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Larval tapeworms (Cestoda: Trypanorhyncha) from some Red Sea fishes, Yemen

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Abstract - A total of 713 fish specimens belonging to 26 species and nine families from the Red Sea, Yemeni coastal waters were examined for the infection with trypanorhynchid cestodes during the period from September 2008 till February 2010. The results showed the occurrence of five different trypanorhynchids in viscera, body cavity and flesh of 12 fish species. These cestodes were: *Pseudotobothrium dipsacum*, *Callitetrarhynchus gracilis*, *Floriceps minacanthus*, *Pseudogrillotia* sp. and *Nybelinia bisulcata*. The first three species are recorded here for the first time in fishes from Yemeni waters of the Red Sea. Also, two fish species (*Lethrinus mahsena* and *Valamugil seheli*) are considered as new hosts for *N. bisulcata* in the Yemeni waters of the Red Sea. *C. gracilis* was found in nine different fish species. Five fish species (*Pomodasys argenteus*, *Lethrinus lentjan*, *L. nebulosus*, *Scomberomorus commerson* and *Thunnus tonggol*) harbored three trypanorhynchids (*P. dipsacum*, *C. gracilis* and *N. bisulcata*) in their muscles. Among fishes, both *L. lentjan* and *T. tonggol* were the most infected hosts, as each of them harbors three different trypanorhynchids.

Key words: Trypanorhyncha, Cestoda, Marine Fishes, Red Sea, Yemen.

Introduction

The Red Sea is one of the major centers of global marine biodiversity and supports 1,248 species of fishes, representing 157 families (See Galli *et al.*, 2007). A high rate of endemism involving an overall 17 % of the fish species is presented in this area. Rohde (1993) stressed the commercial and economic importance of the marine fish resources and indicated that marine fish parasites are a potential threat to fish abundance. The trypanorhynchid cestodes (order Trypanorhyncha) are considered as one of the main groups of fish parasites. They follow three or four host life cycles, before reaching the final host (Palm, 2007). The infected fish may represent marketing problems for commercially exploited species (Petersen *et al.*, 1993). Adult trypanorhynchids are typically found in the stomach and intestine of sharks and rays, whilst their larval forms infect a wide variety of marine invertebrates and teleosts (Palm *et al.*, 2009). They are characterized by a scolex bearing two or four bothria (Jones *et al.*, 2004), and tentacular apparatus, consisting of four retractile tentacles domed with hooks as extensions of tentacle sheaths that are attached to four bulbs (Dollfus, 1942).

Despite their worldwide distribution and importance for commercial fisheries, trypanorhynchids are still a relatively poorly studied group due to their classification. The trypanorhynchids are complex and considered to be the most chaotic and confused of the tapeworm groups (Campbell and Beveridge, 1994). Palm (2004) recognized 254 different trypanorhynchid species. Beveridge and Justine (2007), Campbell and Beveridge (2006) and Beveridge (2008) have since added more species to the order. Thus, a total of 277 trypanorhynchid species can be considered valid, with additional species and genera being described every year. Taxonomists originally considered scolex shape, number of bothria, specific organs (such as a double set of genitalia and bothrial pits) and tentacular armature as the most important characters for trypanorhynchid taxonomy (Dollfus, 1942; Campbell and Beveridge, 1994; Palm, 2004).

Limited studies were done on trypanorhynchids in marine fishes from waters of the Red Sea. Among the literature from Egypt are those of Abdou (2000, 2001, 2005) and Abdou and Palm (2008). Literature from Saudi Arabia included those of Banaja and Roshdy (1979), Banaja *et al.* (1979), Banaja and Roshdy (1981), Abu-Zinada (1998) and Toula (1999). In Yemen, Al-Zubaidy (2006) recorded and briefly described two larval cestode species from *Lethrinus lentjan*. These were *Nybelinia bisulcata* from body cavity, mesenteries and muscles and *Pseudogrillotia* sp. from the body cavity and mesenteries.

The aim of the present paper is to report on the occurrence of some trypanorhynchids in the musculature and viscera of commercially exploited fishes from the Yemeni coastal waters of the Red Sea.

Materials and Methods

A flesh of a total of 713 fish specimens, belonging to 26 species and nine families were examined for trypanorhynchid cestodes. Among these fishes, 567 fishes were examined for plerocerci in the stomach wall, intestine wall, mesenteries and body cavity. Fresh fishes were obtained from local market (Al-Mehwat) at Hodeidah city, during the period from September 2008 till February 2010.

The specimens were placed in bags with ice and transported to the laboratory of the Department of Marine Biology and Fisheries, Hodeidah University. In the laboratory, they were measured to the nearest cm total length, filleted and the skin removed. The fillets were placed on a candling table over a fluorescent light source to detect any parasites. Body cavity and viscera were examined with the help of a stereoscopic dissecting microscope, and the capsulated plerocerci were removed from the infected organs. Walls of parasite blastocysts were opened to remove the juvenile scolices. The isolated cestodes were washed in saline solution and fixed in 10% buffered formalin. Specimens were stained in acetic carmine, dehydrated and then mounted in Canada balsam.

Parasitic identifications were done according to Dollfus (1942), Carvajal and Rego (1985), Campbell and Beveridge (1987, 1994), Palm *et al.* (1994) and Palm (1997). Parasite identifications were ascertained by Prof. Dr. H. W. Palm, Germany. Classification of trypanorhynchids of the present study was done according to WoRMS (2011).

Results and Discussion

Five different species of trypanorhynchid cestodes were encountered in the present study. These are arranged in the following systematic account of WoRMS (2011).

Order Trypanorhyncha
Superfamily Otobothrioidea
Family Pseudotobothriidae
Pseudotobothrium dipsacum (Linton, 1897)
Superfamily Lacistorhynchoidea
Family Lacistorhynchidae
Callitetrarhynchus gracilis (Rudolphi, 1819)
Floriceps minacanthus Campbell and Beveridge, 2006
Pseudogrillotia sp.
Superfamily Tentacularioidea
Family Tentaculariidae
Nybelinia bisulcata (Linton, 1889)

Various hosts and prevalence of infection with these trypanorhynchids are listed in Table (1). Occurrence of the first three trypanorhynchids mentioned above represent their first locality records in the Yemeni waters of the Red Sea. These trypanorhynchids occurred in body cavity and mesenteries of 24.3 % of the examined fishes while flesh infection was recorded in 1.26 % of the examined fishes.

The overall prevalence of infection in flesh of the five fish species recorded in the present study (1.26 %) is lower than that reported by Palm *et al.* (1993) in Philippines (2.25 %); Sao Clemente *et al.* (1997) in Brazil (55.75 %); Abu-Zinada (1998) in coast of Red Sea of Saudi Arabia (29.4 %) and Hassan *et al.* (2002) in Arabian Gulf (7.73 %). On the other hand, the present prevalence is higher than that recorded by Obiekezie *et al.* (1992) in Nigeria (0.44 %). Such differences can be explained by the fact that the combination of selected fish species and fish size are the major important factors in the total prevalence of musculature infections during a survey for trypanorhynchids (MacKenzie, 1987).

The following is an account on these trypanorhynchids with emphasis on their location in fish hosts, description and zoogeography.

1- *Pseudotobothrium dipsacum* (Linton, 1897) (Figure 1):

Specimens of *P. dipsacum* were reported from body cavity and mesenteries of *Lutjanus argentimaculatus*, *Pomodasys argenteus*, *Sphyraena barracuda* and *Thunnus tonggol* as well as from flesh of *T. tonggol* (Table 1). This is the first report on *P. dipsacum* from the Yemeni waters of the Red Sea.

Description (based on 10 specimens): The scolex is situated inside large and oval blastocysts, 5.6-12.3 (9.7) mm long. Scolex total length 3.4-5.7 (4.5) mm. Capsule is large, 7-26 (18) mm in length, ovoid, often darkly colored. The postlarva has two bothridia, 1.37-1.54 (1.51) mm long each, with thick margins. Posterior margin of each bothridium with two prominent fossettes, a short tail and a striated body. Tentacles long, tapering at tip with rows of hooks. The tentacle sheaths are spiral. Pars vaginalis 0.89-1.65 (1.58) mm long. Bulbs are elongated, 1.18-1.67 (1.37)

Table 1. Occurrence of some trypanorhynchid cestodes in the body cavity, viscera and flesh of some commercial Red Sea fishes from Yemeni coastal waters.

Fish families and species	Mean fish length (cm) ± SD	No. fish examined	Cestode species	Prevalence (%)
Carangidae				
1- *Carangoides bajad*	26.5±5.7	23	*C. gracilis*	21.7
2- *Caranx sexfasciatus*	24.0±1.8	15	--*	
Serranidae				
3- *Epinephelus fuscoguttatus*	24.3±4.6	32	--	
4- *E. tauvina*	25.0±2.7	26	*C. gracilis*	19.2
5- *E. microdon*	23.0±3.1	15	--	
6- *E. summana*	24.2±3.6	20	--	
Lutjanidae				
7- *Lutjanus argentimaculatus*	28.8±4.3	11	*P. dipsacum*	9.0
8- *L. gibbus*	23.3±2.6	23	--	
9- *L. bohar*	22.8±3.3	20	--	
Haemulidae				
10- *P. argenteus*	27.9±2.1	25	*C. gracilis*	52.0
			C. gracilis **	4.0
			P. dipsacum	24.0
11- *P. multimaculatum*	25.9±3.8	17	--	
12- *P. commersonni*	25.4±3.2	25	--	
Lethrinidae				
13- *Lethrinus lentjan*	29.3±2.0	30	*F. minacanthus*	13.3
			N. bisulcata	30.0
			N. bisulcata **	10.0
			Pseudogrillotia sp.	23.3
14- *L. nebulosus*	27.8±2.4	20	*C. gracilis*	15.0
			C. gracilis **	10.0
			Pseudogrillotia sp.	10.0
15- *L. mahsena*	26.2±2.7	20	*F. minacanthus*	25.0
			N. bisulcata	5.0
Sphyraenidae				
16- *Sphyraena barracuda*	39.6±7.9	26	*C. gracilis*	34.6
			P. dipsacum	15.4
17- *S. jello*	35.7±4.6	20	--	
18- *S. flavicauda*	34.0±3.9	20	--	
Mugillidae				
19- *Valamugil seheli*	27.4±6.8	16	*C. gracilis*	12.5
			N. bisulcata	56.2
Ariidae				
20- *Arius dussumieri*	33.0±4.5	28	--	
21- *A. thalassinus*	33.7±5.2	25	--	
Scombridae				
22- *Scomberomorus commerson*	41.8±9.7	22	*C. gracilis*	31.8
			C. gracilis **	3.3
23- *S. guttatus*	39.0±11.2	28	*C. gracilis*	14.3
24- *Gymnosarda unicolor*	40.6±8.5	18	--	
25- *Thunnus tonggol*	49.3±12.3	30	*C. gracilis*	43.3
			F. minacanthus	60.0
			P. dipsacum	36.7
			P. dipsacum **	6.0
26- *Rastrelliger kanagurta*	18.7±0.7	12	--	

* = uninfected, ** = occurred in flesh only.

mm long and 0.21-0.30 (0.26) mm wide. Pars post bulbosa 0.23-0.39 (0.35) mm long. Bothridia have a posterior notch and oval sensory pits on the poster lateral margins.

P. dipsacum seems to have a worldwide distribution in tropical and subtropical waters. This parasite was recorded from some fish species in North America (Linton, 1901, 1905; Ward, 1954), Sri Lanka and India (Southwell, 1912, 1929), Celebes (Yamaguti, 1952), Gulf of Guinea (Palm *et al*., 1994), Congo (Dollfus, 1942), Australia (Beveridge *et al*., 2000), Mexico (Cruz-Reyes, 1973), Brazil (Palm, 1997) and Arabian Gulf (See Beveridge *et al*., 2000).

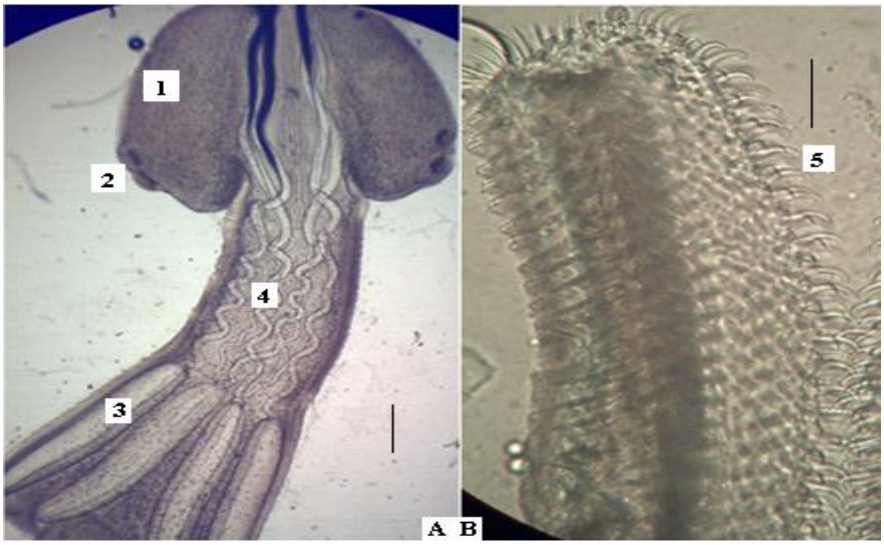

Figure 1. *Pseudotobothrium dipsacum*, A- Scolex (scale bar = 0.5 mm),
B- Surface of tentacle (scale bar = 0.03 mm).
1- Bothridium, 2- Bothridial pit, 3- Tentacle bulb,
4- Tentacle sheath, 5- Hooks.

2- *Callitetrarhynchus gracilis* (Rudolphi, 1819) (Figure 2):

C. gracilis of the present study was detected from body cavity and mesenteries of nine fish species (*Carangoides bajad*, *Epinephelus tauvina*, *Pomodasys argenteus*, *Lethrinus nebulosus*, *Sphyraena barracuda*, *Valamugil seheli*, *Scomberomorus commerson*, *S. guttatus* and *Thunnus tonggol*) as well as from flesh of *P. argenteus*, *L. nebulosus* and *S. commerson* (Table 1). This represents its first record from the Yemeni waters of the Red Sea. The species was found in two widely different size forms, small size plerocercoids: blastocysts 1.3-7.2 (4.7) mm, scolex 2.1-4.3 (3.2) mm total length and larger forms: blastocysts 9-21 (16) mm, scolex 7-22 (18) mm total length.

Description (based on 10 specimens): Body elongated, 8.5-14.8 (12.55) mm long and 0.68-0.95 (0.85) mm wide. The host capsule is bladder-like to elongated and usually white, but older capsules turn brown to blue black

and slightly iridescent. Blastocyst 6-37 (24.2) mm long. The post larva, 5.3-32 (19.8) mm long, has an elongated scolex, 5.8-8.96 (7.6) mm long, long tail and two short, heart shaped bothridia. Bothridial length 0.96-1.3 (1.13) mm and 0.35-0.7 (0.53) mm wide. Pars vaginalis 1.9-4.8 (3.2) mm. Pars bulbosa 0.85-0.99 (0.92) mm. Pars post bulbosa 0.22-0.29 (0.25) mm. Tentacle sheaths are tightly coiled. The tentacle bulbs reach the end of the scolex, but they do not occupy the entire width of the scolex, and they are about three times longer than wide. The base of the tentacles does not have a ring of larger hooks.

This parasite was isolated from more than 150 fish species worldwide such as in Miami (Ward, 1954), Bermuda (Rees, 1969), California (Jensen, 1979), Brazil (Carvajal and Rego, 1985; Sao Clemente *et al*., 1997; Palm, 1997; Pereira and Boeger, 2005), Pakistan (Bilqees, 1987), Arabian Gulf (Kardousha, 1999; Bannai, 2008), Gulf of Guinea (Palm *et al*., 1994), Indonesia (Jakob and Palm, 2006), Turkey (Akmirza, 2006) and the Red Sea, Egypt (Abdou and Palm, 2008).

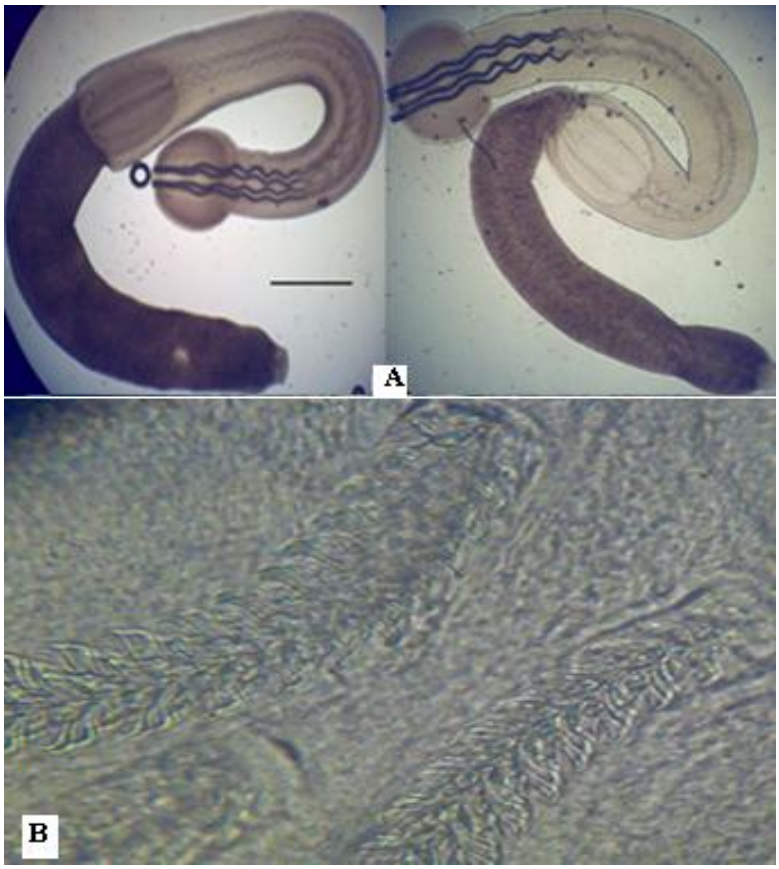

Figure 2. *Callitetrarhynchus gracilis*, A- Scolex (scale bar = 0.8 mm), B- Tentacles showing hooks (scale bar = 0.03 mm).

3- *Floriceps minacanthus* Campbell and Beveridge, 1987 (Figure 3):

Plerocerci of *F. minacanthus* were found in body cavity and viscera (intestine and stomach walls, liver and gonad tissues) of *Lethrinus lentjan*, *L. mahsena* and *Thunnus tonggol* (Table 1). Many cysts present, each contains a single plerocercus. Cysts vary in size and shape. This is the first report on *F. minacanthus* from the Yemeni waters of the Red Sea.

Description (based on 10 specimens): Scolex 2.8-4.1 (3.93) mm long and 0.79-1.25 (1.0) mm wide. Pars bothridialis is composed of two bothridia, each measures 0.63-1.27 (0.96) mm long and 0.65-1.10 (0.88) mm wide. Tentacles are retracted inside their sheaths and both have a much coiled shape. Tentacles are shorter than their sheaths. The four bulbs are small, each measures 0.59-0.81 (0.78) mm long and 0.14-0.21 (0.19) mm wide. Pars vaginalis 2.0-3.2 (2.6) mm. Bulbs are elongated and located in the base of pedunculus scolices area. Pars post bulbosa (appendix) measures 0.9-1.20 (1.16) mm long.

Species of the trypanorhynchid cestode genus *Floriceps* are common parasites of the spiral valves of sharks in many regions of the world with the metacestode stages (plerocerci) occurring encapsulated in the viscera of teleosts (Dollfus, 1942; Campbell and Beveridge, 1987). Abdou (2005) reported this parasite from some Red Sea fishes in the Egyptian coastal waters. In the Arabian Gulf, plerocerci of *Floriceps* sp. were isolated from several different fish species at the coast of the United Arab Emirates (Kardousha, 1991; El-Naffar *et al.*, 1992; Al-Ghais and Kardousha, 1994). Campbell and Beveridge (1987) recorded plerocerci of this species from viscera of few fish species from the coastal waters of Australia.

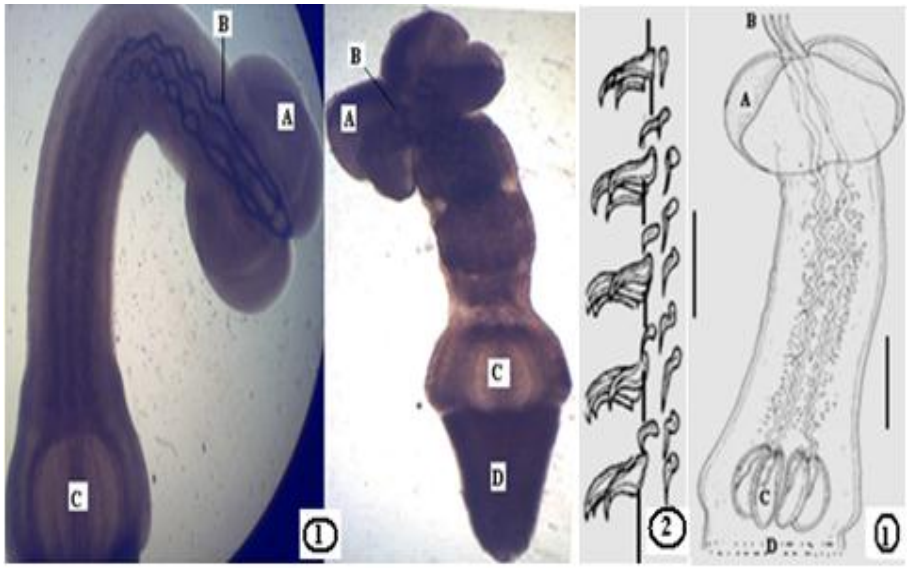

Figure 3. *Floriceps minacanthus*, 1- Scolex (scale bar = 0.8 mm), 2- Basal armature of tentacle (scale bar = 0.1 mm). A- Bothridium, B- Tentacle, C- Bulb, D- Appendix.

4- *Pseudogrillotia* sp. (Figure 4):

This species was found encapsulated in body cavity and mesenteries of both *Lethrinus lentjan* and *L. nebulosus* (Table 1) of the present study. This is the second report on this cestode from the Yemeni waters of the Red Sea. The first report was from the same fishes by Al-Zubaidy (2006).

Description (based on five specimens): Larval scolex is divided into four regions: Pars bothridialis, pars vaginalis, pars bulbosa and pars post bulbosa (appendix). Pars bothridialis, 0.53-0.70 (0.61) mm long, is composed of two posteriorly notched bothridia, and two proboscides in front of each bothridium, which are located at the tip of scolex. Tentacle sheath is spirally coiled. Pars vaginalis is 4.5-7.5 (6.5) mm long. Pars bulbosa is 2.0-3.2 (2.5) mm long. Four bulbs are located in the pars bulbosa. Each bulb is 2.40-3.15 (2.80) mm long and 1.26-1.8 (1.5) mm wide. Pars post bulbosa is 1.1-3.2 (2.2) mm long.

The present larvae belong to the genus *Pseudogrillotia* of the subfamily Grillotiinae. Trypanorhynchid cestodes of the this group have been reported from four species of carangid fishes (*Carangoides bajad*, *C. fulvoguttatus*, *Caranx sexfasciatus* and *C. melampygus*) in Jeddah, Saudi Arabian coast of the Red Sea (Toula, 1999) and from *Lethrinus lentjan* in Yemeni coast of the Red Sea (Al-Zubaidy, 2006). Adult cestodes were recorded from some sharks and skates in the Mediterranean (Dollfus, 1969b), North Atlantic (Dollfus, 1969a), off the west coast of South America (Escalanti and Carvajal, 1984), Hawaii (Carvajal *et al.*, 1976) and in the Australian waters (Campbell and Beveridge, 1993).

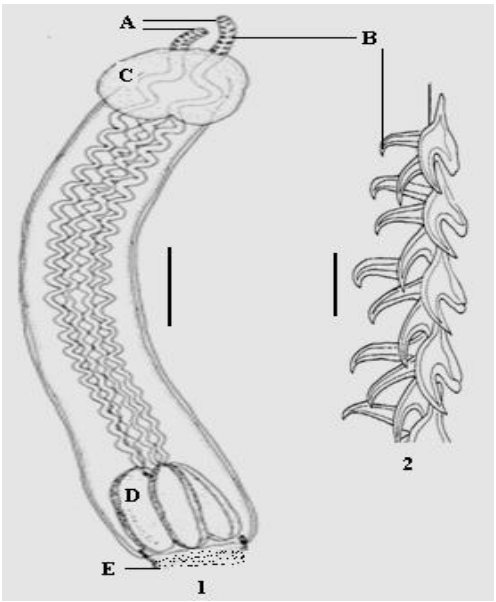

Figure 4. *Pseudogrillotia* sp., 1- Scolex (scale bar = 0.5 mm), 2- Metabasal armature (scale bars = 0.1 mm), A- Tentacle, B- Hooks, C- Bothridium, D- Bulb, E- Appendix.

5- *Nybelinia bisulcata* (Linton, 1889) (Figure 5):

This larval tapeworm was found encapsulated in body cavity, on sides of stomach and intestine of *Lethrinus lentjan*, *L. mahsena* and *Valamugil seheli* as well as from the flesh of *L. lentjan* (Table 1). This is the second report of *N. bisulcata* from fishes from the Yemeni coasts of the Red Sea. The first report was achieved by Al-Zubaidy (2006) from *L. lentjan* only. So, both *L. mahsena* and *V. seheli* of the present study are now considered as new hosts for *N. bisulcata* in the Yemeni coastal waters of the Red Sea.

Description (based on 10 specimens): Most capsules are relatively small and oval. Spine-like structures (microtriches) are visible on the margins of the bothridia. Tentacles are relatively short. Scolex subcylindrical, 1.44-2.3 (2.1) mm long. Bothridia are broad, bean-shaped, 0.55-1.2 (0.9) mm long. Pars bulbosa 0.46-0.49 (0.478) mm long and 0.22-0.41 (0.34) mm wide. Appendix 0.31-0.34 (0.324) mm long. Width of tentacles at the basal region 0.019-0.028 (0.022) mm. Metabasal region 0.019-0.022 (0.020) mm. Basal region with short hooks, 0.012-0.016 (0.014) mm long, with abruptly turned points. In the metabasal region, the hooks increase in size. At the end of the metabasal region near the apical portion, the hooks of the internal surface are longer and the implantation base is narrower.

The adult of *N. bisulcata* occurs in sharks with a wide geographical distribution and its postlarvae have low host specificity in combination with a wide oceanic distribution. *N. bisulcata* is widely spread among teleost fishes of the world oceans (Pereira and Boeger, 2005). From the Arab Gulf, Al-Daraji (1995) and Bannai (2008) reported *N. karachii* and *N. lemonteae*, respectively, from few Arab Gulf fishes. Its postlarvae are common parasites of squids (Brown and Threlfall, 1968).

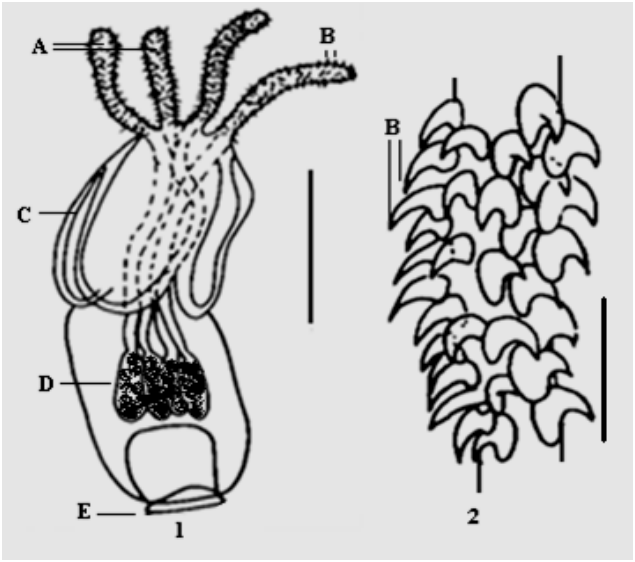

Figure 5. *Nybelinia bisulcata*, 1- Scolex (scale bar = 0.8 mm), 2- Metabasal region (scale bar = 0.05 mm), A- Tentacles, B- Hooks, C- Bothridia, D- Bulb, E- Appendix.

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يرقات الديدان الشريطية (رتبة تريبانورنكا) من بعض أسماك البحرالأحمر، اليمن

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المستخلص - تم فحص مامجموعه 713 نموذجا من الأسماك العائدة إلى 26 نوعا وتسعة عوائل من المياه الساحلية اليمنية للبحر الأحمر للتحري عن الإصابة بالديدان الشريطية من رتبة تريبانورنكا وذلك خلال المدة من شهر أيلول (سبتمبر) 2008 ولغاية شباط (فبراير) 2010. بينت نتائج الفحص ظهور خمسة أنواع مختلفة من هذه الديدان الشريطية في الأحشاء، الجوف الجسمي ولحم 12 نوعا من أنواع الأسماك. شملت تلك الديدان كل من: *Callitetrarhynchus* ، *Pseudotobothrium dipsacum gracilis*، *Floriceps minacanthus*، *Pseudogrillota* sp. و *Nybelinia bisulcata* . سجلت الأنواع الثلاثة الأولى هنا لأول مرة من أسماك مياه البحر الأحمر اليمنية، كما أعتبرت كل من أسماك *Lethrinus mahsena* و *Valamugil seheli* مضيفين جديدين للدودة الشريطية *N. bisulcata* في مياه البحر الأحمر اليمنية. وجدت الدودة الشريطية *C. gracilis* في تسعة أنواع مختلفة من الأسماك. كانت خمسة أنواع من الأسماك وهي *Pomodasys argenteus*، *Lethrinus lentjan* ، *L. nebulosus*، *Scomberomorus commerson* و *Thunnus tonggol* مصابة عضلاتها بثلاثة أنواع من الديدان الشريطية وهي: *P. dipsacum* ، *C. gracilis* و *N. bisulcata*. وكانت أسماك الشعري باشخين *L. lentjan* والزينوب *T. tonggol* من أغنى أنواع الأسماك بالإصابة حيث كانت كل منها مصابة بثلاثة أنواع من تلك الديدان الشريطية.