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ENDOPARASITIC HELMINTHES OF THE STRIPED MULLET, *MUGIL CEPHALUS*, FROM THE NORTHERN RED SEA: EFFECT OF THE HOST'S MODE OF LIFE ON THE INCIDENCE AND INTENSITY OF INFECTION

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Key words: Digenean trematodes, Cestoda, Acanthocephala, *Mugil cephalus*- incidence and intensity of infection- Red Sea.

ABSTRACT

A random sample of 267 individuals of the mullet *Mugil cephalus*, was collected from the coasts of Sharm El-Sheikh, Northern Red Sea, Egypt. Examination revealed that 108 individuals with a general incidence of 40.44% were parasitized; of this number 63 (23.59%) were parasitized by *Lecithobotrys sprenti* (Trematoda: Digenea: Haploporidae), 54 (20.22%) by *Carassotrema bengalense* (Trematoda: Digenea: Haploporidae), 35(13.10%) by plerocercoid larvae (Cestoda: Tetraphyllidea), and 34 (12,73%) by *Heterosentis overstreeti* (Acanthocephala: Arhythmacanthidae). These parasites are recorded, redescribed and figured for the first time from numerous specimens from the Red Sea to give broadened descriptions. However, the female acanthocephalan *H. overstreeti* is hereby described for the first time. The examined sample of *M. cephalus* were separated into three regular size groups. In each group, the incidence and intensity of each parasite were discussed. It was concluded that the incidence and intensity of parasites in marine fishes depend to a great extent on the host's mode of life.

INTRODUCTION

The striped mullet, *Mugil cephalus* has a circumglobal distribution, since it is widely distributed in the coastal waters, brackish waters, and estuaries of the tropical and subtropical zones. In

many regions. the helminth parasites of this fish were comprehensively studied; in the Black Sea by Vlassenko (1931), Reshetnikova (1955) and Polyanski (1958); in the Mediterranean Sea by Paperna (1964); in the Northern Gulf of Mexico by Overstreet (1971); in the Biscayne Bay, Florida by Skinner (1975) and in India by Rekharani and Madhavi (1985). Paperna and Overstreet (1981) gave a checklist of parasites recorded from mullets. Several regions remain to be explored. However, differences in the parasitic fauna of mullets from widely separated areas are expected with the different geographical localities (Manter, 1955; Noble and Noble, 1971; Skinner, 1975; Rekharani and Madhavi, 1985).

Without exaggeration, the parasitic fauna of mullets inhabiting the Red Sea is little known in the literature. Therefore, the present study aimed to examine a random sample of the striped mullet, *Mugil cephalus*, from the coasts of Sharm El-Sheikh, Northern Red Sea to identify its helminth parasites as well as the incidence and intensity of infection.

MATERIAL AND METHODS

In May 2001, 267 specimens of the fish *Mugil cephalus* ranging in size from 10.1 to 34.3 cm (total length), were collected as a random sample from the coasts of Sharm El-Sheikh, Northern Red Sea, Egypt. These specimens were separated into three size groups of regular length intervals (small, intermediate, and large group). Standard parasitological techniques were used to examine the different organs of fish. The number of parasitic worms was carefully recorded. The intensity of infection (mean/host) was estimated as the number of worms recovered per infected fish. Parasitic worms were removed from their host fishes under a dissecting microscope, kept alive in sea water diluted to 1% salinity as recommended by Schroeder (1971), and observed under a research compound microscope. The worms were fixed in alcohol-formalin-acetic (AFA) under slight coverslip pressure, and preserved in 70% ethyl alcohol. Whole mounts were stained by alum carmine, cleared in terpineol, and mounted in Canada balsam. Figures were drawn with the aid of a camera lucida.

RESULTS AND DISCUSSION

Four different species of parasitic helminthes were collected from the examined sample of *Mugil cephalus*. The taxonomic position and the main characteristics of these species are as follows:
(Trematoda: Digenea)
Order: Prosostomata
Family: Haploporidae Nicoll , 1914
Lecithobotrys sprenti Martin, 1973
(Fig. 2 A)
Site of infection: intestine.

Description (based on numerous specimens):

The body is fusiform, covered with minute spines, and measures 0.805-1.150 mm long by 0.165-0.250 mm wide at its middle. The oral sucker is sub-terminal, spheroid, and measures 0.080-0.115 mm long by 0.085-0.120 mm wide. The acetabulum is spheroid, situated in the second fourth of the body, and measures 0.084-0.115 mm in diameter. Sucker ratio is about 1:1. The prepharynx is relatively long, and measures 0.056-0.075 mm in length. The pharynx is well developed, highly muscular, and measures 0.055-0.075 mm long by 0.068-0.095 mm wide. The oesophagus is 0.153-0.225 mm long, and bifurcates just behind the acetabulm into two short saccular intestinal caeca. The single testis is oval in shape, situated in the middle of the hindbody, and measures 0.085-0.115 mm long by 0.060-0.080 mm wide. The external seminal vesicle is present. The hermaphroditic pouch is relatively large, arched around the right border of the acetabulum, and measures 0.159-0.225 mm long by 0.080-0.105 mm wide. It contains a saccular internal seminal vesicle, a moderately developed prostatic complex, and a hermaphroditic duct leading into the genital pore, which lies between the acetabulum and pharynx. The ovary is relatively small, oval in shape, situated just behind the intestinal bifurcation, and measures 0.055-0.070 mm long by 0.040-0.050 mm wide. The uterine loops extend to near the posterior extremity; the terminal loop passes forwards and penetrates the hermaphroditic pouch to join the hermaphroditic duct. The vitelline follicles arranged in two

symmetrical bunches, on each side of the ovary. A transverse vitelline duct arises from each bunch and opens into a swollen vitelline reservoir situating behind the ovary. The eggs are operculated, oculate (contain eye-spotted miracidia), and measure 45-65 µm long by 28-32 µm wide. The excretory vesicle is saccular, and extends anteriorly to near the testis; the excretory pore is postero-terminal.

Nine species have so a been described in the genus *Lecithobotrys* Looss, 1902 viz. *L. putrescens* Looss, 1902 (type species), *L. vitellosus* (Sharma and Gupta, 1970) *L. sprenti* (Martin, 1973), *L. maginovatus* (Szidat, 1954 and Martin, 1973) *L. maguns* (Szidat, 1954) Martin, 1973, *L. elongatus* (Szidat, 1954) Nasir and Gomes, 1976) *L. octavus* (Szidat, 1954 and Nasir & Gomez, 1976, *L. mugilis* Rekharani & Madhavi, 1985) and *L. aegyptiacus* (Hassan *et al.*, 1990)

Most species of the genus *Lecithobotrys* and other genera of the family Haploporidae Nicoll, 1914 are usually parasitic in the intestine of mullets. *Lecithobotrys sprenti* was briefly described from 10 specimens collected by Martin (1973) from the intestine of *Mugil cephalus* in Australia. To date, no other information were published to mention this species. In the present study, *L. sprenti* was redescribed for first time from *Mugil cephalus* inhabiting the Northern Red Sea. However, the given redescription was based on numerous specimens to give a broadened description. *Mugil cephalus* and other species of mullets are widely distributed in the coastal waters, brackish waters, and estuaries of tropical and subtropical zones, and capable of undertaking migrations from the sea into freshwater habitats.Therefore, Manter (1957) suggested that mullets act as "ecological bridges" in the initial dispersal of digenean trematods from marine fishes into freshwater hosts and vice versa. Lumsden (1963), Shireman (1964), Skinner (1975), and Rekharani and Madhavi (1985) provided evidence in fovour of Manter's ecological bridge theory.

Carassotrema bengalense Rekharani and Madhavi, 1985
(Fig. 2 B)
Site of infection: instestine.
Description (based on numerous specimens):

The body is fusiform, covered with minute spines, and measures 0.856-1.130 mm long by 0.288-0.360 mm wide. The oral sucker is well developed, sub-terminal, wider than long, and measures

0.075-0.100 mm long by 0.104-0.130 mm wide. The acetabulum is spherical, situated just pre-equatorial, and measures 0.124-0.160 mm in diameter. Sucker ratio is about 1: 1.19-1.23. The prepharynx is relatively long and measures 0.060-0.081 mm in length. The pharynx is globular, and measures 0.072-0.110 mm long by 0.072-0.094 mm wide. The oesophagus is relatively short measuring 0.065-0.083 mm in length, and bifurcates immediately in front of the acetabulum into two narrow instestinal caeca extending backwards to near the posterior extremity. The single testis is fairly large, elongate, slightly lobed, median, and measures 0.280-0.380 mm long by 0.128-0.170 mm wide. The hermaphroditic pouch is short, extending between the acetablum and pharynx, and measures 0.102-0.130 mm long by 0.060-0.072 mm wide. It contains a saccular internal seminal vesicle, a short pars prostatica surrounded by few prostatic cells, and a hermaphroditic duct leading into the genital pore, which lies immediately behind the pharynx. The external seminal vesicle is present, situated behind the acetabulum, and connected to the internal seminal vesicle by a narrow tube. The ovary is oval, antero-lateral to the testis, and measures 0.104-0.140 mm long by 0.075-0.110 mm wide. The seminal receptacle is rounded and situated antero-lateral to the ovary. The uterus is thin-walled, very short, and composed of a single loop extending between the ovary and the hermaphroditic pouch; the distal portion of the uterus penetrates the hermaphroditic pouch to join the hermaphroditic duct. The vitelline follicles are irregular in shape, moderate in size, and extending in the lateral fields from the anterior border of acetabulum to near the posterior extremity. The eggs are fairly large, operculated, yellowish, few in number (1-3/worm), and measure 80-95 µm long by 65-76 µm wide. The excretory vesicle is saccular, and extending anteriorly to near the posterior border of testis; the excretory pore is postero-terminal.

Nine species have so for been described in the genus *Carassoterma* Park, 1938 viz. *C. koreanum* Park, 1938 (type species), *C. megapharyngus* Wang, 1964, *C. lemelorchis* Wang, 1964, *C. muglilcola* Shireman, 1964, *C. ginetzinskjae* Kulkova, 1976, *C. tilapiae* Nasir and Gomez, 1976, *C. kui* Tang and Lin, 1979, *C. estuarinum* Tang and Lin, 1979, and *C. bengalense* Rekharani and Madhavi, 1985. Many of these species were recorded from mullets.

Carassotrema bengalense was briefly described from 5 specimens collected by Rekharani and Madhavi (1985) from the intestine of *Mugil cephalus* in India. To data, no other information were published to mention this species. In the present study, *C. bengalense* was redescribed for the first time from *Mugil cephalus* inhabiting the Northern Red Sea However, the given redescription was based on numerous specimens to give a broadened description.

(Cestoda: Eucestoda)
Order: Tetraphyllidae
Plerocercoid Larvae
(Fig. 3)
Site of infection: gall bladder.

Description (based on numerous specimens):

The body is elongate, somewhat flattened, and measures 1.72-2.64 mm long by 0.35-0.49 mm wide. The anterior end is provided with 4 bilocular suckers (without accessory suckers). Each sucker measures 0.13-0.17 mm in diameter. The apical sucker is present and measures 0.055-0.073 mm in diameter. The posterior end of the body is bluntly rounded. A distinct water vascular system extending longitudinally from area immediately behind suckers to the posterior extremity. Red pigment patches present behind suckers in all specimens.

Linton (1897, 1901) recorded and sketched larval cestodes from more than 60 widely differing species of fishes. He listed them under the collective name *Scolex polymorphus* Rudolphi, 1819. In a later report, Linton (1908) concluded that these larvae belong to a number of different cestode genera.Yamaguti (1934) accepted this view and distinguished the cestode larvae into 6 different types. The present cestode larvae conform closely to the characteristics of type IV (= plerocercoid larvae). These larvae are frequently referred to in the literature under the name *Scolex polymorphus* Rudolphi, 1981. Cestode larvae were recorded from *Mugil cephalus* in different localities; in the Black Sea by Dogiel (1956), in Israel by Paperna (1964), and in Florida by Skinner (1975).

(Acanthocephala: Paleacanthocephala)
Order: Echinorhynchida
Family: Arhythmacanthidae Yamaguti, 1935
Heterosentis overstreeti (Schmidt and Paperna, 1978) Amin, 1985
(Fig. 4)
Site of infection: intestine.

Description (based on numerous specimens):

The trunk is elongate, sub-cylindrical, spined, 8.10-12.10 mm long by 1.77-2.30 mm wide in males, and 9.10-13.50 mm long by 1.28-2.60 mm wide in females. Proboscis is spheroid, 1.17-2.21 mm in diameter in males, 1.85-2.36 mm in diameter in females, and armed with three types of sharp hooks arranged in 12 alternating longitudinal rows. Each row includes 4 hooks of variable lengths; apical hook 72-90 µm, the next one 170-205 µm, and the remaining two 49-65 µm in length. The neck is relatively short, and measures 0.50-0.67 mm long by 0.70-1.15 mm wide at its base. Proboscis receptacle is cylindroid, double-walled, 1.17-2.21 mm long in males, and 1.92-2.41 mm long in females. The brain (rounded ganglion) lies in the middle region of the proboscis receptacle. Lemnisi are claviform, slightly longer than the proboscis receptacle being 1.84-2.62 mm long in males, and 2.10-2.95 mm long in females. The testes are oval in shape, tandem, and nearly situated in the middle of the body; the anterior testis is 1.20-1.65 mm long by 1.38-1.85 mm wide, while the posterior testis is 1.40-1.81 mm long by 1.50-2.00 mm wide. Cement glands are six in number, tubular measuring 1.69-2.41 mm long, and lead into a saccular cement reservoir. The ejaculatory duct is tubular, and opens into a cylindrical protrusible penis measuring 0.93-1.30 mm long. Copulatory bursa well developed, hemispheric, and measures 0.85-1.11 mm in diameter. The ovarian balls are relatively large in size, and distributed in most of the pseudocoel. The uterine bell is well developed, its base lies at 2.55-3.55 mm from the genital opening. The uterus is tubular, and leading posteriorly into a well-developed vagina surrounded by a sphincter muscle on each side.

Based on a single male specimen, Schmidt and Paperna (1978) described *Arhythmacanthus overstreeti* as a new acanthocephalan species from the intestine of *Silhouettea insinuans*, a fish from Gulf of Elat, Israel. Accordingly, the given description was inadequate and nothing was mentioned about the characteristics of the female. Amin (1985) transferred this species to the genus *Heterosentis* Van Cleave, 1931 *as H. overstreeti* (Schmidt and Paperna, 1978) Amin, 1985. To data, no other information were published to mention this species. In the present study, the female of *H. overstreeti* was described and figured for the first time, while the male is redescribed from numerous specimens to give a broadened description. However, the

fish *Mugil cephalus* is considered as a new host record for this parasite from the Red Sea.

Incidence and intensity of infection:

Out of 267 *Mugil cephalus* examined, 108 individuals with a general incidence of 40.44% were found parasitized; of this number 63 (23.59%) were parasitized by *Lecithobotrys sprenti*, 54 (20.22%) by *Carassotrema bengalense*, 35(13.10%) by plerocercoid larvae, and 34 (12.73%) by *Heterosentis overstreeti*. The incidence and intensity of each parasite in the different size group of *M. cephalus* are recorded in Table (1). In the smaller size group, the infection with both the digenean trematodes and acanthocephalans was completely absent, while the incidence and intensity of infection with plerocercoid larvae of cestodes were relatively high. In the intermediate size group, the infection with the digenean trematodes *L. sprenti* and *C. bengalense*, and with the acanthocephalan *H. overstreeti* started to appear with moderate incidence and intensity, while the incidence and intensity of plerocercoid larvae were very scarce in this group. In the larger size group, the incidence and intensity of infection with digenean trematodes and acanthocephalans were relatively high, while the infection with plerocercoid larvae of cestodes was completely absent in. According to Broadhead (1953) and Odum (1966), the life history of *Mugil cephalus* is distinguished into two distinct phases; the pelagic life of the young fish feeding on planktonic crustaceans, and the inshore life of the adults feeding on detritus. By using these information, the present results can be explained, since individuals of the smaller group of *M. cephalus* act as intermediate hosts for many species of marine cestodes. Accordingly, the incidence and intensity of plerocercoid larvae were relatively high in this group, while the infection with both the digenean trematodes and acanthocephalans was completely absent. Individuals of the intermediate size group are known to feed on algae and the bottom scum, on which the cercariae of the present digenean trematodes (haploporid cercariae) usually encyst (Rekharani and Madhavi, 1985), also adult mullets feed on benthic crustaceans (intermediate hosts of acanthocephalans) that get entangled in the bottom. Accordingly, the incidence and intensity of digenean trematodes and acanthocephalans were moderate in this group, while those of the plerocercoid larvae were very scarce. Individuals of the larger size group are bottom feeding on detritus so, the infection with

plerocercoid barvae was completely absent in this group, while the incidence and intensity of infection with digenean trematodes and acanthocephalan were relatively high. To explain a nearly similar result, Kennedy (1975), Priemer (1979), and Noble and Noble (1982) believed that chances of certain parasitism may be greater for large hosts, which have greater surface area, consume more potentially parasite-laden food, and have lived longer than the small individuals.

In the present area of study, *Mugil cephalus* served as a definitive host for the digenean trematodes *Lecithobotrys sprenti* and *Carassotrema bengalense*, and for the acanthocephalan *Heterosentis overstreeti*. Also, it served as an intermediate host for plerocercoid larvae of cestodes. These larvae can be termed as "childhood parasites", since they become scarcer or disappear with increasing the fish maturity due to a change in the mode of life.

Generally, the above results support Lom's (1970) and Skinner's (1975) openions that the incidence and intensity of parasites in marine fishes depend to a great extent on the host's mode of life.

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Table (1): Incidence and intensity of infection with each parasite in the different size groups of *Mugil cephalus*.

Size groups of *Mugil cephalus* (cm.)	no. examined	No. infected	Incidence (%)	Parasitic helminthes											
				Digenean trematodes						Cestodes			Acanthocephala		
				L. sprenti			*C. bengalense*			Plerocercoid Larvae			*H. overstreeti*		
				no. infected	Incidence (%)	Intensity	no. infected	Incidence(%)	Intensity	no. infected	Incidence (%)	Intensity	no. infected	Incidence (%)	Intensity
Small group (10.1 – 16.1)	121	32	26.44	-	-	-	-	-	-	32	26.44	28.09	-	-	-
Intermediate group (18.2 – 26.2)	97	48	49.48	38	39.17	21.60	33	34.02	16.00	3	3.09	3.66	20	20.61	14.25
Large group (26.3 – 34.3)	49	28	57.14	25	51.02	33.16	21	42.85	27.76	-	-	-	14	28.57	20.78
Total	267	108	40.44	63	23.59	26.19	54	20.22	20.57	35	13.10	26.0	34	12.73	16.94

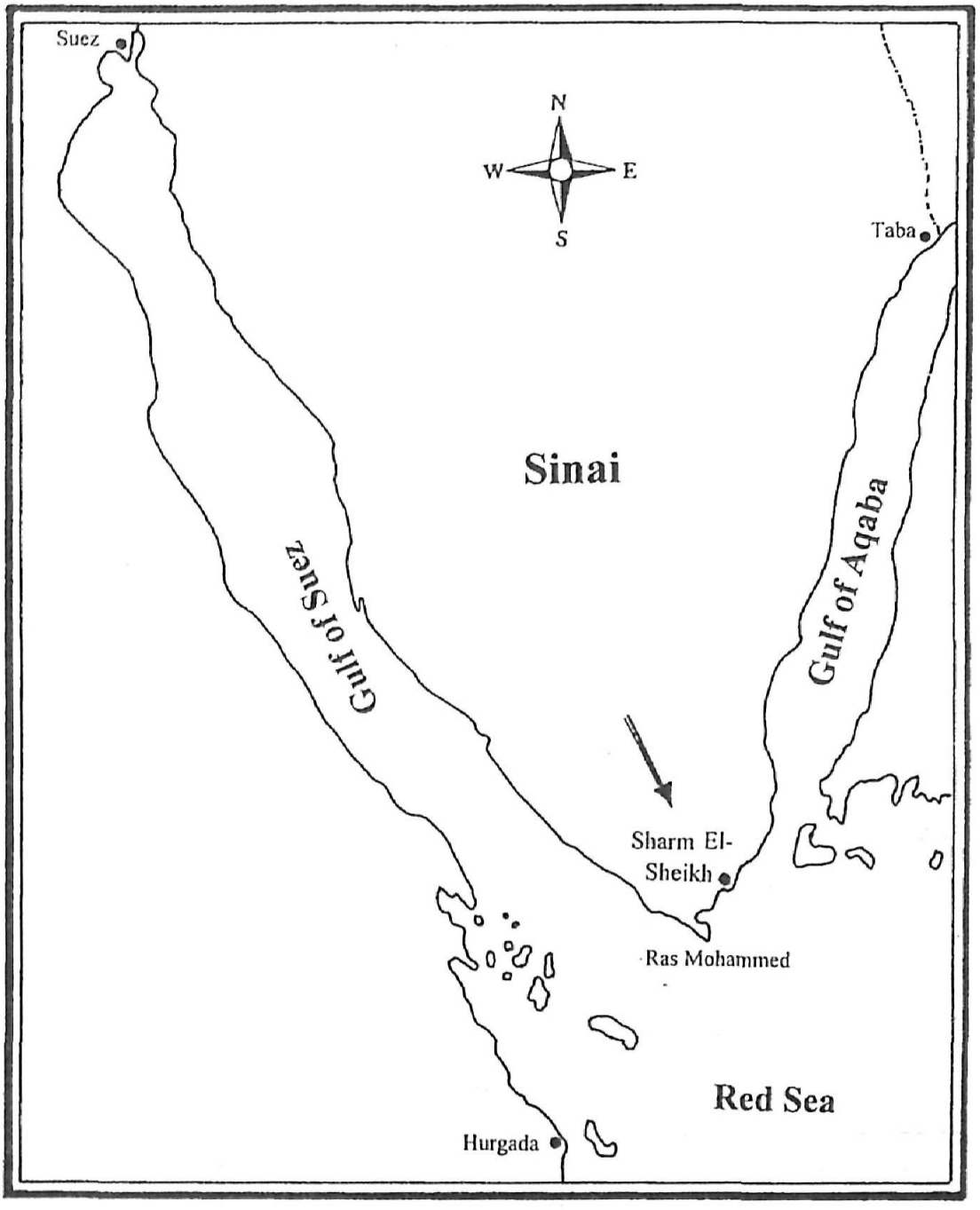

Fig. (1) : A map showing the locality of the examined fishes .

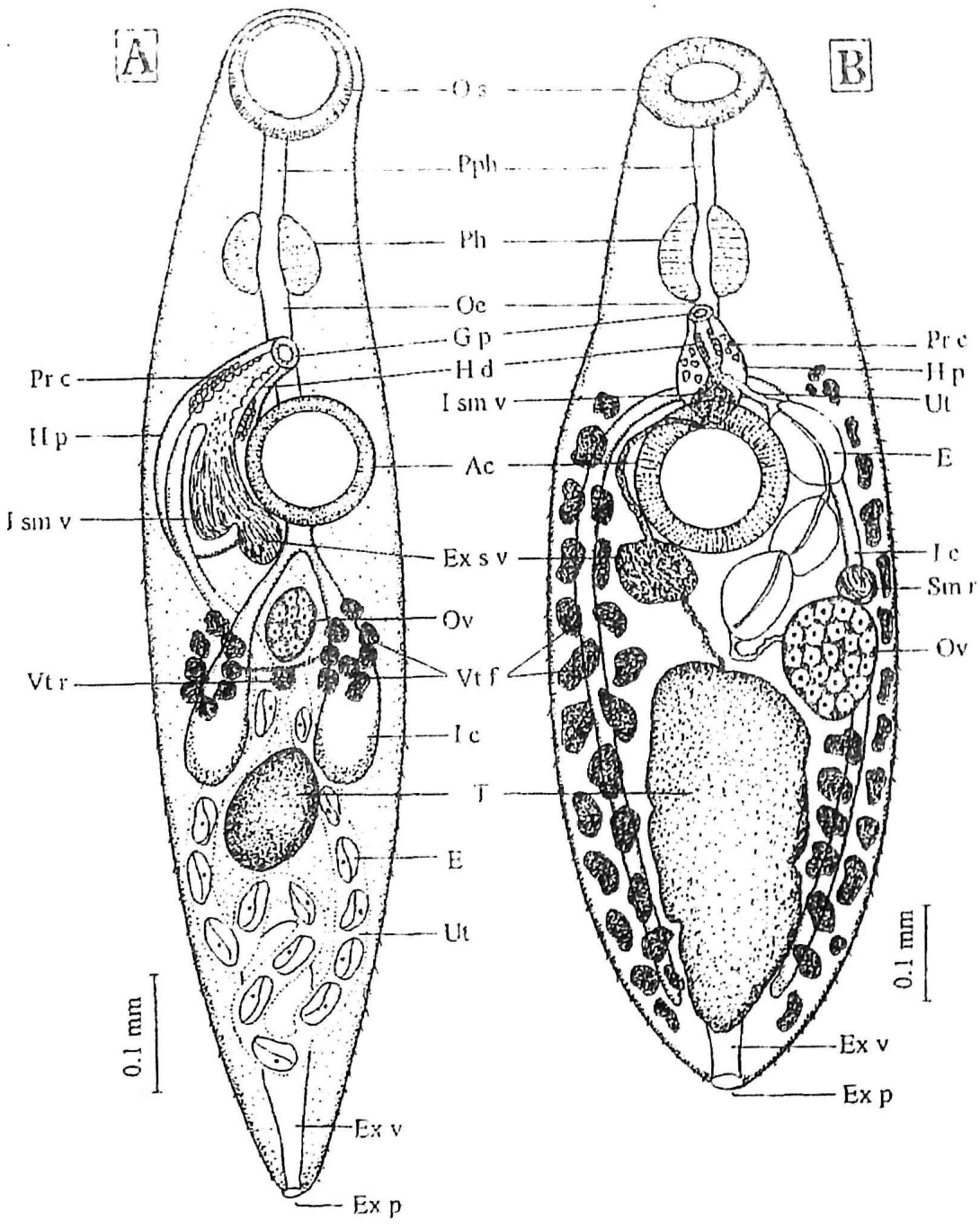

Fig.(2): A) ***Lecithobotrys sprenti* Martin, 1973.**

B) *Carassotrema bengalense* Rekharani & Madhavi, 1985.

Ac= Acetabulum, E=Egg, Ex p= Excretory pore, Ex s v= External seminal vesicle, Ex v= Excretory vesicle, G p= Genital pore, H d = Hermaphroditic duct, H P= Hermaphroditic pouch, I c= Intestinal caecum, I sm v= Internal seminal vesicle, Oe= Oesophagus, O s= Oral sucker, Ov= Ovary, Ph = Pharynx, Pph= Prepharynx, Pr c= Prostatic complex, Sm r = Seminal receptacle, T= Testis, Ut = Uterus, Vt f = Vitelline follicles, Vt r = Vitelline reservoir.

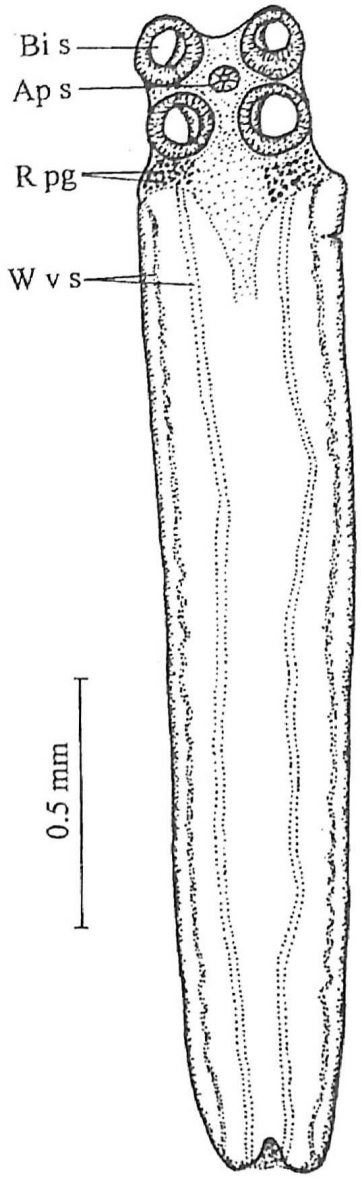

Fig.(3): Plerocercoid larva Yamaguti, 1934.
Ap s= Apical sucker, Bi s= Bilocular sucker, R pg= Red pigments, W v s= Water vascular system .

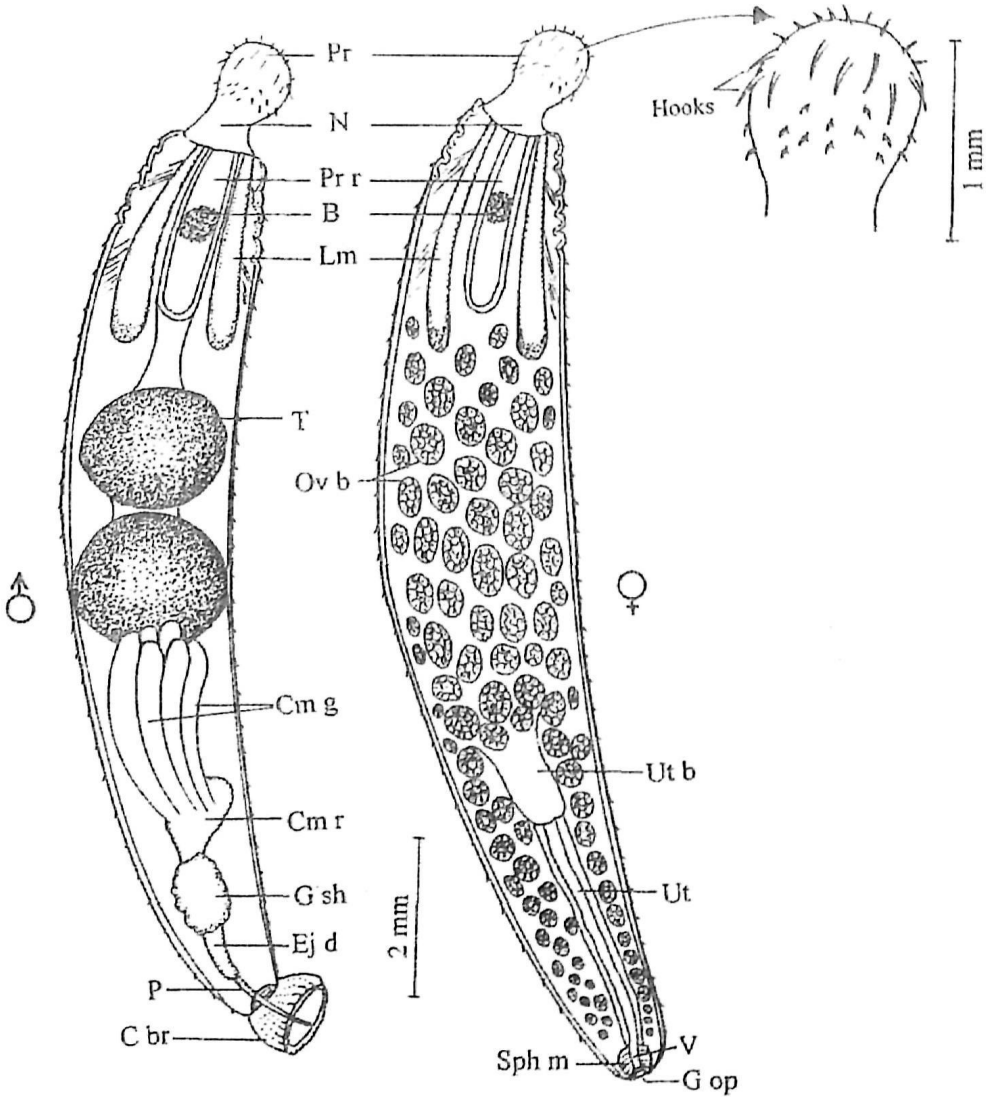

Fig.(4): ***Heterosentis overstreeti*** **(Schmidt&Paperna, 1978) Amin, 1985.**

B=Brain, C br= Copulatory bursa , Cm g= Cement glands, Cm r= Cement reservoir, Ej d = Ejaculatory duct, G op= Genital opening, G sh = Genital sheath, Lm= Lemniscus, N= Neck, Ov b= Ovarian balls, P= Penis, Pr= Proboscis, Pr r= Proboscis receptacle, Sph m= Sphincter muscle, T= Testis, Ut= Uterus, Ut b= Uterine bell, V=Vagina.