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ORIGINAL ARTICLE

On the Status of *Lytocestus mastacembellusi* (Caryophyllidea: Lytocestidae) Pardeshi, 2016: A Critical Study

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ABSTRACT

Pardeshi (2016) reported the occurrence of Lytocestus mastacembellusi from Mastacembellus armatus at Paithan district, Aurangabad, Maharashtra. Her paper suffers from a number of lacunae. The present authors have discussed the status of the said species in the light of researches done by several authors and places the said species under uncertae sedis

***Key words**: Lytocestus mastacembellusi, status, caryophyllaeids, Lytocestidae, uncertae sedis.*

INTRODUCTION

Caryophyllaeids are unique in having a single set of reproductive organs within a non-segmented body and utilizing aquatic oligochaetes as their intermediate hosts. It is an ancient group that in all probability originated from acoelomate tuberllarian larvae and branched out at the beginning of Paleozoic era as parasites of aquatic vertebrates Kulakovaskaja and Deshmin (1978)[2].

There are four families of Caryophyllaeids namely:-

1. Caryophyllaeidae Leukart (in Luhe, 1910)[3]
2. Lytocestidae Wardle & McLeod (1952)[4]
3. Capingentidae Wardle & McLeod (1952)[4]
4. Balanotaenidae Mackiewicz & Blair (1978)[5]

The Caryophyllaeids belonging to the above families are interesting group of cestodes having unique morphology, evolutionary status, and genetic variability showing high degree of endemism. Only *Archigetes sieboldi* Leuckart (1878)[6] & *Glaridacris catostomi* Cooper (1920)[7] are represented from more than one geographical region.

Under the family Lytocestidae Wardle & McLoed (1952)[4] a number of genera have been erected. These are:

1. *Lytocestus* Cohn (1908)[8]
2. *Caryophyllaeids* Nybelin (1922)[9]
3. *Balanotaenia* Johnston (1924)[10]
4. *Monobothrioides* Fuhrmann (1925)[11]
5. *Djombangia* Bovien (1926)[12]
6. *Lytocestoides* Baylis (1928)[13]
7. *Bovienia* Fuhrmann (1925)[11]
8. *Stocksia* Woodland (1937 b)[14]
9. *Khawia* Hsu (1935)[15]
10. *Notolytocestus* Johnston (1950)[16]
11. *Atractolytocestus* Anthony (1958)[17]
12. *Lucknowia* Gupta (1961)[18]
13. *Crecentovitus* Murhar (1963)[19]
14. *Markevitschia* Kulakovaskaja and Akhmerov (1965)[20]
15. *Caryoaustralus* Mackiewicz & Blair (1980)[21]
16. *Thallophylieus* Mackiewicz & Blair (1980)[21]
17. *Moravekia* Sahay (1979)[22]

18. *Neolytocestus* Sahay (1979)[22]
19. *Introvertus* Satpute & Agarwal (1980b)[23]
20. *Lobulovarium* Oros *et al*. (2012)[24]

The genus *Lytocestus* Cohn (1908)[8] is characterized by:-
"Body elongated tapering anteriorly, scolex undifferentiated, inner longitudinal muscles in a ring around testes. Testes is broad median field of preuterine medulla, vas differens convoluted leading into a compact parenchymatous mass not sharply demarcated from surrounding and contains numerous dorsoventral muscle fibres in which the thin walled ejaculatory duct is winding, cirrus with strongly muscular wall, opening into deep narrow midventral pit. Ovary bilobed, lateral lobes outside inner longitudinal muscle sheath, vitellaria surrounding inner longitudinal muscle sheath in testicular zone, no post ovarian vitelline follicles. Uterus looped behind shell gland and then closely 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 midventrally directly behind cirrus." Seminal receptacle, post ovarian vitellaria & external as well as internal seminal vesicle absent.
Parasitic in mormyrid and siluroid fishes. Type species *L.adharens* Cohn (1908)[8] in *Clariasfuscus* Hongkong Yamaguti- (1959)[25]
Nearly 51 species have been reported, mostly from Maharashtra. These are as follows:
1. *L.adhaerens* Cohn (1908)[8]
2. *L.filiformis* Woodland (1923)[26]
3. *L.indicus* Moghe (1925)[27]
4. *L.cunnigtoni* Fuhrmann *et al*. (1925)[11]
5. *L.chalmerisius* Woodland (1926)[28]
6. *L.javanicus* Bovein (1926)[12]
7. *L.birmanicus* Lynsdale (1956)[29]
8. *L.alestesi* Lynsdale (1956)[29]
9. *L.parvulus* Furtado (1963)[30]
10. *L.moghei* Murhar (1963)[19]
11. *L.longicollis* Ramadevi (1973)[31]
12. *L.lativitellarium* Furtado & Kim Low (1973)[32]
13. *L.fossilis* Singh (1975)[33]
14. *L.marathawadensis* Shinde & Phad (1988)[34]
15. *L.alii* Jadhav and Gavahne (1991)[35]
16. *L.clariasae* Jadhav and Gavahne (1991)[35]
17. *L.naldurgensis* Kadam, Hiware & Jadhav (1998)[36]
18. *L.chalisgaonensis* Khalse & Shinde (1999)[37]
19. *L.kopardaensis* Shinde & Borde (1999)[38]
20. *L.teranaensis* Kolpuke, Shinde and Begum (1999)[39]
21. *L.batrachusae* Pawar & Shinde (2002)[40]
22. *L.clariasae* (minor) Pawar & Shinde (2002)[40]
23. *L.govindae* Patil & Jadhav (2002)[41]
24. *L.vishnupurensis* Shomendra *et al.* (2003)[42]
25. *L.nagapurensis* Lakhe, Pawar & Shinde (2004)[43]
26. *L.shindei* Khadap *et al.* (2004)[44]
27. *L.assamensis* Tandon, Chakravorty & Das (2005)[45]
28. *L.attenuatus* Tandon, Chakravorty & Das (2005)[45]
29. *L.clariae* Tandon, Chakravorty & Das (2005)[45]
30. *L.heteropneusti* Tandon, Chakravorty & Das (2005)[45]
31. *L.bokaroensis* Poonam (2007)[46]
32. *L.majumdari* Poonam (2007)[46]
33. *L.paithanensis* Shelke (2007)[47]
34. *L.jagtai* Tripathi *et al*. (2007)[48]
35. *L.punensis* Jadhav, Bhure & Padwal (2008)[49]

36. *L.subhapradhi* Jawlikar, Pawar and Shinde (2008)[50]
37. *L.moghei* Sharma (2009)[51]
38. *L.murhari* Kaul & Suryavanshi (2010)[52]
39. *L.follicularіae* Bhure *et al.* (2010)[53]
40. *L.osamnabadensis* Bhure *et al*. (2010)[53]
41. *L.shindei* Suryavanshi *et al.* (2010)[54]
42. *L.vyasaei* Pawar & Hiware (2011)[55]
43. *L.purnensis* Pawar & Hiware (2011)[55]
44. *L.geriapinusae* Kadam *et al.* (2011)[56]
45. *L.khami* Jawle *et al.* (2011)[57]
46. *L.thapari* Sawarkar (2012)[58]
47. *L.alii* (minor) Sawarkar (2012)[58]
48. *L.manjaraensis* Solunki *et al.* (2012)[59]
49. *L.rekhaensis* Nimbalkar *et al.* (2012)[60]
50. *L.indica* Deshmukh (2015)[61]
51. *L.mastacembellusi* Pardeshi (2016)[1]

Such a huge number of species led Ash (2011.a,b, 2012)[62,63,64] to synonymies most of the *Lytocestus* species with whatever genus and species he felt suitable with no consistency in his opinion. For example,

A. *L.heteropneustii* Tandon *et al.* (2005)[45]&*L.jagtai* Tripathi *et al*. (2007)[48] (Serial 30&34) were synomised with *Lucknowia fossilis* Gupta (1961)[18]- vide Ash *et al.* (2011 b)[63].
B. *L.lativitellarium* Furtado & Kim Low (1973)[32]&*L.assamensis* Tandon *et al.* (2005)[45] Serial no 12 & 27 were synonimised with *Lucknowia microcephla* Bovien (1926)[12]- vide Ash, *et al.* (2011 a)[62]
C. *Lytocestus alii* Jadhav *et al.* (1991)[35]
1. *Lytocestus clariasae* Jadhav *et al*. (1991)[35]
2. *Lytocestus chalisgaonensis* Shinde *et al.* (1999)[38]
3. *Lytocestus kopardaensis* Shinde *et al.* (1999)[38]
4. *Lytocestus naldurgensis* Kadam *et al.* (1998)[36]
5. *Lytocestus teranaensis* Kolpuke *et al.* (1999)[39]
6. *Lytocestus batrachusae* Pawar &Shinde (2002)[40]
7. *Lytocestus clariasae* (minor) Pawar *et al.* (2002)[40] homonym
8. *Lytocestus govindae* Patil *et al*. (2002)[41]
9. *Lytocestus nagapurensis* Lakhe *et al.* (2004)[43]
10. *Lytocestus shindei* Khadap *et al.* (2004)[44]
11. *Lytocestus paithanensis* Shelke (2007)[47]
12. *Lytocestus punensis* Jadhav *et al.* (2008)[49]
13. *Lytocestus subhapradhi* Jawlikar *et al.* (2008)[50]
14. *Lytocestus murhari* Kaul *et al.* (2010)[52]
15. *Lytocestus shindei* Suryavanshi *et al.* (2010)[54]
16. Serial no 15,16,18,19,17,20,21,22,23,25,26,33,35,36,38,41 were considered synonyms of *Lytocestus indicus* Moghe (1925)[27]- vide Ash *et al.* (2011 a)[62]
17. *L.marthawadensis* Shinde & Phad (1988)[34] was considered synonym of *Pseudocaryophyllaeus ritai* Gupta & Singh (1983)[65]– vide Ash *et al.* (2011 a)[62]
18. *L.birmanicus* Lynsdale (1956)[29]
19. *L.parvulus* Furtado (1963)[30]
20. *L.moghei* Murhar (1963)[19]
21. *L.longicollis* Ramadevi (1973)[31]
22. *L.majumdari* Poonam (2007)[46]

Serial nos 7, 9, 10, 11, 31 & 32 were considered synonym of *Pseudocaryophyllaeus tenuicollis* Bovien (1926)[12]- vide Ash *et al*. (2011 a)[62]

D. Others like Sahay & Khalkho (2017) considered *L.rekhaensis* Nimbalkar *et al.* (2012)[60] - a species under enquiry (serial 49) Sahay, Mandal, Saxena & Singh (2017)[66] revalidated *L.heteropneusti* Tandon & Das (2005)[45]

E. Singh, Sahay & Sadaf (2018)[67] held *L.bishnupurensis* (serial 24) Shomendra *et al*. (2003)[42] asynonym of *L.indicus* Moghe (1925)[27]

It appears that Ash (2012)[64] while submitting his Ph.D thesis in the University of South Boheia inadvertently forgot to mention the references of the authors mentioned in the thesis [vide {C} above] .

The aim of the present study is to assess the status of *Lytocestus mastacembellusi* Pardeshi (2016)[1] because the author of the said species has inadvertently committed serious mistakes in considering *Lytocestus mastacembellusi* to be new on insufficient grounds.

MATERIALS & METHODS

The descriptions of *Lytocestus mastacembellusi* has been thoroughly studied, several research papers were consulted and few available slides were observed.

OBSERVATION & DISCUSSION

L. mastacembellusi Pardeshi (2016)[1] is supposed to show the following features.

1. Total numbers of specimen studied were seven.

2. Head- spatulate roughly triangular narrow anteriorly broad posteriorly & measures 5.087 in length and 1.071-1.785 in breadth.

3. Gonads- in posterior part; testes numerous small follicles 6000-6200, pre-ovarian, medullary scattered, unevenly distributed from one lateral to other lateral margin situated from the uterine pore to the base of neck & measures 0.089 - 0.107 x 0.053 - 0.071 in length & breadth respectively.

4. Cirrus pouch- Medium in size, oval obliquely placed, preovarian in central region of worm, measures 0.714 in length and 0.285-0.428 in breath. Cirrus a thin tube, coiled within the cirrus pouch and measures 1.250 in length and 0.017-0.035 in breadth.

5. Vas deferens- Short, thin slightly coiled 0.303 in length & 0.017 in breadth.

6. Ovary- bilobed, lobes with irregular margin in posterior part, extend laterally upto subcorticular & corticular region & measures 1.285–1.305 in length & 0.660 – 0.928 in breadth. Poral lobe is median in size oval in shape extends anteriorly whereas aporal lobe is almost rectangular in shape, antero-posteriorly placed & both the lobes are connected by an isthmus (short wide 0.464 x 0.42-0.160)

7. Vagina- thin, starts from genital pore, runs posteriorly in the middle of worm, slightly curved, runs posteriorly to isthmus reaches & opens into the ootype, measures 3.499 in length and 0.035–0.053 in width.

8. Ootype- Large, round, post ovarian situated in the concavity of the ovarian lobes (?), a little away from isthmus & measures 0.213 in diameter.

9. Genital pore- small, round situated to the left of the centre & measures 0.053 in diameter.

10. Vitellaria- granular, thin strips, cortical on each lateral side, from the posterior margin of neck to ovarian lobe.

11. Uterus- Wide, convoluted starts from ootype, extending anterior to isthmus coiled loop shaped, transversely open separately by an uterine pore & measure 12.584 in length & 0.178–0.249 in width.
Uterine pore-medium, oval double walled slightly to the right of the centre of worm & medium 0.269 x 0.213 in breadth.

12. Host- *Mastacembellus armatus*.
Locality- Godavari River at Paithan district, Aurangabad Maharashtra.
Published in *Ind. Jour. Sci. & Edn*. vol 4(4): 5140-5143.

The present authors have gone through the above description which suffers from a number of lacunae. These are:

1. Abstract- In the abstract, Pardeshi (2016)[1] has stated the history instead of writing an abstract.

2. She has compared her specimens (*L. mastacembellusi* ?) with only *Lytocestus* (*filiformis, indicus, alestei, birmincus, javanicus, parvulus, longicollis*- total 7 species (vide serial 2,3,7,6,9 and 10 of list mentioned above) whereas prior to 2016, 50 species were reported.
3. At many places the worms has been spelt 'warm'.
4. Pardeshi (2016)[1] has not given the minimum and maximum values of the seven worms studied.
5. At many places only one measurement has been given. It is unthinkable to have single measurement- for seven worms studied (Head- 5.087, cirrus sac 0.714, cirrus- 1.250, vas deferens 0.303, ovarian isthmus 0.464, vagina- 3.499, uterus- 12.584 etc) (see-darkened measurements in text above) whereas she has provided a range at certain places.

It is unfortunate that Pardeshi declined to provide (US) a photomicrograph of the species for reviewing.

6. The author of the said species states "vagina is a thin tube, starts from genital pore, runsposteriorly in the middle of the worm, slightly curved runs posteriorly to the isthmus, reaches & opens into the ootype & measures 3.499 in length 0.035-0.053 in width".

Contrary to the opinion of Mackiewicz (1972)[68] who states "Vagina communicates between oviduct and the ventral surface (as per fig 67 Caryophyllidea-A review). At its proximal end it may join the uterus to form utero-vaginal duct (as in *C.laticeps* or *P.differtus*) opening posterior to the male gonopore or it may form the uterovaginal duct that also receives the ejaculatory duct thus forming a short distinct canal (hermaphroditic duct) that terminates at a small, common gonopore (as in Caryophyllaeids, *Isoglaridacris* and *Biacetabulum*)…. A third condition (as in *Aractolytocestus*) occurs when the ejaculatory duct and uterovaginal duct open together or very close to the surface forming a shallow atrium with a single large gonopore through which one can see the male and female gonopore." [See diagram below]

Vagina never opens in ootype neither starts from genital pore. It basically joins with uterus to form utero-vaginal canal which opens through a female gonopore behind male pore & on the other end joins with oviduct. [Diagram II).

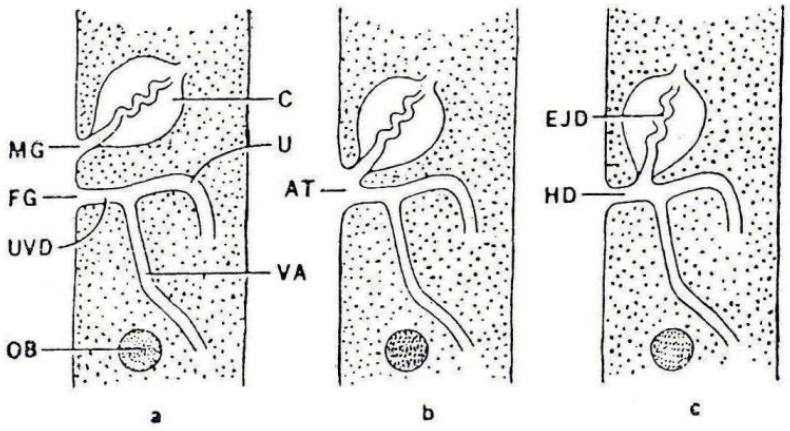

Fig. 1: Gonopore types as shown in midsagittal sections (diagrammatic) (After Mackiewicz, 1972)[68]

Abbreviations:

AT- atrium; C- cirrus; EJD- ejaculatory duct; FG- female gonopore; HD- hermaphroditic duct; MG- male gonopore; OB- Ovarian bridge or commissure; U- uterus; UVD- uterovaginal duct; VA- vagina

TESTIS

The present authors are amazed to see the patience of the author who observed 6000-6200 testicular follicles "distributed from one lateral to other lateral margin".

The later part of the statement in inverted comma is not clear, when every worker has observed the testicular follicles in medulla.Besides, a number of keys for identification of species based on number of testicular follicles have been provided by Jadhav, Bhure and Padwal (2008)[49], Solunke, Fadke, Borde & Jawle (2012)[59]& Jawle and Borde (2011)[57].

Species identification based on number of testicular follicles is rather questionable because, the range depicts that the worms in question were not of the same age and that the worms were more than one. If the worms are of the same age the number of testicular follicles should be constant for a species.

1. The range 230-270 of *L.indicus* Moghe (1925)[27] falls in the minimum maximum range 190-400 of *L.attenuatus* Tandon *et al.*(2005)[45]
2. The range of 460-480 of *L.alii* Jadhav *et al.* (1991)[35] fits very well in the range 400-500 given for the *L.follicularae* Bhure *et al.* (2010)[53]
3. The minimum (350) of *L.shindei* Khadap *et al.* (2004)[44] is the maximum of *L.osemanabadensis* Bhure *et al.* (2010)[53] i.e. 350.
4. In *L.indica* Deshmukh *et al.* (2015)[61] the number of testicular follicles ranges between 1000-1100. The maximum 1100 falls within the range of *L.nagapurensis* (1000-1150) or 1200 Lakhe *et al.* (2004)[43].
5. The maximum range 700 for *L.murhari* Kaul *et al.* (2010)[52] fits in the range 700-800 given for *L.clariasae* Jadhav *et al.* (1991)[35].
6. The maximum of 600 of *L.naldurgensis* Kadam *et al.* (1988)[36] fits very well with the minimum of 600 of *L.murhari* Kaul *et al.* (2010)[52].
7. The range 1425-1475 given for *L.govindae* Patil *et al.* (2002)[41] fits well in the range 1400-1500 given for *L.punensis* Jadhav *et al.* (2008)[49].

In case an investigator gets only one specimen of *Lytocestus* having testicular follicles being 230 where he would place the worm with *L.indicus* or *L. heteropneusti* ?

Therefore, the number of testicular follicles in *Lytocestus* species cannot be said to be a criteria for species identification. Hence, all keys based on testicular follicles becomes redundant & supposed to be of no. value- A suggestion proposed by Sahay, Singh and Saxena (2018)[69] vide *Trends in Parasitology* 2018 pp. 1-7 to which the present authors are in agreement.

It is quite possible that Pardeshi (2016)[1] might have counted some vitellarial follicle to be testicular foillicles (?)

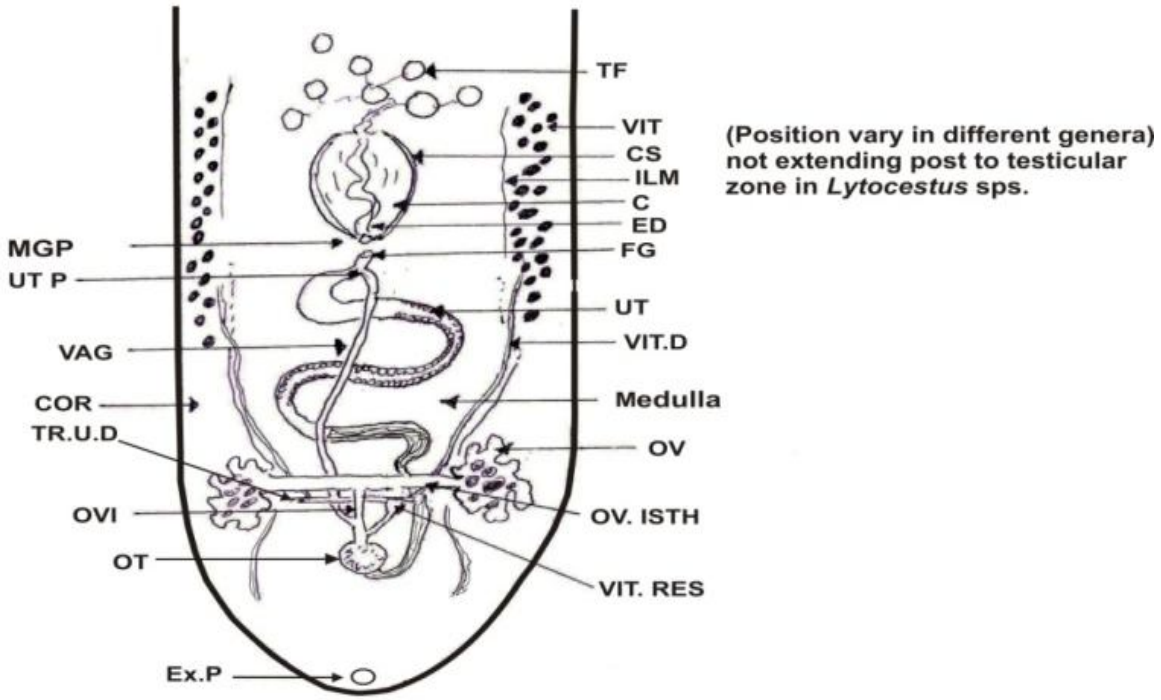

Fig. 2: Diagrammatic representation of post. End of a Caryophyllaeid species showing two ends of vagina, uterogenital duct ut.pore, and separate male & female genital pore etc.

VITELLINE FOLLICLES

Pardeshi (2016)[1] mentioned that *L.mastacembellusi* n.sp. (?) posses granular vitellaria. So far the authors are aware following species are claimed to have granular vitellaria.

1. *L.adhaerans** Cohn (1908)[8]
2. *L.chalisgaonensis* Khalse & Shinde (1999)[37]
3. *L.govindae* Patil and Yadav (2002)[41]
4. *L.shindei* Khadap *et al.* (2004)[44]
5. *L.nagapurensis* Lakhe *et al*. (2004)[43]
6. *L.paithanensis* Shelke (2007)[47]
7. *L.punensis* Jadhav *et al*. (2008)[49]
8. *L.khami* Jawle *et al.* (2011)[57]
9. *L.manjarensis* Solunke *et al.* (2012)[59]

*Jadhav, Bhure & Padwal (2008)[49] have stated that *L.adhaerans* Cohn (1908)[8] possess granular vitellaria.

Out of these *Lytocestus* (*chalisgaonensis, govindae, shindei, naldurgensis, punensis*) were synonymised with *Lytocestus indicus* Moghe (1925)[27] by Ash (2011, 2012)[62-64] although Sahay, Singh, Kamal & Jha (2018)[70] tentatively resurrected them yet THERE VALIDITY HAS TO BE JUDGED SEPARETLY- the present authors opine.

It has been pointed out by Sahay, Jha, Khalko & Sadaf (2012)[71] that possession of "granular vitellaria" was a stage of immaturity of the worm & possibility of their becoming follicular is always there. While tentatively revalidating *Lytocestoides lepidocephali* Kundu (1985)[72] Singh, Sahay and Saxena (2018)[73] considered that specimens with "granular vitellaria" is a state of immaturity & possibility of these becoming follicular is always there.

Likewise the present authors consider the presence of granular vitellaria in *Lytocestus mastacembellusi* Pardeshi (2016)[1] is a state of immaturity & should not have been considered for species identification.

This is substantiated by Pardeshi (2016)[1] herself who failed to mention about the presence of eggs in *L.mastacembellusi*- clearly indicate that the worms studied by her were immature.

Last but not the least, the author failed to provide a photomicrograph of the entire cestode, cross section of the worm to assess its placement in a suitable family.

The present authors are therefore left with the following option-

1. Invalidate the said species
2. Keep the worm in question under uncertae sedis
3. Request the author of the species to restudy the slides in her possession & clarify the status.

REFERENCES

1. Pardeshi K.S. (2016): Cestode; Lytocestus mastacembellusi. *Intl.Jour.Sci.* Res & Education. 4(4). 5140-5143.
2. Kulakovskaja O.P. and Demshin N.I. (1978): Origin and phylogenetic relationships of Caryophyllideans. In Problemy Gidro Parasitologii (Markevic, A.ed) pp. 95-104. *Riev. Naukova* Dumka.
3. Luhe M. (1910): Cestoden. In A. Brauer, Die Susswasser. *Fauna Deutschlands Heft*18, Gustav Fisher, Jena 153 pp.
4. Wardle R.A. and McLeod J.A. (1952): The Zoology of Tapeworms, University of Minnesota Press, Minneapolis p.780.
5. Mackiewicz J.S. and Blair D. (1978): *Balanotaeniidae* fam.n. and *Balanotaenia newguinensis* sp.n. (Cestoidea: *Caryophyllaeidae*) from *Tandanus* (Siluriformes: Plotosidae) in New Guinea. *J.Helminthology.* 52: 199-203.
6. Leuckart K.G.F.R. (1878): Archigetes sieboldi, eine gechlechtsreife cestodenamme. *Z.Wiss.Zool.* 30(Supplem): 593-606
7. Cooper A.R. (1920): *Glaridacriscatostomi* n.g.n.sp. from fresh water fish of India. *Proc. Helm. Soc. Wash.* 28(1): 38-50.
8. Cohn L. (1908): Die Anatomie eines neuen Fishcestoden. *Centralbl. Bakt. Parasitenk*, 46: 134-139.
9. Nybelin O. (1922): Anatomisch-systematich studien uber *Pseudophyllidien*. *Goteborgs Kgl. Velensks-Amt. Handl.* 26: 1-228.
10. Johnston T.H. (1924): An Australian Caryophyllaeid cestode. *Proc. Linn. Soc.* New South. Wales. 49: 439-447.
11. Fuhrmann O and Baer J.G. (1925): Zoological results of third Tanganyika expedition conducted by Dr. W.A Cunnington 1904-1905. Report on the Cestoda. *Proc. Zool. Soc. Lond.* 79-100
12. Bovien P. (1926): Caryophyllaeidae from Java. *Videnskabelige Meddelelser Fra Dansk. Naturhistorisk Forening Kobenhavn.* 82: 157-181.
13. Baylis H.A. (1928): Some parasitic worms mainly from fishes from Lake Tanganyika. *Annalis and Magazine of Natural History,* 1: 552-562.

14. Woodland W.N.F. (1937): Some cestodes from Sierra Leone. II A new Caryophyllaeid *Marsypocephalus* and *PolyonchobothriumProc. Zool. Soc. London.* Sec B: 189-197.
15. Hsu H.P. (1935): Contributions a Letu de des Cestodes de China. Rev. Suise. Zool. 42: 477-570.
16. Johnston T.H and Muirhead N.G. (1950): Some Australian Caryophyllaeid cestodes *Rec. S. Austr. Mus.* 9(3): 339-348.
17. Anthony J.D. (1958): *Atractolytocestushuronensis* n. sp. (Cestoda:*Lytocestidae*) with notes on its morphology. *Tr. An. Micr.Soc.* 77: 383-390
18. Gupta S.P. (1961): *Caryophyllaeids* (Cestoda) from freshwater fishes of India. *Proc. Helm. Soc. Wash*. 28(1): 38-50.
19. Murhar B.M. (1963): *Crecentovitusbiloculus* gen.nov; sp.nov a fish (Cestode: *Caryophyllaeidae*) from Nagpur. India. *Parasitology*. 53: 413-418.
20. Kulakovaskaja O.P. and Akhmerov O.K. (1965): A new cloverheaded worm *Markevitschiasagitatan.g.n.sp.* (Cestoda: Lytocestidae) from common carp in the Amur River. *Problemy Parasitologie,*4: 264-271
21. Mackiewicz J.S. and Blair D. (1980): *Caryoaustralus* gen. n. and *Tholophyllaeus* gen. n. (Lytocestidae) and other caryophyllid cestodes from *Tandanus* spp. (Siluriformes) in Australia. *Proceedings of the Helminthological Society of Washington*, 47: 168–178.
22. Sahay S.N. (1979): Studies on some Trematodes, Nematodes and Cestodes of Chotanagpur Ph.D Thesis Ranchi University, Ranchi.
23. Satpute L.R. and Agarwal S.M. (1980): *Introvertus raipurensis* gen.nov.sp.nov. a fish cestode (Cestoda: Caryophyllidea:Lytocestidae) from Raipur, India. *Proc. Ind. Acad. Parsitol,* 1: 17-19.
24. Oros M., Anirban Ash, Jan Brabee, Pradip Kar and Thomas Scholz (2012): A new monozoic tapeworm, *Lobulovariumlongivatum* n.g n.sp. (Cestoda:Caryophyllidea) from barbs *Puntius* spp. (Teleostei:Cyprinidae) in The Indomalyan region. *Syst. Parasitol.* 83: 1-13.
25. Yamaguti S. (1959): Systema Helminthum. The cestode of vertebrates.vol II 1-860 Inter Science Publishers INC, New York.
26. Woodland W.N.F. (1923): On some remarkable new forms of *Caryophyllaeidae* from Anglo Egyptian Sudan and a revision of the families of Cestodaria. *Q.J.Microsc. Sci.* 67: 435-472.
27. Moghe M.A. (1925): *Caryophyllaeus indicus* n.sp. (Cestoda) from the catfish *Clarias batrachus*. (L). *Parasit*. 17: 232-235.
28. Woodland W.N.F. (1926): On the genera and possible affinities of the Caryophyllaeidae: a reply to Dr. O. Fuhrmann and J.G Baer. *Proc Zool Soc Lond.* 49-69.
29. Lynsdale J.A. (1956): On two new species of *Lytocestus* from Burma and Sudan respectively. *J. Helm*. 30(2-3): 87-96.
30. Furtado J.I. (1963): A new Caryophyllaeid Cestode *Lytocestus parvulus* sp.nov. from a Malayan catfish. *Ann. Mag. Nat.Hist* (Ser. XIII) 6: 97-106.
31. Ramadevi P. (1973): *Lytocestus longicollis* sp. nov. (Cestoda:Caryophyllidea) from the catfish, *Clarias batrachus* in India. *J.Helm*. 47(4): 415-420.
32. Furtado J.I and Jan Kim-Low (1973): Incidence of some helminth parasites in the Malaysian Catfish *Clarias batrachus* (L) *Verhandlungen Internationale fur Theoritische and Angewandte Limnologie.* 18(3): 1674-1685.
33. Singh S.S. (1975): On *Lytocestus fossilis* n.sp. (Cestodea: Lytocestidae) from *Heteropneustus fossilis* from Nepal. In Dr. B.S. Chauhan commemoration volume K.K.Tiwari and CB Srivastava (eds) Zool. Soc. of India. Utkal Univ. Vani Vihar Orrisa. 79-82.
34. Shinde G.B. and Phad A.N. (1988): On a new Cestode *Lytocestus marathawadensis* from freshwater fish. *Riv. Di Parasit*. 47(2): 295-298.
35. Jadhav B.V. and Ghavane A.V. (1991): Two new Cestodes from Caryophyllaeidae at Aurangabad. *Ind.J.inv.zool and Aq. Biol*. 3(1): 28-31.
36. Kadam M.N., Hiware C.J. and Jadhav B.V. (1998): On a new Caryophyllaeid Cestode Genus *Lytocestus* Cohn, 1908 from *Clarias batrachus* Dr. B.A.M. Univ. Aurangabad *J.of.Sci.* 29(6): 143-148.
37. Khalse A.T. and Shinde G.B. (1999): *Lytocestus chalisgaonensis* n. sp. (Cestoidia: Caryophyllidea) from catfish *Clarias batrachus* at Chalisgaon M.S. India. *Riv.Di.Parasit.*XVI(LX)N-1: 39-42.
38. Shinde G.B. and Sunita Borde (1999): On *Lytocestus kopardaensis* n.sp. Cestoode (Lytocesidae: Hunter) from a fish in Maharashtra State India. *Utt.Pra.Jour*. 19(3): 211-213.
39. Kolpuke M.N., Shinde G.B. and Begum I.J. (1999): On a new species of the genus *Lytocestus* Cohn, 1908 (Cestode: Caryophyllidea) from *Wallago attu* from Terna river at Aurangabad, India. *Uttar Pradesh.J.Zool.* 19(1): 93-95.
40. Pawar S.B and Shinde G.B. (2002): A new species *Lytocestus clariasae* n.sp. (Cotyloda: Lytocestidae) from *Clarias batrachus* at kallam, India. *Riv.Di.Parasit.* XIX(LXIII), 2: 157-160.
41. Patil D.N and Yadhav B.V. (2002): On a new Caryophyllaeid Cestode of the genus *Lytocestus* Cohn, 1908 from *Clarias batrachus*. *Ind.J.Helm*. (N.S). 20: 45-48.
42. Shomendra M., Jha A.N. and Pankaj Kumar (2003): A new cestode *Lytocestus bishnupurensis* from a fresh water fish *Mystus senghala* (Sykes). *J.Freshwater.Biol.* 15(1-4): 43-45.
43. Lakhe A.D., Pawar and Shinde G.B. (2004): A new cestode *Lytocestus nagapurensis* n.sp. (Cotyloda: Lytocestidae). *Riv.Di.Parasit*. XXI(LXV-N-2): 95-98.
44. Khadap R.M., Jadhav B.V. and Suryavanshi N.V. (2004): A new species of the genus *Lytocestus* (Cohn, 1908) from *Clarias batrachus* at Aurangabad. *Nat.J.Life.Sciences*. 1(2): 413-416.
45. Tandon V., Chakravarty R. and Das B. (2005): Four new species of the genus *Lytocestus* (Caryophyllidea: Lytocestidae) from edible catfishes in Assam and Meghalaya, India. *Jour.Parasitic.Diseases.* 29(2): 131-142.
46. Poonam (2007): On a new species of the genus *Lytocestus* (Caryophyllidea:Lytocestidae) from *Clarias batrachus*. *Proc.Zool.Soc.India*. 6(1): 77-81.
47. Shelke V.P. (2007): *Lytocestus paithanensis* n.sp. from *Clarias batrachus. Nat.J.Life. Sciences.* 4(3): 151-152.

48. Tripathi N.P., Singh S.P. and Mishra A.K. (2007): A new species of the genus *Lytocestus* (Cestoda:Lytocestidae) from *Heteropneustes fossilis* at Rewa, M.P., *Nat.J.Life.Sciences*, 4(3): 111-114.

49. Jadhav B.V., Bhureand D.B. and Nitin Padwal (2008): Caryophyllidean review from catfishes of Maharashtra (India). *Flora and Fauna*. 14(1): 3-92.

50. Jawalikar J.D., Pawar S.B. and Shinde G.B. (2008): A new species *Lytocestus subhapradhi* n.sp. (Eucestoda: Lytocestidae) from *Clarias batrachus. UttarPradesh.J.Zool*. 28(3): 354-369.

51. Sharma Bindu (2009): Ph.D thesis.

52. Kaul S.S., Kalse A.T. and Suryavanshi R.B. (2010): *Lytocestus murhari* sp.nov. (Cestoda:Caryophyllidea) from the catfish *Clarias batrachus* (L) at Chalisgaon. *Decc.Curr.Sci*. 3(1): 73-84.

53. Bhure D.B., Waghmare S.B., Kasar C.R. and Shaikh K.M. (2010): Taxonomic observation of the Caryophyllidean tapeworm *Lytocestus* Cohn, 1908 from *Clarias batrachus* (Linneus, 1758). *J.Eco.Environ.Sci*. 1(1): 01-06.

54. Suryavanshi S.G., Maske D.K., Shinde G.B. and Bhagwan H.K. (2010): A new tapeworm *Lytocestus shindei* n.sp. (Cestoda: Lytocestidae) from *Clarias batrachus* at Rahuri district Ahmednagar (M.S) *Life.Sc.Bull*. 1: 148-150.

55. Pawar R.T and Hiware C.J. (2011): Two new species of the genus Lytocestus (Caryophyllidea: Lytocestidae) from freshwater catfish *Clarias batrachus* (Linnaeus, 1758). *Recent Research in Sciences & Technology.* 3(12): 25-28.

56. Kadam K.N. and Jaswant S. Dhole (2011): New tapeworm *Lytocestus gariepinusae* n.sp. from a freshwater fish *gariepinus* at Makani Dam, Dist. Osmanabad M.S. India. *Recent.Res.Sc.Tech*. 3(8): 19-23.

57. Jawale Sushil and Sunita Borde (2011): New species of the genus *Lytocestus* (Caryophyllidea: Lytocestidae) from catfish at Aurangabad district (M.S) India. *Int.Multidisciplinary Res.J.,* 1(8): 27-30.

58. Sawarkar B.W. (2012): Record of new tapeworm *Lytocestus alii* n.sp. from freshwater fish *Clarias batrachus* (Bleeker, 1862) at Amravati, Maharashtra, India,. *Jour.of Biology & Life Sciences*. 3(1): 281-287.

59. Solunke Ravi, Swati Fadke, Sunita Borde and Sushil Jawale (2012): New species of the genus *Lytocestus* (Caryophyllidea: Lytocestidae) from cat fish in Latur district M.S. India, *Trends in Parasitology Research*. 1(2): 25-30

60. Nimbalkar R.K., Deolalikar R.V. and Muley S.P. (2012): Study on a new species of *Lytocestus* (Cohn, 1908) *Heteropneustes fossilis* (Bloch) at Jaiwadi Dam of Aurangabad district (M.S). *Life Science Bulletein*. 9(2): 239-242.

61. Deshmukh V.S., Nanware and Bhure D.B. (2015): Biosystematic studies on Caryophyllidean cestode genus *Lytocestus* from freshwater catfish *Clarias batrachus* with description of new species. *Flora & Fauna,* 21(2): 179-190.

62. Ash A., Scholz T., Oros M. and Kar P. K. (2011 a): Tapeworms (Cestoda: Caryophyllidea), parasites of *Clarias batrachus* (Pisces: Siluriformes) in the Indomalayan Region. *Journal of Parasitology*. 97(3): 435–459.

63. Ash Anirban, Thomas Scholz., M. Oros, Celine Levron and Pradip Kumar Kar (2011 b): Cestodes (Caryophyllidea) of the stinging catfish *Heteropneustes fossilis* (Siluriformes: Heteropneustidae) from Asia. *Journol of Parasitology.* 97(5): 899-907.

64. Ash Anirban (2012): Diversity of tapeworms (Cestoda) in freshwater fishes of India. Ph.D thesis. School of Doctoral Studies in Biological Sciences, University of South Bohemia in Ceske Budejovice Faculty of Science. 1-135.

65. Gupta V. and Singh S.R. (1983): On a new species *Pseudocaryophyllaeus ritai* sp.nov. (Family Caryophyllaeidae) from the intestine of a freshwater fish, *Rita rita*, from river Gomati at Lucknow, *U.P. Ind. Jour. Helminth*. 35 (1): 11-14.

66. Sahay Umapati, Dimple Mandal, Nayni Saxena and Ravi Rahul Singh (2017: On the validity of *Lytocestus heteropneustii* (cestode) Tandon, Chakravarty & Das 2005- a critical review. *Biospectra,* 12(2):115-120.

67. Singh Ravi Rahul, Umapati Sahay and Fauzia Sadaf (2018): On the synonymy of *Lytocestus bishnupurensis* Shomendra *et al.* (2003) with *L.indicus* Moghe (1925). *Jour. of Exp. Zool*. 21(2): 893-896

68. Mackiewicz J.S. (1972): Caryophyllaeidae (Cestoidea): A review. *Experimental Parasitology*. 31: 417-512.

69. Sahay Umapati, Ravi Rahul Singh and Nayni Saxena (2018): On the status of *Lytocestus indica* (Lytocestidae: caryophyllidea) Deshmukh *et al.* 2015- A critical review. *Trends in Parasitology Research*. 7(1): 1-7.

70. Sahay Umapati, Ravi Rahul Singh, Shalini Kamal and Anita Jha (2018): On the resurrection of certain *Lytocestus* species (Caryophyllidea: Lytocestidae) showing granular vitellaria - a critical study.). *Jour.of Exp. Zool*. 21(2): 1271-1276.

71. Sahay Umapati, Anita Jha, Khalkho A.P.V. and Fauzia Sadaf (2012): On the status of genus and species of *Lytocestoides* Baylis, 1928 (Cestoda: Caryophyllidea) - a review. *Biospectra*, 7(4): 77-82.

72. Kundu D.K. (1985): On a new species of the genus *Lytocestoides* Baylis, 1928 (Cestoidea: Caryophyllidea : Lytocestidae) from a Cobitid fish *Lapidocephalusguntea* (Ham) from West Bengal. *Bull. Zool. Sur. India.*,7(2-3): 285-290.

73. Singh Ravi Rahul, Umapati Sahay and Nayni Saxena (2018): On the revalidation of *Lytocestoides lepidocephali* Kundu, 1985 - a critical analysis. *Flora and Fauna*. 24(2): 355-361

74. Hunter G.W. (1927): Notes on the *Caryophyllaeidae* of North America. *Journal of parasitology,* 14: 16-26.

75. Mackiewicz J.S. (1962): Systematic position of *Lytocestus* from Burma & Sudan respectively *J.Helm*. 30(2-3): 87-96.

76. Chakravorty R. and Veena Tandon (1989): On the recent status of caryophyllidea with a report on some caryophyllaeid infections in the fresh water catfishes *Clarias batrachus* (L) in North east India and record of an anomalous form. *Indian J. Helminth* (n.s). 5(1): 37-54.

77. Gupta S.P. and N. Sinha (1984): On three new species of Caryophyllaeids from fresh water fishes of Lucknow. *Indian J. Helminth.* 36(1): 73-80.

78. Hafeezullah M. (1993): Caryophyllidean Cestode Fauna of India (Occasional paper no.157). *Rec. Zool. Sur. India*, pp 1-101.

79. Niyogi A., Gupta A.K. and Agarwal S.M. (1982): Morphology of *Lucknowia indica* sp.n. (Lytocestidae: Caryophyllidea), *Proc. Indian Acad Parasitol*. 3(1&2): 17-22.