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***Research Article** (Open Access)*

MORPHOTAXONOMIC OBSERVATIONS OF A NEW PISCEAN TAPEWORM FROM A FRESHWATER FISH *CLARIAS BATRACHUS* OF PANCHGANGA RIVER, KOLHAPUR DISTRICT (M.S.) INDIA WITH REVISED KEY TO SPECIES OF GENUS *LYTOCESTUS*

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ABSTRACT
In the present study to specify the morphological and morphometric characterization of Piscean caryophyllidean tapeworm infecting Intestine of *Clarias batrachus*. Morphotaxonomic characterization reported as mature flattened specimen, unsegmented, testes are pre ovarian, Ovary is bilobed triangular This study provides an approach to understand the diversity of piscean tapeworm found in Panchganga.

Keywords: *Caryophyllidean tapeworm, Intestine, Clarias batrachus, Panchganga River*

INTRODUCTION
The Panchganga River of Maharashtra flows through Kolhapur. (16.44 N latitude & 74.10 E longitudes) It starts from PrayagSangam Kolhapur the Panchganga River, as the river is now called, winds east about thirty miles till it falls into the Krishna at Kurundvad. Length of Panchganga river is 81 Km including the tributaries the Panchganga river is 338 km. A healthy and mature fish of the right weight is considered a nutrient base but when edible fish are found infected with tapeworm parasites that reduce the necessary nutrition from the host fish and secrete harmful substances. So, because of this, the market value of fish is also affected and if consumed, there is a risk of infection. Parasites play crucial roles in ecosystems around the world, making up around 40% of animal species. As freshwater habitat faces the growing threats of climate change and habitat loss, scientists warn that parasites are equally vulnerable. Morphotaxonomic studies of tapeworm parasites are an urgent need today because of all these facts and to obtain more accurate information about the parasite. Cohn in 1908 erected the genus *Lytocestus* with its type species *L. adhaerens* from *Clarias fuscus* in Hong-Kong. This genus was first confirmed by (Woodland, 1926) that included four more species in addition to the type species. Most of the species belonging to genus *Lytocestus* differ from each other due to relatively minor characters. Various authors have reviewed taxonomic status of the species belonging to this genus.
By documenting and analyzing this parasitic relationship, we contribute to the broader knowledge of parasitology and the intricate dynamics of ecosystems in this particular geographical area. The study aims to provide a comprehensive understanding of the taxonomic characteristics *Lytocestus* sp collected from *Clarias batrachus*.

MATERIALS AND METHODS
For the taxonomical study of tapeworm, the freshwater fishes were collected from different places during the period of October 2020 to Sept. 2022 of Panchganga River Kolhapur. The hosts are easily identified by Day. The viscera were brought to the laboratory immediately, repeatedly washed in cold saline, cut

and observed under binocular microscope. The collected worms were washed in distilled water and fixed in hot 4 % formalin for specific identification. The flattened parasites were washed thoroughly under running tap water and subjected to Haematoxylin stain. All drawings were made with the aid of camera lucida. All measurements are in millimeters, unless otherwise indicated. The identification is made with the help of "Systema Helminthum" by Yamaguti (1959)

Description

Seventeen single segment worms of this species were collected from the intestine of freshwater fish *Clarias batrachus* (Linneus, 1758) at Kolhapur districts (M.S.) India during the period of October 2020 to Sept. 2022.

The longest mature flattened specimen, single segmented, tapering at both the ends it measures 22 (21 - 23) in length and 2.5 (2 -3) in width. The body tapers posteriorly and shows no trace of internal or external segmentation. Body proper is divided into outer cortex, inner medulla, by two layers of longitudinal muscle. Head smooth, broad, undifferentiated, unarmed, with bluntly rounded extremity it measures 0.838 (0.822 – 0.855) in length and 0.733 (0.711 – 0.755) in width. Bothria and introvert are absent in head region. Neck is short, indistinct; narrow it measures 0.510 (0.477 – 0.544) in length and 0.782 (0.766 – 0.799) in width.

The testes are pre ovarian which occupy the central medulla from the cirrus pouch region up to the neck region. Shape of testes is rounded, small in size, 205 – 217 (209) in number, it measures 0.018 in diameter. Cirrus pouch is very large, elongated, flask shaped, transversely placed, pre ovarian, it measures 0.594 (0.544 – 0.644) in length and 0.205 (0.188 – 0.222) in width, cirrus wide, thick, curved tube present within the cirrus pouch it measures 0.505 (0.488 – 0.522) in length and 0.016 (0.011 – 0.022) in width. Vas deferens starts from cirrus, curved, long, it measures 1.371 (1.155 – 1.188) in length and 0.027 (0.022 -0.033) width. Vagina and cirrus pouch open at the distal end known genital pores. Genital pore is small in size oval to round in shape with a thick broader transversely, just above the uterus, situated right of the middle of the segment, it measures 0.171 (0.155 – 0.188) in length and 0.282 (0.266 – 0.299) in width.

Ovary is bilobed, situated near the posterior end of worm each ovarian lobe is irregular lateral margin, each lobe is triangular in shape, it measures 0.266 (0.255 – 0.277) in length and 0.277 (0.266 – 0.288) in width. The isthmus is connecting the two ovarian lobes, transversely placed; it measures 0.193 (0.188 – 0.199) in length and 0.033 (0.022 – 0.044) in width. Vagina is wide, thick tube, starts from genital pore, runs posteriorly in the middle of the body, forms receptaculum seminis and measures 1.933 (1.733 – 2.133) in length and 0.027 (0.022 – 0.033) in width. The receptaculum seminis is thin tube, it open into the shell gland, it measures 0.144 (0.133 – 0.155) in length and 0.034 (0.030 – 0.038) in width. Shell gland is broad, oval, and slightly elliptical situated beyond the isthmus; it measures 0.282 (0.266 – 0.299) in length and 0.171 (0.155 – 0.188) in width. The excretory bladder is situated behind the shell gland; it measures 0.088 (0.077 – 0.099) in length and 0.038 (0.033 - 0.055) in width. Uterus arises from the shell gland, pre and post ovarian transversely placed extend anterior to the isthmus, arranged transversely like convoluted tube, opens separately by a double walled uterine pore and measures 3.311 (3.3 – 3.322) in length and 0.033 (0.022 – 0.044). The uterine pore is large, oval situated in the sub corticular region of the worm and measures 0.049 (0.044 – 0.055) in length and 0.044 (0.033 – 0.54) in width. The vitellaria follicular, small follicles, oval in two to four rows on each lateral side.

DISCUSSION

The genus *Lytocestus* is established by Cohn in 1908 with its type species *L. adhaerens* from *Clarias fuscus* at Hong-Kong. The present worm comes closer to all the known species of the genus *Lytocestus* Cohn, 1908 in general topography of organs. But differs due to some characters from following species.

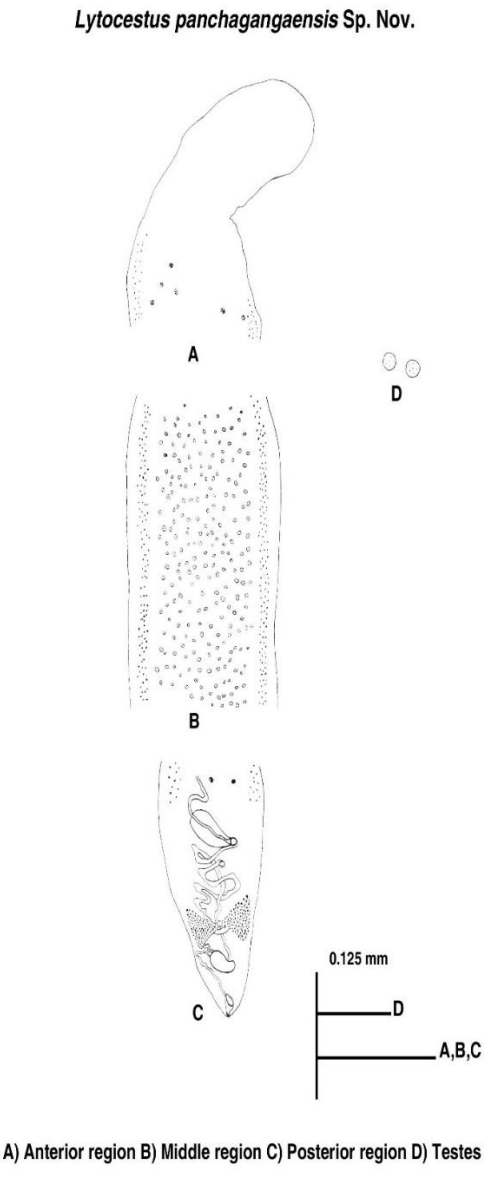
The present tapeworm differs from *L. adhaerens* (Cohn, 1908) in having neck absent, ovary bilobed, uterus looped, vitellaria granular; *L. filiformis* (Woodland, 1923) in having ovary bilobed, cirrus pouch

small, uterus pre-ovarian; *L. indicus* (Moghe, 1925) in having neck absent, testes 230-270 in numbers, cirrus pouch small; *L. biramanicus* (Lynsdale, 1956) in having, head short, ovary wing like, with numerous follicles; *L. alestei* (Lynsdale, 1956) in having testes more or less spherical, cirrus pouch small, oval, uterus short; *L. longicollis* (Ramadevi, 1973) in having testes 140 in numbers, arranged in two layers, ovary 'H' shaped, corticular with closely packed follicles,cirrus pouch small, ova; *L. fossilis* (Singh, 1975) in having head stumpy, cirrus pouch oval, ovary follicular, 'H' shaped, vitellaria granular; *L. marathwadensis* (Shinde *et al.,* 1988) in having head stumpy, testes oval, arranged in 2 or 3 rows, in central medulla, ovary 'H' shaped, uterus saccular; *L. alii* (Jadhav *et al.,* 1991) in having testes 460-480 in numbers, cirrus pouch small, oval, ovary butterfly shaped; *L. clariasae* (Jadhav *et al.*, 1991) in having testes 700-750 in numbers, small, oval, cirrus pouch medium, ovary like bunch of grapes; *L. naldurgensis* (Kadam *et al.,* 1998) in having testes 500-600 in numbers, scattered in medullary region, cirrus pouch small, oval, vertical, obliquely placed and ovary butterfly shaped; *L. teranaensis* (Kolpuke *et al.,* 1999) in having testes numerous, rounded, 1200-1500 in numbers, pre-ovarian and cirrus pouch small; *L. chalisgaonesis* (Kalse *et al.,* 1999) in having testes 1500-1600 in numbers, vitellaria granular, corticular in position; *L. kopardaensis*, (Shinde *et al.,* 1999) having testes oval, 1600- 1700 in number, ovary distinctly bilobed with irregular margin, uterus is wide, coiled loop shaped; *L. govindae* (Patil *et al.,* 2002) in having testes numerous, 1425-1475 in numbers, pre-ovarian, evenly distributed, scattered in single field, cirrus pouch small, oval, obliquely placed, ovary butterfly shaped, vitellaria granular, corticular in position; *L. batrachusae* (Pawar *et al.,* 2002) in having head spatulate, testes 3800-4000 in numbers, rounded, pre-ovarian, scattered centrally, ovary butterfly shaped; *L. clariasae* (Pawar et al., 2002) having head spatulate, testes 5800 – 6000 in number small round; *L. shindei* (Khadap *et al.,* 2004) in having testes 350-360 in numbers, cirrus pouch small, oval, pre-ovarian, obliquely placed, ovary butterfly shaped, vitellaria granular; *L. nagapurensis* (Lakhe *et al.,* 2004) in having testes numerous, 1100-1150 in numbers, oval, scattered all over the segment, cirrus pouch medium, medullary, pre-ovarian, ovary 'H' shaped with numerous oval follicles, vitellaria granular; *L. clariae* (Tandon, 2005.) in having testes 270-495 in numbers, oval, cirrus pouch compact, ovary 'H' shaped and uterus glandular; *L. attenuatus* (Tandon *et al,* 2005) in having cirrus pouch medullary, ovary inverted 'A' shaped, uterus glandular; *L. assamensis* (Tandon *et al.,* 2005) in having testes 266-565 in numbers, ovary inverted 'A' shaped, uterus glandular; *L. heteropneustii* (Tandon *et al.,* 2005) in having testes 235-340 in numbers, uterus glandular; *L. paithanesis,* (Shelke, 2007) having testes 1550; shape oval, number of ovarian follicles; The present tapeworm differs from *L. jagati*, (Tripathi et al 2007) having neck absent, testes numerous oval; *L. mujumdari* (Poonam, 2007) in having, ovary large, 'H' shaped, uterus saccular; *L. bokaroensis* (Poonam, 2007) ovary bent inwards in the shape of inverted 'A', uterus glandular; *L. subhapradhi* (Jawalikar *et al.,* 2008) having shape of head spatulate, testes 300 – 310; *L. punensis*, (Jadhav *et al.,* 2008) having testes 1450 – 1500, uterus is saccular; *L. follicularae* (Bhure *et al.,* 2010) in having testes 400-500 in numbers, oval, large, ovary 'H' shaped, uterus saccular; *L. osmanabadensis* (Bhure *et al.,* 2010) having testes 300 – 350 in number, ovary is 'V' shaped, uterus is saccular. *L. shindei* (minor), (Suryawanshi *et al.,* 2010) testes 1580 in number, oval in shape, ovary distinctly bilobed, with irregular lateral margin, vitellaria granular corticular and sub corticular in position; *L. murhari* (Kaul *et al.,* 2010) testes 600 – 650 in number and ovary large, bilobed; *L. puranensis,* (Kasar *et al.,* 2010) having testes are rounded, small, 1000 – 1200 in number, cirrus pouch small, preovarian, ovary is butterfly shaped, vitellaria are granular; *L. garipinusae* (Kadam *et al.,* 2011) having head short, testes 1380 in number, ovary butterfly shaped and vitellaria granular.

Some additional and differentiating characters are given in the comparative chart at the end. In above aforesaid discussion on the present parasite deserves the status of a new species and named *Lytocestus panchagangaensis* Sp. Nov. is proposed as it is reported from Panchaganga River in Maharashtra, India.

Taxonomic summary

Genus	*Lytocestus* (Cohn, 1908)
Type Species	*Lytocestus panchagangaensis* Sp. Nov.
Host	*Clarias batrachus* (Linnaeus, 1978)
Habitat	Intestine
Locality	Kolhapur, Solapur, Latur, Osmanabad, (M.S.)
Accession Number	HRL/2008-10/1-5
Holotype	Deposited in the Helminthology Research Lab.,
Paratype	Dept. of Zoology, Dr.B.A.M.U. Aurangabad, (M.S.)
Date of collection	Oct. 2008 - Sept. 2010.
Etymology	Named after Locality River the host



A) Anterior region B) Middle region C) Posterior region D) Testes

A key to the species of the genus *Lytocestus*, Cohn, 1908:

Testes 100 – 105	*L. longicollis* (Ramadevi, 1973)
Testes 200 – 210	***L. panchagangaensis* Sp. Nov**
Testes 230 – 270	*L. indicus* (Moghe, 1925)
Testes 300 – 350	1
Testes 350 – 360	*L. shindei* (Khadap *et al.*, 2004)
Testes 460 – 480	*L. alii* (Jadhav *et al.*, 1991)
Testes 500 – 600	*L. naldurgensis* (Kadam *et al.*, 1998)
Testes 600 – 650	*L. murhari* (Kaul *et al.*, 2010)
Testes 700 – 750	*L. clariasae* (Jadhav *et al.*, 1991)
Testes 1000 – 1200	2
Testes 5000 – 6000	*L. clariasae* (minor) (Pawar *et al.*, 2002)
Uterus looped	*L. adhaerens* (Cohn, 1908)
Uterus short	*L. alestei* (Lynsdale, 1956)
Uterus wide, coiled	3
Uterus glandular	*L. heteropneustill* (Tandon *et al.*, 2005)
Uterus convoluted	4
Ovary 'A' Shaped	5
Ovary butterfly shaped	6
Ovary 'H' shaped	7
Ovary wing like	*L. biraminicus* (Lynsdale, 1956)
1. Head blunt	*L. osmanabadensis* (Bhure et al., 2010)
Head spatulate	*L. subhapradhi* (Jawalikar *et al.*, 2008)
2. Ovary H shaped	*L.nagpurensis* (Lakhe *et al.*, 2004)
Ovary Butterfly shaped	*L. puranesis* (Kasar *et al.*, 2010)
3. Testes 1650	*L. kopardaensis* (Shinde *et al.*, 1999)
Testes 1550	*L. paithanesis* (Shelke, 2007)
4. Head rounded	*L. jagati* (Tripathi *et al.*, 2007)
Head short	*L. filiformis* (Woodland, 1923)
Head medium	*L. shindeii* (minor) (Suryawanshi *et al.*, 2010)
Head long conical	*L. teranaensis* (Kolpuke *et al.*, 1999)
Head bluntly rounded	*L. chalisgaonensis* (Kalse *et al.*, 1999)
5. Neck absent	*L. bokaroensis* (Poonam, 2007)
Neck long narrow	*L. attenuates* (Tandon *et al.*, 2005)
Neck short	*L. assamensis* (Tandon *et al.*, 2005)
6. Head spatulate	*L. batrachusae* (Pawar *et al.*, 2002)
Head short	*L. garipinusae* (Kadam *et al.*, 2011)
Head long	8
7. Neck short	*L. clariae* (Tandon *et al.*, 2005)
Neck absent	9
8. Uterus saccular	*L. punensis* (Jadhav *et al.*, 2008)
Uterus wide convoluted	*L. govindae* (Patil *et al.*, 2002)
9. Head undifferentiated	*L. majumdari* (Poonam, 2007)
Head differentiated	*L. follicularae* (Bhure *et al.*, 2010)
Head stumpy	10
10. Uterus coiled	*L. fossilis* (Singh, 1975)
Uterus saccular	*L. marathwadadensis* (Shinde *et al.*, 1988)

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