

RESEARCH ARTICLE

MONOGENOIDEAN PARASITES OF SOME CYPRINID FISHES FROM NORTH COASTAL ANDHRA PRADESH**M. Sujana and U. Shameem**

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INTRODUCTION

India is blessed with rich and diverse natural resources in the form of rivers, streams, estuaries, impoundments, man-made reservoirs, lake tanks and ponds. The country is also endowed with a rich fish genetic biodiversity (2,200 fish species) and ranks 9th in terms of freshwater mega diversity (Miltermeier and Miltermeier, 1997). Nevertheless, a significant portion of the freshwater fish production in India is still based on the harvest from wild population (Sarkar *et al.*, 2008).

Carps are the most commonly cultured fish in India, particularly the three Indian major carps *L. rohita* (Hamilton, 1822), *C. catla* (Hamilton, 1822) and *C. mrigala* (Hamilton, 1822) which alone constitute about 78% of the total aquaculture production. The production went up to 90% when the Chinese carps *Hypophthalmichthys molitrix* (Valenciennes, 1844), *Ctenopharyngodon idella* (Valenciennes, 1844) and the common carp *Cyprinus carpio* (Linnaeus, 1758), were also cultured along with the three Indian major carps (Ayyappan, 2004). These aquaculture programs contribute significantly in food security and improved living conditions.

Monogenoidea parasitize the gills, skin and fins of marine and freshwater fish may cause economic losses in fish farms when present in overwhelming numbers. Investigation is undertaken to study thoroughly, the metazoan parasite fauna of different species. Members of Gyrodactylidae, Dactylogyridae and

ABSTRACT

A total of 1200 freshwater fish belonging to six species of the family cyprinidae (*Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Cyprinus carpio*, *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix*) were collected from Visakhapatnam, Vizianagaram and East Godavari districts of north coastal Andhra Pradesh, India from April 2012 – March 2014. The inspection of fins, scales, gills and buccal cavity revealed infection of these fishes with sixteen species of parasites belonging to three genera *Dactylogyridae*, *Dogielius* and *Gyrodactylidae*. *D. minutus* and *D. lamellatus* are new regional records.

Ancyrocephalidae are the most reported parasites in wild and cultured fish. Fish harbouring monogenoids may show necrosis on gills, which facilitates secondary infection of bacteria, fungi and protozoa. Their life cycle involves only one host and they mostly spread by way of egg releasing and free-swimming infective larvae (Ozturk and Ozer, 2014). There is a published list of over 900 nominal species of *Dactylogyridae* (Gibson *et al.*, 1996).

In India, studies on monogenoidean parasites were started with the publication of *Dactylogyridae moorthyi* by Price, 1938. This was followed by some notable publications of Sproston (1946); Thapar (1948); Kaw (1950); Ramalingam (1952-55); Kulkarni (1969); Chauhan (1953-54); Tripathi (1957); Jain (1961) and Gussev, (1976). But unfortunately after the comprehensive report of Gussev (1976) no intense studies are available on these flukes except for some fragmentary reports on new species records (Agrawal, 1980; Gupta, 1983; Fotedar and Parveen, 1987; Gupta and Krishna, 1988; Agrawal and Sharma, 1989; Dubey *et al.*, 1997; Datta and Tandon, 1994; Agrawal *et al.*, 2004, 2005; Vivek Kumar and Singh, 2004; Pandey and Agrawal, 2008; Gupta *et al.*, 2007).

Literature on Monogenoidea is dominated to a great extent by papers dealing with two genera- *Dactylogyridae* and *Gyrodactylidae*.

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Recently Pandey and Agrawal (2008) compiled the entire information on monogenoidean parasites reported so far from the Indian region into a book "An Encyclopaedia of Indian Monogenoidea". This book dealt with Monogenoidea of marine as well as fresh water fishes of Indian region and covered as many as 52 species under the genus *Dactylogyrus* (Diesing, 1850) and 14 species under the genus *Gyrodactylus* (Nordmann, 1836).

MATERIAL AND METHODS

The carp species collected during the present investigation include six species viz., *L. rohita*, *C. catla*, *C. mrigala*, *C. carpio*, *C. idella* and *H. molitrix*. Monthly samples of fish comprising different species of carps were collected for two consecutive years April 12 – March 13 and April 13 –March 14. During the first year, carps were collected from culture ponds located in and around the regions of Vizianagaram and Visakhapatnam districts, whereas during the second year, they were collected mostly from culture ponds located in the Bikkavolu region of East Godavari district. Fish were captured in live and fresh condition and were brought to the laboratory in well aerated plastic bags.

The total length, the standard length and the weight of each fish were recorded before dissecting the fish. For parasitological studies, the fish were killed by inserting a needle in the head. External surfaces like fins, scales, eyeball, gills and buccal cavity were thoroughly examined for the presence of ectoparasites. Attempts were made to study ectoparasites in live condition to note the body movement and other fine morphological details, which were not visible in permanent slides. Since the dactylogyrid species were too small to prepare permanent slides, temporary slides were prepared using neutral red and ammonium picrate glycerol. Neutral red ($C_{15}H_{17}N_4Cl$) was used to study the details of reproductive organs, whereas ammonium picrate glycerol was used to study the sclerotised hard parts (Malmberg, 1970).

In this method, a parasite is taken in a drop of water onto a slide, then water is removed carefully, dried with the help of tissue paper and a drop of freshly prepared ammonium picrate glycerol was added. Coverslip is placed over it and nail polish is applied to the sides of the coverslip to avoid drying. More attention was given to study the structure of opisthaptoral hard parts and copulatory organs for each monogenoidean parasite as they are considered as important in the species identification.

RESULTS

The following is an account on description and measurements of these parasites

- *D. labeli (atypical)* Musselius and Gussev, 1976
- Hosts : *L. rohita*, *C. catla*, *C. mrigala*, *C. idella* and *H. molitrix*
- Site of infection : Gills
- Description : Body 265 (212-320) X 81 (64-100, pharynx 20 (16-24), opisthaptor 61.5 (54-66) X 82 (72-90), anchors wegeneri type, 40-63.2 (48.4) in total length,

shaft 32.8 (30.4-35.2) in length, recurved point 13.4 (12.8-16), basal part 14 (9.6-16), inner root and outer root 14.4 (11.2-17.6) and 5.4 (3.2-6.4) respectively, dorsal bar 20 (16-22.4) X 3.8 (3.2-4.8) ventral bar (onchium) situated along longitudinal axis of body, 23.8 (19.2-28.8) X 3.2 in width, marginal hooks seven pairs, 7th pair shortest, 3rd, 4th & 5th pairs longest, 17.2 (14.4-20.8), 7.6 (6.4-9.6) in handle length and 4.2 (3.2-4.8) in blade length.

Testis 24 (20-40) X 25 (20-28) in sizes. Copulatory tube long, slender with bubble like spherical base and tapering anterior end, 36 (24-40) in length and 1.6 (1.6) in width, accessory piece 17 (16-24) in length and 1.8 (1.6-3.2) in width, terminates into two unequal claw-like sclerites. Ovary 81 (76-100) X 33 (32-36) in size.

- ***D. n.sp.I***
- Host : *L. rohita* and *C. catla*
- Site of infection : Gills
- Description : Body 367 (292-512) X 92 (80-112) in width, pharynx 24.5 (16-28) x 19.5 (16-28), opisthaptor 70 (60-96) X 94 (88-112), anchors juvenile type, 40-48 (43), shaft 28.8-33.6 (32), base 13 (12.8-14.4), inner root 14 (13 -17), outer root 5.4 (5 -6.4) and recurved point 14 (13 -14.4), dorsal bar slightly bent in middle, with smoothly curved, downwardly directed lateral ends, 4 (3- 5) X 22 (14-26), ventral bar (onchium) 27.8 (24-32) in length, 3.8 (3.2-4.8) in width. Marginal hooks seven pairs, 3rd, 4th, 5th and 6th pair of marginal hooks larger in size, 18 (16 - 22) in total length, 6.6 (4.8-8.0) in handle length and 4.6 (3.2-4.8) in blade length, 1st, 2nd and 7th pairs comparatively small.

Testis 25 (12-40) X 23.5 (12-40), copulatory tube 58 (48-72) in length and 4 in width, accessory piece small, plate like, 22 (16-28) X 3.9 (3.2-4) in size, terminates in two unequal claw-like sclerites, ovary 74 (48-100) X 34.5 (16-60) in size.

- ***D. catlaius* (Thapar, 1948) Monaco & Mozielle, 1955**
- Host : *C. catla* and *L. rohita*
- Syn : *Paradactylogyrus catlaius* Thapar, 1948
- *P. bati* Tripathi, 1959
- *P. thapari* Agrawal, 1980
- *P. indicus* Singh and Rastogi, 2000
- Site of infection : Gills
- Deescription : Body 691.3 (510-880) X 118.8 (90-140), pharynx 66 (56-68) X 48.5 (32-56), opisthaptor 121 (72-188) x 156 (90-204), anchors 36.3 (27.2-44) in total length, 29.3 (27.2-32) in shaft length, 19.7 (16-24) in base size, 4.3 (3.2-4.8) inner root length, and 9.3 (6.4-12.8) outer root length, dorsal bar 6.9 (4.8-12) in length and 53 (46.4-60) in width, ventral bar (onchium) 38.1 (33.6-43.2) in length and 3.5 (3.2-4.8) in width, marginal hooks seven pairs, 5th and 7th pair large, 25.4 (19.2-30.4) in total length, 15 (9-17.6) in handle length and 4.3 (3.2-6.4) in blade length.

Testis 53 (48-56) x 65 (60 -72), copulatory 122.5 (84-172) x 3.2 (3.2) in length, accessory piece horse-shoe shaped, 53.5

(52-56) x 4 (4) in size, ovary sausage shaped, equatorial in position, 148.5 (132-152) x 63.5 (56-104) in size.

- **D. n. sp. II**
- Host : *C. catla* and *L. rohita*
- Site of infection : Gills

• Description : Body 285 (224-384) long, 102 (64-160) wide, pharynx 20 X 20 in diameter, distance from the anterior end to the pharynx 34 (28-36), opisthaptor 90 (80-110) long, 105 (98-115) wide, anchor (38.4-44.8) 41.9 in total length, 36.52 (33.8-40) in shaft length, 12.9 (11.2-16) in base size, 13.8 (9.6-20) inner root length and 5.8 (3.2-8) outer root length, point recurved 14.4 (11.2-16) in length, dorsal bar "bow" shaped, thick, broad middle region, tapering terminal end, 4.3 (3.2-4.8) in length and 26.8 (25.6-28.8) in width, ventral bar (onchium) 28.6 (27.2-30.4) in length and 3.2 (3.2) in width, marginal hooks 7 pairs - 4th, 5th and 7th pair of marginal hooks large, 20.6 (12.8-24) in total length, 7.6 (6.4-9.6) in handle length and 4.6 (3.2-4.8) in blade length.

Testis 34 (32-40) x 45 (38-48), copulatory tube long, J-shaped 32 (24-40) in length, 1.6 in width, accessory piece clasper like, horse-shoe shaped, 14 (12-22) x 1.6 in size. Cirrhal thread runs along the copulatory tube. Ovary 92 (80-96) X 48 (40-50) in size.

• **D. spinutibus Gussev, 1976**

- Host : *C. catla*
- Site of infection : Gills
- Description : Body 140-250 (201.3) X 40-70 (53.8), pharynx 12 in length, 11 (8-12) in width, distance from anterior end to pharynx 16 (14.8-17.2), opisthaptor 48 (40-52) X 72 (64-80), anchors anchoratoid-wegeneri type, 36.8-40 (38.6) in total length, 29.4 (28.8-30.4) in shaft length, 6.8 (6.4-8) in base length, 12 (11.2-12.8) inner root length, 1 (1) in outer root and 17 (16-17.6) in point recurved length, dorsal bar 3.2 (3.2) in length and 22.8 (20.8-24) in width, marginal hooks 7 pairs - 4th and 5th pair of marginal hooks long, 34 (32-40) x 45 (38-48) in size, 6th, 7th pair of marginal hooks small.

Testis 22 (20-24) x 25 (24-48) in size, copulatory tube 20 (18-26) in length and 3.2 (1.6-4.8) in width, accessory piece chitinized, ovary 74 (64-80) x 31 (28-32) in size.

• **Dogielius catlaius (Jain, 1961) Gussev, 1976**

- Host : *C. catla*
- Site of infection : Gills
- Description : Body 207 (160-400) X 60 (40-100), distance from the anterior end of the body to the eyespots 30 (16-40), pharynx 24 (20-28) X 25 (16-40), opisthaptor large, bilobed, 24 (20-32) X 65 (40-80), anchors 32-38.4 (35.4) in total length, 29 (24-33.6) in shaft length, 12.2 (11.2-14.4) in base length, 8.4 (6.4-9.6) in inner root length, 3.2 (3.2) in outer root length and 26.1 (16-36) in point recurved length, dorsal bar dumb-bell shaped 11 (8-13) in length and 76 (66-96) in width, marginal hooks seven pairs, 3rd, 4th and 5th pair of marginal hooks long, 20.4 (19.6-22.4) in total

length, 6.4 (4.8-8) in handle length and 4.8 (4.8) in blade length, 1st and 7th pair of hooks short.

Testis 21.5 (16-36) X 16 (12-36), copulatory tube bracket like with a slightly curved initial part provided with finger like processes, 27.9 (24-36) in length and 3.1 (1.6-4.8) in width, accessory piece pivot shaped, 20.1 (16-24) in length and 3.3 (1.6-4.8) in width, ovary 50.5 (40-72) X 25 (20-28) in size.

• **D. kalyanensis Musselius and Gussev, 1976**

- Host : *C. catla*
- Site of infection : Gills
- Description : Body large, 424 (336-528) X 138.5 (112-208), distance between two pairs of eyespots 9.5 (8-16) and distance from anterior end of body to eyespots 43 (32-64), pharynx 26.5 (24-32) X 23 (20-28), opisthaptor 98 (90-130) X 145 (130-165), anchor 72-96 (78.6) in total length, 7.9 (6.4-9) in base length, 51.9 (40-76) in shaft length, 31.9 (30.4-36) inner root length, 2.6 (1.6-3.2) outer root length and 26.9 (24-32) in point recurved length, dorsal bar 4.9 (3.2-6.4) in length, 22.2 (14.4-24) in width, marginal hooks seven pairs, 4th & 5th pair long, 16.4 (14.4-22.4) in total length, 5.3 (4.8-6.4) in handle length and 4.2 (3.2-4.8) in blade length and 1st & 7th pair smaller in size.

Testis 26.5 (24-32) X 30 (24-40), copulatory tube long, 140 (132-144) in length, 1.6 (1.6) in width, accessory piece 32 (27-35) in length, 9 (8-12) in width, ovary 78.5 (60-96) X 48.5 (40-52) in size.

• **D. speciosus Gussev, 1976**

- Host : *L. rohita*
- Site of infection : Gills
- Description : Body 156.9 (120-172) X 50.1 (41.6-68), pharynx 12.2 (11.2-16) x 11.2 (9.6-12.8), opisthaptor 44.6 (33.6-59.2) X 75.4 (54.4-105.6), anchor 40.4 (36.8-44.8) in total length, 24.8 (24-27.2) in shaft length, 7.6 (6.4-9.6) in base size, 19.2 (16-22.4) inner root length, 1 (1) outer root length and 15 (14.4-16) in point recurved length, dorsal bar simple, straight, rod like with thick lateral ends, 1.6 (1.6) in length, 25.8 (24-27.2) in width, marginal hooks seven pairs, 4th and 5th pairs large, 16 (11.2-19.2) in total length, 6.2 (4.8-8) in handle length and 3.4 (1.6-4.8) in blade length, 1st & 7th pairs small in size.

Testis 13.6 (12.8-16) X 13.2 (11.2-16), copulatory tube thin, coiled, turned into a spire, 16 (1.4-17.6) in length and 1.6 (1.6) in width, accessory piece 15.4 (12.8-16) in length and 1.6 (1.6) width, ovary 14.2 (11.2-16) X 17 (12.8-19.2) in size.

• **D. mrigali Gussev, 1976**

- Host : *C. mrigala*
- Site of infection : Gills
- Description : Moderate sized flukes, 259 (176-368) X 88.5 (64-128), pharynx 12 (12) X 11 (8-12), distance from the anterior end to pharynx 16 (16), opisthaptor 61 (40-67) X 92 (80-112), anchors varicorhinus type, anchor 33.6-44.8 (40.6) in total length, 33.4 (30.4-38.4) in shaft size, 11.6 (9.6-12.8) in base, 11.3 (9-12.8) in inner root, 3.4 (3.2-4.8) in outer root and 10.12 (9-11.2)

in point recurved, dorsal bar saddle shaped, (8-14.4) X 23.4 (17.6-28.8), ventral bar star shaped with five rays, posterior ray slightly bulged at the tip, 20 (17.6-24) X 35 (32-38.4) in width, marginal hooks 7 pairs - 4th pair of marginal hook longest, 21.2 (19.2-24) in total length, 9.2 (8-11.2) in handle length and 4.2 (3.2-4.8) in blade size, 6th pair of marginal hook relatively short.

Testis 19.9 (14.4-24) X 14 (12-17.6, copulatory tube 27.5 (24-40) in length and 1.6 (1.6) in width, accessory piece 61 (40-67.2) in length and 92 (80-112) in width, ovary elongated, 37.1 (12-59.2) X 31 (12-44.8) in size.

- **D. yogendrai Gussev and Musselius, 1976**

- Host : *C. mrigala*
- Site of infection : Gills
- Description : Body 111 (92-132) X 40 (40-52), pharynx 14 (8-16) X 10 (8-12), opisthaptor 40 (36-48) X 52 (48-56), anchors nanus type, anchor 40-45 (43) in total length, 39 (36-42) in shaft length, 13.4 (12-14.4) inner root length, 6.8 (6.4-8) outer root length, 9 (8-9.6) in base size and 9 (8-10) in point recurved length, dorsal bar 7 (6-8) in length and 27.57 (24-30.4), ventral bar absent, marginal hooks seven pairs, 5th pair of marginal hook longest, 23.2 (22.4-24) in total length, 13.6 (12.8-14.4) in handle length and 4.6 (3.2-4.8) in blade size. 1st & 6th pairs small in size.

Testis 14 (12-16) X 16 (12-20), copulatory tube coiled, spirally curved into 3-5 coils, 92 (80-112) X 1.6 (1.6), accessory piece triangular in shape, situated terminally with an elastic ligament, ovary 24 (20-28) X 16 (12-20) in size.

- **D. chauhanus Gussev and Musselius, 1976**

- Host : *C. mrigala*
- Site of infection : Gills
- Description : Body 111 (92-132) X 47.5 (40-60), pharynx 10 (8-14) x 10 (8-12), opisthaptor 38 (36-40) x 51 (48-56), anchor 48-54 (49.8) in total length, 41.2 (32-44.8) in shaft length, 11.8 (9.6-12.8) in base length, 11.8 (11.2-12.8) inner root length, 6.4 (6.4) outer root length and 1.07 (1-1.6) in recurved point length, dorsal bar 4.8 (4.8) X 27.4 (27.2-28.8), marginal hooks seven pairs, 1st & 2nd pair of marginal hooks long, 22 (19.2-24.2) in total length, 11.8 (9.6-12.8) in handle length and 4.4 (3.2-6.4) in blade length, 5th pair small in size.

Testis 14 (12-20) X 18 (16-20), copulatory tube thin, coiled into 2-3 coils with bubble-like initial part, 18.2 (14-20.8) X 1.6 (1.6), accessory piece claw-like 13.6 (12-16) in length and 6.4 (4.8-8) in width, ovary 31 (24-32) X 18 (16-24) in size.

- **D. lamellatus Akhmerov, 1952**

- Host : *C. idella*
- Site of infection : Gills
- Description : Body 318 (224-384) X 96 (64-128), distance from anterior region of body proper to eye spots 23.5 (20-28), pharynx 27.5 (20-36) X 22 (16-28), opisthaptor 50 (40-55) X 100 (90-130), anchors provided with joint pieces (conic patches of **Gussev, 1976**) at the inner root, 44.8-49.6 (47) in total length, 29

(27.2-30.4) in shaft length, 22.4 (20.8-24) inner root length, 3.8 (3.2-4.8) outer root length, 7.8 (6.4-9.6) in base length and 17.2 (16-20.8) in point recurved length, dorsal bar 4.6 (3.2-6.4) X 31 (28.8-33.6), ventral bar very thin, thread like, bow shaped 1 (1) X 23.6 (20.8-27.2), marginal hooks 7 pairs, 4th, 5th and 6th pairs long 32.6 (27.2-36.8) in total length, 7.2 (6.4-8) in handle length and 12.8 (9.6-16) in blade length, 7th pair short.

Testis 14 (12-20) x 23 (16-28), copulatory tube 28.2 (24-32) in length and 4.5 (4-8) in width, accessory piece 16.6 (12-20) in length and 4.3 (4-4.8) in width, ovary 46.5 (32-56) in length and 42 (24-56) in width.

- **D. minutus Kulwiec, 1927**

- Host : *C. carpio*
- Site of infection : Gills
- Description : Body 272.5 (236-324) X 86 (80-100), distance between two pairs of eyespots 6.4 (4-12), the distance from the anterior end of the body to the eyespots 43 (40-48), pharynx 18.7 (16-28) X 16 (12-28), opisthaptor 68.5 (56-96) X 92 (76-108), anchors wunderoid type anchor 48-68 (52.1) in total length, 39.5 (36-43.2) in shaft length, 16.2 (16-17.6) in inner root length, 4.2 (3.2-4.8) in outer root length, 15.8 (14.4-16) in base width and 14.6 (14.4-16) in point recurved length, dorsal bar dumb-bell shaped, 5.1 (4.6-6.4) X 29.5 (25.6-30.4), ventral bar absent, marginal hooks seven pairs, 2nd and 3rd pairs large, 21.4 (19.2-24) in total length, 7.2 (6.4-8) in handle length and 4 (3.2-4.8) in blade length.

Testis 15.9 (12.8-20) X 15.7 (9.6-20), copulatory tube 37 (28.8-40) in length and 4.4 (4-4.8) in width, accessory piece 9.5 (8-12) x 4.3 (4-4.8), ovary 34.5 (32-40) x 28 (20-48) in size.

- **D. n.sp.III**

- Host : *C. mrigala*
- Site of infection : Fins and scales
- Description : Body 342.5 (280-444) X 128.5 (88-208), the distance from anterior region of body proper to eye spots 35 (24-40), pharynx 24.5 (20-32) X 23 (16-32), opisthaptor 79 (64-96) X 113 (92-148), anchors juvenile type, anchor length 38.4 (32-56) in total length, 9.2 (8-12) in inner root, outer root negligible 1 (1-1.6) in size, 8.9 (8-12) in base width, 30.9 (28-32) in shaft length and point recurved 4.6 (4-6.4) in length, dorsal bar saddle shaped, 7.8 (6.4-8) X 35.2 (32-36), a membranous sheath is attached on the posterior side of dorsal bar, ventral bar thin, '+' (plus) shaped 18.7 (16-25.6) X 16.6 (16-19.2), marginal hooks seven pairs, 2nd and 6th pairs long, 18.2 (14.4-20.8) in total length, 5.8 (4.8-8) in handle length and 5 (4.8-6.4) in blade length, 1st and 7th pairs short.

Testis 22.5 (16-28) X 27.5 (16-32), copulatory tube 49.6 (32-84) in length and 1.6 (1.6) in width, accessory piece spade-like, 14.9 (9.6-20) in length and 4.2 (4-4.8) in width, ovary 30.5 (24-44) X 42.5 (32-48).

- **Gyrodactylus vivekanensis Shukla, 2001**

- Host : *C. carpio*

- Site of infection : Gills
- Description : Body 256 (190-310) 76 (60-90), pharynx 42.6 (36-56) x 40 (32-48), opisthaptor 62 (50-80) X 88 (66-102), anchor 24-48 (32.5) total length, 6.93 (6.4-8) inner root length, 1.6 (1.6) outer root length, 9.3 (8-12) point recurved length, 4.2 (4-4.8) base size, ventral bar 11.2 (9-12.8) X 1.6 (1.6), dorsal bar 20 (16-24) X 14.8 (14-22.8), marginal hooks 16 of same size with long handle and sickle shaped blade, 27.2 (25.6-30.4) in total length.

Ovary club-shaped, vaginal armature pitcher shaped. Testis large, spherical, situated dorsally. Fully mature flukes enclose 2 or 3 generations of different stages of development.

- *G. hyderabadensis* (Venkatanarsaiah, 1979) Singh et al., 1994
- Host : *L. rohita*
- Site of infection : Gills
- Description : Body 336 (288-368) X 92 (80-112), pharynx 13.5 (12-16) X 19 (16-24), opisthaptor discoidal, 88 (80-96) X 108 (96-128), anchors 72 (68-80) total length, 53.3 (52-56) shaft length, 12 (12) base length, 16 (16) inner root length, 1.6 (1.6) outer root length, 29.3 (28-32) recurved point, dorsal bar 28 (24-32) x 9.3 (8-12), ventral bar 20 (20) x 1.6 (1.6), marginal hooks eight pairs, of same size and shape, 28.8 (25.6-30.4) in total length consists of handle, straight loops and sickle shaped tips.

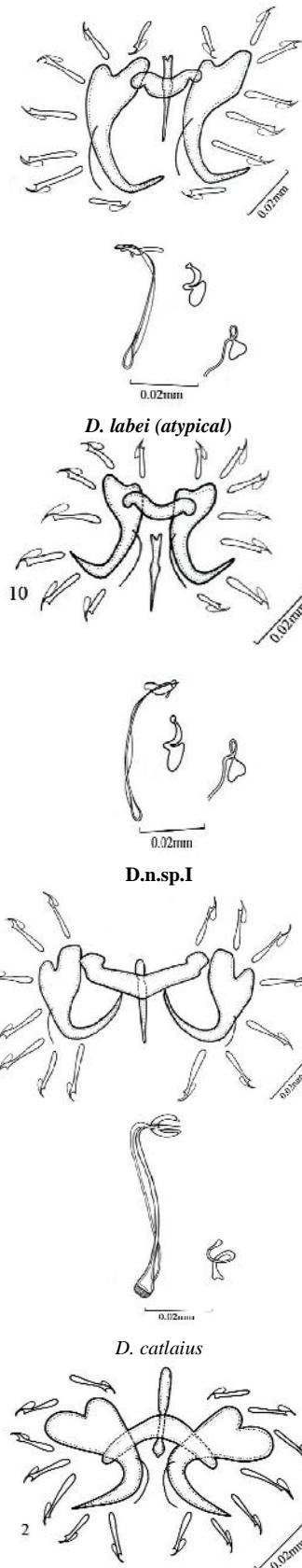
Testis large, spherical, dorsal, situated between posterior part of intestinal caeca. Ovary pre-testicular club-shaped. Copulatory complex rounded, below pharynx, uterus wide. Embryo fully developed, two generations are seen.

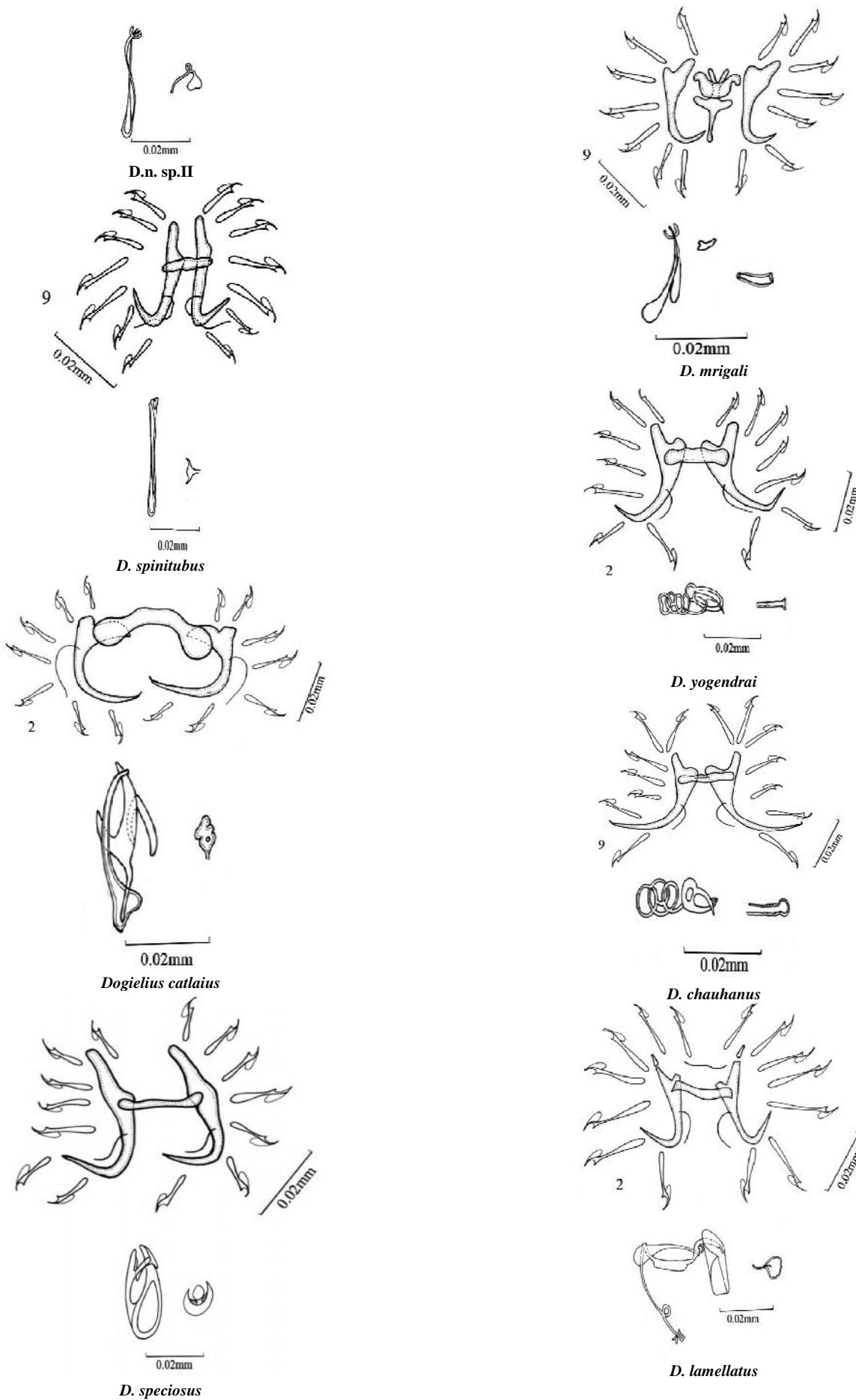
DISCUSSION

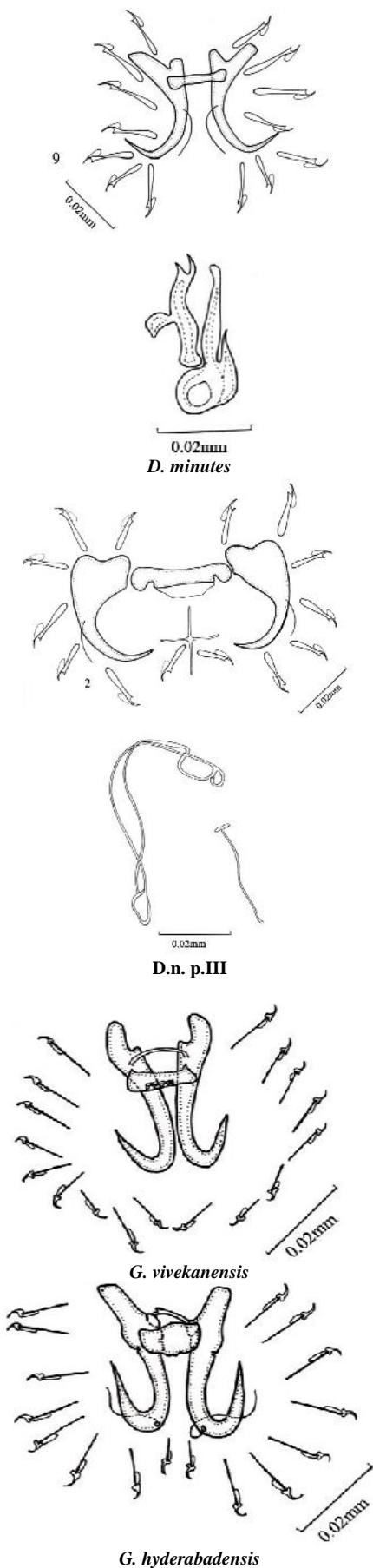
Disease outbreaks in fish farms depends on many factors which are ideal for the propagation and development of parasitic population. Some of these factors include density of fish populations, inhabitancy of fish surrounded by their own metabolic waste and variations in the environmental factors. Host age and sex, though appear minor, also play a part in determining the susceptibility of fishes to various parasitic infections. Moreover, the close habitat of fish in the pond also helps in the transmission of parasites, especially those having a direct life cycle, from one fish to another by contact (Dogiel, 1961). Although vast information is available on the parasite fauna of various groups of freshwater fishes from all over the world, detailed investigations involving specific fish groups are still lacking, particularly from the Indian region.

Keeping these facts in view, the present investigation is undertaken to study thoroughly, the metazoan parasite fauna of different species of carps, collected from culture ponds of Vizianagaram, Visakhapatnam and East Godavari districts of Andhra Pradesh. Altogether six species of carps were examined for parasitological studies viz., *C. catla* (Hamilton, 1822), *L. rohita* (Hamilton, 1822), *C. mrigala* (Hamilton, 1822), *C. carpio* (Linnaeus, 1758), *H. molitrix* (Valenciennes, 1844) and *C. idella* (Valenciennes, 1844).

The Monogeneoidea, an ectoparasitic group with a direct life cycle that predominantly live on the gills and fins of fish and showing high morphological and ecological diversity, fits as an appropriate model for studying the process of parasite diversification (Poulin, 2001b).







Dactylogyrids are a highly diverse group of parasites, with their biogeography and distribution clearly linked to the

evolutionary history of their cyprinid hosts (Simkova *et al.*, 2004). The genus *Dactylogyrus* is a highly diversified group within the group Monogenoidea (Gussev, 1985) with more than 900 nominal species, mainly restricted to freshwater fishes of the Cyprinidae family (Gibson *et al.*, 1996), although occasionally reported on the Percidae (Gussev, 1985; Valtonen *et al.*, 1900; Cone *et al.*, 1994; Hayward, 1997). During the present study sixteen species of Monogenoidea belonging to three genera were identified, thirteen species under the genus *Dactylogyrus*, one species under *Dogielius* and two species under *Gyrodactylus*. Among the thirteen dactylogyrid species, three species were considered as new and are designated as *D. n.sp.I*, *D. n.sp.II* and *D. n.sp.III*. The remaining species were identified as *D. labei* (atypical) *Musselius* and *Gussev*, 1976, *D. catlaius* (Thapar, 1948), *Monaco* and *Mozielle*, 1955, *D. kalyanensis* *Musselius* and *Gussev*, 1976, *D. speciosus* *Gussev*, 1976, *D. spinitus*, *Gussev*, 1976, *D. lamellatus* *Akhmerov*, 1952, *D. chauhanus* *Gussev* and *Musselius*, 1976, *D. yogendrai* *Gussev* and *Musselius*, 1976, *D. minutus* *Kulwiec*, 1927, *D. mrigali* *Gussev*, 1976, *D.n.sp. I*, *D.n.sp. II* & *D.n.sp. III* (present study). The other species identified were *Dogielius catlaius* *Gussev*, 1976, *Gyrodactylus vivekanensis* *Shukla*, 2001 and *G. hyderabadensis* (Venkatanarasaiah, 1979) Singh *et al.*, 1994.

D. catlaius (syn. *P. catlaius* Thapar, 1948, *Monaco* and *Mozielle*, 1955) was originally reported under the genus *Paradactylogyrus* by Thapar (1948) as *P. catlaius* based on the presence of onchium (ventral bar) in the opisthaptoral armature. But later *Monaco* and *Mozielle*, 1955 and *Gussev*, 1976 synonymized the genus *Pseudodactylogyrus* with *Dactylogyrus* and transferred the species to the genus *Dactylogyrus*. But, Yamaguti (1961), Agrawal (1980), Agrawal *et al.*, (2001) retained separate generic status for *Paradactylogyrus*. However, during the present study after a careful analysis, it was felt that it would be prudent to synonymize the genus *Paradactylogyrus* with *Dactylogyrus* and thus we agree with *Gussev* (1976) and *Monaco* and *Mozielle* (1955).

In the present study *D. catlaius* was found to be infecting both *C. catla* and *L. rohita*, but heavy infections were noticed on *C. catla*, whereas infections on *L. rohita* were comparatively less. However, since infections with *D. catlaius* was noticed quite frequently on *L. rohita*, it cannot be treated as an accidental host. Moreover, *D. catlaius* was not reported from other species of carps inhabiting the same ponds.

The other dactylogyrid species recorded during the present study were *D. kalyanensis* *Musselius* & *Gussev*, 1976 from *C. catla*; *D. speciosus* *Gussev*, 1976 from *L. rohita*; *D. spinitus* *Gussev*, 1976 from *C. catla*; *D. chauhanus* *Gussev* and *Musselius*, 1976 from *C. mrigala*, *D. mrigali* *Gussev*, 1976 from *C. mrigala* and *D. yogendrai* *Gussev* and *Musselius*, 1976 from *C. mrigala*.

In the present investigation, three species of monogenoidean parasites were reported as new to science and are designated as *D. n.sp.I*, *D. n.sp. II* and *D. n.sp. III*. The species *D. n.sp.I* is found to be occurring on the gills of *L. rohita* and *C. catla*. It is characterized by the presence of a longitudinally placed onchium (ventral bar), small, juvenile type opisthaptor with anchors showing poorly developed inner and outer roots. It

resembles *D. labei* (atypical) reported by *Musselius* and *Gussev* (1976) in possessing an onchium without lateral processes and a copulatory tube with free lying chitinoid piece. However, distinct differences were noticed between the two in the highly muscular nature of the body, size of the body, rudimentary nature of opisthaptor with small anchors and larval marginal hooks and also in the vaginal armature. It also shows significant differences with other dactylogyrid species like *D. labei* (typical) *Musselius* and *Gussev*, 1976; *D. mrigali* *Gussev*, 1976; *D. crucitrabus* *Gussev*, 1976; *D. lohani* *Gussev*, 1976; *D. chiravanshii* *Gussev*, 1976; *D. vicinus* *Gussev*, 1976; *D. calbasu* *Jain*, 1957; *D. indicus* *Jain*, 1957 and *D. sarani* *Tripathi*, 1959 in possesing a simple transversely placed ventral bar, in the structure of copulatory organ with a free lying chitinoid piece and in the structure and shape of vaginal armature. Contrary to these forms, *D. n.sp I* is characterized by having a five rayed ventral bar with prominent lateral extensions.

Dactylogyrus new species II (*D. n.sp. II*) is characterized by the presence of an onchium (ventral bar), broad based anchors, bow shaped ventral bar, larval marginal hooks and small sized body. It closely resembles *D. catlaius* (syn. *P. catlaius* *Thapar*, 1948) in possesing an onchium along the longitudinal axis of the body. Similar structure is also present in *D. labei* (atypical) and *D. n.sp. I* (present study). However, the present form vary distinctly from all these species in the small size of the body, large anchors with a broad base, presence of two pairs of eye spots, in the structure of copulatory complex and vaginal armature. Whereas in other dactylogyrid species the ventral bar is either 5-rayed or a thin thread like structure. Thus, it was felt that the differences are significant enough to raise it to a new species status.

The third new species of *Dactylogyrus* *D. n.sp. III* is characterized by having a plus (+) shaped ventral bar, juvenile anchors, well developed inner root, negligible outer root and a copulatory tube with a broad spade like accessory piece. A similar “+” shaped ventral bar was also noticed in the case of *D. magnicordes* (*Gussev*, 1976), *D. brevicardus* (*Gussev*, 1976) and *D. tetraradiatus* (*Kulkarni*, 1969). Even though *D. n.sp. III* resembles these species in possessing a ‘+’ shaped ventral bar, it shows marked differences in the presence of broad based anchors with a knob, two pairs of eye-spots and a thread like copulatory tube. Hence, the present species is considered as new and designated as *D. n.sp. III*.

Two species of monogenoidean parasites were recorded under the genus *Gyrodactylus*, viz., *G. hyderabadensis* *Venkatanarasaiah*, 1979 and *G.vivekanensis*, *Shukla*, 2001. *G. hyderabadensis* and *G.vivekanensis* were originally reported from *Channa* species and *Puntius sophera* respectively. But during the present study *G. hyderabadensis* is reported from *L. rohita* and *H.molitrix*, whereas *G. vivekanensis* is reported from *C. carpio*. The occurrence of these two species on exotic carps is an indication of the migration and establishment of parasites to new localities along with their hosts.

A review of the available Indian literature reveals that, there is a dearth of information on studies dealing with monogenoidean

parasites infecting specific group of fishes. Moreover, such studies would help in better understanding the co-evolutionary patterns and processes between the host and the parasite. Hence, the present study is an initiation towards this direction and will certainly be countable in enhancing the knowledge not only on the taxonomic details of these parasites, but also in understanding the intricacies of host parasite relationships more precisely.

The three new species of dactylogyrids reported during the present study are an addition to the list of dactylogyrids reported so far from the Indian region.

References

1. Agrawal, N. and Sharma, R., 1989: Two new species of the genus *Mazocraes* Hermann, 1782 (Monogenea) from *Hilsa illisha* (Ham.) from India. *Helminthologia*, 26 (3): 187-194 pp.
2. Agrawal, N.; Amit Tripathi and Richa Shukla, 2005: *Spicocleidus namae* n.g., n.sp. (Monogenea: Dactylogyridae) on *Chanda nana* (Hamilton) from Lucknow, India. *Systematic Parasitology*, 61 (3): 185-189 pp.
3. Agrawal, N.; Pandey, K.C. and Amit Tripathi, 2004: Studies on two new species of genus *Gyrodactylus* Nordmann, 1832 from *Puntius* (Ham.). *Journal of Parasitology and Applied Animal Biology*, 13 (1&2): 25-31 pp.
4. Agrawal, N.; Yadav, V.S. and Kritsky, D.C., 2001: On *Ancyrocephalus etropi gussev*, 1963 from *Etroplus suratensis* (Perciformes: Cichlidae) in India. *Comparative Parasitology*, 68 (1): 87-90 pp.
5. Agrawal, N., 1980: On two dactylogyrid worms from major carps of district Lucknow. *Proceedings of the Indian Academy of Parasitology*, 1 (2): 87-92 pp.
6. Akhmerov, A.K., 1952: New species of monogenetic trematodes of fish from the river Amur. *Parazitologicheski sbornik*, 14: 181-212 pp.
7. Ayyappan, S., 2004: Enhancing global competition. The Hindu Survey of Indian Aquaculture, 97-99 pp.
8. Cone, D.; Euzet, T. and Beasley, V., 1994: A report of *Dactylogyrus amphibothrium* (Monogenea) on the gills of European ruffe in Western lake Superior. *Journal of Parasitology*, 80 (3): 476-478 pp. Dogiel, V.A., 1961: Ecology of the parasites of freshwater fishes. In: Dogiel, V.A.; Petrushevski, G.K. & Polyanski, Yu, I. (Eds.). *Parasitology of Fishes* (Engl. Transl.). Oliver and Boyd Ltd., Edinburgh and London: 1-47 pp.
9. Dubey, A.; Gupta, A.K. and Agrawal, S.M., 1997: Studies on monogenean parasites in freshwater fishes at Raipur. V. Redescriptions of *Dactylogyroides tripathii* (Tripathi, 1959) *Gussev*, 1976 and *Dactylogyroides longicirrus* (Tripathi, 1959) *Gussev*, 1976 and a note on taxonomy of species of the genus. *Journal of Parasitology and Applied Animal Biology*, 6 (1): 31-38 pp.
10. Dutta, M. and Tandon, V., 1994: The nervous system of *Polystoma indicum* (Monogenea: Polystomatidae) as revealed by non-specific esterase localization. *Folia Parasitologica*, 41 (3): 177-182 pp.

11. Fotedar, D.N. and Parveen, Q.N., 1987: On two species of trematode genus *Diplozoon* Nordmann, 1832 from fishes of Kashmir and notes on some species of the genus. *Indian Journal of Helminthology*, 39 (1): 66-76 pp.
12. Gibson, D.I.; Timofeeva, T.A. and Gerasev, P.I., 1996: A catalogue of the nominal species of the nominal species of the monogenean genus *Dactylogyridae* Diesing, 1850 and their host genera. *Systematic Parasitology*, 35 (1): 3-48 pp.
13. Gupta, P.C., 1983: *Bifurcohaptor hemlatae* n.sp. (Monogenea: Dactylogyridae)
14. Gupta, R.K.; Yadava, N.K.; Gahlawat, S.K.; Jain, K.L. and Burman, A.S, 2007: Ectoparasitic diseases in fresh water fishes and their control. In Perspectives in animal ecology and reproduction, 4: 180-191 pp.
15. Gupta, V. and Krishna, 1988: On four new species of monogenetic trematodes of the family Mazocraeidae Price, 1936 from fishes of India. *Indian Journal of Helminthology*, 40 (1): 32-43 pp.
16. Gussev, A.V., 1976: The origin of freshwater fish monogeneans. Izvestiya Gosudarstvennogo Nauchno-Issledovatel'skogo Instituta Ozernogo I Rechnogo Rybnogo Khozyaistva (1976) 105, 69-75 [Ru, en].
17. Gussev, A.V., 1985: In: BAUER, O.N. (ed.) Identification key to parasites of freshwater fishes. Part 2, Nauka, Leningrad (in Russian). 424 pp.
18. Hayward, C.J., 1997: Revision of Diplectanid monogeneans (Monopisthocotylea, Diplectanidae) in sillaginid fishes with a description of new species of *Monoplectanum*. *Zoological Scripta*, 25 (3): 203-213 pp.
19. Jain, S.L., 1957: Monogenea of Indian fresh water fishes. VI. Three new trematodes belonging to the genus *Neodactylogyridae* Price, 1938 (Family: Dactylogyridae) from some freshwater fishes of Lucknow, India. Proceedings of the National academy of Sciences, India. Section B. 27 (1): 53-63 pp.
20. Jain, S.L., 1961: Monogenea of Indian freshwater fishes. XI. Three new trematodes belonging to the genus *Dactylogyridae* Diesing, 1850. *Journal of the Zoological society of India*, 13: 99-107 pp.
21. Miltermeier, R.A.; Robles – Gil, P. and Miltermeier, C.G., 1997: Megadiversidad los países biológicamente más ricos del mundo. CEMEX, Mexico.
22. Monaco, L.H.M. and Mizelle, J.D., 1955: studies on monogenetic trematodes XVII. The genus *Dactylogyridae*. Amer. Midl. Nat., 53 (2): 455-477 pp.
23. Ozturk, T. and Ozer, T, 2014: Monogenean fish parasites, their host preferences and seasonal distribution in the lower kizilirmak Delta (Turkey). *Turkish Journal of Fisheries and Aquatic Sciences*, 14: 367-378 pp.
24. Pandey, K.C. and Agrawal, N., 2008: An encyclopaedia of Indian Monogenoidea. Lucknow, India. 1-522 pp.
25. Poulin, R., 2001b: Interactions between species and the structure of helminth communities. *Parasitology*, 122: S3-S11.
26. Sarkar, U.K.; Pathak, A.K. and Lakra, W.S., 2008: Conservation of freshwater fish resources of India: New approaches, assessment and challenges. *Biodiversity and Conservation*, 17: 2495-2511 pp.
27. Shukla, S.K., 2001: A new species of the genus *Gyrodactylus* Nordmann, 1832: from *Puntius sophore* (Ham.) from Sultanpur, U.P. *Indian Journal of Helminthology*, (New series) 19: 67-71 pp.
28. Simkova, A.; Morand, S.; Jobet, E.; Gelnar, M. and Verneau, O., 2004: Molecular phylogeny of congeneric monogenean parasites (*Dactylogyridae*). A case of interhost speciation. *Evolution*, 58 (5): 1001-1018 pp.
29. Singh, H.S.; Vibha; Agrawal, A. and Kumar, A.: 1994: A redescription of *Gyrodactylus hyderabadensis* Venkatanarasaiah, 1979. *Rivista di Parassitologia*, XVI (LX), 273-281 pp.
30. Sproston, N.G., 1946: A synopsis of the monogenetic trematodes. *Transactions of the Zoological Society of London*, 25: 185-600 pp.
31. Thapar, G.S., 1927: On *Acanthogyrus* n.g. from the intestine of the Indian fish, *Labeo rohita*, with a note on the classification of the Acanthocephala. *Journal of Helminthology*, 5 (2): 109-120 pp.
32. Tripathi, Y.R., 1959: Monogenetic trematodes from freshwater fishes of India. *Indian Journal of Helminthology*, 9:1-149 pp.
33. Valtonen, E.T.; Prost, M. and Rakhonen, R., 1990: Seasonality of gill monogeneans from two freshwater fish from an oligotrophic lake in northeast Finland. *International Journal for Parasitology*, 20 (1): 101-107 pp.
34. Venkatanarasaiah, J., 1979: *Gyrodactylus hyderabadensis* n.sp. from *Channa* sp. from Hyderabad. *Indian Journal of Parasitology*, 3 (1): 41-42 pp.
35. Yamaguti, S., 1961: *Systema helminthum*. Interscience Publisher: New York.

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