

DESCRIPTION OF FOUR NEW SPECIES OF *SENGA* (PLATYHELMINTHES: CESTOIDEA) FROM FRESHWATER FISHES OF INDIA***SURANJANA BANERJEE¹, BUDDHADEB MANNA² AND A. K. SANYAL¹**¹Zoological Survey of India,
M-Block, New Alipore,
KOLKATA - 700053, INDIA²Parasitology Research Unit,
Department of Zoology,
University of Calcutta, KOLKATA (W.B.) INDIA

*Corresponding Author:

E-mail: serenebanerjee@gmail.com

Received : 28.01.2017; Revised : 25.02.2017; Accepted : 24.03.2017**ABSTRACT**

The genus *Senga*⁶ contains 47 valid species. Four new species of *Senga*⁶, reported from India. *Senga kakdwipensis* sp.nov. collected from the intestine of a freshwater fish, *Mastacembelus armatus* from Kakdwip, South 24-Parganas, West Bengal; *Senga bengalensis* sp.nov. collected from the freshwater fish, *Mastacembelus armatus* from Hasnabad, North 24-Parganas, West Bengal; *Senga orissaensis* sp.nov. collected from the intestine of a freshwater fish, *Channa punctatus* from Puri district of Orissa and *Senga nagalandensis* sp.nov. collected from the intestine of a freshwater fish *Colisa fasciata* from Mokokchung district of Nagaland. *Senga kakdwipensis* sp.nov. characterized by a triangular scolex, 0.115-0.56 in length and 0.275-0.08 in breadth; absence of neck; rostellar hooks arranged in a single circle, 46-56 in number and testes 45-48 in number. *Senga bengalensis* sp.nov. characterized by a triangular scolex, 0.23-0.445 in length and 0.085-0.27 in breadth; a pair of fleshy bothria present; rostellar hooks 48-50 in number of two different sizes arranged in two semicircles; presence of neck; testes 50-60 in number. *Senga orissaensis* sp.nov. characterized by a pear-shaped scolex that measures 0.1 in length and 0.2 in breadth; rostellar hooks 54 in number arranged in two semicircles; presence of short apical disc; short neck present; testes 39-40 in number. *Senga nagalandensis* sp.nov. characterized by an ovoid scolex with a pair of fleshy half-moon-shaped bothria, measures 0.45 x 0.35; apical disc present and is provided with 46 unequal rostellar hooks arranged in a single circle; neck absent; testes are 60-70 in number. The presence of these new morphological characters differentiates the three observed new species from the rest of the described species in the genus.

Figures : 14

References : 44

Tables : 03

KEY WORDS : *Channa punctatus*, *Colisa fasciata*, *Mastacembelus armatus*, *Senga bengalensis* sp.nov., *Senga kakdwipensis* sp.nov., *Senga nagalandensis* sp.nov., *Senga orissaensis* sp.nov.**Introduction**

The genus *Senga* was established⁶ in 1934 with the type species *Senga besnardi* collected from the host *Betta splendens*, the Siamese fighting fish in an aquarium at Vincennes in France. The genus

*Circumuncobothrium*³³ was synonymized²² with the genus *Senga*⁶.

A total of 38 species under the genus *Senga*⁶ reported from India. The most common fish hosts from where the genus *Senga*⁶ has been reported from India belong to the genus *Channa* and

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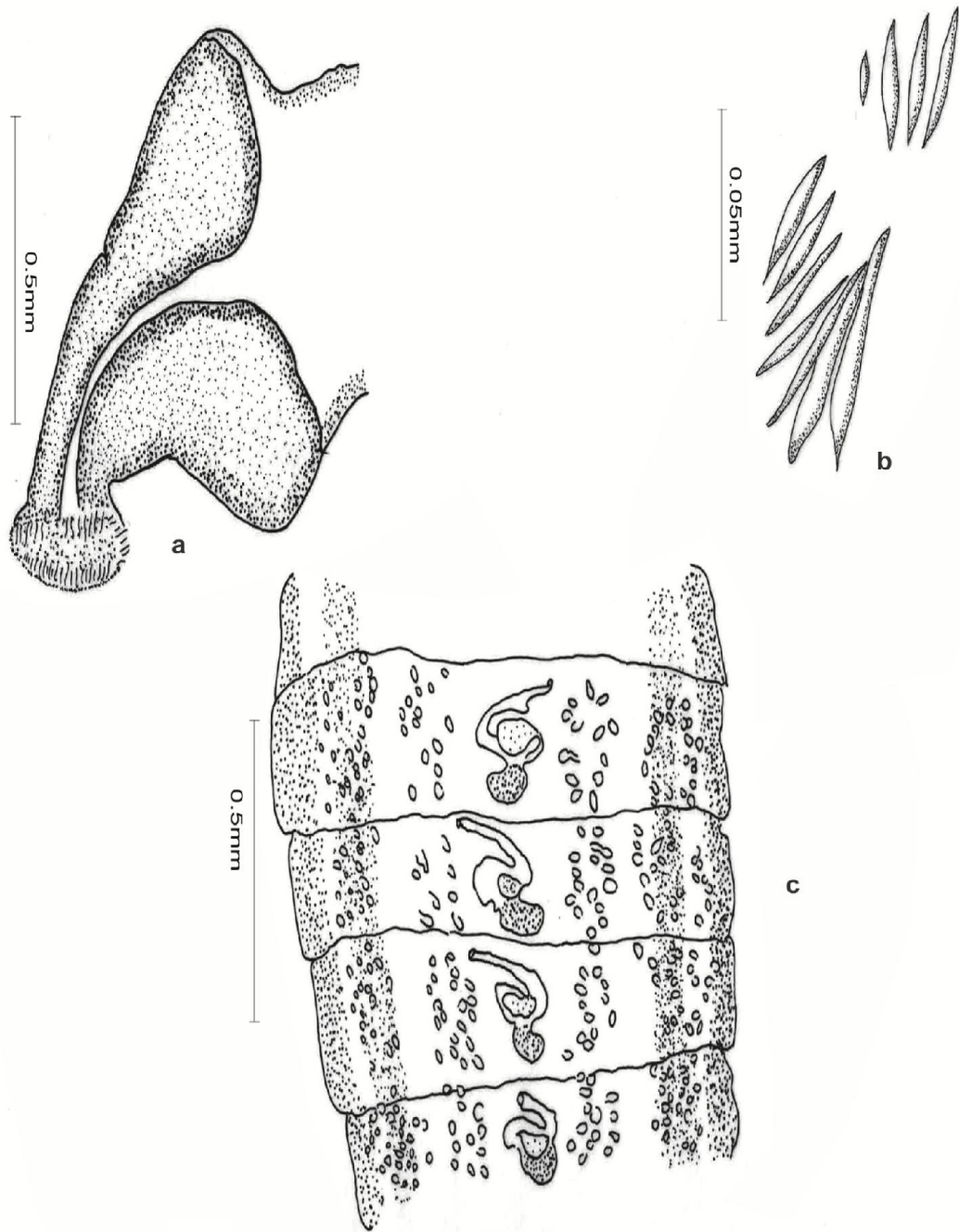


Fig. 1: Camera lucida drawings of *Senga kakdwipensis* sp. nov.

a : Scolex b : Rostellar hooks c : Immature proglottids

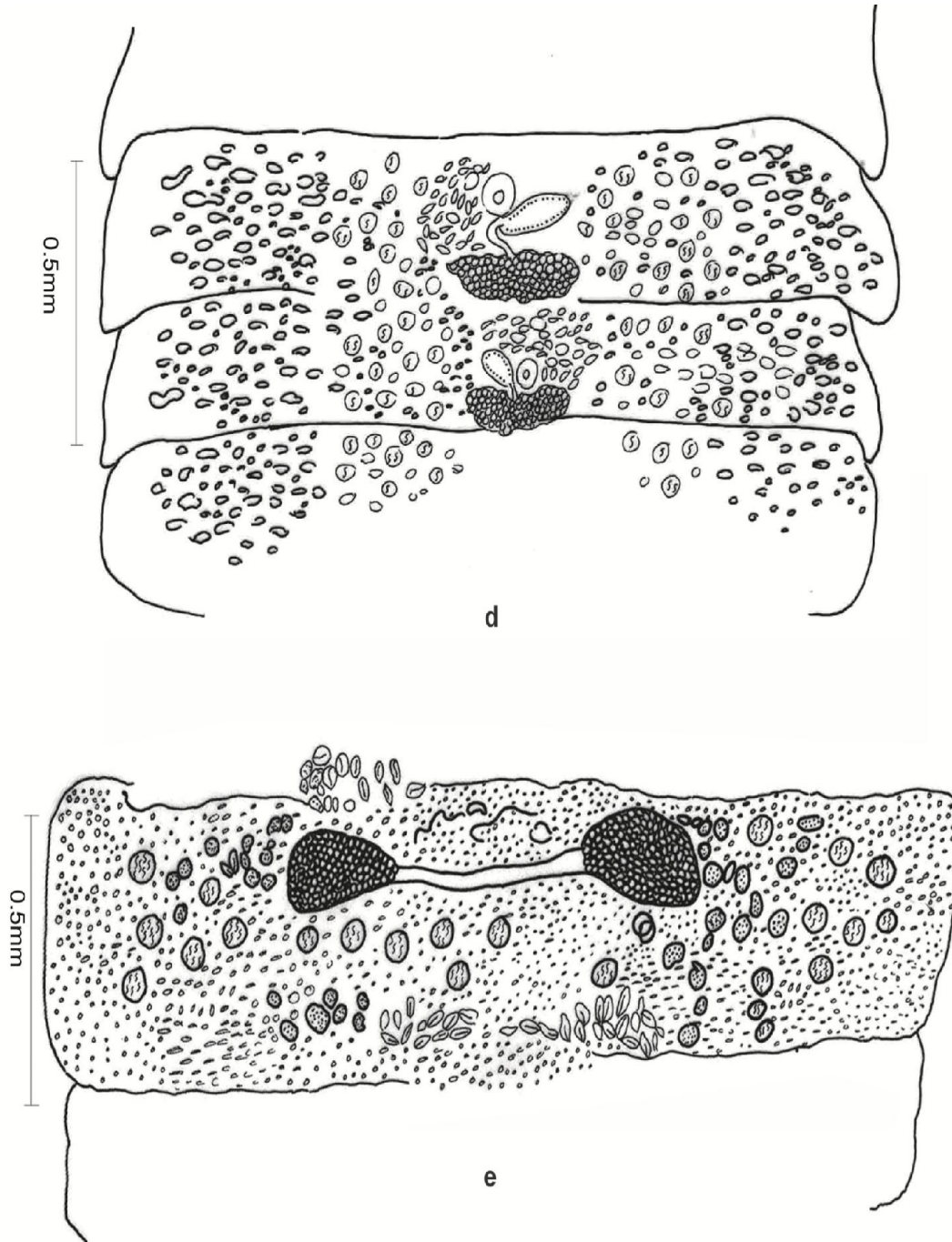


Fig. 2 : Camera lucida drawings of *Senga kakdwipensis* sp.nov.

d : Mature proglottids e : Gravid proglottid

Mastacembelus.

At present, the following 47 valid species collected from different hosts are present under the genus *Senga*⁶ as follows:

- 1) *Senga besnardi*⁶, the type species of this genus from *Betta splendens* in France.
- 2) *Senga ophiocephalina*^{6,39} from *Ophiocephalus argus* from China
- 3) *Senga taunsaensis*⁴⁴ from *Channa gachua* from Taunsa barrage in Pakistan.
- 4) *Senga lucknowensis*¹⁸ from *Mastacembelus armatus* from Lucknow, India.
- 5) *Senga pycnomerus*⁶ from *Ophiocephalus marulius* from Allahabad in Uttar Pradesh, India.
- 6) *Senga malayana*⁸ from *Channa striatus* from Malaysia.
- 7) *Senga parva*⁸ from *Channa micropeltes* from Malacca in Malaysia.
- 8) *Senga filiformis*⁸ from *Channa micropeltes* from Malacca in Malaysia.
- 9) *Senga pahagensis*⁹ from *Channa micropeltes* from Malaysia.
- 10) *Senga vishakhapatnamensis*³¹ from *Ophiocephalus punctatus* from Vishakhapatnam in Andhra Pradesh, India.
- 11) *Senga kham*³⁴ from *Ophiocephalus marulius* from Aurangabad, Maharashtra in India.
- 12) *Senga yamunica*¹⁰ from *Mystus vittatus* from the river Yamuna in Allahabad, Uttar Pradesh, India.
- 13) *Senga indica*¹² from *Mastacembelus armatus* from river Gomati in Lucknow, Uttar Pradesh, India.
- 14) *Senga nayari*²⁶ from the freshwater fish *Mastacembelus armatus* from Satpuli, Pauri-Garhwal district in Uttarakhand, India.
- 15) *Senga punctati*¹¹ from *Ophiocephalus punctatus* from Lucknow in Uttar Pradesh, India.
- 16) *Senga mastacembali*¹¹ from *Mastacembelus armatus* from Lucknow in Uttar Pradesh, India.
- 17) *Senga teleostei*¹ from *Channa punctatus* from the River Song, Garhwal Himalayas in Uttar Pradesh, India.
- 18) *Senga aurangabadensis*¹⁶ from *Mastacembelus armatus* from Aurangabad in Maharashtra, India.
- 19) *Senga godavari*³⁵ from *Mastacembelus armatus* from Nanded, Maharashtra in India.
- 20) *Senga paithanensis*¹⁹ from *Mastacembelus armatus* from Paithan, Maharashtra in India.
- 21) *Senga maharashtrii*¹⁵ from *Mastacembelus armatus* at Daryapur, Maharashtra in India.
- 22) *Senga mohekarae*³⁸ from *Mastacembelus armatus* from Parli, district Beed in Maharashtra, India.
- 23) *Senga chaingmaiensis*⁴³ from *Mastacembelus armatus* from Bung Borapet reservoir in Nakhon Sawan Province in Thailand.
- 24) *Senga armatusae*¹⁴ from a freshwater fish *Mastacembelus armatus* from Pune in Maharashtra, India.
- 25) *Senga vittati*¹⁰ from the host *Mystus vittatus* from Ganges river in Allahabad, Uttar Pradesh in India.
- 26) *Senga gangesii*¹⁰ from *Mystus vittatus* from Allahabad in Uttar Pradesh, India.
- 27) *Senga rao*²⁵ from *Channa punctatus* from Puri in Orissa, India.
- 28) *Senga jagannathae*²⁵ from *Channa punctatus* from Puri district in Orissa, India.
- 29) *Senga pathankotensis*⁷ from *Labeo rohita* from Punjab.
- 30) *Senga striatus*³² from *Ophiocephalus striatus* from Kalri Lake in Pakistan.
- 31) *Senga kaigaonensis*⁴⁰ from *Mastacembelus armatus* from Kaigan toka in Aurangabad, Maharashtra, India.
- 32) *Senga panzraensis*²⁷ from *Mastacembelus armatus* from Dhule, Maharashtra, India.
- 33) *Senga chauhani*¹³ from *Channa punctatus* from Jamshedpur, Bihar in India.
- 34) *Senga tappi*³⁰ from *Mastacembelus armatus* from Shripur dist., Dhule, Maharashtra in India.
- 35) *Senga jadhavae*⁴ from *Mastacembelus armatus* from Aurangabad in Maharashtra, India.
- 36) *Senga gachuae*¹⁵ from *Channa gachua* collected from Aurangabad in Maharashtra, India.
- 37) *Senga govindii*¹⁷ from *Mastacembelus armatus* from Maharashtra, India.
- 38) *Senga ayodhensis*²⁸ from *Amphipnous cuchia* and from Uttar Pradesh in India.
- 39) *Senga baugh*²⁸ from *Rita rita* from Uttar Pradesh in India.
- 40) *Senga madhavi*² from *Mastcembelus armatus*

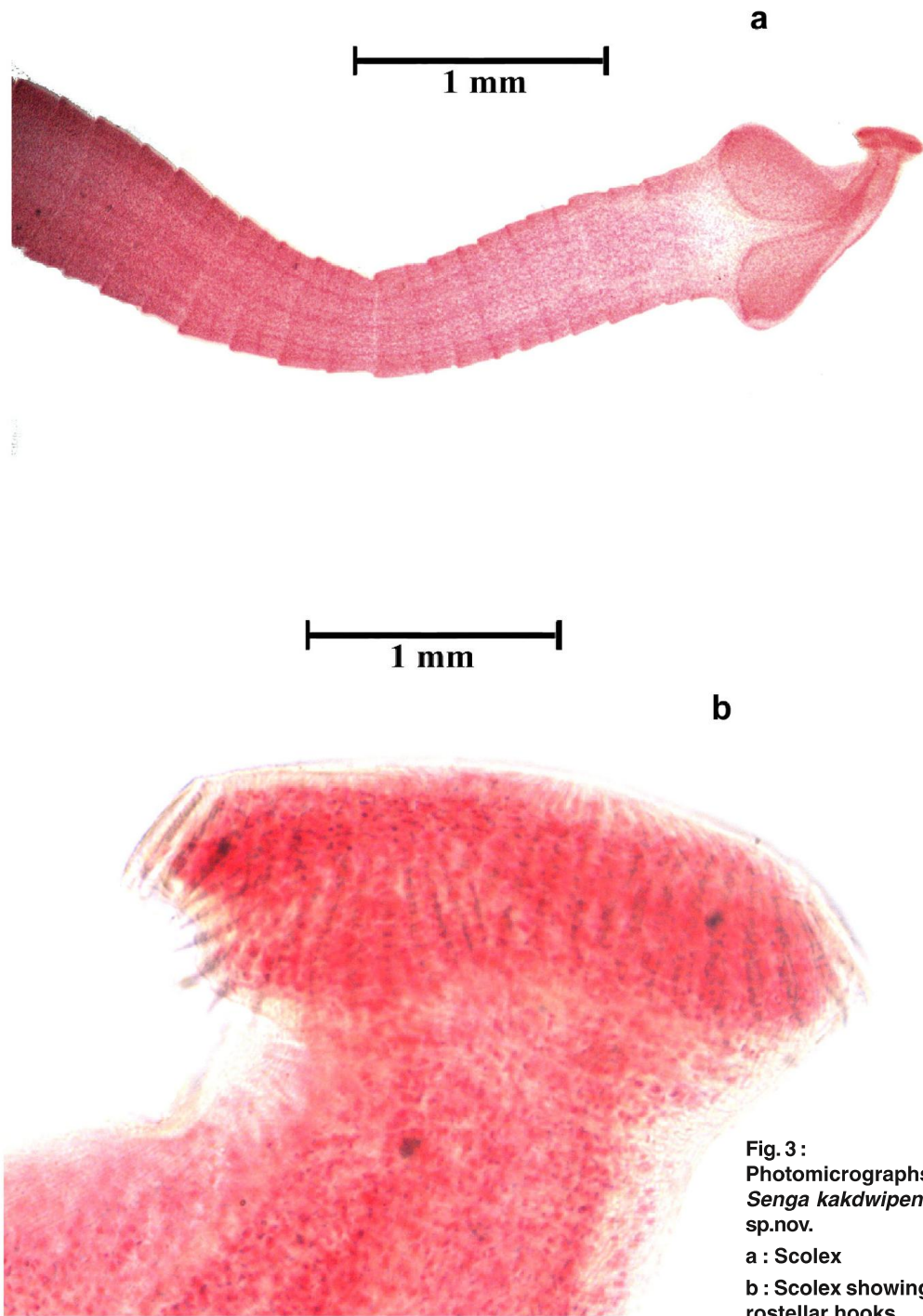


Fig. 3 :
Photomicrographs of
Senga kakdwipensis
sp.nov.
a : Scolex
b : Scolex showing
rostellar hooks

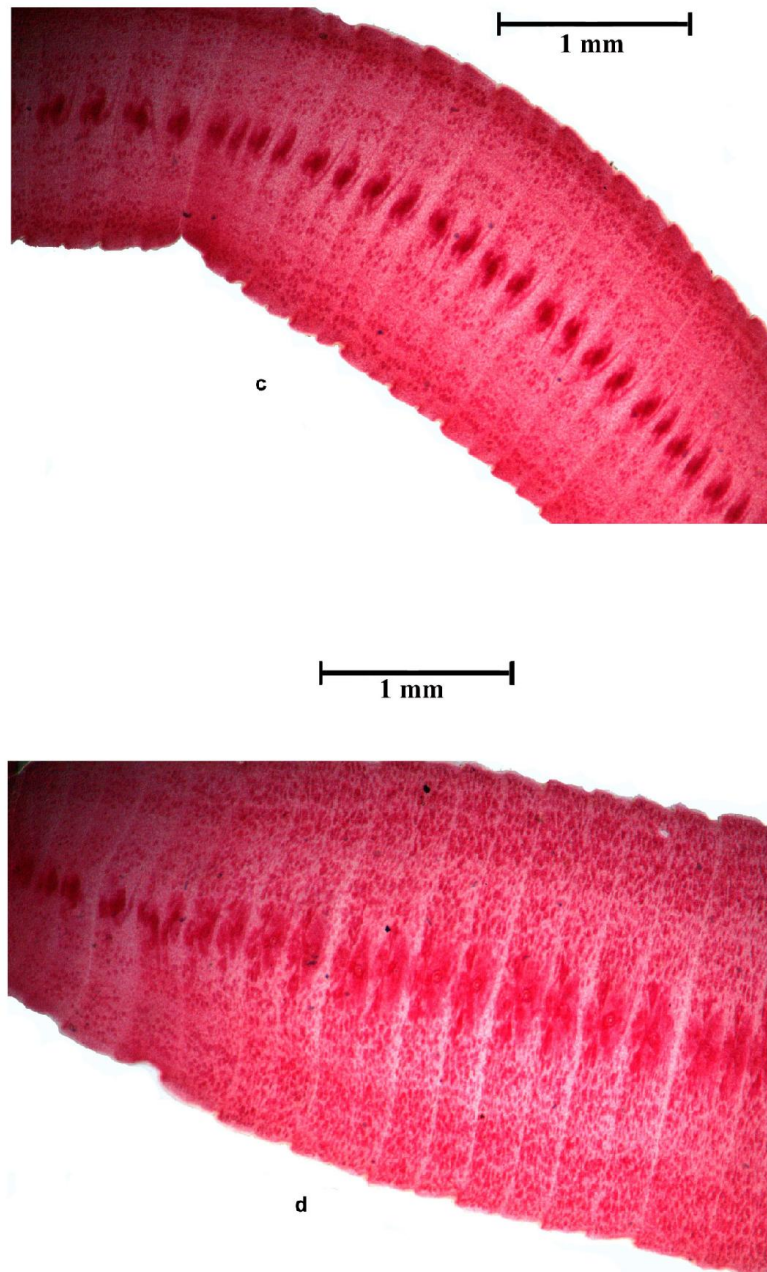


Fig. 4 : Photomicrographs of *Senga kakdwipensis* sp. nov.
c : Immature proglottids d : Mature proglottids

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from Maharashtra in India.

- 41) *Senga rupchandensis*²⁹ from *Channa striatus* from Jalna district in Maharashtra, India.
- 42) *Senga sataraensis*² from *Mastacembelus armatus* from Satara district in Maharashtra, India.
- 43) *Senga rostellare*⁵ from *Mastacembelus armatus* from Maharashtra in India.
- 44) *Senga chandrasekhar*⁵ from *Mastacembelus armatus* from Maharashtra in India.
- 45) *Senga nathsagarensis*²⁰ from *Mastacembelus armatus* from Maharashtra in India.
- 46) *Senga chandikapurensis*²¹ from *Mastacembelus armatus* from Maharashtra in India.
- 47) *Senga ticto*³⁷ from *Puntius ticto* from Jhansi in Uttar Pradesh, India.

List of synonyms:

*S.gordon*⁴² synonymized²⁴ with *Kirstenella gordon*.

In course of a survey on piscian tapeworms of fishes from West Bengal, Orissa and Nagaland parasites belonging to the genus *Senga*⁶ were recovered from *Mastacembelus armatus*, *Channa punctatus* and *Colisa fasciata*. On further study the collected parasites appeared to be four new species described here as *Senga kakdwipensis* sp.nov., *Senga bengalensis* sp.nov., *Senga orissaensis* sp.nov. and *Senga nagalandensis* sp.nov. *Colisa fasciata* a new host record for the genus *Senga*⁶ from where the proposed new species *Senga nagalandensis* sp.nov. from Nagaland, India had been recovered. The aim of the study was to investigate the unexplored cestode fauna of West Bengal, Orissa and Nagaland in India.

Materials and Methods

Fourteen specimens of the proposed new species. *Senga kakdwipensis* sp.nov. were collected from the intestine of a freshwater fish, *Mastacembelus armatus* from Kakdwip, South 24-Parganas, West Bengal in the month of December, 2006. Ten specimens of the proposed new species *Senga bengalensis* sp.nov. were collected from the intestine of a freshwater fish, *Mastacembelus armatus* from Hasnabad, North 24-Parganas, West Bengal, India in the month of June, 2006. A single specimen of the observed new species *Senga orissaensis* sp.nov. was collected from the intestine of a freshwater fish, *Channa punctatus* from Puri

district of Orissa in the month of June, 2006. A single specimen of the observed cestode parasite, *Senga nagalandensis* sp.nov. was collected from the intestine of a freshwater fish, *Colisa fasciata* from Mokochung district of Nagaland in the month of March, 2009. All the cestode specimens were recovered from the intestine of the infected fish hosts caught with the help of fish traps of fishermen. The specimens were fixed, stained, observed and identified following standard techniques. The specimens were pressed and flattened between two slides, post fixed and preserved in 70% ethyl alcohol. The specimens were then dehydrated in increasing concentrations of alcohol, stained in alcoholic borax carmine, cleared in xylol and mounted on slide in Canada balsam. The specimens were studied under microscope (Magnus MLX-Trinocular from Olympus, Japan) and camera lucida drawings and photomicrographs were taken as per need to describe the species. Cestodes were identified up to genus and species level. The hosts were identified on the spot. All the measurements given are in millimetres unless otherwise stated.

Description

1. *Senga kakdwipensis* sp.nov. (Figs.1, 2, 3, 4)

Worms long with thin musculature, consisting of scolex, immature, mature and gravid proglottids. Proglottids craspedote, wider than long. Some of the anterior immature proglottids more or less squarish while mature and gravid proglottids much wider than long. Immature proglottids measure 0.03-0.15 in length and 0.06-0.26 in breadth. Mature proglottids measure 0.04-0.16 in length and 0.03-0.75 in breadth respectively. The parasite measures 8.8-25.09 in length and 0.5-0.6 in breadth. Scolex triangular, narrow anteriorly and broad posteriorly, measures 0.115-0.56 in length and 0.275-0.08 in breadth, bears a pair of two shallow, elongated bothria that extend to the posterior end of the scolex. The bothria measure 0.1-0.53 in length and 0.025-0.09 in breadth. A mid-ventral groove is present. Scolex bears armed rostellum. Rostellar hooks arranged in a single crown around its circumference. Rostellar hooks 46-56 in number, in different sizes large hooks 30-36 in number and 0.045-0.095 in length and small hooks 16-20 in number and 0.01-0.025 in length. Neck absent. Testes 45-48 in number, spherical to oval, scattered in the medullary region of the strobila around the ovary. Testes measures 0.055-0.01 in

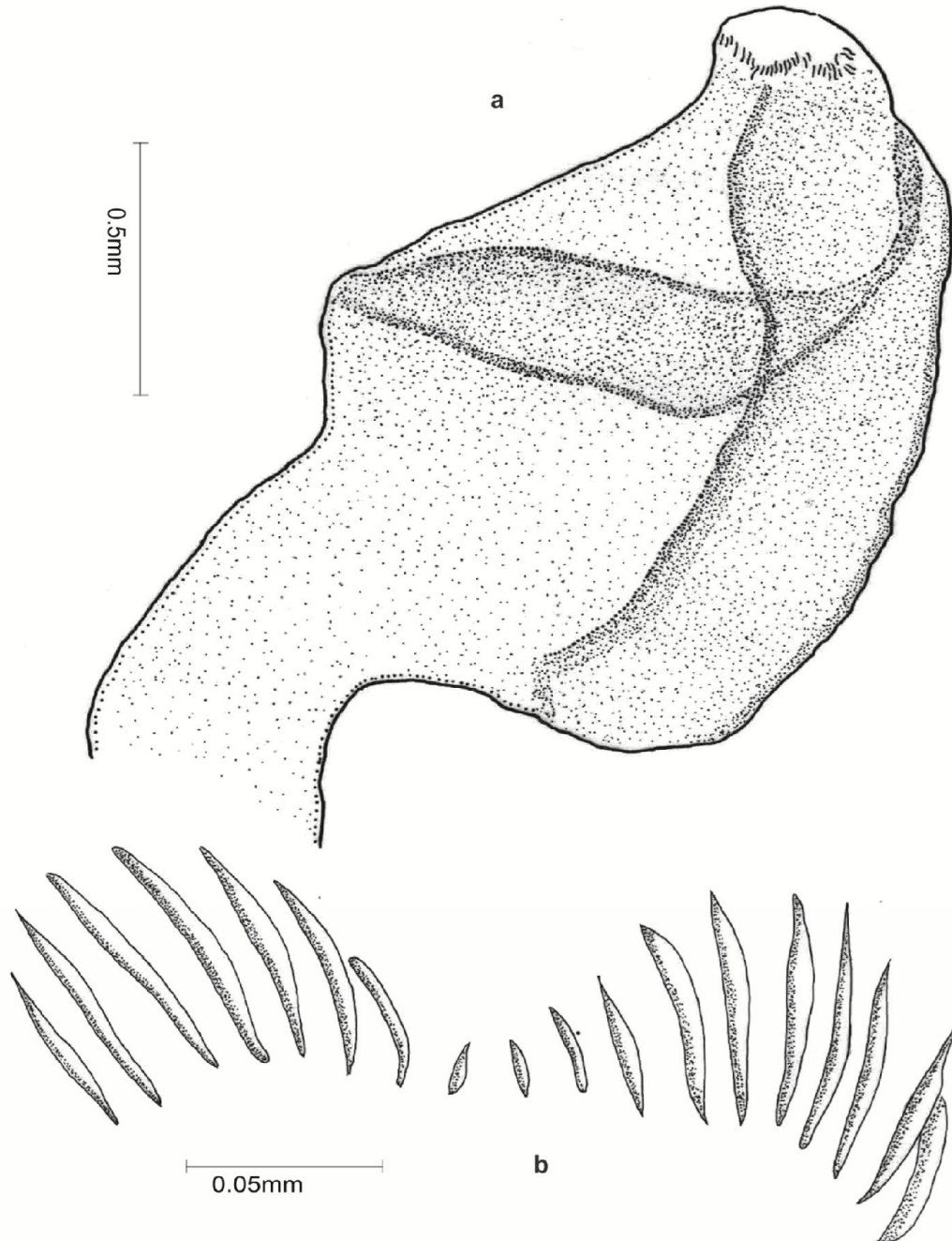


Fig. 5: Camera lucida drawings of *Senga bengalensis* sp. nov.

a : Scolex b : Rostellar hooks

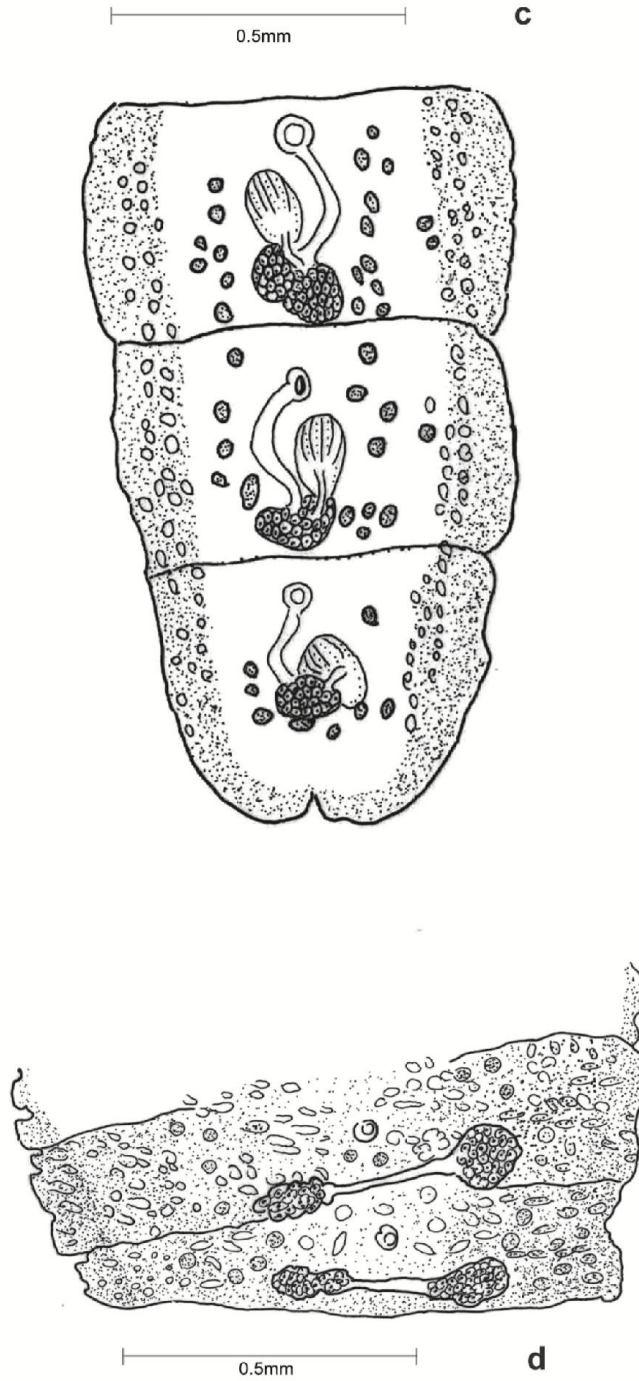


Fig. 6 : Camera lucida drawings of *Senga bengalensis* sp. nov.
c : Mature proglottids
d : Gravid proglottids

1 mm

a

1 mm

b

Fig. 7: Photomicrographs of *Senga bengalensis* sp.nov.
a : Scolex b : Scolex showing rostellar hooks

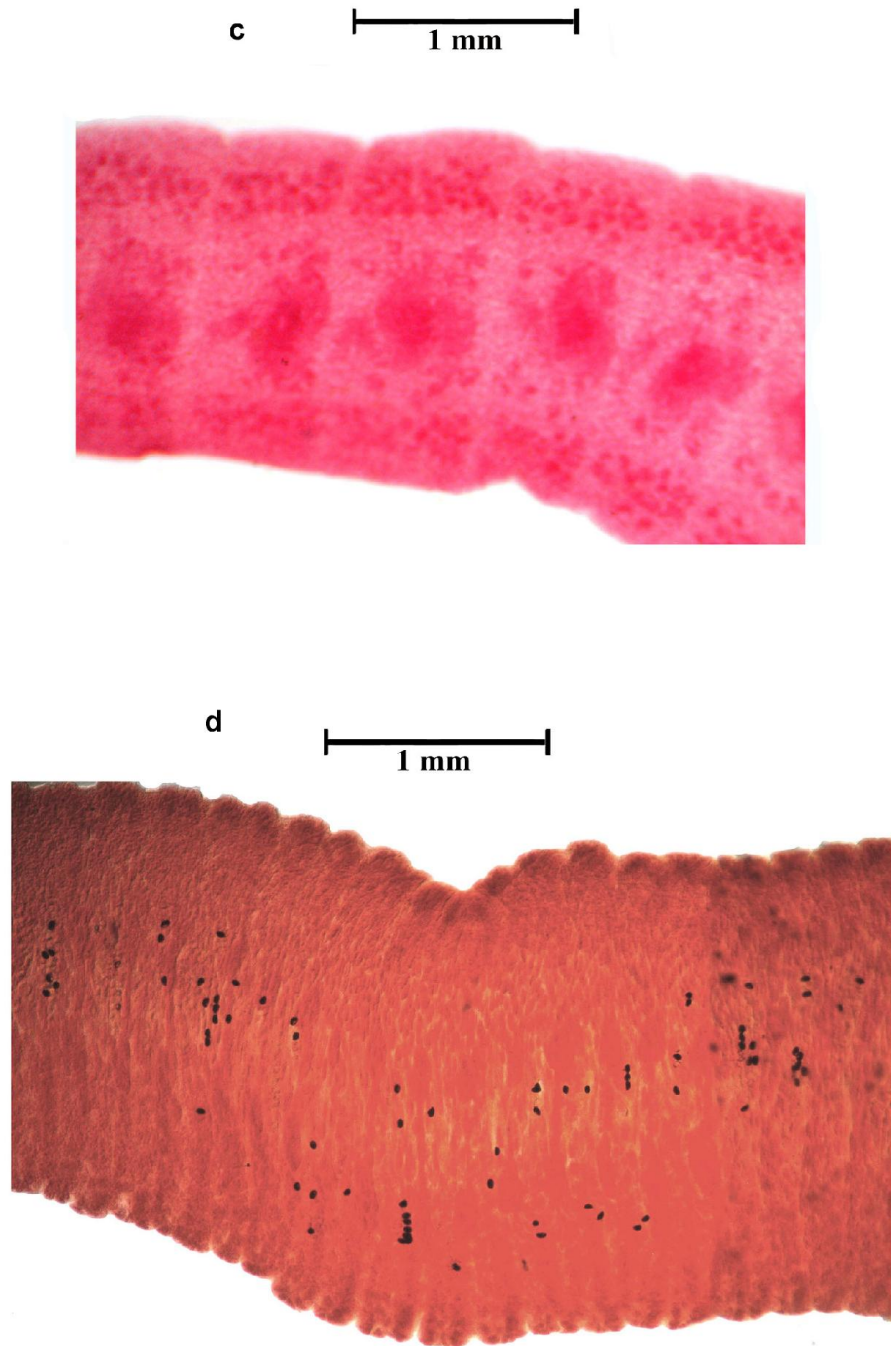


Fig. 8 : Photomicrographs of *Senga bengalensis* sp. nov.

c : Mature proglottids d : Gravid proglottids

length and 0.005-0.015 in breadth. Cirrus sac oval, situated in the midline, obliquely placed, measures 0.08-0.012 in length and 0.024-0.03 in width, opens anterior to the ovary through the common genital pore or the cirro-vaginal aperture which is mid dorsal in position and lies anterior to the ovary. Genital pores irregularly alternating. Ovary bilobed, located in the posterior region of the proglottids. Unequal ovarian lobes connected by a narrow isthmus. In mature proglottids right ovarian lobe measures 0.01 - 0.075 in length and 0.025-0.085 in breadth. The left ovarian lobe measures 0.01-0.075 in length and 0.02-0.055 in breadth. In gravid proglottids the right ovarian lobe measures 0.025-0.085 length and 0.02 - 0.075 in breadth. The left ovarian lobe measures 0.025-0.085 in length and 0.025 - 0.09 breadth. Vagina a narrow tube that arises from the ovary and opens through the cirro-vaginal aperture anterior to the ovary but posterior to the cirrus sac in the midline. Uterus sac-like and opens through the uterine pore anterior to the cirrus sac. The uterine duct makes 3-4 turns and S-shaped in appearance. In the gravid proglottids the uterine coils not distinct due to the large number of eggs present in them. The coiled uterine duct eventually dilates into a large uterine sac which opens ventrally either to the left or to the right of the median line, near the anterior margin of each proglottid and measures 0.07-0.08 in length and 0.17-0.2 in width. The uterine sac opens through the uterine pore mid-ventrally near the anterior margin of the proglottid and measures 0.005-0.02 in length and 0.005-0.015 in width. Vitellaria follicular, arranged in two lateral fields on either side of the proglottid in the cortical parenchyma. Eggs oval to round, thin shelled, non-operculated and measures 0.005-0.01 in length and 0.005-0.015 in breadth. The longitudinal osmoregulatory canals two in number and dorsal in position.

Type Host : *Mastacembelus armatus*
Location : Intestine
Type Locality : Kakdwip, South-24 Parganas, West Bengal, India.
Date : 24.12.2006
No. of specimens : Fourteen in nine slides
Holotype : One specimen in 1 slide, one Paratype present in same slide under the Zoological Survey of India. Accession No. W9893/1.

Paratype : Twelve specimens in 8 slides under the Zoological Survey of India. Accession Number W9894/1 to W9901/1
Deposition : The type specimens with Accession Numbers starting from W9893/1 to W9901/1 have been deposited in Platyhelminthes Section, Zoological Survey of India, New Alipore, Kolkata.

2. *Senga bengalensis* sp. nov. (Figs. 5, 6, 7, 8)

Worms long and consist of scolex and numerous immature, mature and gravid proglottids. Proglottidscraspedote, wider than long. Some of the anterior immature proglottids more or less squarish while mature and gravid proglottids much wider than long. Immature proglottids measure 0.24-0.25 in length and 0.205-0.215 in breadth. Mature proglottids measure 0.19-0.2 in length and 0.215 -0.225 in breadth. Worms measure 4.675-74.425 in length and 0.025-0.745 in breadth. Scolex triangular, bears a pair of fleshy bothria, narrows anteriorly but broadens posteriorly, measures 0.23-0.445 in length and 0.085-0.27 in breadth. The margins of each bothridium intersect and overlap each other. Each bothridium measures 0.225-0.395 in length and 0.05-0.15 in breadth. Scolex armed and bears a spiny rostellum. Rostellar hooks arranged in two semicircles. Rostellar hooks 48-50 in number. The 1st semi-circle close to the tip of the scolex has 20-21 hooks. While 2nd semi-circle has 28-29 hooks. The rostellar hooks are of various sizes. The large hooks measure 0.044-0.054 in length and 0.004-0.006 in width. The medium hooks measure 0.024-0.038 in length and 0.002-0.004 in width. The small hooks measure 0.012-0.02 in length and 0.002 in width. A distinct long neck is present measuring 2.72-5.2 in length and 0.045-0.1 in breadth. Testes 50-60 in number, oval to round surrounding ovary and measure 0.005-0.01 in length and 0.01 in width. Scattered in the medullary region of the proglottid. Ovary bilobed located in the posterior region of the proglottid. Unequal ovarian lobes connected by a narrow ovarian isthmus. In mature proglottids right ovarian lobe measures 0.035-0.06 in length and 0.015-0.025 in breadth. The left ovarian lobe measures 0.035 -0.065 in length and 0.015-0.025 in breadth. In gravid proglottids right ovarian lobe measures 0.025-0.03 in length and 0.055-0.06

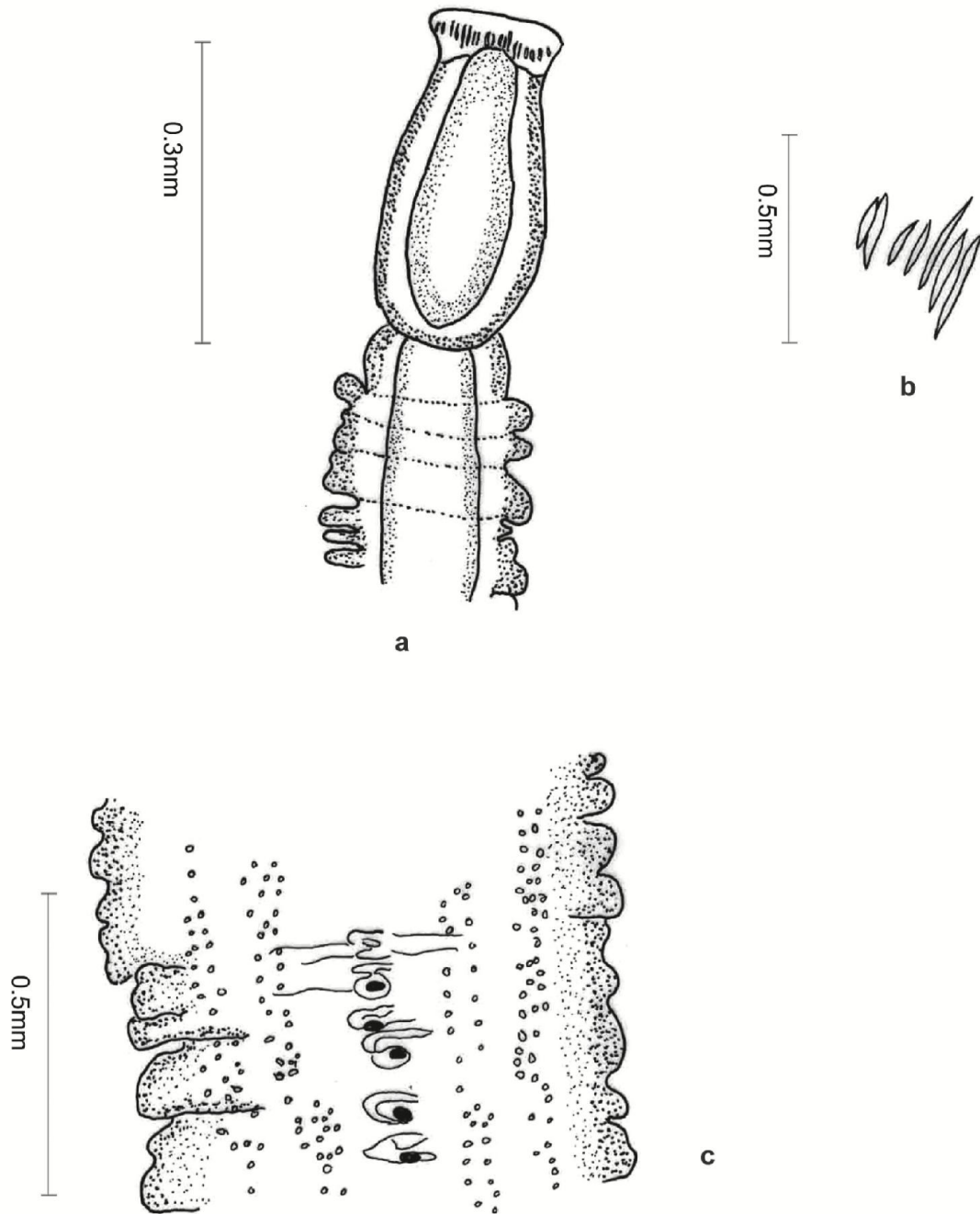


Fig. 9 : Camera lucida drawings of *Senga orrisaensis* sp. nov.
a : Scolex b : Rostellar hooks c : Immature proglottids

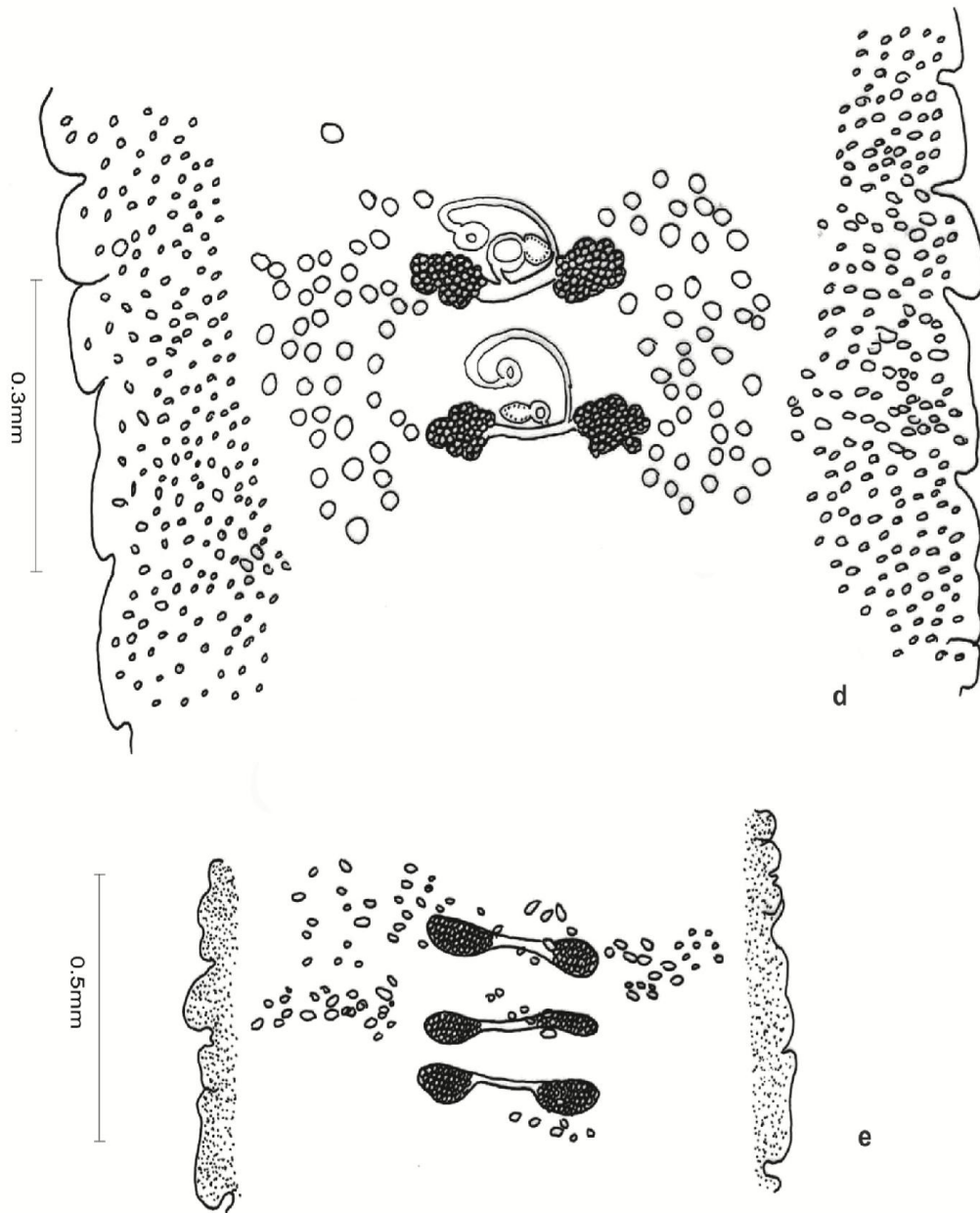


Fig. 10 : Camera lucida drawings of *Senga orrisaensis* sp. nov.

d : Mature proglottids e : Gravid proglottids

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in breadth. The left ovarian lobe measures 0.025-0.03 in length and 0.055-0.06 in breadth. The vagina opens anterior to the cirrus sac. The vagina and the cirrus sac open through a common genital pore which is the cirro-vaginal pore in the midline posterior to the uterine pore. Genital pores irregularly alternating. The uterus opens through the uterine pore. The uterus is anterior to the ovary and it winds anteriorly making about 5-6 turns. The uterine coil appears to have an S-shape. The coiled uterine duct eventually dilates into a large uterine sac which opens ventrally either to the right or to the left of the median line, near the anterior margin of each proglottid. The uterine sac measures 0.005-0.02 in length and 0.005-0.01 in width, opens through the uterine pore mid-ventrally near the anterior margin of the proglottid and measures 0.005-0.02 in length and 0.005-0.01 in width. In the gravid proglottids the uterine coils not distinct due to the large number of eggs present in them. The vitellaria are arranged laterally in two groups on either side of the proglottid in the cortical parenchyma. Eggs oval to round, thin-shelled, non-operculated and measure 0.005-0.01 in length and 0.005-0.015 in breadth. The longitudinal osmoregulatory canals two in number.

Type Host	: <i>Mastacembelus armatus</i>
Type Locality	: Hasnabad, North 24-Parganas, West Bengal, India.
Location	: Intestine
Date	: 15.06.2006
No. of specimens	: Ten in 10 slides
Holotype	: One specimen in one slide, one Paratype present in same slide under the Accession number Z.S.I. W9902/1.
Paratype	: Nine specimens in 9 slides under the Zoological Survey of India. Accession Number W9903/1 to W9911/1.
Deposition	: The type specimens with Accession Numbers starting from W9902/1 to 9911/1 have been deposited in Platyhelminthes Section, Zoological Survey of India, New Alipore, Kolkata.

3. *Senga orissaensis* sp. nov. (Figs.9, 10, 11, 12)

Warm consists of scolex, neck, immature, mature and gravid proglottids. Incomplete Segmentation and secondary segmentation present. Proglottids broader than long and craspedote. Immature proglottids 0.15-0.27 in length and 0.54-0.6 in breadth. Mature proglottids 0.12-0.22 in length and 0.755-0.915 in breadth.

Worms measures 5.8 in length and 0.475 in breadth. Scolex pear-shaped and broad in the middle. Measures 0.1 in length and 0.2 in breadth. Two bothria one on each lateral side of the scolex. Each bothria measures 0.3 in length and 0.04 in breadth. Scolex armed and the rostellum measures 0.05 in length and 0.15 in breadth. Rostellum bears 54 rostellar hooks in 2 semicircles of two sizes. Large hooks 40 in number and measure 0.351-0.39 in length and small hooks 14 in number and measure 0.156-0.234 in length. Each semicircle bears both large and small hooks. Neck short. Measures 0.05 in length and 0.18 in width. Testes spherical in shape and 39-40 in number distributed in the medullary region in two lateral fields on either side of the ovary and measure 0.02-0.03 in length and 0.04-0.05 in width. In gravid proglottids the testes lie scattered, surrounding the ovary on all sides. The cirrus sac lies close to the ovary in the median field and opens dorsally through the common cirro-vaginal pore. It measures 0.1-0.17 in length and 0.02-0.05 in width. Genital pores irregularly alternating. Ovary bilobed and the two lobes are connected by a narrow ovarian isthmus. Ovarian isthmus measures 0.15-0.19 in length and 0.02 in width. Ovary is situated in the median line on the posterior margin of the proglottid. The right ovary in mature proglottids measures 0.05-0.09 in length and 0.1-0.12 in breadth. The right ovary in gravid proglottids measures 0.08-0.1 in length and 0.18-0.2 in breadth. The left ovary in mature proglottids measures 0.06-0.1 in length and 0.09-0.14 in breadth. In gravid proglottids the left ovary measures 0.1-0.14 in length and 0.13-0.15 in breadth. Vagina a curved tube which runs for a short distance from the ovary to the posterior part of the cirrus sac and opens through the common cirro-vaginal pore on the dorsal side of the proglottid. Receptaculum seminis absent. Uterus in the form of a sac. Uterine duct coiled and ends into a uterine sac which measures 0.07-0.13 in length and 0.19-0.2 in breadth. The uterine sac alternates on the

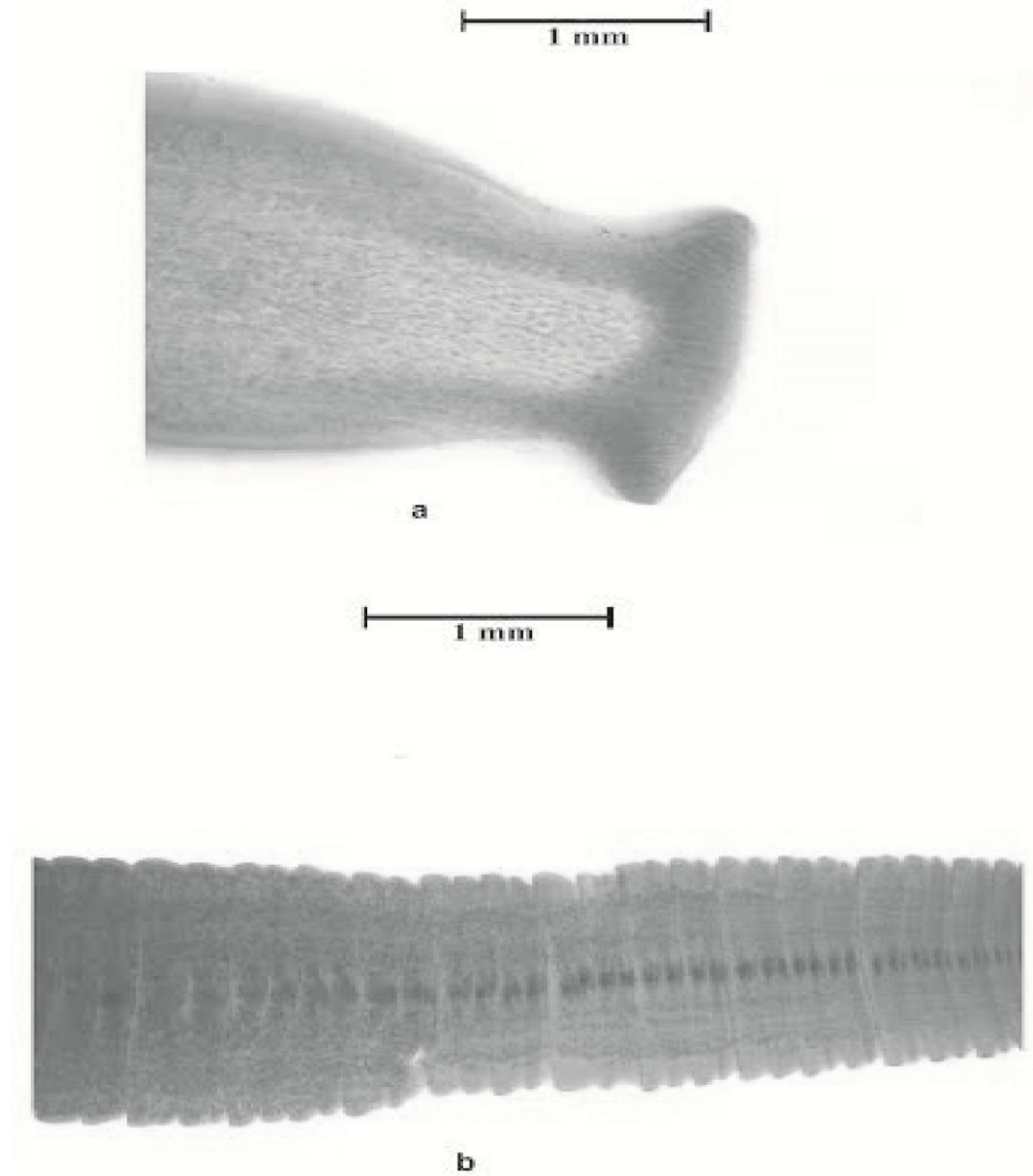


Fig. 11: Photomicrographs of *Senga orrisaensis* sp.nov.

a : Scolex b : Immature Proglottids

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right and left side of the median line near the anterior margin of each proglottid. The uterine sac opens through the uterine pore ventrally which measures 0.01-0.02 in length and 0.02-0.036 in width. Vitellaria lie in two lateral fields on either side of the proglottid in the cortical parenchyma. Eggs oval to round in shape and measures 0.02-0.03 in length and 0.01-0.02 in width. Osmoregulatory canals four in number, two dorsally and two ventrally located.

Type Host : *Channa punctatus*
Type Locality : Puri, Orissa, India
Location : Intestine
Date : 6.6.2006
No. of specimens : One in 1 slide
Holotype : One specimen in one slide under the Z.S.I. Accession number W9912/1.
Paratype : None
Deposition : The type specimen with Accession Numbers 9912/1 has been deposited in Platyhelminthes Section, Zoological Survey of India, New Alipore, Kolkata.

4. *Senga nagalandensis* sp.nov. (Figs.13, 14)

Diagnosis

A adult parasite consist of scolex, neck, immature, mature and gravid proglottids. Incomplete external segmentation present. Proglottids acraspedote. Proglottids wider than long except in the gravid where the proglottids longer than broad.

The parasite measures 12.38 in length and 0.36-0.4 in breadth. Scolex ovoid and measures 0.16 in length and 0.24 in breadth from the posterior end of the rostellum to the anterior end of the 1st proglottid. Scolex provided with a pair of fleshy half-moon shaped bothria measuring 0.26 in length and 0.05 in breadth. Scolex terminates into an armed apical disc and provided with 46 unequal rostellar hooks arranged in a single row. Apical disc measures 0.15 in length and 0.24 in breadth. Large hooks 14 in number and measure 0.05-0.052 in length and 0.004-0.008 in breadth. Medium hooks 17 in number and measure 0.034-0.044 in length and 0.004-0.006 in breadth. Small hooks 13 in number and measure 0.02-0.028 in length and 0.004 in breadth. The very small hooks two in

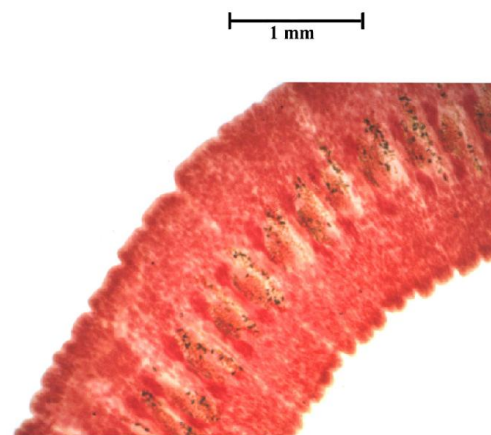


Fig. 12 : Photomicrographs of *Senga orrisaensis* sp.nov.

number and measure 0.01-0.014 in length and 0.002-0.004 in breadth. Neck absent. Testes 60-70 in number, ovoid to round, measures 0.016-0.034 in length and 0.02-0.026 in breadth distributed in the medullary region on both sides of the ovary. Cirrus sac mid dorsal in position, anterior to the ovary and measures 0.08-0.1 in length and 0.04-0.05 in breadth. Cirrus sac opens through the cirro-vaginal aperture which is mid dorsal in position situated close to the ovarian isthmus and measures 0.052-0.054 in length and 0.05-0.06 in width. Genital pores irregularly alternating. Ovary bilobed and located posteriorly. In mature proglottids the left lobe of the ovary measures 0.12-0.13 in length and 0.06-0.13 in breadth and right lobe of the ovary measures 0.1-0.13 in length and 0.07-0.12 in breadth. In gravid proglottids the left lobe of the ovary measures 0.11-0.15 in length and 0.14 in breadth and the right lobe of the ovary measures 0.12-0.15 in length and 0.15 in breadth. Two lobes of the ovary connected by a narrow isthmus. Ovarian isthmus measures 0.08-0.15 in length and 0.01-0.03 in width. Vagina a curved tube which opens through the cirro-vaginal aperture on the dorsal surface. Shell gland lies posterior to the ovarian isthmus and measures 0.09-0.1 in width. Uterus sac-like and the uterine duct terminates into a uterine sac which measures 0.095-0.105 in length and 0.115-0.12 in breadth. Uterus opens through the uterine pore near the anterior margin of each proglottid. It is mid-dorsal in position and measures 0.03-0.055 in length and 0.035-0.06 in width. Uterine pore irregularly

alternating. Vitellaria scattered in two lateral fields in the cortical parenchyma of each proglottid. Eggs elliptical, measure 0.018-0.03 in length and 0.01-0.016 width. The longitudinal excretory vessels four in number, two dorsal and two ventral.

Type Host : *Colisa fasciata*
Type Locality : Mokokchung, Nagaland, India
Location : Intestine
Date : 14.3.2009
No. of specimens : One in one slide
Holotype : One specimen in one slide under the Z.S.I. Accession number W9913/1.
Paratype : None
Deposition : The type specimen with Accession Numbers 9913/1 has been deposited in Platyhelminthes Section, Zoological Survey of India, New Alipore, Kolkata.

Results and Discussion

Differential Diagnosis and relationship of Senga kakdwipensis sp.nov.: The observed cestode measures 8.8-25.09 in length and 0.5-0.6 in breadth; scolex triangular, 0.115-0.56 in length and 0.275-0.08 in breadth; a single pair of fleshy bothria present; rostellar hooks arranged in a single circle, 46-56 in number; rostellar hooks of two different sizes; neck absent, testes medullary, lateral, 45-48 in number; common genital pore posterior to uterine pore; ovary bilobed, transversely elongated; uterine pore anterior to common genital pore; uterine duct makes 3-4 turns and S-shaped in appearance; uterine sac present; egg round to oval in shape; vitellaria follicular, cortical in two lateral bands.

The observed species comes closer to *Senga vishakhapatnamensis*³¹ and *Senga panzraensis*²⁷.

The observed species differs from *Senga vishakhapatnamensis*³¹ in which scolex is rectangular; body length 40-60; hooks in the rostellum 48-56 in number and testes 50-55 in number.

The observed species differs from *Senga panzraensis*²⁷ in which neck is present; rostellar hooks 58 in number; testes 40-50 in number; vitellaria granular in 4-5 rows on the two lateral sides

of the proglottid.

The observed species differs from another new species *Senga bengalensis* n.sp. body measurement 4.675-74.425 in length and 0.025-0.745 in breadth; scolex 0.23-0.445 in length and 0.085-0.27 in breadth; rostellar hooks arranged in two semicircles; rostellar hooks 48-50 in number of two different sizes; neck present; testes 50-60 in number.

The observed species differs from another new species *Senga orrisaensis* n.sp. in which body is 5.8 in length and 0.475 in breadth; scolex pear-shaped and measures 0.1 in length and 0.2 in breadth; rostellar hooks 54 in number arranged in two semicircles; apical disc short; bothria shallow; short neck present; testes 39-40 in number; eggs measure 0.02-0.03 x 0.01-0.02.

The observed species differs from another new species *Senga nagalandensis* n.sp. body measurement 12.38 in length and 0.36-0.4 in breadth; scolex ovoid with a pair of fleshy half-moon-shaped bothria, measures 0.45 x 0.35; rostellar hooks 46 in number, unequal, arranged in a single circle; testes are 60-70 in number; eggs 0.018-0.03 x 0.01-0.016 in dimension.

Etymology: Considering all these differences in characteristics from all the valid species of the genus the present species is considered new to science and the authors suggest its name as *Senga kakdwipensis* n.sp. after the locality Kakdwip in South-24 Parganas district in West Bengal from where it had been recovered.

Differential diagnosis and relationship of Senga bengalensis sp.nov. : The present cestode measures 4.675-74.425 in length and 0.025-0.745 in breadth; testes medullary, scolex triangular, 0.23-0.445 in length and 0.085-0.27 in breadth; a pair of fleshy bothria present; rostellar hooks arranged in two semicircles; rostellar hooks 48-50 in number of two different sizes; neck present; arranged in 2 lateral bands and 50-60 in number; common genital pore posterior to uterine pore; uterine pore opens mid-ventrally near the anterior margin of the proglottid.

The observed species comes closer to *Senga ophiocephalina*^{6,39} and *Senga mastacembeli*¹¹.

The observed species differs from *Senga ophiocephalina*^{6,39} in which scolex is bottle-shaped; hooks 56-57 in number present in a single

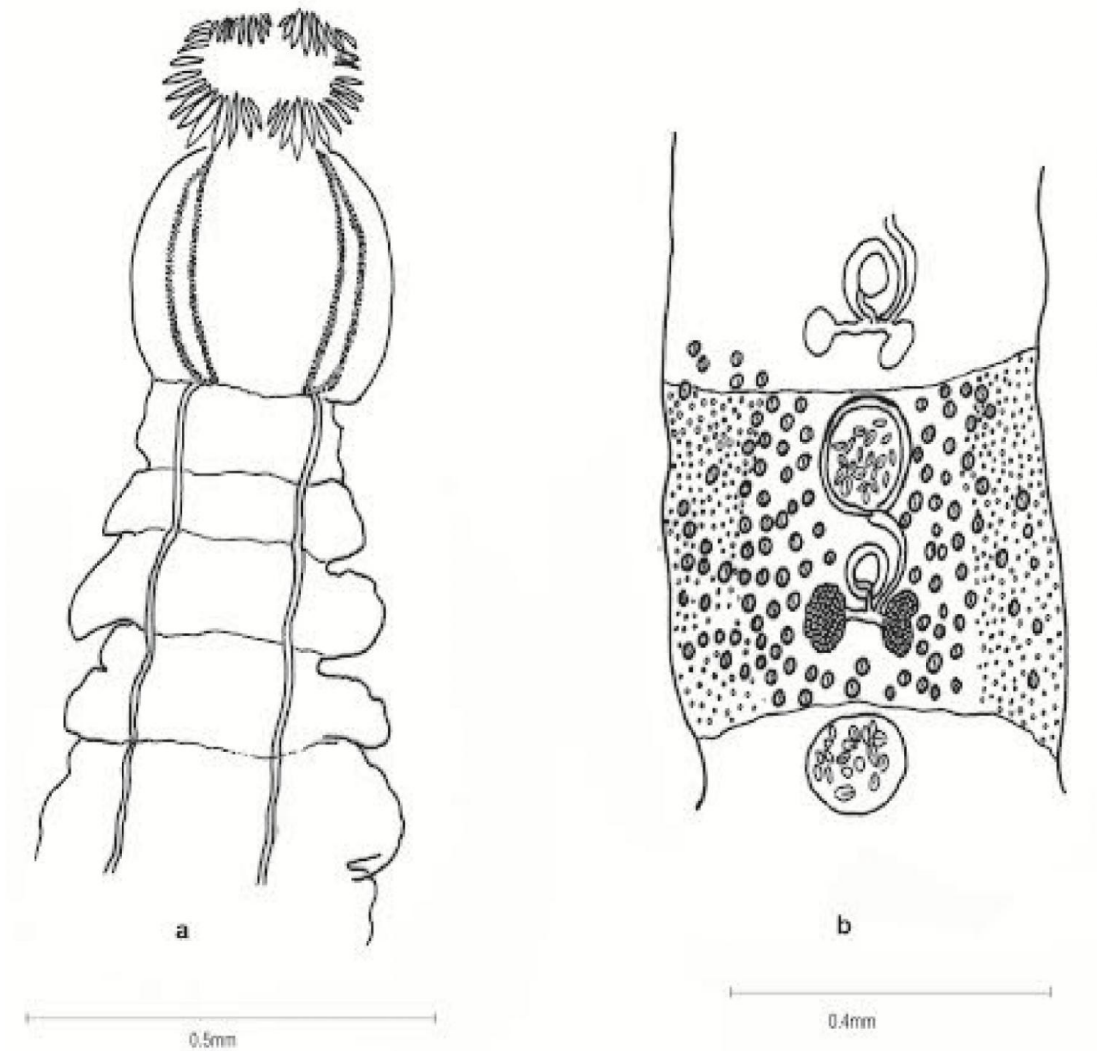


Fig. 13 : Camera lucida drawings of *Senga nagalandensis* sp. nov.

a : Scolex b : Gravid proglottids

crown; neck absent; testes 50-55 in number; vitellaria lobate.

The observed species differs from *Senga mastacembeli*¹¹ body length 180.0-200.0; scolex pear-shaped; rostellar hooks 30-36 in number; neck absent; testes 60-70 in number; vitellaria scattered in cortical parenchyma.

The observed species differs from another

new species *Senga kakdwipensis* n.sp. in which body measures 8.8-25.085 in length and 0.5-0.545 in breadth; scolex 0.115-0.56 in length and 0.080.275 in breadth; rostellar hooks arranged in a single circle, 46-56 in number; rostellar hooks of two different sizes; no neck; testes 45-48 in number; uterine duct makes 3-4 turns and S-shaped in appearance .

The observed species differs from another new species *Senga orrisaensis* n.sp. in which body 5.8 in length and 0.475 in breadth; scolex pear-shaped and measures 0.1 in length and 0.2 in breadth; rostellar hooks 54 in number arranged in two semicircles; apical disc short; bothria shallow; testes 39-40 in number; eggs measure 0.02-0.03 x 0.01-0.02.

The observed species differs from another new species *Senga nagalandensis* n.sp. in which body measures 12.38 in length and 0.36-0.4 in breadth; scolex ovoid with a pair of fleshy half-moon-shaped bothria, measures 0.45 x 0.35; rostellar hooks 46 in number, unequal, arranged in a single circle; neck absent; testes are 60-70 in number; eggs 0.018-0.03x0.01-0.016 in dimension.

Etymology: Considering all these differences in characteristics from all the valid species of the genus the present species is considered new to science and the authors suggest its name as *Senga bengalensis* sp.nov. named after the state of West Bengal from where it had been recovered.

Differential Diagnosis and relationship of *Senga orrisaensis* sp.nov.: The present cestode measures 5.8 in length and 0.475 in breadth; scolex pear-shaped and measures 0.1 in length and 0.2 in breadth; rostellar hooks 54 in number arranged in two semicircles; apical disc short; a pair of shallow bothria; short neck present; testes 39-40 in number, medullary and lateral in distribution; ovary bilobed, transversely elongated; vagina short, thick, curved tube; cirrus sac round; uterus opens into uterine sac near anterior margin of the proglottid; common genital pore opens below uterine pore; uterine pore anterior to the genital pore; seminal receptacle absent; eggs measure 0.02-0.03 x 0.01-0.02.

The observed species comes closer to *Senga pycnomerus*^{6,41}; *Senga punctati*¹¹; *Senga teleostei*¹ *Senga panzraensis*²⁷ and *Senga baugh*²⁸.

The observed species differs from *Senga pycnomerus*^{6,41} in which total body length 76.0; rostellar hooks 68 in number; elongated apical disc present; neck absent and testes 30-40 in number.

The observed species differs from *Senga punctati*¹¹ in body length 150-180; neck absent; a pair of fleshy bothria present; rostellar hooks 28-30 in number; testes 40-50 in number; vitellaria interrupted in groups; ovary bilobed but pear-shaped.

The observed species differs from *Senga teleostei*¹ in body length 38.4-44.0; neck is absent; rostellar hooks 40-44 in number; testes 40-45 in number; ovary bilobed, compact; cirrus sac round, 0.110-0.136 x 0.009-0.129 in dimension.

The observed species differs from *S.panzraensis*²⁷ in which 58 rostellar hooks present; testes 40-50 in number; granular vitellaria in 4-5 rows on two lateral sides of the proglottid; vagina thin and curved.

The observed species differs from *S.baugh*²⁸ in which 28 rostellar hooks present; testes 40-50 in number; ovary compact, oval, single lobed; vagina thin and coiled.

The observed species differs from *Senga kakdwipensis* sp.nov. in which body measures 8.8-25.085 in length and 0.5-0.545 in breadth; scolex 0.115-0.56 in length and 0.080-0.275 in breadth; rostellar hooks arranged in a single circle, 46-56 in number; rostellar hooks of two different sizes; neck absent, testes 45-48 in number; uterine duct makes 3-4 turns and S-shaped in appearance.

The observed species differs from *Senga bengalensis* sp.nov. in which body measurement 4.675-74.425 in length and 0.025-0.745 in breadth; scolex 0.23-0.445 in length and 0.085-0.27 in breadth; rostellar hooks arranged in two semicircles; rostellar hooks 48-50 in number of two different sizes; neck present; testes 50-60 in number.

The observed species differs from *Senga nagalandensis* sp.nov. in worm size 12.38 in length and 0.36-0.4 in breadth; scolex ovoid with a pair of fleshy half-moon shaped bothria, measures 0.45 x 0.35; rostellar hooks 46 in number, unequal, arranged in a single circle; neck absent; testes 60-70 in number and eggs 0.018-0.03 x 0.01-0.016 in dimension.

Etymology: Considering all these differences in characteristics from all the valid species of the genus the present species is considered new to science and the authors suggest its name as *Senga orrisaensis* sp.nov. named after the state of Orissa from where it has been recovered.

Differential Diagnosis and Relationship of *Senga nagalandensis* sp.nov.: The observed cestode measures 12.38 in length and 0.36-0.4 in breadth; scolex ovoid with a pair of fleshy half-moon shaped bothria, measures 0.45 x 0.35; apical disc present and is provided with 46 unequal rostellar

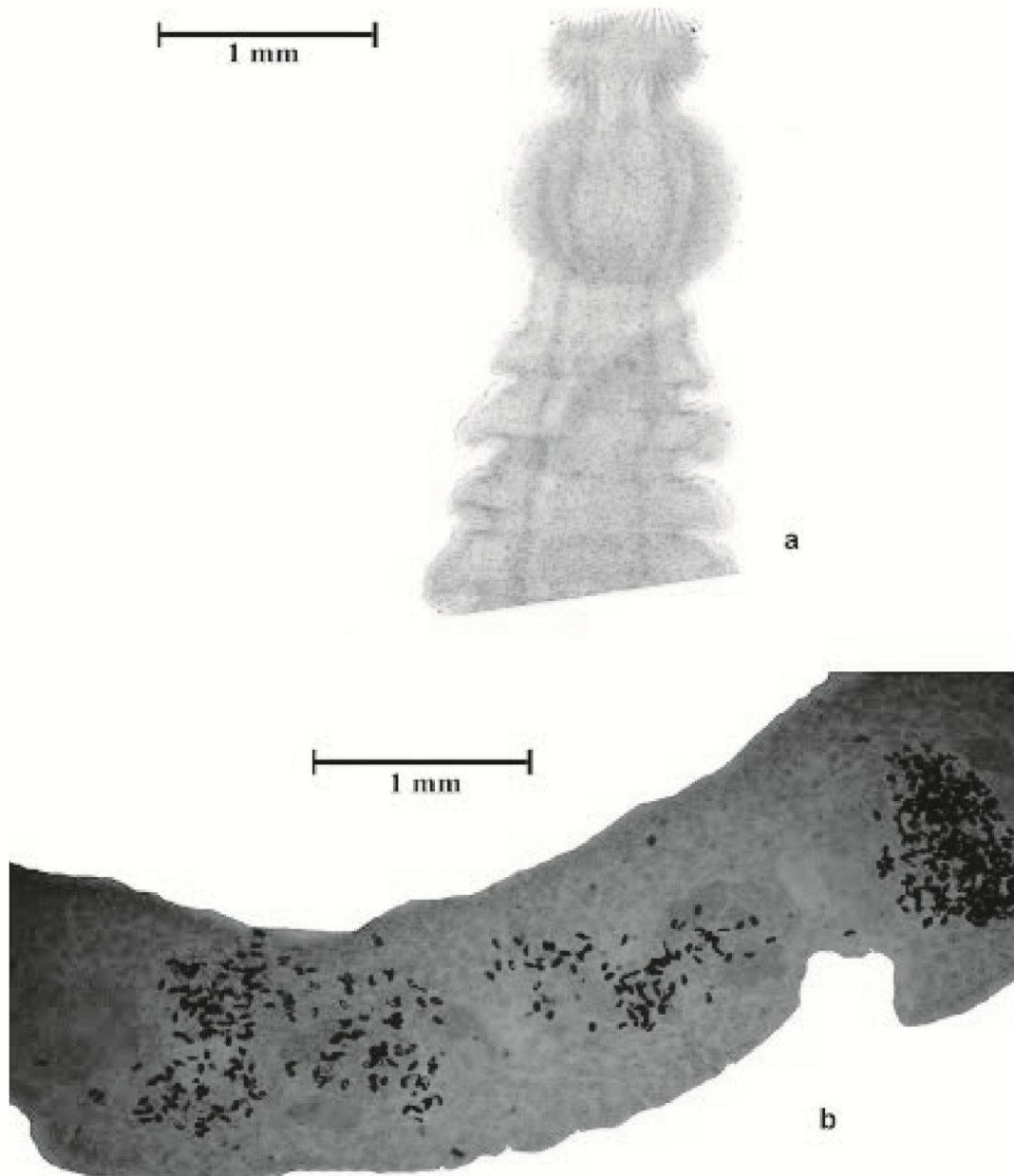


Fig. 14: Photomicrographs of *Senga nagalandensis* sp. nov.
a : Scolex b : Mature proglottids

hooks arranged in a single circle; neck absent; testes 60-70 in number; proglottids acraspedote; testes medullary in distribution, lateral; vitellaria follicular, cortical in two transverse bands; ovary bilobed, transversely elongated; vagina short, curved, thin tube; uterine sac opens through uterine pore near anterior margin of the proglottid; common genital pore posterior to uterine pore located in mid-line; eggs 0.018-0.03x0.01-0.016 in dimension.

The observed species comes closer to *S.mastacembali*¹¹ and *S.gachuae*¹⁵.

The present observed species differs from *S.mastacembali*¹¹ in which total body length 180-200; pear-shaped scolex; a pair of fleshy bothria; 30-36 rostellar hooks; uterine duct with 2-3 turns; ovary bilobed with subequal lobes.

The present observed species differs from *S.gachuae*¹⁵ in which scolex pear-shaped; rostellar hooks 22-25 in number; neck absent; vagina short; thin and curved.

The observed species differs from *Senga kakdwipensis* n.sp. another new species described in the present work in which body measures 8.8-25.085 in length and 0.5-0.545 in breadth; scolex 0.115-0.56 in length and 0.080-0.275 in breadth; rostellar hooks arranged in a single circle, 46-56 in number; rostellar hooks of two different sizes; testes 45-48 in number; uterine duct makes 3-4 turns and S-shaped in appearance.

The observed species differs from *Senga bengalensis* n.sp. another new species described in the present work in which body measures 4.675-74.425 in length and 0.025-0.745 in breadth; scolex 0.23-0.445 in length and 0.085-0.27 in breadth; rostellar hooks arranged in two semicircles; rostellar hooks 48-50 in number of two different sizes; neck present; testes 50-60 in number.

The observed species differs from *Senga orrisaensis* n.sp. another new species described in the present work in which body is 5.8 in length and 0.475 in breadth; scolex pear-shaped and measures 0.1 in length and 0.2 in breadth; rostellar hooks 54 in number arranged in two semicircles; apical disc short; bothria shallow; testes 39-40 in number; eggs measure 0.02-0.03 x 0.01-0.02.

Etymology: Considering all these differences in characteristics from all the valid species of the genus the present species is considered new to science and the authors suggest its name as *Senga nagalandensis* sp. nov. named after the state of Nagaland from where it had been recovered.

Key to the species of the genus *Senga* Dollfus⁶

1. Neck present.....2
-Neck absent.....9
2. Rostellar hooks 30 or less than 30.....3
-Rostellar hooks more than 30.....4
3. Testes 100 or less than 100,5
-Testes more than 100,6
4. Testes 100 or less than 100,7
-Testes more than 100,8
5. Rostellar hooks 22-25 in number, testes 60-70.....*S. gachuae*¹⁵
-Rostellar hooks 28 in number, testes 40-50 in number.....*S. baugh*²⁸
6. Rostellar hooks 30-32, testes 200-250 in number.....*S. nathsagarensis*²⁰
7. Rostellar hooks 45-50 in number, testes 100-130.....*S. govindii*¹⁷
-Rostellar hooks 48-50 in number, testes*S. bengalensis* n.sp.
-Rostellar hooks 54 in number, testes 39-40.....*S. orissaensis* n.sp.
-Rostellar hooks 58 in number, testes 40-50.....*S. panzraensis*²⁷
-Rostellar hooks 78 in number, testes 98-117.....*S. chandrasekhar*⁵
-Rostellar hooks 44 in number, testes 240-250.....*S. jagannathae*²⁵
-Rostellar hooks 40-44 in number, testes 200-210.....*S. chauhan*¹³
-Rostellar hooks 55-57 in number, testes 155.....*S. kham*³⁴
-Rostellar hooks 54 in number, testes 130-155.....*S. paithanensis*¹⁹
-Rostellar hooks 51 in number, testes 300-310.....*S. mohekar*³⁸
-Rostellar hooks 42-44 in number, testes 285-295.....*S. tapp*³⁰
-Rostellar hooks 50-54 in number, testes 310-320.....*S. jadhavae*³
-Rostellar hooks 36 in number, testes 285-295.....*S. kaigaonensis*⁴⁰
6. Neck absent, rostellar hooks 30 or less than 30.....10
-Neck absent, rostellar hooks more than 30.....11

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7. Rostellar hooks 30 or less than 30, testes 100 or less than 100.....12
-Rostellar hooks 30 or less than 30, testes more than 100.....13
8. Rostellar hooks more than 30, testes 100 or less than 100.....14
-Rostellar hooks more than 30, testes more than 100.....15
9. Rostellar hooks 28-30, testes 40-50.....*S.punctati*¹¹
-Rostellar hooks 30-36, testes 60-70.....*S.mastacembali*¹¹
-Rostellar hooks 28-30, testes 40-50.....*S.ticto*³⁷
-Rostellar hooks 28-30 in number, testes 175-200.....*S.satraensis*²
10. Rostellar hooks 28 in number, testes 100.....*S.chiangmaiensis*⁴³
-Rostellar hooks 29, testes numerous.....*S.ayodhensis*²⁸
11. Rostellar hooks 56-57 in number, testes 50-55.....*S.ophiocephalina*³⁶
-Rostellar hooks 38-40 in number, testes 64-132.....*S.nayari*²⁶
-Rostellar hooks 40-44 in number, testes 40-45.....*S.teleostei*¹
-Rostellar hooks 46-52 in number, testes 50-55.....*S.vishakhapatnamensis*³¹
-Rostellar hooks 45-47 in number, testes 80-90.....*S.maharashtra*¹⁵
-Rostellar hooks 46-47 in number, testes 45-48.....*S.kakdwipensis* n.sp.
-Rostellar hooks 46 in number, testes 60-70.....*S.nagalandensis* n.sp.
-Rostellar hooks 66 in number, testes 27-46.....*S.striatus*³²
-Rostellar hooks 68 in number, testes 30-40.....*S.pycnomerus*⁶
12. Rostellar hooks 50 in number, testes 350-370.....*S.besnard*⁶
-Rostellar hooks 42-44 in number, testes 150-180.....*S.parva*⁸
-Rostellar hooks 55-56 in number, testes 350-370.....*S.filiformis*⁸
-Rostellar hooks 42-56 in number, testes 120-150.....*S.malayana*⁸
-Rostellar hooks 53-54 in number, testes numerous.....*S.pahagensis*⁹
-Rostellar hooks 36-48 in number, testes numerous.....*S.lucknowensis*¹⁸
Rostellar hooks 53-56 in number, testes 340-370.....*S.yamunica*¹⁰
-Rostellar hooks 36 in number, testes numerous.....*S.indica*¹²
-Rostellar hooks 65-66 in number, testes 300-320.....*S.vittati*¹⁰
-Rostellar hooks 46 in number, testes 240-250.....*S.raoi*²⁵
-Rostellar hooks 50-52 in number, testes 240-260.....*S.aurangabadensis*¹⁶
-Rostellar hooks 40-42 in number, testes 220-230.....*S.godavari*³⁵
-Rostellar hooks 32-40 in number, testes 230-240.....*S.armatusae*¹⁴
-Rostellar hooks 42-45 in number, testes 350-370.....*S.rupchandensis*²⁹
-Rostellar hooks 41 in number, testes 217-242.....*S.rostellare*⁵
-Rostellar hooks 44-46 in number, testes numerous.....*S.taunsaensis*⁴⁴
-Rostellar hooks 72-75 in number, testes numerous.....*S.gangesii*¹⁰
-Rostellar hooks 56 in number, testes numerous.....*S.pathankotensis*⁷

Footnote: *Senga chandikapurensis*²¹ and *Senga madhavii* Bhure *et al.*⁴ have not been included in key due to non-availability of adequate literature.

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