MORPHOLOGY
Lytocestus moghei n. sp.

Fig. 1. Scolex enlarged.

Fig. 2. Eggs enlarged.

Fig. 3. Posterior part of body enlarged.
Class : Cestoda

Sub Class : Cestodaria Monticelli, 1892

Order : Caryophyllidea Ben. and Olsson, 1893

Family : Lytocestidae Mackiewicz, 1972

Sub Family : Lytocestinae Satpute and Agrawal, 1980

Genes : Lytocestus Cohn, 1908.

L. moghei n.sp.
Lytocestus moghei n.sp.

(Fig. 1 - 3)

The worms are creamy white in colour elongated measuring 6.17 to 32.44 (15.26) mm in length and 0.82 - 1.56 (1.11) mm in breadth. The scolex is well marked. The body is differentiated into three parts based on the distribution of testes (pre-testicular, testicular and post-testicular.) The pre-testicular part of the body measures 2.5 - 6.7 (3.2) mm in length and 2.4 - 3.3 (2.8) mm in width. The testicular part of the body measures 2.17 - 22.48 (17.5) mm in length and 2.8 - 3.5 (2.9) mm in width, whereas the post-testicular part of the body measures 1.5 - 4.4 (3.2) X 2.1 - 2.4 (2.2) mm.

The testes are numerous distributed in cortical region of the body from slightly behind the anterior vitelline follicles and extend up to anterior border of cirrus. Each testes measures 0.1 - 0.2 (0.15) mm in diameter. The shape of testicular follicles in most of the cases rounded. From each testes minute vasa eferentia arises and opens into vas deferens. The vas deferens enters into the cirrus sac, get convoluted and dilate to form vesicula seminales interna. The size of seminal vesicle ranges from 0.25-0.28 (0.26) X 0.152-0.15 (0.17) mm. The cirrus sac is thin walled, rounded in shape highly muscular measuring 0.68-0.72 (0.7) mm in diameter. Posteriorly, it opens out through male gonopore which is sub-terminal in position. The size of male gonopore ranges from 0.08 - 0.12 (0.1) mm in length and 0.21 - 0.23 (0.22) mm in width. The prostrate glands are wanting.

The ovary is in last portion of the body bilobed, ovarian follicles are cortical in position. The central isthmus gives off a small oviduct which opens at ootype complex. The size of ovary ranges from 0.6 - 0.9 (0.75) mm in length and 0.32-0.45 (0.39) mm in width. The individual ovarian follicles are rounded in shape and measures 0.02 - 0.09 (0.06) mm in diameter. The
ootype complex is oval in shape, transversely elongated situated posterior to ovary measuring 0.22-0.28 (0.25) mm X 0.32-0.36 (0.34) mm in size. Besides the oviduct, common vitelline duct, uterus and female genital duct also open at ootype complex. The uterus is in the form of elongated coiled tube forming many loops between the ootype complex and posterior margin of the cirrus in the cortical region of the body. The wall of the uterus is glandular having prominent nuclei. The vagina is funnel shaped, present just behind the cirrus sac and extend downwardly and opens at ootype complex in the form of utero-vaginal canal. The vitelline follicles are in the form of two lateral rows extending from neck region of the body upto anterior border of the cirrus. The eggs are oval measuring 0.04 - 0.05 (.045) mm in length and 0.031 - 0.35 (0.033) mm in width. These are golden brown in color, thick shelled, operculate having single prominent nucleated cell and reserve food material. These are embryonated. The excretory bladder is present at posteriormost extemity of the body, triangular in shape measuring 0.11 00.13 (0.12) X 0.22-0.26 (0.24) mm in size. From the excretory bladder two pairs of excretory duct arise which extend anteriorly.

**DISCUSSION**

Cohn (1908) erected the genus *Lytocestus* under the family Lytocestidae Mackiewiez 1972. The present form belongs to the genus *Lytocestus* on the basis of having the following characteristics -

Body elongate, tapering anteriorly, scolex undifferentiated, inner longitudinal muscles in a ring around testes. Testes in broad median field of preuterine medulla, vas deferens convoluted, leading into compact parenchymateous mass, not sharply demarcated from surrounding and containing numerous dorsoventral muscle fibres, in which the thin walled wide ejaculatory duct is winding. Cirrus with strong muscular wall, opening
into deep narrow midventral pit. Ovary bilobed, with lateral lobes outside of inner, longitudinal muscle sheath. Vitellaria surrounding inner longitudinal muscle sheath in testicular zone, no postovarian 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 the cirrus.

To the best of my knowledge, so far following species are known under the genus from different parts of the world including India viz,

1) *L. adhaerens* (Woodland, 1923) Fuhrmann and Baer, 1925
2) *L. filiforms* (Woodland, 1923) Fuhrmann and Baer, 1925
3) *L. indicus* (Moghe, 1925) Woodland 1926
4) *L. javanicus* (Bovien, 1926) Furtado, 1963
5) *L. birmanicus* Lynsdale, 1956
6) *L. parvulus* Furtado, 1963
7) *L. longicollis* Ramadevi, 1973
8) *L. fossilis* Singh, 1975

The present form differs from all these species except *L. fossilis* in position of ovary, uterus, genital aperture and size of egg, besides other body measurements. However, it differs from *L. fossilis*, in presence of post ovarian vitelline gland and absence of recepticulum seminis. The present form is, therefore, described as a new species viz., *L. moghei* n.sp., named in honour of Dr. M.A. Moghe, for his valuable contribution in the field of helminthology.
Introvertus indicus n.sp.

Fig. 1. Anterior part of the body enlarged.

Fig. 2. Scolex (protruded) enlarged.

Fig. 3. Scolex enlarged.

Fig. 4. Eggs enlarged.

Fig. 5. Posterior part of body enlarged.
Class : Cestoda
Sub Class : Cestodaria Monticelli, 1892
Order : Caryophyllidea Ben. and Olsson, 1893
Sub family : Lytocestinae Satpute and Agrawal, 1980
Genus : Introvertus Satpute and Agrawal, 1980

*Introvertus indicus* n. sp.
*Introvertus indicus* n. *sp.*

(Fig. 1–5)

The body of the worm is elongated, creamy white in colour in live condition. The holdfast is fairly set off from the body proper. Total length of body ranges from 0.85 - 36.80 (22.48) mm. The width of worm ranges from 0.85 - 1.68 (1.27) mm. On the basis of distribution of testes in the body, it is divisible into 3 parts: pre-testicular part, testicular part, and the post-testicular part. The pre-testicular part measures 1.60 - 7.90 (4.75) X 0.23 - 0.68 (0.46) mm. The testicular part of the body measures 4.85 - 25.48 (15.17) X 0.75 - 1.45 (1.15) mm. The post-testicular part of the body measures 1.55 - 2.85 (2.2) X 0.85 - 1.68 (1.27) mm. The holdfast is provided with a pair of groove, extending across the longitudinal axis of the body and a well developed introvert. The size of holdfast ranges from 2.5 - 3.8 (3.15) X 0.45 - 0.68 (0.57) mm. The introvert terminates blindly and is swollen to form a knob-like structure measuring 0.5 - 0.6 (0.55) mm X 0.04 - 0.06 (0.05) mm. It has an elongated neck measuring 0.52 - 1.2 (0.7) mm in length and 0.2 - 0.3 (0.22) mm in width.

Testes are numerous, medullary in position, strew in central portion of the body and distributed from shortly behind the outset of vitelline follicles and extend up to the anterior border of the cirrus. These are rounded in shape each measuring 0.04 - 1.8 (0.92) mm in diameter. From each testes, a fine vasa efferentia arises which joins to form a vas deferens. The vas deferens extends posteriorly and after reaching in posterior 1/8th of the body, immediately anterior to cirrus sac, dilate to form a fusiform vesicula seminalis externa. The size of seminal vesicle ranges from 0.12 - 0.24 (0.18) X 0.11 - 0.18 (0.15) mm. From seminal vesicle a fine ejaculatory duct arises and enters into cirrus sac forming a loose coiling and terminates in a wide
oriphice of male gonopore. The cirrus sac is massive, elongate oval centrally placed structure measuring 0.35-0.48 (0.42) X 0.25 - 0.36 (0.31) mm in size. Prostrate glands are absent.

Ovary is located in posterior most body compartment, above the ootype complex. It is 'H' shaped structure. The right of lobe ovary is larger as compared to left lobe. The right lobe measures 0.40-0.5 (0.45) X 0.12-0.18 (0.15) mm. The left lobe of ovary measures 0.5-0.6 (0.55) X 0.11-0.14 (0.12) mm. The isthmus which joins both the ovarian lobes is a transversely elongated structure, measuring 0.08 - 0.12 (0.10 )X 0.51 - 0.64 (0.58 ) mm. Individual ovarian follicles are rounded in shape each measuring 0.02 - 0.08 (0.05 ) mm in diameter. The ootype complex is situated just beneath the isthmus of ovary, rounded in shape measuring 0.12 - 0.15 (0.14 ) mm in diameter. In ootype complex, oviduct, common vitelline duct and a fine duct from receptacula seminalis opens. However, the uterus extends from ootype complex in its anterior direction. The receptaculum seminalis is fusiform structure, located just anterior to ovarian isthmus measuring 0.2-0.3 (0.25)X 0.13 0.17 (0.10) mm. The uterus is found extended between posterior border of cirrus and anterior margin of ovarian isthmus. It is largely packed with eggs. The vitelline follicles are found distributed irregularly in cortical region of the body from behind the neck upto its posterior extremity. The eggs are thick shelled, oval, operculated, measuring 0.06-0.09 (0.08) X 0.03-0.05 (0.04) mm. These are embryonated and well equipped with reserve food material.

The excretory bladder is club shaped measuring 0.08-0.12 (0.10) mm.

Discussion

Satpute and Agrawal (1980) erected the genus *Introvertus* for the worms collected from duodenum of *Clarias batrachus* at Raipur, M.P. The present form belongs to the genus *Introvertus* on account of having following characters: -

1. Holdfast having a pair of grooves and a terminal introvert.
2. Presence of narrow and elongated neck.

3. Testes numerous, medullary in distribution from the level of vitelline follicles anteriorly and the level of cirrus sac posteriorly.

4. Vas deferens, loosely coiled, vesicula seminalis externa present.

5. Cirrus bell shaped, massive.

6. Ovary in last 10th of body, bilobed, joined by isthmus.

7. Ootype complex posterior to ovary.

8. Receptaculum seminalis present.

9. Female genital aperture opposite to cirrus.

10. Vitellaria distributed in pre and post ovarian zones.

11. Eggs thick shelled, smooth and operculate.

To the best of my knowledge, till date the only known species under the genus *Introvertus* is *I. raipurensis* Satpute and Agrawal, 1980. The present form differs from it in following features -

i) Presence of vitelline glands in pre-testicular zone.

ii) Having much elongated neck.

iii) Shape of vitelline glands.

iv) Shape of testes.

These features are sufficient enough to establish a new species viz., *I. indicus* n. sp., with a new host record as found parasitizing *Heteropneustes fossilis* Bloch.
*Capingentoides globosa* n. sp.

Fig. 1. Posterior part of body enlarged.

Fig. 2. Anterior part of body enlarged.

Fig. 3. Eggs enlarged.
Class : Cestoda
Sub Class : Cestodaria Monticelli, 1892
Order : Caryophyllidea Ben. and Olsson, 1893
Family : Caryophyllaeidae Mackiewiez, 1972
Genus : Capingentoides Gupta, 1961

C. globosa n. sp.
Capingentoides globosa n. sp.

(Fig. 1-3)

The body of worm is elongated, dorsoventrally flattened, unsegmented, broader in posterior part and tapers anteriorly to form a scolex. The scolex is fairly set off from the body proper with the help of a short and narrow neck. The total length of body ranges from 9.92 - 16.34 (13.15) mm and 3.24-4.58 (3.9) mm in width. The scolex is cone shaped fringed structure measuring 0.5-0.6 (0.55) X 0.3-0.4 (0.25 ) mm in size. The neck is very short and narrow measuring 0.22 - 0.26 (.24 ) mm X 0.15 - 0.16 (0.15 ) mm . The trunk region of the body is divisible into 3 parts :

1. Pre-testicular part measuring 1.4 - 2.8 (2.1) X 0.50-0.6 (0.55 ) mm in size .

2. Testicular part measuring 4.8 - 6.6 (5.7 ) X 0.6-0.8 (0.7 ) mm in size .

3. The post - testicular part measures 1.1-1.56 (1.34 ) X 0.6-0.8 (0.7) mm in size .

Testes are numerous, distributed in medullary region of the body, from shortly behind the beginning of vitelline follicles and upto the anterior margin of the uterus. The testes are oval, transversely elongated in shape and each measuring 0.02 - 0.03 (0.025) X 0.05-0.08 (0.065) mm in size. The vas deferens is loosely convoluted tube before entering into the cirrus sac. The cirrus is a massive rounded structure situated immediately anterior to the uterus measuring 0.11-0.14 (0.12) mm in diameter. The seminal vesicle is a highly convoluted structure situated inside the cirrus and occupy almost
at Guwahati. The present form belongs to the genus *Capingentooides* on the basis of having following features:


To the best of my knowledge, so far following five species are known under the genus *Capingentooides* Gupta, 1961

1. *C. batrachii* Gupta, 1961
2. *C. singhi* Verma, 1971
3. *C. moghei* Pandey, 1973
4. *C. heteropneustusi* Gupta and Sinha, 1979
5. *C. gorakhnathai* Agrawal and Singh, 1985

The present form differs from *C. batrachii* in having fringed scolex, shape of eggs, shape of ovary and shape of cirrus sac.

The present form differs from *C. singhi* in having fringed scolex, extension of uterine coils and having vitellaria posterior to ootype complex.

The present form differs from *C. moghei* in having shorter neck, shape of scolex and distribution of vitelline follicles.
It differs from *C. heteropneustusi* in having different shape of scolex, less elongated neck distribution of testes and shape of ovary.

Moreover, it differs from *C. gorakhnathai* in shape of ovary, position of cirrus and shape of cirrus.

The present form is therefore, described here as new species viz., *C. globosa* n. sp., on account of having globular and fringed scolex.
*Lucknowia ovocompactum* n.sp.

Fig. 1. Scolex enlarged.

Fig. 2. Eggs enlarged.

Fig. 3. Posterior part of body enlarged.
Class : Cestoda

Sub Class : Cestodaria Mounticelli , 1892

Order : Caryophyllidea Ben. and Olsson ,1893


Sub family : Lytocestinae Satpute and Agrawal , 1980

Genus : Lucknowia Gupta , 1961

L. ovocompactum n. sp.
Lucknowia Ovocompactum n.sp
(Fig. 1-3)

The worms are whitish yellow in colour and elongated. The length of worm ranges from 8.07-35.91 (21.83) mm. The breadth of the worm is 1.15-1.81 (1.62) mm. The holdfast is bluntly pointed measuring 1.2 - 1.18 (1.15) mm in length and 0.3-0.4 (0.35) mm in width. The body is differentiated into three parts viz., pre-testicular, testicular and post-testicular. The pretesticular part of the body is very short measuring 0.1-0.3 (0.2) mm in length and 0.41 - 0.56 (0.48) mm in breadth. The testicular part of the body is however, considerably long measuring 3.6-14.6 (8.18) mm in length and 0.61 - 1.85 (1.23) mm in breadth. The post - testicular part of the body ranges from 0.77-2.2 (1.48) mm in length and 1.32-1.6 (1.45) mm in breadth. The unfixed contracted worms considerably differ from the flattened and fixed worms as far as the length of different sections of the body are concerned. In unfixed specimens it was seen that the testicular and post testicular part of the body shows several lateral constrictions and in outline they appears to be pseudosegmented.

The testes are numerous distributed in medullary part of the body upto the level of cirrus sac. The testes are transversely elongated measuring 0.04 - 0.06 (0.05) mm in length and 0.07-0.11 (0.09) mm in breadth. In most of the cases they are transversely elongated and occupy a broad area between the anterior vitelline follicles and cirrus sac, bounded laterally by the vitelline follicles. From each testes, minute vasaferentia arises which join each other and finally open into a thin walled non - muscular tube, the vasdeferens. The vasdeferens extend posteriorly and dilate to form a seminal vesicle before entering into cirrus sac. The size of seminal vesicle ranges from 0.0152 - .022 (0.18) mm in length and 0.011 - 0.014 (0.03) mm in
breadth. The cirrus sac is highly muscular, transversely elongated, oval in outline in post equatorial part of the body. It measures 0.02 - 0.03 (0.025) mm in length and 0.04 - 0.05 (0.045) mm in breadth. Inside the cirrus, there exists a convoluted ejaculatory duct, cirrus is eversible, aspinose, roughly funnel shaped in outline measuring 0.004-0.006 (0.005) mm in length and 0.011 - 0.015 (0.013) mm in breadth. The prostrate glands are absent and the male gonopore is situated at the posterior extremity of the cirrus sac.

The ovary is follicular, lobed and posterior in position, just behind the ootype complex. The length of ovary ranges from 0.31 - 0.35 (0.33) mm. The breadth of ovary ranges from 0.27-0.32 (0.29) mm. The size of individual ovarian follicle ranges from 0.04-0.07 (0.06) mm. A short oviduct arises from the anterior border of ovary, ascend anteriorly and open at ootype complex. The ootype complex is rounded in shape measuring 0.05 - 0.08 (0.06) mm. Besides, the oviduct two more ducts also open at ootype complex viz., common vitelline duct and a fine duct from receptaculum seminalis. The uterus starts from the posterior border of ootype complex, descend downwardly beneath the ovary, after reaching at the posterior apex of ovary, ascend once again and starts forming glandular uterus. The glandular uterus is found extended between the receptaculum seminalis and cirrus sac. The lateral extension of glandular uterus reach upto the uterine follicles situated on the either lateral sides of the body. The uterine gland cells are equipped with prominent nuclei. The vagina is funnel shaped, present just behind the cirrus sac extend downwardly. After reaching at the level of common vitelline duct, it dilates to form a transversely elongated receptaculum seminalis measuring 0.5 - 0.08 (0.07) mm in length and 0.12 - 0.16 (0.14) mm in width. The eggs are rounded, thin shelled measuring 0.021-0.025 (0.023) mm in diameter. These are non operculated and without
any polar elongation. The vitelline follicles are cortical in position extend from testicular region of the body upto hind end.

The excretory system is not clearly visible as the region is highly occupied with well developed ovary. The excretory bladder is however present measuring 0.05-0.07 (0.06) mm in length and 0.03 - 0.06 (0.04) mm in width.

**DISCUSSION**

Gupta (1961) established the genus *Lucknowia* for the monozootic cestodes collected from the intestine of *Heteropneustes fossilis*, a fresh water fish of the river Gomti, Lucknow, with *L. fossilisi* as type species having following generic diagnosis

Lytocestinae, scolex unspecialized, varying little in shape and not broader than remainder of body. Cirrus sac and uterovaginal canal open separately at the beginning of last seventh of body length. Uterine and vaginal pores common. Ovarian follicles cortical, commissure or isthmus being medullary. Uterine coils much convoluted, compactly coiled behind ovarian isthmus and not extending anterior to cirrus sac. Uterine glands present. Receptaculum seminis absent. Vitellaria cortical and extending up to posterior end of body. Terminal excretory bladder present.

The present form belongs to the genus *Lucknowia*, Gupta 1961 on the basis of following characters.

i) Scolex non specialized, constant in shape and not broader than the remaining part of the body.

ii) Cirrus sac and uterovaginal canals open separately in posterior 1/7 th part of the body.
iii) Uterine and vaginal pores common. Uterine coils convoluted and not extending beyond the cirrus.

iv) Vitelaria cortical and extending up to the posterior end of body.

v) Excretory bladder terminal.

Earlier, Mackiewicz (1972) doubted the presence of polar filament and absence of the receptaculum seminalis in *L. fossilisi*. He was of the opinion that it may be an error. After reexamination he amended the generic diagnosis of the worm and included these characters too. Subsequently, one more species viz., *L. indica* Niyogi et al. (1982) was added to it. These workers also followed the amended generic diagnosis and recorded the presence of receptaculum seminalis in the worms and absence of operculum and polar elongation.

The present form differs from *L. fossilisi* on the basis of having following features:

i) Extension of testes (in present form testes are co extensive with vitelline follicles whereas, in case of *L. fossilisi* it extends a short distance posterior to anterior vitelline follicles.

ii) In presence of vesicula seminalis externa.

iii) In shape and disposition of ovary.

iv) Shape of testes and vitelline follicles. (In case of *L. fossilisi* it is irregular in outline whereas in present form it is transversely elongated and oval in outline) and.

v) Presence of receptaculum seminalis.
Moreover, it differs from *L. indica* in extension of testes (In *L. indica* it extends slightly posterior to anterior vitelline follicles but in present form it is co-extensive with vitelline follicles).

ii) Shape and disposition of ovary and,

iii) disposition of vitelline follicles.

The present form is therefore, described as a new species viz., *Lucknowia ovocompactum* n. sp., on account of the presence of compact ovary rather that transversely elongated band shaped structure.