

A record of four monopisthocotylean monogeneans on gills of three fish species from the Yemeni coastal water of the Red Sea

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Abstract - A total of 210 fish specimens belonging to three species from the Red Sea, Yemeni coastal waters were examined for the infection with monopisthocotylean monogeneans during the period from October 2009 till May 2010. The results showed the occurrence of four species of monogeneans. These were *Pseudolamellodiscus sphyraenae* from *Sphyraena barracuda*, *Cabellaria liewi* from *Pomadasys argenteus* and both *Chauhanellus indicus* and *C. chauhani* from *Plicofollis dussumieri*. The occurrence of these monogeneans represents their first record from the Yemeni fishes of the Red Sea except *C. indicus* which is reported here for the second time.

Key words: Monogenea, Monopisthocotylea, Fishes, Red Sea, Yemen.

Introduction

Fishes are the most numerous and diverse of the vertebrate groups, and have a great importance and significance in the life of mankind. A compilation of fish species lists 23,250 species with valid descriptions (Moyle and Cech, 2004). However, 32,500 fish species are recognized by Froese and Pauly (2013). Fishes are an important source of protein and are one of the most utilized food sources. The availability of fish supplies, however, can be affected by parasites and diseases, which could ultimately affect nutrition and economics of population (Hadfield, 2007). Rohde (1993) stressed the commercial and economic importance of marine fish resources, indicating that marine fish parasites are a potential threat to fish abundance.

Apart from very few exceptions, worms of the class Monogenea are important and numerous ectoparasites of fish which exhibit a relatively high degree of host specificity, with most fish species being infected with one or more specific parasites (Williams and Jones, 1994). Monogeneans are responsible for important epizootics with serious consequences. Monogeneans which classically comprise two very distinct groups, the Monopisthocotylea and the Polyopisthocotylea, differ considerably, with important implications for pathogenicity, treatment and host response (Purivirojkul, 2008).

In the Red Sea, monogeneans have been studied principally by Paperna, (1972 a, b, c), Paperna *et al.* (1984), Diamant and Paperna (1986), Diamant (1989), Tawfik *et al.* (2006), Bayoumy *et al.* (2007), Kritsky *et al.* (2007) and more recently by Al-Zubaidy (2013). However, these studies are considered relatively few in relation with their fish host diversity in the area, and it is clear that additional research is needed to determine total diversity in this region. In the present article, a survey of the monopisthocotyleans infesting three marine fish species from the Yemeni coastal waters of the Red sea was conducted between October 2009 and May 2010. The present paper includes parasite descriptions and their infection parameters.

Materials and Methods

Fishes used in this study were obtained from Al-Mehwat local fish market at Hodeidah city, Yemen, during the period from October 2009 till May 2010. The specimens were placed in bags with ice and transported to the laboratory of the Department of Marine Biology and Fisheries, Hodeidah University. Scientific names of hosts are according to Froese and Pauly (2013).

The gills from both sides of fishes were removed, lamellae were separated one by one by cutting them at their extremities and they were examined immediately in seawater. Monogeneans were removed alive with fine needles and immediately fixed on slides. Live specimens were fixed with AFA (alcohol-formalin-acetic acid) and mounted in glycerol gelatin (Malmberg, 1970). Phase contrast microscope was used to study the hard parts of the haptor and reproductive system of the parasites. The drawings were made by using a camera Lucida and photographs were made with a Samsung digital camera, 10.1 mega pixels. Parasitic identifications were done according to Yamaguti (1963, 1968) and confirmed by Prof. Dr. Jean-Lou Justine, France and Prof. Dr. Delane C. Kritsky, U.S.A.

Results and Discussion

Four species of monogeneans were found on three species of marine fishes belonging to three families collected from Red Sea, Yemeni coast. These are arranged in the following systematic account of WoRMS (2013).

Phylum Platyhelminthes

Class Monogenea

Subclass Monopisthocotylea

Order Dactylogyridea

Family Diplectanidae

Pseudolamellodiscus sphyraenae Yamaguti, 1953

Family Ancyrocephalidae

Cabellaria liewi Lim, 1995

Chauhanellus indicus Rastogi, Kumar and Singh, 2004

Chauhanellus chauhani Venkatanarasaiah and Kulkarni, 1990

1- *Pseudolamellodiscus sphyraenae* Yamaguti, 1953 (Figs. 1 & 2):

Description: Body elongated, dorsoventrally flattened, 0.9-1.5 (1.20) mm in length, with a maximum width of 0.10-0.24 (0.18) mm in anterior trunk. Tegument smooth. Cephalic margin tapered; cephalic lobes poorly developed; head organs numerous along anterolateral margins of cephalic area. Neck region with two pairs of eye spots. Mouth sub-terminal, ventral to anterior portion of pharynx. Pharynx elliptical, 0.048-0.075 (0.060) mm wide. Esophagus short to nonexistent; caeca simple, terminating blindly near posterior end of body.

Haptor bilaterally lobed, 0.088 -0.150 (0.112) mm long x 0.255-0.418 (0.328) mm wide. Ventral anchor 0.033-0.046 (0.039) mm long with elongated deep root. Dorsal anchor 0.026-0.034 (0.031) mm long with short deep root. Ventral bar long, narrowed medially, ends tapered, recurved anteriorly, 0.209-0.316 (0.260) mm. Dorsal bar club-shaped, 0.060-0.082 (0.066) mm long. Hooks similar, each 0.011 mm long, with protruding depressed thumb, delicate point and a shank. Hook pair one sub-marginal, posterior to bars near base of haptoral lobes; pairs 2-7 on lateral haptoral lobes.

Male copulatory organ 0.030-0.037 (0.032) mm long. Male genital pore ventral to left of body midline, slightly posterior to male copulatory organ. Uterus delicate, extending to right of body midline, opening posterosinistral to male aperture. Uterine pore ventral. Testis longitudinally elongated, situated at about junction of posterior with middle third of body, 0.135-0.190 (0.156) mm long x 0.055-0.085 (0.078) mm wide. Vas deferens running forward in median field, 0.010-0.020 (0.014) mm wide. Ovary forming lobed cap on anterior margin of testis, 0.065-0.100 (0.077) mm wide. Vagina tubular, opening widely on right of median line at level of male genital aperture. The vaginal duct arising from near posterior end of wide vaginal aperture runs straight backwards. Vitelline follicles extending along each side of body, from level of posterior end of pharynx to caecal ends. Transverse vitelline ducts meeting immediately in front of ovary.

Host and locality: Great barracuda, *Sphyraena barracuda* (Edwards, 1771) (Sphyraenidae) from the Red Sea, Yemeni coastal waters. Infected fish length and weight ranged between 20-65 cm and 0.410-2.100 kg, respectively.

Infection parameters: Mean prevalence of the infection was 25.9 %, while the intensity of infection was 1-5 (1.7) worms.

Record of specimens: Thirty-seven specimens of this parasite were collected. Parasites were observed frequently on large fishes (36-65 cm, n= 69) and absent on small- sized fishes (20-35 cm, n= 16). This is due to the facts that bigger fishes provide larger surface area of gills available for the

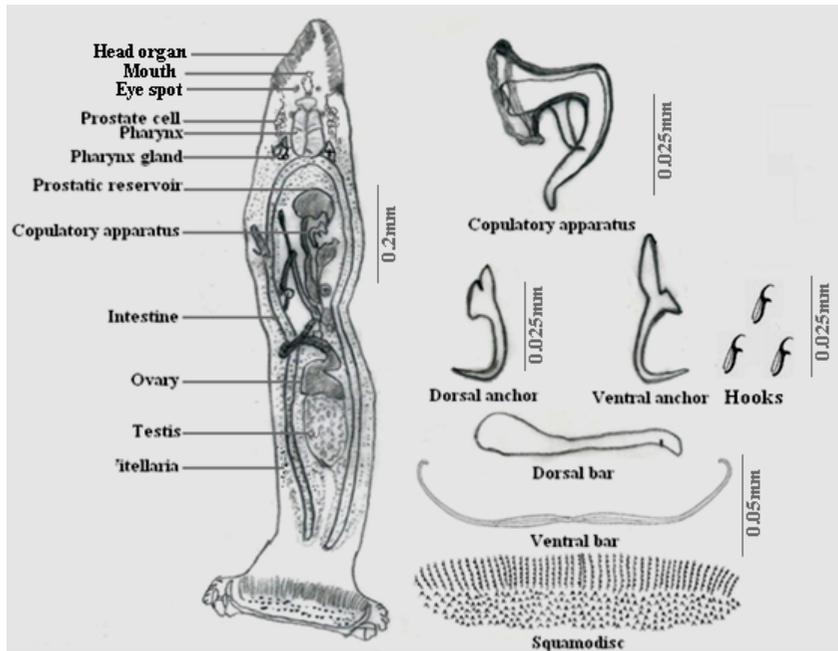


Figure 1. *Pseudolamellodiscus sphyraenae* from Red Sea fish.

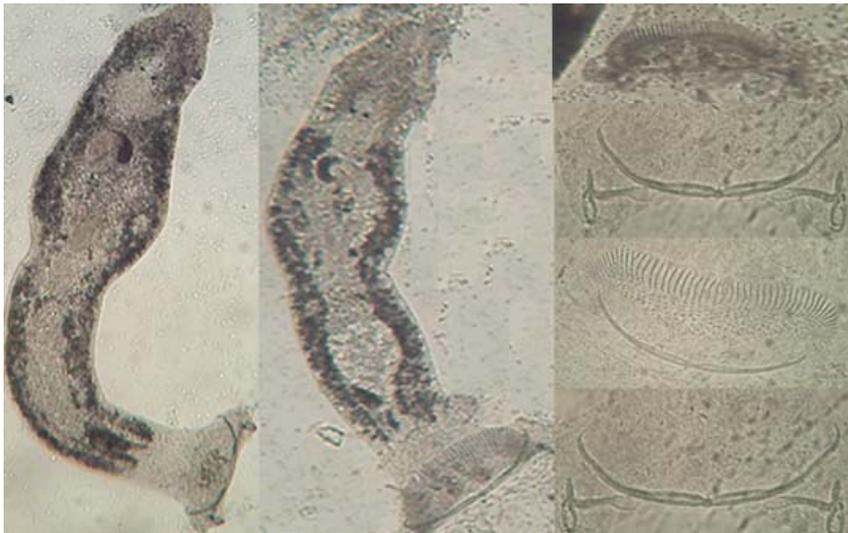


Figure 2. Microphotographs of *Pseudolamellodiscus sphyraenae* from Red Sea fish.

infection than the smaller ones, an increase in water flow over the gills in bigger fishes (Beamish, 1964) and larger individuals having higher physical (ventilation volume) and chemical (mucus) stimuli which increase gill's attractiveness by providing more food (Kearn, 1967).

Previous records: This parasite was previously reported from *S. barracuda* from Macassar, Celebes (Yamaguti, 1953) and Nosy Be, Madagascar (Rakotofiringa and Maillard, 1979) and from *S. chrysotaenia* Klunzinger, 1884 from the Arabian Gulf off Kuwait (Kritsky *et al.*, 2000).

Habitat: Most parasites were mainly isolated from the 2nd and 3rd gill arch filaments. These observations agree with those of Chun (2002) who reported a preference by *Microcotyle sebastis* Yamaguti, 1958 for the gills of black rockfish *Sebastes melanops* Girard, 1856. Site specificity in Monogenea has been described in several ways. Llewellyn (1956) analyzed five parasite species and found that each occurred most frequently on the 1st or 2nd gill arches of their respective host species, but he did not quantify the distributions further. Hanek and Fernando (1978) divided gills into six sections and plotted the distribution of seven monogenean species on the centrarchid fishes *Lepomis gibbosus* (Linnaeus, 1758) and *Ambloplites rupestris* (Rafinesque, 1817). Most parasites occurred on the anterior gill faces, anterior-medial sections of the gill and on the 2nd and 3rd arches.

Remarks: The present specimens of *P. sphyraenae* collected from gills of *S. barracuda* had the same morphological features of those reported by Yamaguti (1953), Rakotofiringa and Maillard (1979) and Kritsky *et al.* (2000). This is the first report of *P. sphyraenae* from fishes of the Yemeni waters of the Red Sea.

2- *Cabellaria liewi* Lim, 1995 (Figs. 3 & 4):

Description: Body elongated, 0.692-0.820 (0.758) mm in length with a width of 0.159-0.235 (0.210) mm.

Anterior region of body narrow; posterior region bulges just anterior to haptor, giving the worm a shape of elongated cone or pear shape. Eye spots two pairs. Alimentary system with sub-terminal mouth, muscular pharynx, 0.045-0.063 (0.055) mm, oesophagus 0.036-0.042 (0.038) mm and intestinal caeca reuniting posterior to testis.

Haptor small, distinct from body proper. Four pairs of extensible haptoral digits in posterior region of haptor; each pair consists of one long and one short digit associated with each anchor. Four anchors with canal extending from shaft to point; dorsal anchors 0.020-0.029 (0.025) mm inner length and 0.019-0.025 (0.022) mm outer length. Ventral anchors with 0.026-0.035 (0.03) mm inner length and 0.026-0.035 (0.30) mm outer length. Dorsal bar with two knobs on anterior surface, 0.008- 0.011 (0.009) mm x 0.045-0.055 (0.050) mm. Ventral bar 0.007-0.009 (0.008) mm) x 0.050 - 0.062 (0.055) mm. Four haptoral glands. Ovary ovoid;

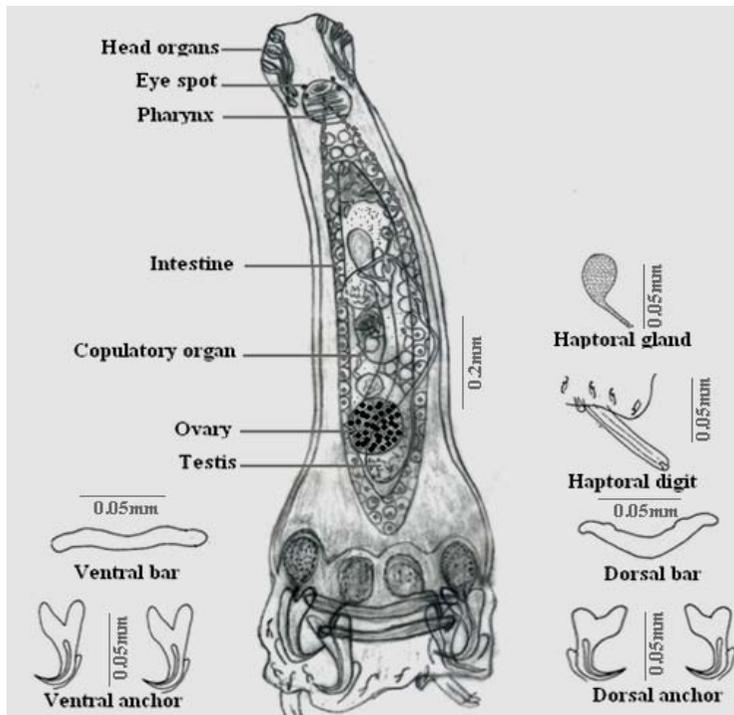


Figure 3. *Cabellaria liewi* from Red Sea fish.

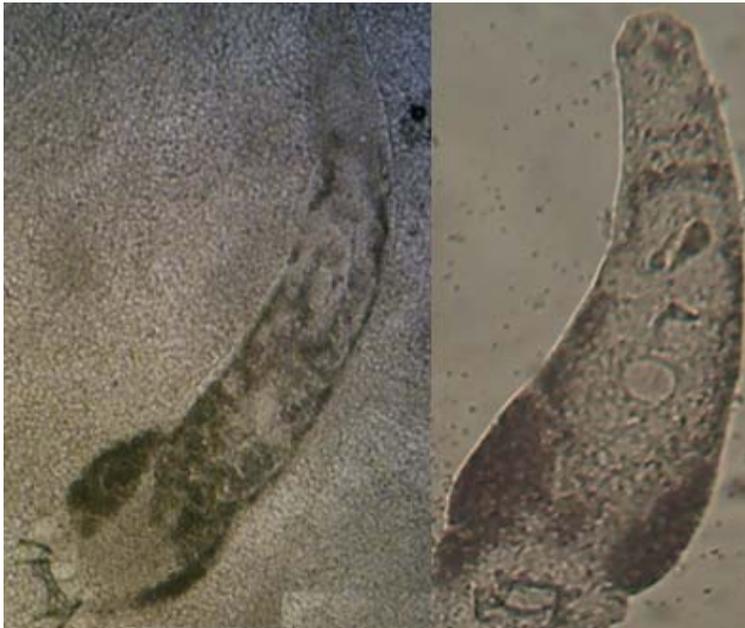


Figure 4. Microphotographs of *Cabellaria liewi* from Red Sea fish.

oviduct arises from anterior of ovary; uterine pore near copulatory organ. Vaginal pore sclerotized. Testis, elongated, dorsal, posterior to ovary; vas deferens arises from anterior part of testis. Ductus ejaculatorius enters large oval-shaped initial part of copulatory tube. Copulatory organ without accessory piece, oval initial part 0.019-0.022 (0.020) mm x 0.010-0.021 (0.015) mm, long tapering tube 0.065-0.075 (0.069) mm. Genital pore muscular; path of copulatory tube lightly sclerotized.

Host and locality: *Pomadasys argenteus* (Forsskål, 1775) (Haemulidae) from the Red Sea, Yemeni coastal waters, Hodeidah. Infected fish length and weight ranged between 15-35 cm and 0.350-1.400 kg, respectively.

Infection parameters: Mean prevalence of the infection was 29.23 %, while the intensity of infection was 5 -15 (6.7) worms.

Record of specimens: A total of 128 specimens of the parasite were collected. Parasites were observed frequently on small fishes (15-20 cm, n= 28) rather than big ones (21-35 cm, n= 37). Serious erosions were realized in gills of four fishes (15-18 cm length). Most of these effects are related to the mechanical injuries caused by these parasites. Smaller fishes suffer from even low infections. This is based on the anatomical relationship between host length and gill surface area (Hughes, 1966).

Previous records: This parasite was previously reported from *Pomadasys hasta* (Bloch, 1790) from the west coast of Malaysian peninsula by Lim (1995).

Habitat: All specimens of *C. liewi* were found exclusively on the 1st, 2nd, 3rd and 4th gill arch filaments. Various monogeneans are known for their strict site specificity (Whittington, 2005). Buchmann and Lindenstrøm (2002) reported that monogeneans are selective in their choice of attachment site. They stated that different water currents influence the settlement of the oncomiracidia on the various gill microhabitats. Dzika and Szymanski (1989) studied the distribution of four species of *Dactylogyrus* on the gills of *Abramis brama* (Linnaeus, 1758) and found no preference for sites of attachment.

In the present study, difference between numbers of parasites on different gill arches was found. The highest was on the 3rd, then on the 2nd gill arch, while the 1st and 4th gill arches had the lowest. Koskivaara *et al.* (1992) found that *Dactylogyrus* species exhibited species-specific preferences in their occurrence on the gill arches. A preference for *C. liewi* predominantly occurring on the 3rd, then 2nd gill arches concurs with the findings of Özer and Öztürk (2005) who found greater and statistically significant numbers of *Dactylogyrus* species on the 2nd gill arches. Also, the differences in monogenean site specificity has been recorded to be

influenced by factors such as the hydrostatic pressure of the branchial pump, coughing action and the water current over the gill surface area during respiration (Le Roux *et al.*, 2011).

Remarks: The present occurrence of *C. liewi* on gills of *P. argenteus* represents its first record in fishes of the Yemeni coastal waters of the Red Sea.

3- *Chauhanellus indicus* Rastogi, Kumar and Singh, 2004 (Figs. 5 & 6):

Description: Body elongated and elliptical in shape, 1.021-1.350 (1.22) mm long x 0.065-0.175 (0.119) mm wide. Prohaptor and opisthaptor fairly set off from bilobed prohaptor. Body proper with nine pairs of head organs and two pairs of eye spots. Posterior pair of eye spots larger than anterior pair. Cephalic glands in two groups on both anterolateral and posterolateral sides of pharynx. Pharynx small, muscular, oval structure, 0.036-0.060 (0.048) mm long x 0.040-0.067 (0.049) mm wide. Prepharynx long and slender, 0.109-0.157 (0.130) mm in length. Oesophagus short, 0.023-0.032 (0.028) mm long x 0.019-0.026 (0.023) mm wide. Intestine crura simple, slightly anterior to peduncle.

Male reproductive system comprises of testis, vas deferens, seminal vesicle, vasa efferentia and cirrus. Testis single, post equatorial, post ovarian, intercaecal, conical in shape, 0.211-0.225 (0.221) mm long x 0.062-0.070 (0.065) mm wide. Vas deferens 0.158-0.164 (0.160) mm in length. Proximal part of seminal vesicles 0.024-0.229 (0.125) mm x 0.009-0.048 (0.029) mm. Proximal and distal seminal vesicles joined by a slender cylindrical duct. Seminal vesicle opens at base of male copulatory organ through a fairly long vasa efferentia or ejaculatory duct measuring 0.119-0.124 (0.120) mm in length. Male copulatory apparatus with cirrus proper and accessory piece. Cirrus of double walled chitinous tube with funnel shaped swollen base.

Female reproductive system with ovary, vagina, vaginal duct and receptaculum seminis. Ovary pre-equatorial, intercaecal, pretesticular, oval, 0.119-0.136 (0.125) mm x 0.047-0.059 (0.051) mm. Vagina dextral, post bifurcal and preovarian. Vaginal opening oval in shape. Vitellaria follicular, extending from pharynx to base of haptor peduncles. Opisthaptor fairly set-off from body by a narrow peduncle, 0.165-0.225 (0.192) mm x 0.170-0.229 (0.205) mm.

Armature of haptor with four transverse sclerotized folds on ventral surface of peduncle, two pairs of unequal and dissimilar (dorsal and ventral) anchors, two transverse connective bars and seven pairs of marginal hooklets. Sclerotized folds 0.075-0.120 (0.093) mm x 0.006-0.008 (0.007) mm. Dorsal anchors of pterocleidus type, 0.095 - 0.122 (0.104) mm in

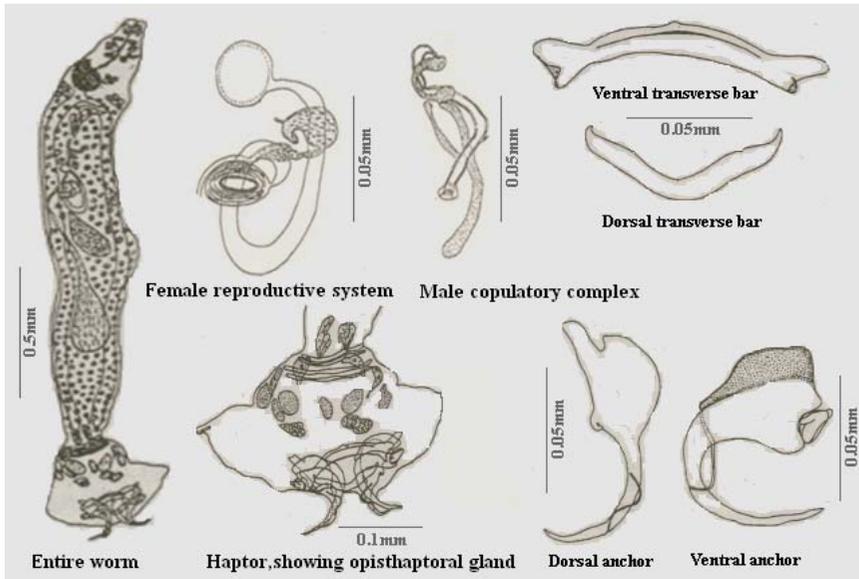


Figure 5. *Chauhanellus indicus* from Red Sea fish.



Figure 6. Microphotographs of *Chauhanellus indicus* from Red Sea fish.
 A- anterior part of the body, B- ventral transverse bar, C- haptor.

length, with a sleeve sclerite associated with hook and shaft region. Dorsoapical length of dorsal anchor 0.092-0.100 (0.095) mm, ventroapical length 0.086-0.096 (0.092) mm. Shaft 0.046-0.057 (0.053) mm. Dorsal transverse bar connecting dorsal anchors of wunderoid type, wide V-shaped bar, 0.078-0.084 (0.080) mm in length and 0.006-0.008 (0.007) mm in width. Ventral anchors stout with a broad base, measuring 0.062-0.069 (0.066) mm in length. Dorsoapical length of ventral anchor 0.028-0.049 (0.038) mm, ventroapical 0.024-0.030 (0.027) mm. Ventral transverse bar of widened type with stout shaft, 0.122-0.128 (0.124) mm x 0.0120- 0.0140 (0.0126) mm. Marginal hooklet 0.002-0.006 (0.004) mm in length, of a sickle and a handle.

Hosts and locality: *Plicofollis dussumieri* (Valenciennes, 1840) (Ariidae) from Red Sea, Yemeni coast. Infected fish length and weight ranged from 33-70 cm and 0.770-1.500 kg, respectively.

Infection parameters: The mean prevalence of infection was 30 %, while the intensity of infection was 2-6 (2.6) worms.

Record of specimens: Forty-seven specimens of this parasite were collected.

Previous records: *C. indicus* was previously reported from *Mystus tengara* (Hamilton, 1822) and *Wallago attu* (Bloch & Schneider, 1801) from Meerut, India by Rastogi *et al.* (2004), from *Mystus seenghala* (Sykes, 1839) from Meerut, India by Rastogi *et al.* (2007) and from *Tachysurus dussumieri* (Valenciennes, 1840) (synonym of *P. dussumieri*) in the Yemeni coastal waters of the Red Sea, (Al-Zubaidy, 2013).

Habitat: Gill filaments. *C. indicus* was restricted to the gill filaments and particularly to the internal filaments of the 2nd gill and the external filaments of the 3rd gill of the fish host. No specimens were found on the 1st first gill. When the distribution of *C. indicus* was plotted, specimens were found on the 2nd and 3rd gills but significant numbers were on the 3rd gill. According to Raymond *et al.* (2006) microhabitat selection on gills also may reflect a response to the biotic environment. As suggested by Chapman *et al.* (2000), it is possible that site attachment is influenced by the pattern of respiratory current over the gills.

Remarks: This is the second report of *C. indicus* from fishes of Yemeni coasts of the Red Sea. The first report was achieved by Al-Zubaidy (2013).

4- *Chauhanellus chauhani* Venkatanarasaiah and Kulkarni, 1990 (Fig. 7):

Description: Body elongated, elliptical, 0.685-0.698 (0.695) mm long x 0.115-0.140 (0.128) mm wide. Cephalic end tapers and with three pairs of

head organs and four eye spots. Posterior pair of eye spots isolated. Pharynx spherical, 0.025-0.040 (0.035) mm. Oesophagus short, 0.022-0.038 (0.029) mm.

Opisthaptor well set off from body by a narrow peduncle, measuring 0.140-0.155 (0.150) mm in length and 0.175-0.185 (0.180) mm in width. Peduncle marked by five transverse structures on its ventral surface, and with two pairs of unequal and dissimilar (dorsal and ventral) anchors. Anchors marked by wings. Each anchor measures 0.080-0.085 (0.083) mm in length and 0.025-0.028 (0.026) mm in width at base. Dorsal bar wide with tapering ends, 0.080-0.090 (0.085) mm in length and 0.008-0.012 (0.009) mm in width. Stout ventral anchor, 0.035-0.045 (0.040) mm in length and 0.020-0.030 (0.025) mm wide. Straight ventral bar stout, shaft 0.075-0.088 (0.083) mm in length and 0.005-0.009 (0.008) mm in width. Marginal hooks 0.012- 0.015 (0.013) mm in length.

Ovary small and oval-shaped, 0.050-0.075 (0.060) mm x 0.020-0.035 (0.030) mm. Testis, large, 0.080-0.100 (0.088) mm x 0.035-0.050 (0.045) mm. Copulatory apparatus with tubular cirrus. Prostatic reservoir club-shaped. Seminal vesicle fusiform, single chambered. Vitellaria follicular. Vagina dextral, tube obliquely joins oviduct.

Hosts and locality: *Plicofollis dussumieri* (Valenciennes, 1840) (Ariidae) from Red Sea, Yemeni coast, Hodeidah. Infected fish length and weight ranged from 35-68 cm and 0.870-1.300 kg, respectively.

Infection parameters: The mean prevalence of infection was 6.7 %, while the intensity of infection was 2-5 (3.3) worms.

Record of specimens: Thirteen specimens of this parasite were collected. All parasites were observed frequently on big fishes (40-68 cm, n= 44) rather than small ones (35-39 cm, n= 16).

Previous records: This parasite was previously reported from *Tachysurus dussumieri* (synonym of *P. dussumieri*) from the Bay of Bengal, off the coast of Kakinada, Andhra Pradesh, India by Venkatanarasaiah and Kulkarni (1990).

Habitat: *C. chauhani* was found mostly on the middle part of the gills and/or distal half of the gill filaments. As each gill has thinner and shorter filaments at the anterior and posterior ends, these filaments obviously have less chance to become infected than the filaments of the middle part. The nature of the attachment organs determines the ability of the ectoparasites to move on the gills and thus influences their site restrictions (Martens and Moens, 1995).

Remarks: The present record of *C. chauhani* from *P. dussumieri* is its first

occurrence in the Yemeni coastal waters of the Red Sea. *C. chauhani* was originally described from the gills of *Tachysurus dussumieri* (synonym of *P. dussumieri*) from the Bay of Bengal, off the coast of Kakinda, Andhra Pradesh, India by Venkatanarasaiah and Kulkarni (1990). It is worth to draw the attention here that WoRMS (2013) reported the year of publication of the above article as 1988 instead of 1990.

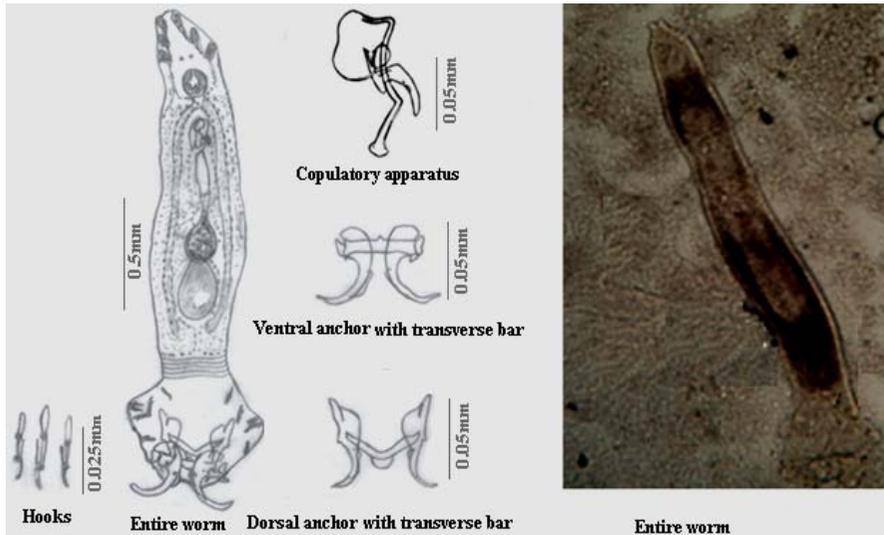


Figure 7. Sketches of *Chauhanellus chauhani* from Red Sea fish. Left-general aspects with hooks, copulatory apparatus, ventral anchor and dorsal anchor. Right- microphotograph of the entire worm.

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تسجيل أربعة أنواع من المخرمات أحادية المحاجم الخلفية على غلاصم ثلاثة أنواع من الأسماك من المياه الساحلية اليمانية للبحر الأحمر

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المستخلص - تم فحص 210 نماذج من الأسماك العائدة لثلاثة أنواع من البحر الأحمر، المياه الساحلية اليمانية للتحري عن الإصابة بالمخرمات أحادية المحاجم الخلفية أثناء المدة من شهر تشرين الأول (أكتوبر) عام 2009 وحتى مايس (مايو) 2010. أظهرت النتائج وجود أربعة أنواع من هذه المخرمات وهي *Pseudolamellodiscus sphyraenae* من سمكة القد *Cabellaria liewi*، *Sphyraena barracuda* و *Pomadasys argenteus* وكل من *Chauhanellus indicus* و *C. plicifollis* من سمكة الجري البحري أسود القمة *chauhani*. ويمثل ظهور هذه الأنواع من المخرمات أول تسجيل لها من الأسماك اليمانية في البحر الأحمر عدا النوع *C. indicus* الذي يسجل هنا للمرة الثانية.