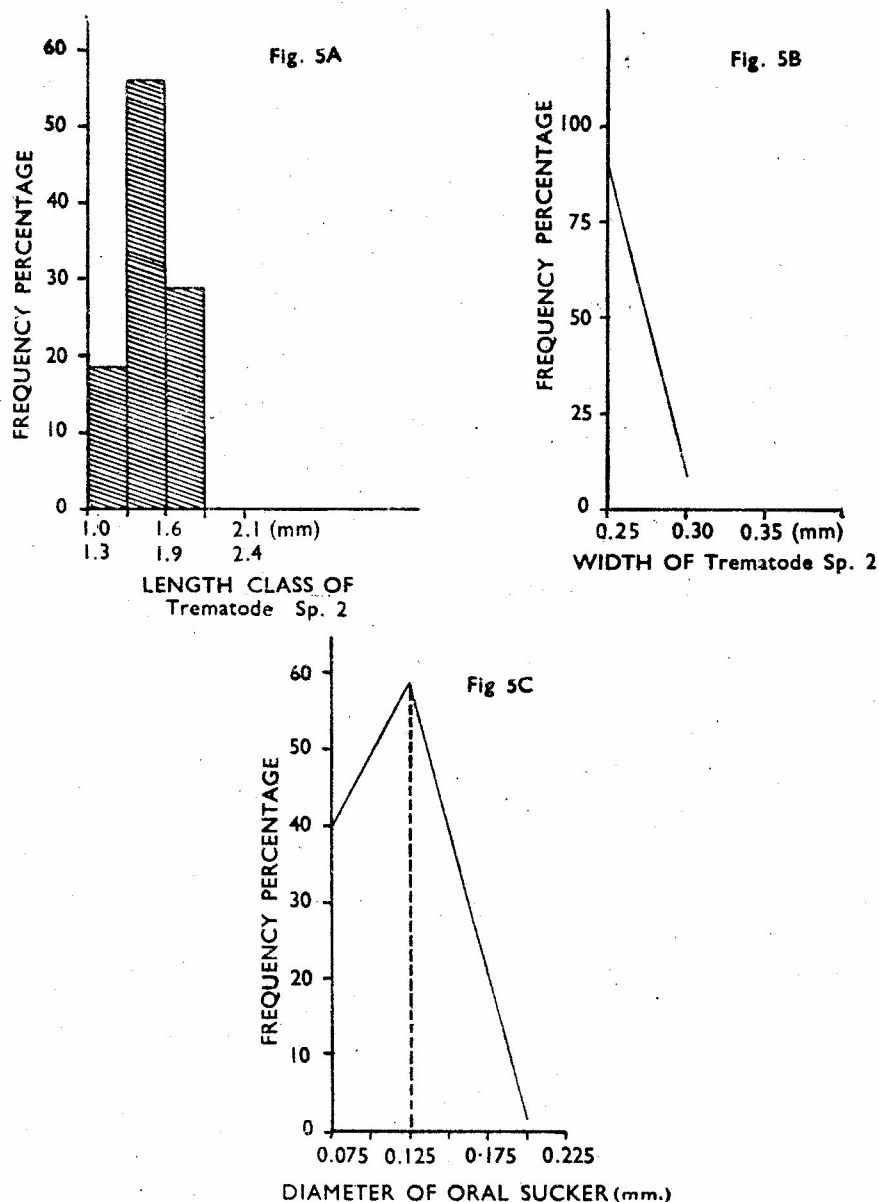
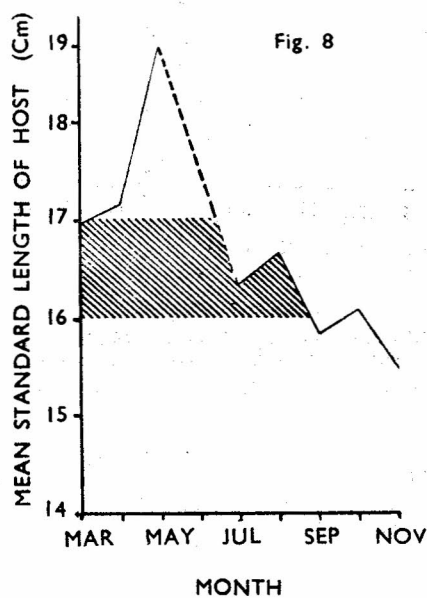
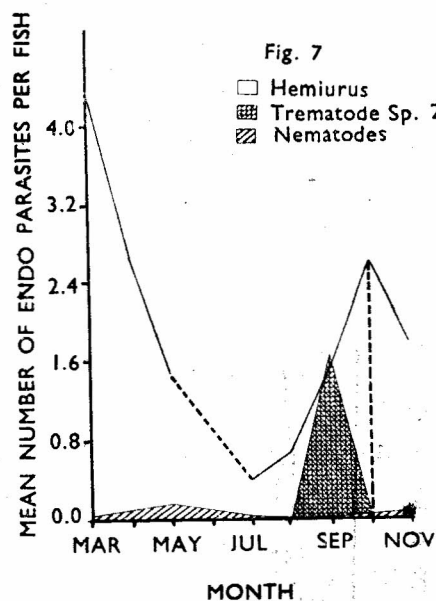
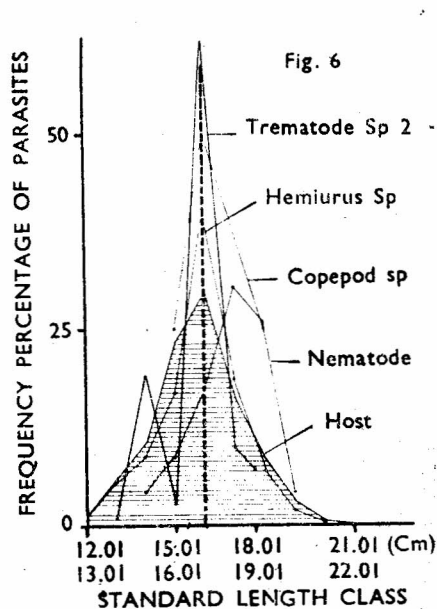


Fig. 5. The relationship between frequency percentage *versus*

- A. Length class of Trematode sp 2.
- B. Width of Trematode sp 2.
- C. Diameter of oral sucker (mm)

According to the graphic representation the highest frequency percentage of the Trematode sp 2 belongs to 1.0 - 2.1 mm length class, 0.25—0.3 mm width class & 0.075 mm to 0.20 mm oral sucker diameters.





- Fig. 6. The relationship between frequency percentage of parasites *versus* standard length class of fish. The shaded area indicates the relationship between frequency percentage and the length class of the host animals. This length class represents the highest population of the host organisms as shown by the shaded area. Also highest parasitic densities area recorded in fish belonging to the size class ranges of 16.01–17.01 cm.
- Fig. 7. The relationship between mean number of parasites per fish *versus* month. Highest number of *Hemiurus* sp. is recorded in March & Oct. months, *Trematode* sp. 2 in Aug. & Sept. months & the nematodes in May.
- Fig. 8. The relationship between mean standard length of host & the month. The shaded area indicates that the fish belonging to the size class of 16–17 cm are common during the March to August period.

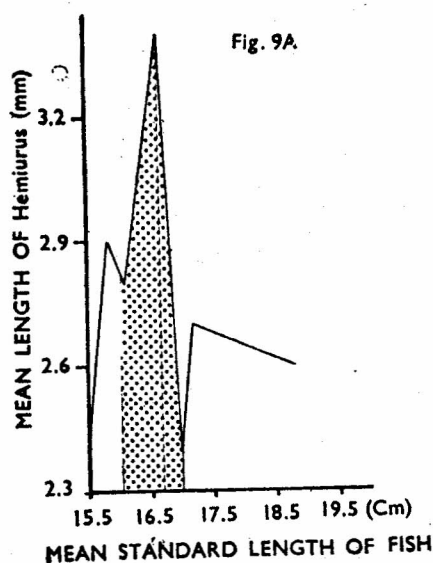


Fig. 9A. The relationship between mean length of *Hemiurus* sp. versus the mean standard length of fish. This relationship indicates that the longest or the largest *Hemiurus* sp. specimens are recorded from fish belonging to the size class of 16-17 cm (the shaded area)

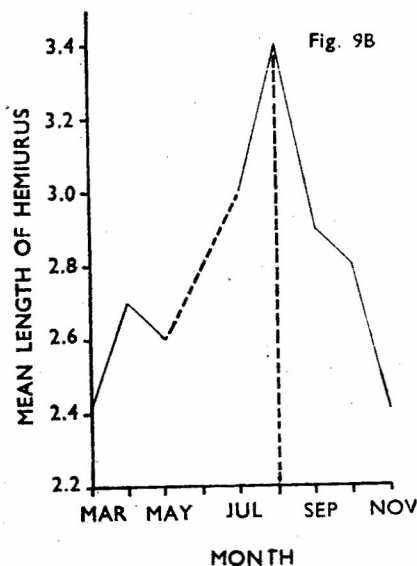


Fig. 9B. The relationship between mean length of *Hemiurus* sp. versus month. The dotted line indicates that the largest or longest *Hemiurus* sp. specimens are recorded in August during the survey.

Name of the Parasite	Habitat	Main characteristics
Mite species	... Stomach and attached to the body of <i>Hemiurus</i> sp.	They are 0.25–0.35 mm in length and 0.15 mm in width, oval shape body. The integument thin and soft and posses four pairs of the limbs which are ended with one claw. Chelicerae are scissor-like. Hairs present on limbs and the integument
<i>Caligus</i> sp. (1)	... On gills	... Body is elongate and consist of three parts; head, thorax and abodomen. Five pairs of head appendages present in the head. Pair of caudal rami situated at the posterior end of the body. Three elongate egg sacs present between thorax and abdomen
<i>Caligus</i> sp. (2)	... On gills	... Body consists of two parts; the cephalothorax and abdomen. Total length of the body 2–3 mm and 0.5–1.0 mm in width. Head appendages present. Two egg sacs present. Eggs are oval in shape. A pair of caudal rami present at the posterior end of the body
Copepod species	... On gills	... Body consists of two parts; the cephalothorax and abdomen. Anterior end of the body bears a crown like appendage and at the posterior end their is a tail like projection. At the junction of the cephalothorax and tail the two egg sacs are present. The body is 0.5–1.0 mm in length and 1.0–1.25 mm in width,
<i>Bopyrus</i> sp.	... On gills	... Body consists of a chitiniuou cover. Length of the body is 16 mm and width is 9–10 mm. Seven pairs of limbs present and have a rudimentary pair of anterior thoracic limbs

Name of the parasite	Habitat	Main characteristics
Gastropod species ...	On gills ...	The shell is clock-wisely curved. 2 mm in length and 2–3 mm in width and white in colour.

### Population patterns

The ecto-parasites found in the survey are very few in number and it is impossible to trace their seasonal or size class distribution related to the host.

Fig. 6 shows the percentage frequency distribution of all the parasites found in the survey versus the standard length class of the fish. The shaded area indicates the frequency percentage of fish versus their standard length class. This shows that the highest population of fish belongs to the size class of 16.01–17.01 cm. Accordingly, most of the parasites showed their occurrence in high frequency percentages in fish belonging to this size class range of 16.01–17.01 cm, indicating that they are common in the host animals of this size.

### The Endo-parasites

When the endo-parasites are considered the highest population densities of *Hemiurus* sp. are recorded in the months of March and October and the lowest in July. Peak values are reported for prosostomata trematode populations in September whereas nematodes have peak values in May (Fig. 7).

#### *Hemiurus* sp.

The mean number of parasites per fish do not increase with the increasing length of fish. As these parasites occur in high numbers in fish belonging to the standard length class of 16.01–17.01 cm, they are common during the months of March to September (Fig. 8), during which period the highest populations of fish belong to the above size class. However Fig. 8 (shaded area) shows how the number of *Hemiurus* sp. per fish change with time.

Further, Fig. 9 A indicates that the largest parasites occur in fish belonging to the size class in between 16.01–17.01 cm (which is the commonest size class of the observed fish population) which is in the month of August. (Fig. 9 B).

Further analysis of the data shows that the density of parasites is independent of the sex of the host. Out of about six hundred fish examined, 313 female fish carried 685 *Hemiurus* sp. parasites and the male fish carried 287 parasites, indicating that the density of parasites in the host animal is independent of the sex of the host.

### Other Endo-parasites

The highest percentage frequency of prosostomata trematodes are also seen in host organism in the 16.01–17.01 cm size class (Fig. 6).

Fig. 7 shows that the highest mean number of nematodes are found in May and the highest percentage frequency of nematodes per fish is observed in the fish length class of 17.01–18.01 cm.

### Discussion

#### Why study fish parasites ?

One of the most serious gaps in our knowledge of fisheries biology is that of the parasites and diseases of fish. Also, information of the pathogenic effects of metazoan parasites on fish is lacking. In Sri Lanka the demand for fish food is increasing due to the problem of protein deficiency in the diet. Fish is the cheapest and best animal protein available to man. As fish parasites may act as carriers or vectors of pathogenic organisms and cause disease in man, it has to be studied in detail.

#### Types of parasites

The present study reveals that the metazoan parasites of *A. clupeioides* are quite diversified. Nine different parasitic species (two species of Caligids, one copepod, *Bopyrus* sp., mites, Gastropods, *Hemirurus* sp. Prosostomata trematode species and Nematode species) were found in the survey and it is clear that metazoan parasitic fauna is rich in number and in species.

#### Morphological features

A description of the morphological feature of ecto- and endo-parasites is important because it gives the necessary background knowledge about the types of fish parasites and help in identifying the parasites. The present study records the parasitic fauna of *A. clupeioides*. A description of parasitic copepods of fish recorded from Sri Lanka is available (Kirtisinghe, 1964). The parasites found in the present survey are not identified up to the species level. However, the collection of all the parasites found in the survey will be deposited in the Department of Zoology, University of Sri Jayawardenepura, Sri Lanka.

#### Ectoparasites

##### The Caligids

Two species of caligids were found attached to the gills of *A. clupeioides*. Baer 1952 stated that caligids never stay very far from their hosts and are found from their hosts and are found wondering over their body sucking their food with the aid of tubular mouth parts. Caligids have two sucker like organs located close to the anterior end of the cephalothorax. These caligids are mostly recorded from host species of the cod and flounder families (Baer, 1952).

### Isopods

Two Specimens of *Bopyrus* sp. were found attached to the gills of *A. clupeioides*. Parasitic isopods were considered as absolutely host specific. However, in parasitic isopods the host-parasite relationship is distinctly ecological and more over is found to occur both at the larval and at the adult levels (Baer, 1952). Appropriate hosts get infected when they appear in cyclic fashion within a given biotope (Reverberi & Pitotti, 1942).

### Gastropods

Two gastropods in the present survey were attached to the gills of *A. clupeioides*. The nature of the association between gastropod and its host is not always clear and it is possible that further research will reveal that a number of species recorded as parasites are actually sedentary predators.

### Endoparasites

#### *Hemiurus* sp.

The morphological features of *Hemiurus* sp. found in the survey show distinct similarities to *H. appendiculatus* described by Dawes 1956. According to him this species occur in the stomach, intestine and pyloric caecae of perch, burbot, river trout, houting, twaite shad, allis shad and river lamprey. Also Patzelt (1930) made a detailed study of specimens found in *Sardinella aurita* at Palma (Majorca). Linton (1940) gave diagnosis and measurements of specimens found in nineteen species of fishes.

*Hemiurus ocreatus* is reported from herring, sprat, mackerel, etc. However, the morphological features of the *Hemiurus* sp. found in this study show close similarities to *H. appendiculatus*. Therefore, instead of arriving at a definite conclusion only the necessary measurements of the specimens found in the present survey are recorded leaving room for a detailed further study of the species. *Hemiurus* sp. is the commonest parasite found in *A. clupeioides* and is abundant from March to September. Also, according to Fig 6 the highest population densities of *Hemiurus* sp is found in fish belonging to the 16–17 cm size class which class occurs at high densities during the months from March to October.

Information about population fluctuations of the host animal is lacking and, therefore, it is impossible to clarify the relationship between host and parasitic population fluctuations and it is beyond the scope of this study. There is little evidence to indicate that helminths may kill their fish hosts under certain conditions. Where this species is concerned the highest population densities and the largest parasites were found in hosts belonging to the average size class of 16.01–17.01 cm. The reason is that consist of the highest frequency of specimens belonging to the herring population are of the size class 16.01–17.01 cm (Fig. 6).

When the host animals harbour large numbers of *Hemiurus* sp. parasites, fibrous cysts have been observed in the stomach wall of the host. However, the pathogenic effects caused by this parasite on the host is not known. Perhaps it may be harmful to the host.

Helminths as parasites of fish were not considered as important for study by most workers. However, a number of text books and papers appeared after 1950 giving greater prominence to this field of study (Prost, 1953; Kocylowski, 1963; Dogiel et al 1958; Lyaiman, 1963 & Freeman, 1964).

Most of the information available is on helminth diseases of freshwater fish. Little is known about them in marine fish. (Guberlet, 1934).

Shipley & Fearnside (1906) cited 130 references in a review of the effect of metazoa parasites, especially helminths, on their hosts.

#### Prosostomata trematodes

Other endoparasites, namely prosostomate trematodes and nematodes are low in numbers compared to the density of *Hemiurus* sp. found in *A. clupeioides*. The combined effect of these parasites on the host is not known.

However, Williams (1967) stated that occasionally two or more parasitic species may either have synergistic or combined effects on the host or be antagonistic to one another. Problems of this nature can only be solved by well designed experiments.

#### Nematodes

The type of nematodes found in the survey are described in Fig. 3 C. These nematodes were found together with *Hemiurus* sp. but in low numbers. They were not found attached to the wall of the stomach like how the *Hemiurus* sp. were attached.

Studies of the pathogenic effects of nematodes is one of the most neglected fields of study in fishery biology due to a lack of knowledge about the occurrence, distribution and taxonomy and such nematodes.

There are only a few brief reports of nematodes that act as fish pathogens (McIntosh, 1864; Shipley, 1906; Romotti, 1933 a & b). According to Berland (1961) not much is known about the effects of these parasites upon the host fish although nematode larvae are so common in fish. Their presence may be considered normal. Berland also cited references which stated that the presence of larval nematodes may reduce the fat content of fish.

#### Mites

Parasitic mites show variable adaptations to their specialized modes of life. The mites found in the present survey were found inside the stomach and they possess a claw like modification in their legs. These modifications

may help the mite to attach to the stomach wall of the host. The information that is available about this parasite is insufficient to comment on their life cycle or about their feeding habits, etc.

#### Acknowledgements

We wish to thank Professor Winston E Ratnayake, Head, Department of Zoology, for the facilities and encouragement given during this study, Mr. W. Abeywickrema for his kind support and Mrs. K.M-L. Perera for helping to collect isopod parasites.

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