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Research Article

DIGENEAN PARASITES OF TELEOST FISHES *GAZZA ACHLAMYS* (JORDAN & STARKS, 1917) AND *ARIOMMA INDICA* (DAY, 1871) FROM VISAKHAPATNAM COAST, ANDHRA PRADESH, INDIA

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ABSTRACT

Digeneans have a heteroxenic life cycle, their impact is not limited to the definitive host, which harbours the sexual adults, but is extended to the first host (mollusc) and to the second host (fish). Within the first host, 'larval' stages of digenean parasites invade the gonads, resulting in its castration, then exhaustion and eventually death. The diversion of energy from the second hosts towards the parasites forces them to intensify their search for food, resulting in decreased fitness and an increased risk of being eaten; in addition, manipulation of the host's behaviour by parasites drives this host into the food chain of the definitive host. The present study aims to perform the survey of digenean parasites of two marine fishes G*azza achlamys* and *Ariomma indica* from Visakhapatnam coast, South east coast of India. Samples were made for two years. Altogether, two species were observed.

INTRODUCTION

Parasites are important components of communities and constitute great part of the biological diversity found in ecosystems, providing valuable information about their hosts and the environment in which they live. Digeneans have a heteroxenic life cycle, their impact is not limited to the definitive host, which harbours the sexual adults, but is extended to the first host (mollusc) and to the second host (fish). Studies on digenetic trematodes of marine fishes from various regions of the world have received a great deal of attention since the turn of century. Extensive and widely scattered literature has been the result of these studies. Digenea are endoparasites of which it may be mentioned that didymozoids, which live sometimes single but mostly encysted in pairs and may be hermoproditic or gonochoristic, represent the highest degree of adaptation to their special habitat culminating in protected parasitism.

Studies on digenea of fishes may be said to have begun in the nineteenth century by large number of investigators. Digenean family like, *Opecoelids* that are widely distributed around the world. The genus was erected by Gibson and Bray (1982) for marine species of *Plagioporus* Stafford, 1904 (*sensu lato*), with a ventro-lateral genital pore and an excretory vesicle reaching at least to the level of the anterior testis. In 1954 appeared monographic volumes of Skrjabin and Guschanskaya which form a major landmark in the study of digenetic trematodes. Consequently, a series of publications have come from Russian workers by Skrjabin and Guschanskaja (1959), Dogiel (1962), Nikolaeva (1970), Oshmarin and Mamaev (1963), Mamaev and Oshmarin (1966) and Parukhin (1970). Of the more recent literature on digenia of marine fishes are Fischthal (1977), Overstreet (1973), Nikolaeva (1978), Fabio (1976), Cambel and Munro (1977) and Stunkard (1978).

Among other investigators who contributed to the knowledge of digenetic trematodes of Indian waters are Chauhan (1954), Srivastava (1968), Hanumantharao (1974), Madhavi (1976), Hafeezullah (1977) and Singh (1979). While the first research on trematodes in marine fish was carried out in the north Adriatic Sea, most of the flukes occur frequently in the fish of the Adriatic Sea (Looss, 1907). Afterwards the research was continued by Janiszewska (1953) who described 22 digenean species, and Sey (1970) isolating 33 species in the middle Adriatic. In 1985, Jardas and Hristovski examined 220 fish of 63 species and found 13 species of digenean trematodes. A ten years' research by Yugoslav and French parasitologists, culminated with a monograph that documented some 26 species of digenean trematode in 124 examined species of sea

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fish (Radujković *et al.,* 1989). In the area of the north Adriatic Sea, further research was carried out by Brglez and Paradižnik (1988). Some of the other Opecoelids have been reported from Australian waters by Bray (1990). It is clear that Australian waters harbour many species, and the exploration of these worms is carried further in this study where nine species were reported, eight new. Cribb (2005) recognized this genus in his key to the *Opecoelidae*, based on the characters mentioned here. It became a large genus, with many described species and many species awaiting to be described. Some of the recent investigators worked on digenetic trematodes of family Poecilids by Gibson and Bray (1982), Rodney (1987), Blend *et al*. (2004), Aken'ova *et al*. (2006) and Blend *et al*. (2007).

Parasitic worms infecting marine fishes of Andhra coast have been receiving attention for the last four decades. Though *Gazza achlamys* and *Ariomma indica* are known to serve as a good host for parasites, detailed knowledge of parasitic fauna of *Gazza achlamys* and *Ariomma indica* is limited. In the present study, an attempt has been made on the taxonomic studies of digenean parasites of *Gazza achlamys* and *Ariomma indica* from Visakhapatnam coast.

MATERIALS AND METHODS

The collections fish, *Gazza achlamys* and *Ariomma indica* from Visakhapatnam coast have been regularly examined for a period of two years (2016-2017). As soon as the fish were collected they were examined immediately. Parasitic helminthes including mainly Digenea, Monogenea, Copepoda and other parasites if any were collected, the data was recorded carefully. Most marine fish could be obtained in dead condition, but the trematodes harboured by them especially didymozoids and opeocoelids were collected in active condition. The fish were dissected out and all the possible sites particularly for didymozoids and other trematodes were examined. Digeneans are endoparasites mostly collected from different locations such as body cavity, muscular or adipose tissue, orbit, stomach wall etc.

After collection, the didymozoidae and opecoelids were washed in 1% saline or Ringer's solution and then appropriately pressed in between two slides for fixation. For whole mount preparation FAA is generally used as an effective fixative. Sufficient pressure is used to flatten the trematodes. Necessary precaution is taken while pressing the didymozoidae and other trematodes so that the specimen does not get ruptured as to avoid the emergence of eggs. For smaller and delicate worms like the genus *Skrjabinozoum* and *Plagioporus* coverslip pressure was sufficient.

After fixing for few hours, the specimens were washed and put in alum carmine for 12 hours. If they are over stained they were washed with acid alcohol and later washed with distilled water. The parasites were washed in a graded series of alcohols and cleared in Carboxyolol or Cedor wood oil and then mounted with Canada balsam or D.P.X mountant. Figures were drawn by using camera lucida. All measurements were given in millimeters (mm).

For every collection counts of digenean parasites were maintained for comprehensive study. In the systematic account, the incidence and intensity of infection of each specimen is also maintained. Information pertaining to the number of fishes examined, their size, sex and incidence of infection with particular species of parasite mainly Digenea and finally the habitat has been furnished.

RESULTS

Digeneans, commonly known as flukes, are members of the Subclass Digenea, Class Trematoda, and Phylum Platyhelminthes. They are among the most common and abundant parasitic worms, next to nematodes in their distribution. Flukes are important fish parasites with fishes serving both as intermediate and final hosts. *Gazza achlamys* and *Ariomma indica* harbours a diverse variety of ecto and endo parasitic groups including copepods, monogeneans, digeneans, nematodes and acanthocephalans. During the present study, altogether two digenean species were identified. They are *Skrjabinozoum* n.sp. and *Plagioporus* sp**.** Detailed description of each digenean parasite is given bellow. All measurements were in millimeters, unless otherwise mentioned.

***Skrjabinozoum* n.sp**

Collected from connecting tissue of operculum and orbit of *Gazza achlamya*. Based on six specimens only four were measured. Cyst round containing two specimens of unequal size and one being very small and the other larger with well-developed ovary and vitellaria. But testis is found well developed and branched in the young specimens (Fig. 1).

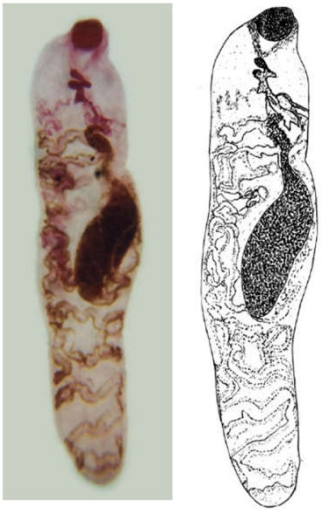

Figure 1 *Skrjabinozoum* n.sp.

Body not differentiated into forebody and hindbody, elongated, cylindrical, nearly uniform, slightly broad near the anterior end at the testicular level and narrow posteriorly (Fig. 1). The length of the worm after mounting in Canada balsam varies between 2.032-9.904. The largest individual measures up to 1.568 in maximum width at testicular swollen region, the smallest only 0.554. In young specimens only the testes are well developed and the female reproductive system is not differentiated. A minute male worm could always be found together with a fully developed hermaphroditic individual inside a cyst.

At the anterior extremity, there is an oral sucker highly muscular and oval to round in shape, measures 0.144-0.192 X

0.144-0.256, its dimensions being roughly proportional to the size of the specimen. Pharynx is absent or rudimentary surrounded with thick glandular cells. Oesophagus 0.048-0.0360 long narrow tube provided with a layer of glandular cells appearing like accompanying thick cells. Caeca simple slightly winding, but inflated posteriorly reaching near the posterior extremity. Acetabulum is completely absent.

Testes two, just a posed, tubular slightly branched winding situated near the anterior end of the body. The two vasa efferentia unite to form vas deferens running alongside with metraterm. Genital pore median and ventral to oral sucker. In young specimen's testes occupy most of the anterior part of the body and show many coils but in older individuals they are reduced to tubular structures. Ovary single, undivided, tubular, strongly winding originating a distance of 0.264-0.288 below the testes, extending up to the shell gland complex to the lateral side in the middle of the body. Genital junction 1.968-3.216 from the anterior end and 1.952-3.776 from posterior extremity. Both ovary and vitellarium converge towards a point at a distance above the middle length of the body and connect with the oviduct, and shell gland. Receptaculum seminis, small saccular 0.160 X 0.064 close to genital junction. Vitellarium single, tubular, unbranched, strongly winding between the posterior extremity and the genital junction. The uterus runs forward as a complicated tube close to ovary near the posterior end of testes and turns back on itself forming a loop anteriorly and descends to posterior extremity close to vitellarium to take its final ascending much convoluted course thus forming two loops, one anterior and one posterior and terminating below the oral sucker as the metraterm. Eggs very small oval shaped measures 0.002 X 0.007.

***Plagioporus* sp**

Collected from *Ariomma indica.* Body flattened elliptical, fusiform or oval (Fig. 2). Oral sucker, pharynx and acetabulum well developed, latter pre-equatorial, sometimes equatorial. Ceca terminating at, or near, posterior extremity. Testes tandem or oblique, toward midbody in subgenus *Plagioporus,* or near posterior extremity in subgenus *Caudotestis*. Cirrus pouch more or less claviform, containing winding seminal vesicle, rather indistinct pars prostatica surrounded by prostate cells, and eversible ejaculatory duct. Genital pore sub median, (usually sinistral), level with esophagus or intestinal bifurcation, or occasionally with pharynx. Ovary pretesticular, sub median, sometimes median. Seminal receptacle and laurer's canal present. Vitellaria usually extending into forebody, usually not reaching to posterior extremity in subgenus *Caudotestis*. Uterus winding between ovary or anterior testis and acetabulum. Excretory vesicle tubular, reaching to ovary, occasionally to anterior end of acetabulum or further forward (subg. *Paraplagioporus*). Flame cell formula 2 (2+2) + (2+2) = 16 in p. (plagioporus) ira and p. (paraplagioporus) isagi. Parasitic in marine, occasionally fresh water, fishes.

Based on a single adult specimen. Body elongated, flattened elliptical, more or less fusiform or oval, sub cylindrical, unarmed, with rather blunt ends, slightly narrow near the anterior extremity. It measures 3.392 in length and 0.960-1.003 in maximum width and widest at the level of acetabulum.

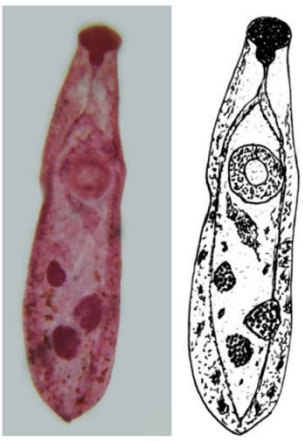

Figure 2 *Plagioporus* sp

Oral sucker, pharynx and acetabulum well developed pre-equatorial. Oral sucker terminal 0.208 x 0.224 in diameter, prepharynx present. Pharynx round 0.144 x 0.160. Oesophagus narrow 0.080 wide and 0.176 in length. Caeca terminating at, or near, posterior extremity. Caeca united posteriorly and opening near the posterior end of the body. Acetabulum larger than oral sucker, usually in anterior half of body. Acetabulum round, without peduncle with rather rudimentary marginal papillae 0.448 x 0.432 in diameter, situated about 1/3rd of body length i.e., about 0.688 from the anterior end. Sucker ratio 1:2.

Testes tandem or oblique, toward midbody in subgenus *Plagioporus*, or near posterior extremity in subgenus *Caudotestis*. Testes, irregular in shape, distinctly or indistinctly lobed 0.352- 0.368 x 0.528-0.560, tandem, close together at about middle of hindbody. Seminal receptacle and laurer's canal present. Seminal vesicle elongated claviform 0.960 x 0.112-0.144 gradually tapering anteriorly extending to posterior end of the acetsbulum. Cirrus pouch more or less claviform, containing winding seminal vesicle, rather indistinct pars prostatica surrounded by prostate cells, and eversible ejaculatory duct. Genital pore submedian, (usually sinistral), level with esophagus or intestinal bifurcation, or occasionally with pharynx. Genital pore submedian, (usually sinistral), level with esophagus or intestinal bifurcation, or occasionally with pharynx. Common genital pore to right of oesophagus behind the pharynx.

Ovary pretesticular, sub median, sometimes median. Ovary, pre-testicular, indistinctly lobed, transversely elongated 0.160 x 0.448 in median line. Seminal receptacle and laurer's canal present. Vitellaria usually extending into forebody, usually not reaching to posterior extremity in subgenus caudotestis. Uterus confined to space between testes or ovary and genital pore, overreaching caeca laterally or not. Vitelline follicles large or small, variable in extent, usually along caeca between level of esophagus and posterior extremity, but may be confined to hindbody. Uterus winding between ovary or anterior testis and acetabulum. Excretory vesicle tubular, reaching to ovary, occasionally to anterior end of acetabulum or further forward (subg. *Paraplagioporus*). Flame cell formula 2 (2+2) + (2+2) = 16 in p. (*Plagioporus*) ira and p. (*Paraplagioporus*) isagi.

DISCUSSION

The genus *Skrjabinozoum* was erected by Nikolaeva and Parukhin (1969), the type species being *Skrjabinozoum exocoeti*. Subsequently *S. vodjanitskii* in the Arabian Sea.

The present specimens closely resemble *S. vodjanitskii* Nikolaeva and Parukhin, 1975 in the cylindrical shape of body, arrangement of tubular winding ovary between genital junction and testes, and in that the ovary does not extend into the testes area, but differs from it mainly in the shape of the body being swollen anteriorly at the level of testes and narrow posteriorly, in the size of the well-developed oral sucker, very small pharynx surrounded by gland cells, much longer oesophagus with gland cells on either side, branched testes, smaller seminal receptacle and in the size of the eggs. It is therefore felt that a new species has to be erected for this. In the present study, the specimens have been collected from *Gazza achlamys*. It is a new host recorded.

The genus *Plagioporus* was established by Stafford, 1904 with type species being *P. serotinus* Stafford, 1904, in *Moxostoma macrolepidotum*, Canada. 1.62 x 0.43. Also in *Archoplites interruptus*, California-Haderlie (1953). Haderlie's specific determination questioned by Manter (1954). In the present study, the specimens have been collected from *Ariomma indica*. It is new host recorded.

CONCLUSION

Gazza achlamys and *Ariomma indica* harbours a diverse variety of ecto and endo parasitic groups including copepods, monogeneans, digeneans, nematodes and acanthocephalans. The present study revealed that parasite infracommunity of *Gazza achlamys* and *Ariomma indica* were species rich, with low diversity and abundance of parasites. G*azza achlamys* and *Ariomma indica* appears to be a medium host for digenean parasites. During the study, two species of digeneans have been obtained. The factors responsible for parasite assemblages in two hosts may attribute to the biology of host, like host vagility, composition of diet, complexity of gut. Sometimes host size and phylogeny may be responsible for the structure of parasite community in a host.

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