On two new species of the genus *Cornudescoides* Kulkarni, 1969 (Monogenea: Ancyrocephalinae) from a freshwater fish *Mystus vittatus* from Meerut (U.P.), India

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Received: 23 January 2011 / Accepted: 15 August 2011 / Published online: 3 September 2011
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Abstract During study of freshwater monogeneans of Meerut region, we came across five infected specimen of fish *Mystus vittatus*, infected with monogeneans belonging to the genus *Cornudescoides* Kulkarni 1969. On subsequent study, the worms appear new to us and are described here in as such. *C. kulkarnii* n. sp. is characterized by four pairs of head organs, nut cracker shaped accessory piece of cirrus, capitulum or patches with proximal conical protruberance, longer inner root of dorsal anchor and difference in shape and extension of dorsal bars. While *C. susanii* n. sp. is characterized by presence of seven pairs of head organs, caliper like accessory piece of cirrus, longer and inwardly curved lateral hooks, prominently protruded outer roots and larger inner roots of dorsal anchor.

Keywords Monogenea · *C. kulkarnii* · *C. susani* · *Mystus vittatus* (Bloch 1794)

Introduction

Class Monogenea is one of largest classes of Phylum Platyhelminthes. Fishes are major host of monogeneans. Monogeneans, in most of the cases, cause dual type of injury to their hosts. Through their hooks and other organs of attachment monogeneans injure host tissue at

the site of attachment, break its continuity and cause localized hemorrhages. At the same time, they feed on the cells of ruptured tissues (Bychowsky 1957; Uspenskaya 1962; Bauer 1977). During the study of parasitic fauna of freshwater fishes of Meerut region, the gill arches and gill filaments of cat fish, *Mystus vittatus* were found infected with two new species belonging to the genus *Cornudescoides* (Ancyrocephalinae). During examination of 5 specimens of *Mystus vittatus*, a large number of specimens belonging to same genus *Cornudescoides*, but of different species, were collected from Indian rivers. All these parasites belong to two new species viz., *C. kulkarnii*, and *C. susani*. On further study these parasite appeared new to us and have been described here in as such.

Materials and methods

Fishes, for present investigation, were collected from the freshwater bodies of Meerut. Worms were removed in live condition, as suggested by Mizelle (1936, 1938), washed thoroughly with cold distilled water and fixed in cold 10% neutral formalin. Study of hard parts was made in glycerin mounts. Permanent mounts were made after staining with Aceto alum carmine, dehydrating through ascending grades of alcohol, clearing in Xylene and mounting in Canada balsam. Camera Lucida sketches were made both from temporary and permanent preparations. All measurements were taken with the help of stage micrometer and oculo-meter, as suggested by Mizelle (1936, 1938). Haptor hard parts were measured as suggested by Gussev (1973). All measurements are in mm (values given in parenthesis show the range observed).

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Observation

Dactylogyridae Bychowsky 1933; Ancyrocephalinae Bychowsky 1937 *Cornudescoides kulkarnii* n. sp. (Figs. 1–11)

Description (based on 30 specimens)

Small to moderate sized, elliptical worms (Fig. 1). 0.297 (0.170–0.424) long. Maximum width 0.060 (0.035–0.085),

at the level of testis. Prohaptor and haptor fairly set off from body proper. Body length to haptor length ratio is approximately 1:5. Prohaptor bilobed and possesses four pairs of head organs. Two pairs of eyespots present anterior to the pharynx. Posterior pair of eye-spots is larger. Pharynx well developed circular muscular organ 0.180 (0.009–0.350) in diameter. Three pairs of unicellular pharyngeal glands present on either posterior-lateral sides of pharynx. A group of cephalic glands is present on either antero-lateral sides of the pharynx. Intestine is

Figs. 1–11 *Cornudescoides kulkarnii* n. sp. 1. Whole mount, 2. Egg, bearing a small polar filament at its broad end, 3. Funnel shaped vaginal opening and receptaculum seminis, 4. Male copulatory complex, with trumpet shaped cirrus tube and nut cracker like accessory piece, 5. Haptor showing disposition of various parts, 6. ‘Robustus’ type dorsal anchors showing long inner root and short and stumpy outer root, 7. Conical beak shaped capitulum, 8. ‘Anchoroid Wegeneri’ type dorsal transverse bar, 9. Paired ventral transverse bar, both halves connected by a long thin filament (ligament), 10. Pine-needle like lateral hooks, 11. ‘Merus’ type Ventral anchors with strongly curved inner root and straight outer root

simple, and bifurcates soon after its origin behind the pharynx. Intestinal caecae unite posteriorly slightly anterior to haptor.

Male reproductive organ (Fig. 1) consists of testis, vas deferens, seminal vesicle, vasa efferentia and copulatory complex. Testis single, post-equatorial, post-ovarian, intercaecal, elongate and oval, $0.052 (0.036–0.068) \times 0.0245 (0.001–0.048)$. Anterior border of testis narrows into a fine vas deferens that runs forwards and loops around left intestinal caeca. Vas deferens dilates into an elongated fusiform seminal vesicle, $0.027 (0.011–0.042)$ long and $0.016 (0.003–0.029)$ wide, in post-bifurcal, extra-caecal, pre-gonadal region, at the level of male copulatory complex (Fig. 4). At its anterior end, seminal vesicle narrows into a fine vasa efferentia or ejaculatory duct, $0.043 (0.017–0.069)$ long, that opens at the base of cirrus. Male copulatory complex is post-bifurcal, intercaecal, pre-gonadal and comprises of cirrus proper and accessory piece. Cirrus is double walled, trumpet shaped tube slightly broad at end more or less straight, $0.037 (0.034–0.039)$ long. Accessory piece is nut cracker shaped. One part has an adjustable groove into which cirrus tube glides. It is fusiform in shape $0.030 (0.027–0.033)$ long, with one arm extending over the other arm to form the gliding groove for cirrus. Second accessory piece is claw shaped $0.029 (0.027–0.031)$ long, with three digitizing processes.

Female reproductive organ (Fig. 1) consists of ovary, ootype complex, receptaculum seminis and vagina. Ovary single, intercaecal, post-bifurcal, pre-equatorial, pre-testicular and fusiform $0.033 (0.016–0.049) \times 0.015 (0.009–0.021)$. Receptaculum seminis (Fig. 3) is intercaecal, pre-ovarian and oval, $0.015 (0.008–0.022) \times 0.013 (0.007–0.019)$. Receptaculum seminis gives a fine vaginal duct $0.027 (0.040–0.013)$ long, from its posterior side that runs towards the right intestinal caeca. Vaginal opening funnel shaped (Fig. 3), $0.012 (0.004–0.020)$ in diameter. Egg oval (Fig. 2), $0.062 (0.036–0.088) \times 0.040 (0.022–0.058)$, bearing a polar filament at its broad end. Vitellaria extend from post-bifurcal region, at the level of copulatory complex in the intercaecal region up to the union of intestinal caecae.

Haptor bilobed (Fig. 5), $0.055 (0.024–0.085) \times 0.056 (0.035–0.077)$, fairly set-off from body proper. Armature of haptor consists of two unequal pairs of anchors (dorsal and ventral), strengthened by sleeve sclerite, a dorsal connective bar, a paired ventral bar, and a pair of lateral hooks; seven pairs of marginal hooklets are seen in live worms, but they might have been shed during processing in fixed specimens. Dorsal anchors (Fig. 6) are 'Robustus' type, with powerful and smooth transition of shaft into long recurved points. Its total length is $0.031 (0.021–0.041)$ mm. Base is divided into long inner root and

short and stumpy outer root. Dorso-apical length is $0.027 (0.020–0.034)$ mm while ventro-apical length is $0.019 (0.014–0.024)$. Shaft is $0.017 (0.016–0.017)$ long, more or less cylindrical and narrows into a strongly recurved and fairly long point $0.011 (0.005–0.016)$. Dorsal anchor also possesses a small conical beak shaped capitulum, with a broad base, bearing small conical protuberance. The base tapers gradually into a blunt point, near its inner root. A narrow ridge bisects the capitulum from conical projection to its recurved tip, giving it a beak-like appearance. Capitulum (Fig. 7) is $0.0010 (0.006–0.013)$ long and $0.004 (0.003–0.005)$ mm in proximal width. Dorsal transverse bar (Fig. 8) is 'Anchoroid Wegeneri' type, with forwardly projecting ends. It is a curved cylindrical bar with widened ends. Dorsal transverse bar is $0.025 (0.018–0.032)$ long and $0.003 (0.002–0.003)$ in median width. Length of process is $0.0040 (0.003–0.005)$ and the distance between two processes is $0.018 (0.014–0.021)$. Ventral anchors (Fig. 11) are 'Merus' type with a broad base which is divisible into strongly curved inner root and straight outer root. It is $0.028 (0.016–0.040)$ long. Dorso-apical length of ventral anchor is $0.026 (0.012–0.039)$ while ventro-apical length is $0.021 (0.012–0.030)$. Shaft is more or less cylindrical $0.015 (0.012–0.017)$ long and narrows into a long straightened point $0.012 (0.008–0.015)$ long which is recurved rectangularly to axis of the rest part of anchor. Ventral connective transverse bar (Fig. 9) is paired, each half is shaped like a walking stick widened in the middle. Both halves are connected by a long thin filament (ligament). First bar is $0.030 (0.011–0.048)$ long and $0.003 (0.002–0.003)$ wide while second bar is $0.026 (0.014–0.043)$ long and $0.003 (0.002–0.004)$ wide. In addition to this, a pair of slightly curved, pine-needle like lateral hooks (Fig. 10), $0.057 (0.013–0.043)$ long, are also present on either side, disposed in such a way, that they seem to be connecting the dorsal and ventral anchors. Marginal hooklets (Fig. 7) are 'Larval' type with a thin protruding heel of the sickle, a long handle and sickle filament loop or vesicle. It is $0.011 (0.007–0.014)$ long, sickle is $0.009 (0.006–0.012)$ long, handle is $0.005 (0.002–0.007)$ long and sickle filament loop is $0.010 (0.005–0.014)$ long.

Taxonomic summary

- a. Type specimen: Syntypes. No. Z/Par/C/131/10; deposited in the Parasitology laboratory, Department of Zoology, Meerut College, Meerut, (UP) India
- b. Type host: *Mystus vittatus* (Bloch 1794)
- c. Type locality: Meerut
- d. Collection time: December 2008, January 2009
- e. Site of infection: Gills

Remarks

Key generic characters of genus *Cornudescoides* Kulkarni 1969 are: Fusiform body, bilobed haptor, intestinal caecae confluent posteriorly, Dorsal anchors large, with patches, curved dorsal bar, ventral anchors small, ventral transverse bar “V” shaped, presence of needle-like lateral hooks, Copulatory complex with accessory piece.

Present form differs from all the Malaysian species reported by Lim (1987) in having significant difference in shape of copulatory complex.

Present form differs from *C. heterotylus* Kulkarnii, 1969 in having four pairs of head organs, patches having a conical protuberance proximally; well defined inner and outer roots of dorsal anchor and differences in shape of male copulatory complex. The authors agree with Gussev (1973) that specimens of *C. heterotylus* warrant re-examination. In our opinion, Kulkarni (1969) might have overlooked these structures. However, the authors also agree with Gussev (1973) that vas deferens in this genus loops around left intestinal crura, but, at sometimes it also loops around right intestinal crura.

Present form differs from *C. microtylus* Kulkarni 1969 in having different shape of male copulatory complex; and presence of four pairs of head organs.

It differs from *C. jaini* (Gussev 1963, 1973) in having difference in shape and nature of accessory pieces of male copulatory complex and shape and expansions of lateral hooks.

Present form also differs from *C. proximus* Gussev 1973, *C. raipurensis* and *C. vittati* Dubey et al. 1992 in shape of accessory piece of male copulatory complex; shape and expansion of lateral hooks, shape and degree of development of inner root of dorsal anchor (more developed and rounded in present form); patches with conical protruberance in the proximal part; shape of ventral anchors (in present form, the inner root is curved like a crochet hook, and the outer root possesses a small semi-circular cap like patch). Besides this, the filament of ventral transverse bar is much longer in *C. proximus* while, it is very short in present form.

Moreover, it differs from *C. geminus* Gussev 1973 in having difference in the shape of accessory piece of cirrus, in having difference in the shape of patches (in present form, the patches are provided with a conical protruberance proximally); the inner roots of dorsal anchors are developed better in the present form; in having difference in shape and degree of development of roots of ventral anchors and in having difference in shape and expansion of lateral bars.

Present form is therefore described as a new species viz., *C. Kulkarnii* n. sp.

Etymology: Named in honour of Prof. T. Kulkarni, Osmania University, Hyderabad for his valuable contributions in this field

C. susani n. sp. (Figs. 12–16)

Description (based on 15 specimens)

Small to moderate sized elliptical worms (Fig. 12). 0.290 (0.270–0.311) long. Width at the level of testis is 0.065 (0.055–0.075). Prohaptor and opisthaptor are fairly set off from body proper. Ratio of body length to haptor is 7.2 : 1. Prohaptor bilobed and possesses seven pairs of head organs. Two pairs of eye spots are also present anterior to the pharynx. Pharynx well developed circular and muscular organ, 0.016 (0.014–0.017) in diameter. Three pairs of unicellular pharyngeal glands are present on either postero-lateral side of pharynx. A group of cephalic glands is present on either antero-lateral side of the pharynx. Intestine is simple and bifurcates soon after its origin behind the pharynx. Intestinal caecae unite posteriorly slightly anterior to haptor. At the point of union, intestinal caecae are tilted towards right side.

Male reproductive organ (Fig. 12) consists of testis, vas deferens, seminal vesicle and copulatory complex. Testis single, inter-caecal, post-ovarian, post equatorial and elongate-oval, 0.054 (0.049–0.059) × 0.012 (0.0090–0.014). Anterior border of testis narrows into a fine vas deferens (Fig. 15) 0.0173 (0.064–0.082) long. Vas deferens loops around the right intestinal caeca and dilates into an elongated fusiform seminal vesicle, 0.016 (0.010–0.021) × 0.006 (0.005–0.006), in post bifurcal, pre-ovarian, intercaecal region posterior to copulatory complex. Male copulatory complex (Fig. 14) is post bifurcal and extends backwards from extra-caecal to inter-caecal region. It comprises of cirrus proper and an accessory piece. Cirrus proper is slightly curved, double walled, trumpet shaped chitinous tube, 0.035–0.039 long. Accessory piece of cirrus is made of three parts. Two fusiform parts are attached with each other giving the appearance of a caliper. However, third part is filamentous, spring like and crescent, as if it acts like a spring to open the clasping blades of caliper. Part of accessory piece attached to the cirrus proper has a groove that provides space for gliding the cirrus proper. It is 0.026 (0.024–0.028). Other arm of caliper is 0.027 (0.025–0.029) long. Crescent shaped piece is 0.028 (0.027–0.029) long.

Female reproductive organ (Fig. 12) consists of ovary and vagina. Ovary (Fig. 15) intercaecal, pre-equatorial, post-bifurcal, pre-testicular in position, fusiform, 0.018 (0.017–0.019) × 0.009 (0.007–0.011). Vaginal opening (Fig. 13) bilobed pre-ovarian, extra-caecal and sinistral, 0.008 (0.007–0.009) in diameter. A sclerotized vaginal duct 0.027 (0.025–0.029) long and 0.0020 (0.0015–0.0025) in diameter opens into a chitinous ring like median chamber 0.007 (0.006–0.008) in diameter. Vitellaria extend from pharynx up to the haptor in the extra-caecal region. While in intercaecal region vitellaria are present only up to the copulatory complex.

Figs. 12–16 *Cornudescoides susani* n. sp. 12. Whole mount, 13. Bilobed vaginal opening leading to ring like median chamber, 14. Male copulatory complex showing caliper like accessory piece with crescent shaped third piece, 15. Reproductive system, 16. Haptor showing disposition of various parts

Haptor bilobed (Fig. 16), 0.036 (0.031–0.050) long and 0.094 (0.082–0.105) wide and fairly set-off from body proper. Armature of haptor consists of two unequal pairs of anchors (dorsal and ventral) provided with sleeve sclerite, a dorsal connective, a paired transverse bar and a pair of lateral hooks. Seven pairs of marginal hooklets were seen in live worms and temporary mounts, but in permanent mounts, they might have been shed during processing. Dorsal anchors ‘Robustus’ type, 0.035 (0.032–0.037) long, with a broad base, which is divisible into a long inner root and straight stub-like outer root. Dorso-apical length of dorsal anchor is 0.032 (0.028–0.036) while ventro-apical length is 0.025 (0.023–0.026). Shaft is more or less cylindrical 0.021 (0.016–0.026) long and narrows into a strongly recurved and fairly long point 0.012 (0.008–0.016) long. Dorsal anchors also possess a small conical, beak

shaped capitulum 0.009 (0.008–0.011) long and 0.006 (0.005–0.007) wide, with a broad base, that tapers gradually into a blunt point, near its inner root. Base of capitulum is protruded into a small conical projection in its middle; a narrow ridge bisects the patch from conical projection to its recurved tip, giving it a beak-like appearance. Dorsal transverse connective bar is ‘Anchoroid Wegeneri’ type, 0.024 (0.022–0.025) long and 0.0035 (0.003–0.004) in median width. It is a wide ‘V’ shaped bar, weakly bent backwards with widened ends. Maximum distance between two process of bar is 0.019 (0.016–0.021) while process is 0.004 (0.003–0.005) long. Ventral anchors are ‘Varicorhinus’ type 0.0275 (0.027–0.028) long, with a broad base which is divisible into curved inner root and straight outer root. Dorso-apical length is 0.024 (0.022–0.025) and ventro-apical length is 0.020

(0.018–0.022). Shaft is more or less cylindrical 0.020 (0.018–0.022) long and narrows into a long straightened point 0.012 (0.010–0.014) long which is curved rectangularly to the axis of rest part of anchor. Ventral anchors are further strengthened by the presence of sleeve sclerite in the region of shaft. Ventral connective transverse bar is paired, each half is shaped like a walking stick (¶), widened in the middle. Both halves are connected by a long thin filament (ligament). First bar is 0.031 (0.028–0.034) long and 0.0002 (0.0002–0.0003) wide, while second bar is 0.033 (0.029–0.036) long and 0.003 (0.002–0.003) wide. In addition to this, a pair of thin needle like, strongly curved lateral hooks 0.033 (0.031–0.036) long and 0.001 wide are also present on either side, disposed in such a way that they seem to be connecting the dorsal and ventral anchors. Marginal hooklets are ‘Definite’ type 0.010 (0.007–0.013) long, with a thin protruding heel of the sickle, a long handle, and sickle filament loop or vesicle. Sickle is 0.008 (0.004–0.010) long, handle is 0.003 (0.002–0.004) long and sickle filament loop is 0.006 (0.004–0.007) long.

Taxonomic summary

- a. Type specimen: Syntypes. No. Z/Par/C/132/10; deposited in the Parasitology laboratory, Department of Zoology, Meerut College, Meerut, (UP) India
- b. Type host: *Mystus vittatus* (Bloch 1794)
- c. Type locality: Meerut
- d. Collection time: December 2008, January 2009
- e. Site of infection: Gills

Remarks

Present form differs from all the known species of the genus in having greater number (seven pairs) of head organs; differences in shape and arrangement of accessory piece of cirrus (it is caliper shaped with three pieces); lateral hooks are larger and inwardly curved; the outer roots of dorsal anchors are prominently protruded and inner roots are comparatively larger.

However, it differs from *C. kulkarnii* n.sp. in having seven pairs of head organs (four in *C. kulkarnii*) and difference in shape of male copulatory complex and extension of vaginal tube. Above mentioned differences are sufficient enough to diagnose the present form as new species viz., *C. susani* n. sp.

Etymology: Named in honour of Prof. L.H.S. Lim, Department of Zoology, University of Malaya, Malaysia for her valuable contribution in this field.

Discussion

Genus *Cornudiscoides* was established by Kulkarni (1969) for the worms collected from *Mystus tengara* at Hyderabad. Kulkarni (1969), with *Conudiscoides heterotylus* as type species. He forwarded following generic diagnosis for the new genus *Cornudiscoides*.

Flukes with somewhat fusiform body, three pairs of isolated head organs, two pairs of eye spots. Haptor slightly expanded, haptor armature consisting of two pairs of unequal anchors, a pair of large and horn like anchors, a pair of acute and winged ventral anchors, a short dorsal transverse bar, a pair of lateral bars, hooklets comprising six pairs, caeca confluent, testis elongated and club shaped; ovary small and pyriform or rounded; vas deferens sinuous and over lapping the caecum; vagina sinistral and vaginal tube simple. Cirrus coiled with a complicated accessory piece.

Generic diagnosis of *Cornudiscoides* Kulkarni 1969 has been amended by Agarwal and Vishwakarma (1996) as follows:

Body fusiform with bilobed haptor. Caeca unite posterior to testis. Dorsal anchor usually very large, outer root stumpy with patches. Ventral anchors usually smaller than dorsal anchors, with prominent roots, almost straight point, with no patches, positioned on haptor lobes. Dorsal bar slightly “V” shaped. Ventral bar either divided into two or “V” shaped, with very long, thin medial ligament. Hooks larval type, plus one pair of very long needle like hooks lying near ventral anchors. Seminal vesicle, blind sac-like. Copulatory complex of straight or coiled tube, with accessory piece. Two prostatic reservoirs. Vagina sinistral or mid ventral, with large seminal receptacle. On freshwater Bagrids.

The authors agree with Agarwal and Vishwakarma (1996) in amendment of generic diagnosis, but the ligament joining the two halves of ventral bar may be long or short.

As regard the zoogeographical distribution of this genus is concerned, it is limited to Indo-Malaysian region including Ceylon only. This parasite is blessed with additional sclerites in comparison to other genera of the family, in which it has been placed. Authors are of the opinion that it evolved later as compared to other genera. That is why, this parasite has never been abstracted by earlier helminthologists like Chauhan, Tripathi, Jain etc., although, the hosts were examined at several occasions and at different places and are reported to harbour other monogeneans.

Acknowledgments Financial assistance from UGC, New Delhi is thankfully acknowledged.

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