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The taxonomic status of *Lytocestus bhadatae* Patil, 2018 – A critical study

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Abstract: Patil (2018)¹ reported a new species *Caryophyllaeid* Cestode belonging to the genus *Lytocestus* (*Caryophyllidea: Lytocestidae*) which he recovered from *Clarias batrachus* at Gulbarga (Karnataka) India. The description of the said species *L. bhadatae* appeared in *Review Research* vol.7(6) on page 1-4. His paper suffers from a number of lacunae. The present authors have pointed out the mistakes, after critically going through the description & observing the sketches provided, and suggested some remedial measures to delineate the existence of the species till then the species has been kept under uncertain status (*incertae sedis*)

Key words: *Lytocestus bhadatae*, *incertae sedis*, review.

INTRODUCTION

Caryophyllidean cestodes are interesting group, with a unique morphology, evolutionary status, and genetic stability showing high degree of endemism. Only *Archigetes sieboldi* Leuckart (1878)² and *Glaridacris catostomi* Cooper (1920)³ are represented from more than one geographical area.

These show monozoism and low fecundity yet are quite successful, the relative abundance in fishes is on account of “Vitelline cells” which can synthesize and store glycogen in the nuclei as a normal function-“a phenomena unique to animals kingdom”-Agarwal (1985)⁴. The increase in glycogen without concomitant increase in the number of vitelline cells or in egg size could lead to prolonged period of infectivity & utilisation of glycogen and not lipid as energy source. Glycogen being heavier than lipid, it can be utilised under anaerobic condition are

consistent with life cycle that has benthic intermediate hosts-Mackiewicz (1981,a)⁵.

Higher level of glycogen in *Caryophyllaeids* is indicative of lower calorific value than lipid which are the result of lower oxygen concentration in the enteric environment but low fecundity and relative abundance is due to K-selection strategies as an environmental condition Sahay *et al.* (2007)⁶.

The order *Caryophyllidea* van Beneden (Carus, 1863)⁷ include a group of Cestodes (one segmented) which has four families:

- 1) *Caryophyllaeidae* Leuckart (in Luhe,1970)⁸
- 2) *Lytocestidae* Wardle & McLeod (1952)⁹
- 3) *Capingentidae* Wardle & McLeod (1952)⁹
- 4) *Balanotaenidae* Mackiewicz & Blair (1978)¹⁰

These families have been erected giving cognisance to the relationship between inner longitudinal muscle, vitellarial follicles & position of testicular follicles.

Under the family *Lytocestidae* Wardle & McLeod (1952)⁹, a number of genera have been reported. One of

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the genus is *Lytocestus* Cohn (1908)¹¹ which is characterised by “Body elongate tapering anteriorly, Scolex undifferentiated, inner longitudinal muscles in a ring around testes. Testes in broad median field of pre-uterine medulla, vas deferens convoluted, leading into compact parenchymatous mass not sharply demarcated from surrounding and containing numerous dorso-ventral muscle fibres, in which the thin walled ejaculatory duct is winding, cirrus with strongly muscular wall opening into deep narrow mid ventral pit. Ovary bilobed, with lateral lobe outside the inner longitudinal muscle sheath. Vitellaria surrounding inner longitudinal muscle sheath in testicular zone, no post ovarian follicles, uterus looped behind shell gland and then coiled between ovary and male terminalia where it is surrounded by a layer of tall radiating accompanying cells. Vagina also provided with a layer of accompanying cells opening mid ventrally directly behind cirrus.” Parasites of mormyrid fishes.

More than fifty species have been reported in the genus *Lytocestus* Cohn (1908)¹¹, surprisingly majority of them are from the state of Maharashtra. Out of these quite a good number of *Lytocestus* species have been synonymised/kept under incertae sedis / transferred to another genera, for example: Ash (2012)¹² without having a consistent opinion took following decisions:-

- 1) Synonymised *L.lativitellarium* Furtado & Kim Low (1973)¹³ with *Lucknowia microcephala* Boviein (1926)¹⁴.
- 2) *L.heteropneusti* Tandon *et.al.* (2005)¹⁵, *L.jagtai* Tripathi *et. al.* (2007)¹⁶ with *Lucknowia fossilisi* Gupta (1961)¹⁷.
- 3) *L.attenuatus* Tandon *et. al.* (2005)¹⁵, *L.clariae* Tandon *et al.* (2005)¹⁵ with *Bovienia indica* (*Lucknowia indica*) Niyogi *et.al.* (1982)¹⁸.
- 4) *L. marthawadensis* Shinde *et. al.* (1988)¹⁹ was synonymised with *Pseudocaryophyllaeus ritai* Gupta and Sinha (1984)²⁰.
- 5) *L.parvulus* Furtado *et. al.* (1963)²¹, *L.moghei* Murhar *et. al.* (1963)²², *L. longicollis* Ramadevi (1973)²³ *L.majumdari* Poonam (2007)²⁴, *L.bokaroensis* Poonam (2007)²⁴ were synonymised with *Pseudocaryophyllaeus tenuicollis* Boviein (1926)¹⁴.
- 6) Follicular vitellaria bearing forms like *L.alii* Jadhav *et. al.* (1991)²⁵, *L.clariasae* Jadhav *et. al.*

(1991)²⁵, *L.naldurgensis* Kadam *et. al.* (1998)²⁶, *L.kopardaensis* Shinde & Borde (1999)²⁷, *L.teranaensis* Kolpuke *et. al.* (1999)²⁸, *L.batrachusae* Pawar & Shinde (2002)²⁹, *L.clariasae* (minor) Pawar *et.al.* (2002)²⁹, *L.subhapradhi* Jawlikar *et.al.* (2008)³⁰, *L.murhari* Kaul *et.al.* (2010)³¹, were synonymised with *L.indicus* Moghe (1925)³².

It seems that Patil (2018)¹ did not have access to the literature of 50 species of *Lytocestus* else he would not have compared his specimens with only 11 species:

- 1) (viz.; 1) *L.filiformis* Woodland (1923)³³,
- 2) *L.indicus* Moghe (1925)³²,
- 3) *L.alestes* Lynsdale (1950)³⁴,
- 4) *L.birmanicus* Lynsdale (1956)³⁴,
- 5) *L.javanicus* Bovein (1926)¹⁴, Mackiewicz (1962)³⁵.
- 6) *L.parvulus* Furtado (1963)²¹,
- 7) *L.longicollis* Ramadevi (1973)²³,
- 8) *L.fossilis* Singh (1975)³⁶,
- 9) *L.marathawadensis* Shinde & Phad (1990)¹⁹,
- 10) *L.alii* Jadhav and Gavhane (1991)²⁵,
- 11) *L.clariasae* Jadhav and Gavhane (1991)²⁵.

Knowing fully well that out of the above serial 6, 9, 10, 11 were not existing as these had undergone synonymy with *L.indicus* Moghe (1925)³² vide Ash (2012)³⁷

At least Patil (2018)¹ should have compared his specimen with granular vitellaria bearing forms viz.; *L.adhaerens* Cohn 1908¹¹; *chalisgaonensis* Khalse *et.al.* 1999³⁸; *govindae* Patil *et.al.* 2002³⁹; *shindei* Khadap *et. al.* 2004⁴⁰; *nagapurensis* Lakhe *et. al.* 2004⁴¹; *paithanensis* Shelke 2007⁴²; *punensis* Jadhav *et. al.* (2008)⁴³; *majaraensis* Solunke *et.al.* 2012⁴⁴ and *khami* Jawle *et.al.* 2011⁴⁵.

Following species of *Lytocestus* have been kept under INCERTAE SEDIS

- 1) *L.indica* Deshmukh *et. al.* (2015)⁴⁶ by Sahay, Singh and Saxena 2018⁴⁷.
- 2) *L.bishnupurensis* Shomendra *et. al.* (2003)⁴⁸ was synonymised with *L.indicus* by Singh, Sahay & Sadaf (2018)⁴⁸.
- 3) *L. jagtai* Tripathi *et. al.* (2007)¹⁶ and *L.fossilis* Singh (1975)³⁶ were considered synonym of *Lucknowia fossilisi* Gupta (1961)¹⁷ by Sahay & Ekka (2019)⁴⁹.
- 4) Sahay, Mandal, Saxena and Singh (2017)⁵⁰ held *L.heteropneusti* Tandon *et.al.* (2005)¹⁵ valid and

not a synonym of *Lucknowia fossilisi* Gupta (1961)¹⁷.

- 5) *L. mastacembelusi* Pardeshi (2016)⁵¹ was kept by Sahay, Khalkho, Singh and Mandal (2019)⁵² under incertae sedis.
- 6) *L. paithanensis* Kale (2017)⁵³ was held invalid species by Sahay, Khalkho, Ekka and Mandal (2019)⁵⁴.

The main aim of the study is to assess critically the status of *Lytocestus bharatae* Patil (2018)¹ as the description of the species suffers from a number of lacunae inadvertently committed by the author.

MATERIALS AND METHODS

Several research papers have been consulted & few slides observed.

DISCUSSION

The main characteristics of *Lytocestus bharatae* Patil (2018)¹ are as follows:

“Scolex (Head) elongated narrow anteriorly and broad posteriorly, neck short squarish slightly convex lateral margin, bears 1470 to 1480 (1475) number of testicular follicles, pre-ovarian median extending between base of neck to ovary, cirrus pouch median elongated cylindrical curved anteriorly, pre-ovarian transversely or obliquely placed, ovary dumbbell shaped distinctly bilobed near posterior end follicles being 28-32, (cortical or median not mentioned), isthmus present, Vagina starts from genital pore runs medially posteriorly opens in ootype, ootype large, irregular in shape post ovarian situated in the concavity of the ovarian lobe, uterus coiled, commence from ootype, runs posteriorly beyond isthmus taking a turn anteriorly pre-ovarian with several coils & open through uterine pore behind genital pore. Vitellaria are granular strips of medium width on each lateral side from base of neck to the posterior end of the worm.”

Lacunae:

- 1) A number of spelling mistake in the said paper.
- 2) Ovarian lobes are cortical or not, has not been mentioned.
- 3) No mention has been made about the presence of oviduct, receptaculum seminis & utero-vaginal duct. Normally vagina and uterus joins anteriorly (some distance before the male genital opening)

and forms utero-vaginal duct which opens through female genital opening behind the male gonopore.

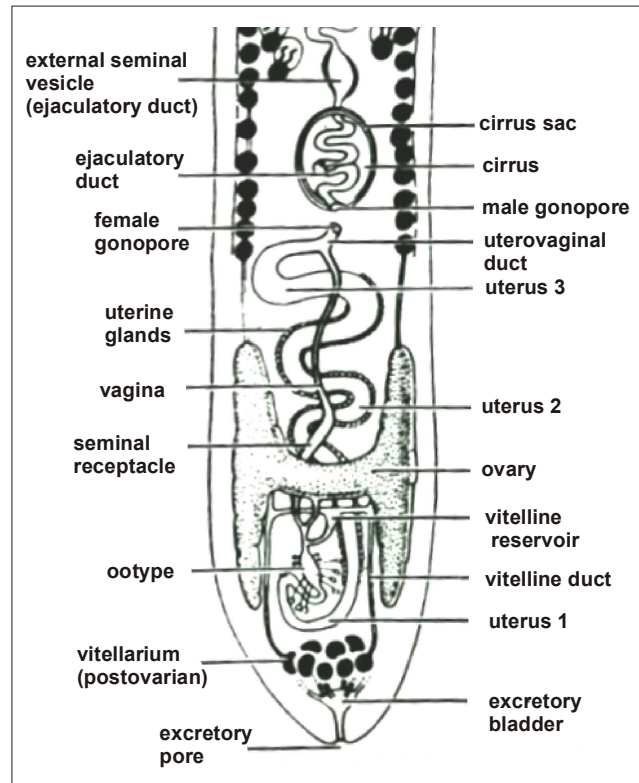


Fig- 1 Posterior end of a Caryophyllaeid (Taken from Mackiewicz, 1972)

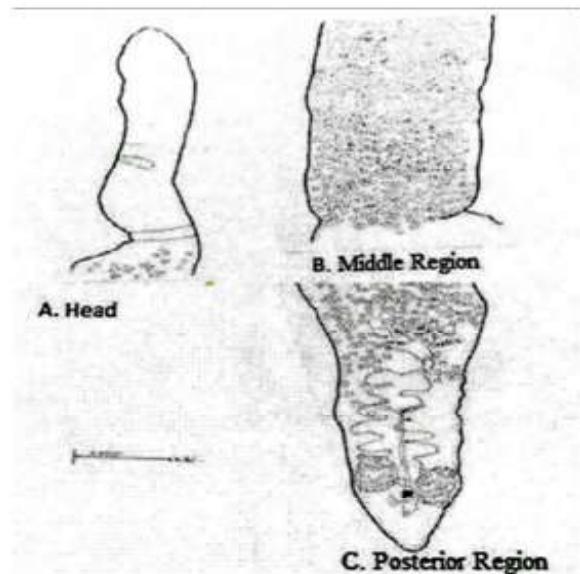


Fig- 2 Camera lucida drawing of *Lytocestus bharatae* Patil (2018) (from his research paper)

Besides, in some cases the posterior part of vagina becomes swollen to form receptaculum seminis, which continues behind the isthmus and receives a common duct arising from the isthmus & also receives common vitelline duct, continues further behind to end in the ootype as depicted in the figure below.(Fig -1)

- 1) The author of *Lytocestus bharatae* (?)¹ forgot to give the measurement of eggs. This indicates that worms studied were not fully grown.
- 2) Vitellaria have been mentioned to be granular. If that be so, it is a sign of immaturity.
- 3) *Lytocestus bharatae* (?)¹ has been separated from aforesaid 11 species on the basis of the number of testicular follicles (being 1470-1480 mean 1495). Species separation on the basis of number of testicular follicles has already been negated by Sahay, Singh and Saxena (2018)⁴⁷ because the range depicts that the worms studied were not of the same age and are in different stages of growth & maturity and that number of testicular follicles should normally be constant provided the worms are of same age. The range creates problem for example the range of testicular follicles 230-270 in *L.indicus* Moghe (1925)³² fits very well in the range of testicular follicles 190-400 of *L.attenuatus* Tandon *et.al* (2005)¹⁴, also with range 230-340 in *L.heteropneusti* Tandon *et.al* (2005)¹⁵.

The range of testicular follicles 460-480 of *L.alii* fits very well in the range 400-500 for *L.follicularae* Bhure *et.al* (2010)⁵⁵.

Similar is the situation in the *L. Bharatae* (?) Patil (2018)¹ where the number of testicular follicles have been shown to be (1470-1480 mean 1475). This range nearly falls in the range of testicular follicles given for *L. govindae* Patil and Yadav (2002)³⁹ where range is 1425-1475; in case of *L. punensis* Jadhav *et.al* (2008)⁴³ to the range of testicular follicles is 1400-1500, the testicular range of *L. Bharatae* fits very well in the range for *L. punensis*.

The range 1425-1475 of *L. bharatae* (?) fits well in the range 1200-1500 testicular follicles given for *L. teranaensis* Kolpuke (1999)²⁸.

If at all Patil (2018)¹ gives cognisance to the number of testicular follicles as criteria for species separation/

recognition, he ought to have compared his specimens with above two species (*L.govindae* & *L. punensis*) which he miserably failed.

Does it mean that Patil (2018)¹ believed in the synonymy of *L. (govindae, punensis)* with *L.indicus* Moghe (1925)³², this he failed to mention.

Sahay, Singh, Kamal & Jha (2018)⁵⁷ negated the synonymy of *L. (chalisgaonensis, govindae, shindei, nagapurensis, paithanensis and punensis)* with *L.indicus* as proposed by Ash (2012)³⁷ on the ground that the above species do not possess 230-270 testicular follicles met in *L.indicus* neither the vitelline follicles are granular (Refer –*J.Exp.Zool.India* vol **21** pp.271-276).

Another mistake to be pointed out here is that Patil (2018)¹ has mentioned 11 species of *Lytocestus* in text but their authors name does not appear in the Reference except that of Shinde *et.al* (1990)¹⁹ and of Singh (1975)³⁶.

The camera lucida drawings provided by Patil (2018)¹ & the structural similarity between the species in question & *L.indicus* is so strong that one is inclined to consider Patil's species a synonym of *L.indicus* Moghe (1925)³¹.

CONCLUSION

On the above stated grounds the taxonomic status of *L. bharatae* (?) Patil (2018)¹ becomes doubtful unless the errors are corrected. Further it is suggested that Patil (2018)¹ should undertake electrophoretic study of the said species or go for molecular characterisation & karyotypic studies, provide photomicrographs of the said species in question, cross sections etc., in order to substantiate the validity of the species till then authors keep the said species under 'incertae sedis'. Provision of a good camera lucida is also needed.

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Biospectra : Vol. 15(1), March, 2020

An International Biannual Refereed Journal of Life Sciences

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