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MORPHOLOGICAL DESCRIPTION OF TWO DIGENEAN PARASITES, FROM LABRIDAE, AND SIGANIDAE HOSTS OF THE RED SEA IN EGYPT

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Abstract

During a parasitological survey on marine fish species inhabiting Hurghada Coasts of the Red Sea, Eighty seven fish specimens of 2 different species were found naturally infected by three different species of digenean parasites, one of them was reported as new host and locality in Egypt. These were *Phyllodistomum hoggettae* (family: Gorgoderidae) infecting the Arabian mallas *Thalassoma klunzingeri* (family: Labridae). Body length to width ratio 1:3. Oral sucker opened subterminally. Intestinal bifurcation midway between oral and ventral suckers. Ventral sucker distinctly equal in size to the oral sucker. Testes slightly lobed, oblique, in mid-body; ovary entire, heart shaped, sinistrally posterior to ventral sucker and anterior to testes. Vitelline lobes entire and almost round. *Gyliauchen volubilis* (family: Gyliauchenidae) infecting the marbled spinefoot *Siganus rivulatus* (family: Siganidae). Body fleshy, robust, conical, tapered anteriorly, convex dorsally, concave ventrally, with small tail-like protubera-nce postero-dorsal to acetabulum. Prepharynx very long and convoluted, occupied greater part of the anterior body half. Pharynx elongated, prephanyx very coiled and situated close to intestinal bifurcation. Ventral sucker well developed and spherical. Oesophagus very long, wide, longer than body straightened length. Two testes oval, symmetrical, dorsal to ventral sucker, subequal in diameter. Ovary spherical, dextro-submedian between right testis and cirrus sac. Vitelline follicles relatively small, irregular, numerous, extended in lateral fields between testes and mid-oesophageal level, confluent in region of intestinal bifurcation. All of the recovered species were compared with others recorded from different hosts.

Key words: Egypt, Red Sea, *Phyllodistomum hoggettae, Gyliauchen volubilis,* Morphology.

Introduction

Fisheries in the Red Sea are of considerable socio-economic importance to Red Sea countries in terms of national food security and income generation for rural communities. Studies on the helminth parasites of the Red Sea fishes tend to be limited to short reports describing new taxa (Khalifa *et al*, 2015). The Red Sea is the habitat of over 1,000 invertebrate species and 200 soft and hard corals and is the world's most northern tropical sea (Fis-cher and Bianchi; 1984, Persga, 2001). Arabian Mallas, *Thalassoma klunzengri* is considered to be one of the most important fish species in the Red Sea aquaria as it is used as ornamental fish, also as seafood at fish markets and restaurants. The rabbit fish *Siganus rivulatus* is common in the northern Red Sea. It is herbivorous fish found in schools over sandy substrates covered by benthic algae and sea grasses. Parasitic helminths of these fishes are one of the least known parts of the Red Sea fauna (Hassanine and Gibson, 2005). However, study of fish Parasitology is one of the more interesting branches for many researchers all over the world especially for the marine fishes (Al-Jahdali, 2010) either for the internal or external parasites. Members of Gorgoderidae (Looss, 1899) are parasitic flukes that typically inhabit the urinary bladder of fishes, amphibians and reptiles. Of these, *Phyllodistomum* (one of the most specious groups in class Digenea with more than 100 species) has a worldwide distribution, including parasites of amphibians, and both marine and freshwater fishes (Campbell, 2008; Rosas-Valdez *et al*, 2011). The classification of the genus *Phyllodistomum* within the family Gorgoderidae, which species composition, is under scrutiny and remained controversial (HO *et al*, 2014). *Gyliauchen*

(Ni-coll, 1915) is the type genus of Gyl-iaucheni- dae (Fukui, 1929) which is a small family within superfamily Lepocreadioidea Odhner, 1905 (Bray, 2005). Its members constitute a group of intestinal trematodes, which are al-most entirely found in certain herbivorous tel-eost fishes (e.g. siganids & acanthurids). Dur-ing a survey on helminth parasites infecting Red Sea fishes collected from Hurghada Coa-sts, two different species of digenean parasites were recovered from two different fish species. The isolated parasites were studied morphologically and morphometrically by light microscopy.

Materials and Methods

A total of 78 fish specimens were collected from water locations along the Red Sea at Hurghada coasts during the period from June 2014 to April 2015. These were, the Arabian mallas *Thalassoma klunzingeri* (family: Labridae, n 43), and the marbled spinefoot *Siganus rivulatus* (family: Siganidae, n 35). Fish were transported alive or in an insulated ice box filled with ice immediately to the National institute of Oceanography and Fisheries (N.I.O.F) laboratory at Hurghada City. Fish were identified and classified (Froese and Pauly, 2003). In the laboratory, the external surface of the fish was examined thoroughly by naked eyes for the detection of any visible cysts using a hand lens. After that, fish was opened up dorso-ventrally and the internal organs examined. Entire digestive system was removed and placed in a petri dish filled with a physiological saline 0.9%. Gut was divided into sections and each one examined for parasites under a Leica S6D stereozoom microscope (Leica, Wetzlar, Germany). The worms of digenean type were removed alive by fine forceps, heat-killed with freshwater heated to 60^{o}C, immediately fixed in and held in 10% neutral buffered formalin for 48hr, placed overnight in distilled water, stained overnight in acetocarmine, dehydrated in ethanol series, cleared in clove oil, and permanently mounted on glass slides using Canada balsam. Illustrations of stained, whole mounted specimens were made with Zeiss Axiovert 135 microscope equipped by a power shot Canon digital Camera. All measurements were in millimeters and given as range followed by the mean in parentheses.

Results

Twenty out of 78 (25.64%) fish specimens were found to be naturally infected with two different species of digenean parasites, these were *Phyllodistomum hoggettae* infecting the urinary bladder of the Arabian mallas *Thalassoma klunzingeri*, and *Gyliauchen volubilis* infecting intestine of the marbled spinefoot *Siganus rivulatus.*

Family Gorgoderidae: *P. hoggettae* Ho *et al*. (2014) Figs. A & B:

Body length to width ratio 1:3. Oral sucker opened subterminally, measured 0.226-0.576 (0.312±0.002) mm in length & 0.217-0.423 (0.298±0.002) mm in width. Intestinal bifurcation midway between oral & ventral suckers. Ventral sucker distinctly equal in size to oral sucker, measured 0.235-0.561 (0.317± 0.002) mm in length & 0.221-0.429 (0.304± 0.002) mm in width. Oral sucker to ventral one width ratio 1:1. Oesophagus 0.121-0.465 (0.296±0.002) mm long. Caeca simple, blind tube. Testes slightly lobed, oblique, in mid-body; anterior testis 0.183-0.423 (0.298± 0.002) mm in length & 0.113-0.387 (0.228± 0.002) mm in width; posterior testis 0.191-0.482(0.314±0.002) mm in length & 0.163-0.412(0.257±0.002) mm in width. Genital po-re median situated 0.045-0.298 (0.212±0.002) mm anterior to ventral sucker. Seminal ves-icle bipartite, extended from slightly posteri- or to anterior ventral sucker margin to about midway between intestinal bifurcation and ventral sucker, directly dorsal to genital pore. Ovary entire, heart shaped, sinistrally poster-ior to ventral sucker and anterior to testes, 0.085-0.289 (0.212±0.002) mm in length & 0.078-0.284 (0.175±0.002) mm in width. Vitelline lobes entire almost round, left lobe immediately anterior to ovary, posterior to ventral sucker, 0.116-0.266 (0.198±0.002) mm in length &

0.083-0.178 (0.135±0.002) mm in width; right lobe 0.113-0.275 (0.219± 0.002) mm in length & 0.098-0.256 (0.126± 0.002) mm in width. Laurer's canal not detec- ted. Uterus intracaecal in hindbody, in exten-sive coils extended just posterior to ends of intestinal caeca. Eggs 0.022-0.055 (0.037± 0.002) mm in length & 0.018-0.036 (0.027±0.002) mm in width. Excretory vesicle tubular; anterior extent obscured by uterus in all specimens. Excretory pore dorsal, midway between posterior extremity and caecal end.

Taxonomic summary

Type-host: *Thalassoma klunzingeri* (Family: Labridae)

Type-locality: Coasts of Hurghada City, the Red Sea, Egypt.

Infection site*:* Urinary bladder.

Prevalence: 9/43 (20.93%) natural infected.

Deposition: Zoology Department, Faculty of Science, Cairo University, Giza, Egypt

Family: Gyliauchenidae, *G. volubilis* Nagaty (1956) Figs. C-F

Body fleshy, robust, conical, tapered anteriorly, convex dorsally, concave ventrally, with small tail-like protuberance postero-dorsal to acetabulum nearly pyriform, 2.12-4.63 (3.54±0.02) mm in length, 0.689-1.38 (0.825±0.002) mm in maximum width middly, with small postero-dorsal papilla-like protuberance. Tegument smooth and unspined. Oral sucker embedded in paranchyma, pyriform, measured 0.351-0.488 (0.412± 0.002) mm length & 0.213-0.343 (0.287± 0.002) mm width in fully mature specimen; mouth narrow and subventral. Prepharynx very long, convolut- ed, occupied greater part of anterior body half. Pharynx elongated, prephanyx very coiled, close to intestinal bifurcation, measured 0.128-0.137 (0.132±0.002) mm long & 0.119-0.167 (0.145±0.002) mm wide. Ventral sucker well developed, spherical, measured 0.278-0.542 (0.389±0.002) mm located close to posterior extremity; hind body very short. Oesophagus very long (longer than straightened body length), 2.23-5.15 (3.12±0.02) mm long, highly coiled, with 2-3 loops, surrounded by glandular cells along most of its length. Oesophageal bulb round, measured 0.122-0.214 (0.188±0.002) mm long. Intestinal bifurcation at middle of body; caeca simple, wide, extended into middle body third. Two testes oval, symmetrical, dorsal to ventral sucker, subequal in diameter, 0.246-0.583 (0.356±0.002) mm in length & 0.218-0.415 (0.308±0.002) in width. Cirrus sac short, claviform, mainly intercaecal, 0.189-0.345 (0.265±0.002) mm in length & 0.108-0.175 (0.126±0.002) mm wide basally with tubular seminal vesicle (partly external to cirrus sac), well-developed prostatic complex, relatively short ejaculatory duct; prostatic cells extended outside cirrus sac to cover external seminal vesicle part. Genital pore median, posterior to intestinal bifurcation. Ovary spherical, dextro-submedian between right testis; cirrus sac, 0.098-0.158 (0.121 ±0.002) mm. Seminal receptacle oval submedian, opposite to ovary. Laurer's canal opened on dorsal surface at ventral sucker level. Uterus relatively short, winded between ovary, left testis & left cae-cum. Eggs thin shelled, yellowish, mesured 0.043-0.078 (0.069±0.002) mm in length & 0.021-0.043 (0.039±0.002) in width. Vitelline follicles relatively small, irregular, numerous, extended in lateral fields between testes & mid-esophageal level, confluent in intestinal bifurcation. Transverse vitelline collecting ducts arised from vitelline follicles at body each side, opened into small spherical vitelline reservoir dorsal to anterior margin of ventral sucker. Excretory vesicle claviform, extended anteriorly to reach ventral sucker; excretory pore postero-terminal, at tip of papilla-like protuberance (excretory papilla).

Taxonomic summary

Type-host: *Siganus rivulatus* (Family: Siganidae)

Type-locality: Coasts of Hurghada City, the Red Sea, Egypt.

Infection site*:* intestine.

Prevalence: 11/35(31.42%) \natural infected

Deposition: Zoology Department, Faculty of Science, Cairo University, Giza, Egypt

Table 1: Comparative measurements in mm between present *P. hoggettae* & other species of *Phyllodistomum*

Aspect	*P. thalassomum* (Soheir and Ahmed, 2000)	*P. parichhaii* (Naz & Sidique, 2012)	*P. pahujii* (Naz & Siddique 2012)	*P. vaili* (Ho *et al*, 2014)	*P. hoggettae* (Ho *et al*, 2014)	*P. hoggettae* Present study
Host	*Thallassoma klun-zingeri, Cheilinus abudjuppe and Ch.undulatus*	*Xenentodn cancila*	*Xenentodn cancila*	*Mulloidichthys vanicolensis*	*Plectropomus le-opardus, Leopard coralgrouper*	*Thallassoma klunzingeri*
Total body length	6.4-10.8	0.75-0.76	0.9-1.0	1.498-2.303	3.483-4.765	3.14 – 5.21
Total body width	2.625-3.575	0.28-0.29	0.48-0.49	0.409-0.681	0.968-1.855	1.01 – 1.92
Oral sucker length	0.36-0.49	0.08-0.09	0.8-0.9	0.137-0.208	0.280-0.445	0.226 –0.576
Ventral sucker length	-	0.15-0.16	0.16-0.17	0.119-0.183	0.368-0.554	0.235–0.561
Anterior testis length	0.50-1.03	0.11-0.12	0.19-0.2	0.080-0.192)	0.155-0.341	0.183–0.423
Anterior testis width	0.43-0.78	0.13-0.14	0.13-0.14	0.060-0.183	0.091-0.390	0.113–0.387
Posterior testis length	0.70-1.05	0.11-0.12	0.16-0.17	0.067-0.211	0.179-0.457	0.191–0.482
Posterior testis width	0.55-0.88	0.08-0.09	0.1-0.11	0.061-0.175	0.152-0.544	0.163–0.412
Eggs lengths	0.049	0.02-0.03	0.02-0.03	0.027-0.050	0.036-0.057	0.022–0.055
Ovary length	0.25-0.375	0.04-0.05	0.05-0.06	0.051-0.155	0.078-0.331	0.085–0.289

Table 2: Comparative measurements between present *G. volubilis* and previously recorded host species.

Aspects	*G. volubilis* (Nagaty, 1956)	*G. volubilis* (Al-Jahd-ali & Hassanin, 2012)	*G. volubilis* (Abd El-Latif & Ahmed, 2014)	*G. volubilis* Present study
Host	*Pseudoscarus harid, amphacanthus sigan*	*Siganus rivulatus*	*amphacanthus sigan*	*Siganus rivulatus*
Total body length	3.12	2.361-3.775	1.81	2.12 – 4.63
Total body width	1.18	0.769-1.153	0.80	0.689 – 1.38
Oral sucker length	0.4	-	0.13	0.351 – 0.488
Oral sucker width	0.29	-	0.15	0.213 – 0.343
Ventral sucker	-	0.320-0.480	-	0.278 – 0.542
Pharynx length	0.14-0.17	0.202-0.309	-	0.128 – 0.137
Testis length	0.19-0.55	0.321-0.555	0.24	0.246 – 0.583
Testis width	-	0.220-0.395	0.13	0.218 – 0.415
Eggs lengths	0.09	0.058-0.071	0.091-0.098	0.043 – 0.078
Ovary length	0.1-0.14	0.111-0.175	0.13	0.098– 0.158

Discussion

Phyllodistomum hoggettae: The parasite was isolated from intestine of the arabian mallas *Thalassoma klunzingeri* of family Georgoderidae. Six different species of family Georgoderidae were described (Dawes, 1946), two or three of them occurred in amphibia, others in fresh water shrimps but the great majority occurred in fishes. Looss (1901) described *P. acceptum* from *Crenilabrus pavo* and *C. griseus*. Odhner (1902) reported *P. unicum* from *Serranus* sp., *P. linguale* from *Gymnarchus niloticus*, *P. spatula* from *Bagrus docmac* and *B. bayad*, and *P. spatulaeforme* from *Malapterurus electricus*. Nagaty (1956) described *P. leilae* from *Pseudoscarus harid* from Red Sea at Hurghada. Also, *P. lazeri* recorded from the urinary bladder of *Clarias lazera* and *P. minianum* isolated from *Claries lazera* from El-Minia, Egypt. Three species were added worldwide; *P. parichhaii* and *P. pahujii* (Naz and Siddique, 2012) from *Xenentodon cancila* from district Jhansi Bundelkhand region and *P. vaili* (Ho *et al*, 2014) from *Mulloidichthys vanicolensis* from Off Lizard Island, northern Great Barrier Reef. Of the three comparable species have small measurments dimentions except for *P. thalassomum* was larger than the present species. The present species was distinguished by the clear marginal undulations in hindbody which are marine representatives of the genus, suggesting that they may be closely related to marine forms. In contrast to *P. thalassomum*, *P. parichhaii*, *P. pahujii* and *P. vaili*, it was observed that oral to ventral sucker ratio in the present species was 1:1.

In the present study, the described species was not comparable with *P. acceptum* Looss (1902) by diference in some measurements.

G. volubilis (Nagaty 1956) was isolated from the intestine of marbled spinefoot *S. rivulatus* of family Siganidae. This fluke was closely related to *G. volubilis* (Nagaty, 1956) collected from *Siganus rivulatus* by many authors; Nagaty (1956) at Hurghada City, Al-Jahdali (2012, 2013), Al-Jahdali and Hassanine (2012) from Mangrove swamps on Egyptian Gulf of Aqaba Coasts and mangrove swamps near Rabigh on the Saudi Arabia western Red Sea coast and Abd El-Latif and Mohammed (2014) from Sharm El-Naga Coast southern of Hurghada City. Cable and Hunninen (1942) reported that the peculiar body shape

of gyliauchenids was due to failure of the hind body to grow during post-cercarial development, with a compensating elongation of the fore body such that the so-called excretory papilla would correspond to the hind body of other trematodes. Jones *et al*. (2000) interpreted peculiar gut morphology of gyliauchenids to be an adaptation to the predominantly herbivorous diets of definitive fish host. The method of collection of fishes may affect the normal distribution of helminths along their gastrointestinal tracts. Williams *et al*. (1991) showed that certain capture methods resulted in significant stress to fish. Such stress causes regurgitation and contributes to expell some intestinal helminthes (Mackenzie and Gibson 1970), the migration of helminths along the gastrointestinal tract of fish, during periods of starvation or after death, may also affect their normal distribution. In the present study, fish were caught by hand net (by scuba-diving) and examined in a field laboratory in the least possible time after capture in order to avoid significant changes. The present parasite shared the characteristic features of genus *Gyliauchen*, body tapered anteriorly, convex dorsally, concave ventrally, oral sucker absent and functionally replaced by pharynx or embedded in paranchyma, the ventral sucker was either at or close to the posterior end of the body and oesophagus was very long (longer than straightened body), highly convoluted and formed many coils within the fore body and it was surrounded by dense gland-cells and ends in an oesophageal bulb. Ovary of *Gyliauchen volubilis* between testes, but it was slightly more anterior than in genus *flagellotrema* (Ozaki, 1936), where ovary was posterior to anterior testis at some distance from the other, and both testes anterior to acetabulum. In genus *Gyliauchen*, the ovary was anterior to oblique testes, which are dorsal to acetabulum and ovary was intermediate to that described for *Flagellotrema* and *Gyliauchen*. Topography of gonads was on whole more like that of *Gyliauchen* and for that reason the present species was assigned to genus. *G. volubilis* resembled most of *G. papillatus* (Goto and Matsudaira, 1918) Goto, 1919 new synonymy, but differs from that species: (a) in more ovary posterior position, (b) in greater development and vitellaria extent, (c) in constant disposition of pre-pharyngeal convolutions which were also longer and more voluminous; (d) in better developed excretory protuberance.

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Conclusion

Phyllodistomum hoggettae, and *Gyliauchen volubilis*, digenean parasites recorded from the Red Sea water in Egypt as new host and locality records.

It is recommended to focus the further parasitological surveys on fishes of the Red Sea to discover and record this amazing and incompletely known parasite world of the Red sea in Egypt.

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Explanations of figures

Figs. A&B: *Phyllodistomum hoggettae* (F: Gorgoderidae) infecting *Thalassoma klunzingeri* showing: A: Whole mount preparation of the worm with general architecture of digenean body, an anterior oral sucker (OS), a short oesophagus (OE) bifurcated as two blind intestinal

caeca (IC), ventral sucker (VS) situated below genital pore (GP) below point of intestinal bifurcation, two large testes (TE) in tandem situated in body mid part surrounded by a large mass of uteri (UT) and an irregularly shaped ovary (OV) with two kidney-shaped vitelline glands (VG). B: High magnification of body mid part including testes (TE), ovary (OV), intestinal caeca (IC), vitelline glands (VG) and uterine eggs (EG).

Figs. C-F: *Gyliauchen volubilis* (F: Gyliauchenidae) infecting marbled spinefoot *Siganus rivulatus*. C, D: High magnification, the oral sucker (OS) followed by long prepharynx (PPH), oesophagus (OE), ventral sucker (VS) located at the posterior part of the body, just above the two testis (TE), small ovary (OV) situated behind testis, and multi-lobed vitellaria (VT) spread all over body. E, F: High magnifications of the worm posterior part showing region of reproductive organs, one ovary (OV) and two testes (TE).