

Aquatic Annelida (Polychaeta, Oligochaeta, Hirudinea) of the Ganga River and adjacent water bodies in Patna (India: Bihar), with description of a new leech species (Family Salifidae)

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Abstract

New records of thirty-nine aquatic annelids (Polychaeta, Oligochaeta, Hirudinea) from Bihar (India), are presented, belonging to ten families Nereidae, Nephthyidae, Naididae, Tubificidae, Glossoscolecidae, Megascolecidae, Glossiphoniidae, Ozobranchidae, Hirudinidae, and Salifidae. They include two species of polychaetes, twenty-seven oligochaetes and ten leeches. A new leech, *Salifa biharensis* sp.n., is described. Two naidid species, *Nais bretscheri* and *Pristina acuminata*, are found for the first time from the Indian subcontinent.

Key Words: Freshwater annelids; morphology, ecology; India, Bihar, Ganges; new species.

Zusammenfassung

Aus Bihar (Indien) werden Neunachweise von neununddreissig Süßwasser-Anneliden (Polychaeta, Oligochaeta, Hirudinea) des Ganges vorgestellt, die zu den zehn Familien Nereidae, Nephthyidae, Naididae, Tubificidae, Glossoscolecidae, Megascolecidae, Glossiphoniidae, Ozobranchidae, Hirudinidae, und Salifidae gehören. Es sind hierbei zwei Polychaeten, siebenundzwanzig Oligochaeten und zehn Egel vertreten. Eine Egelart, *Salifa biharensis* sp.n., wird neu beschrieben und zwei Naidide, *Nais bretscheri* und *Pristina acuminata*, werden erstmals vom indischen Subkontinent nachgewiesen.

Introduction

The distribution and ecology of several aquatic annelids collected during 2001 - 2003 from the Ganga River and several adjacent lentic water bodies of the Gangetic plain in Patna, India, are presented. Short descriptions on their morphology, supported by detailed figures, are provided. Although extensive published descriptions are available for most of the species discussed herein, the present study provides additional observations on morphological characteristics to aid in the identification of taxa collected from the study area. Brief descriptions of habitats from which these taxa have been collected are also included. The annelid fauna of the largest river in India, virtually unknown prior to this study, is compared with our present knowledge of annelids occurring elsewhere on the Indian subcontinent and associated with several large European rivers.

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Material and Methods

Annelids were collected qualitatively using a hand net. All oligochaete and polychaete specimens were preserved in 70% ethanol; leeches were relaxed in 15% ethanol, then transferred to 70% ethanol for preservation. The figures were prepared as ink drawings by the first author. All specimens collected during this study have been deposited in the first author's collection, in the collections of the Naturhistorisches Museum in Wien, Österreich (NHMW-EV), Naturmuseum und Forschungsinstitut Senckenberg in Frankfurt am Main, Deutschland (SMF) and the Polychaeta Collection of the Zoologisches Museum der Universität Rostock, Deutschland (ZSRO).

Study area and sampling sites

Patna (25° 37' 00" N 85° 12' 30" E, altitude 53 m above sea level), the capital of the state of Bihar in northern India, is located on the right bank of the Ganga River, 1020 km upstream from its mouth and confluence with the Bay of Bengal. Here the Ganga River is sluggish with a gradient of 6 cm/km and the riverbed consists mainly of fine silt and clay. The river floods every year during the months of June - September; during this flood period, the water level often rises to 10 m above normal pool. The ecology of this section of the Ganga River in Bihar were published by SHARAN & SINHA (1989). During this study, annelids were collected from seven localities, described below.

1. Mahendrughat: right bank of the Ganga River at Patna (25° 37' 19" N, 85° 09' 18" E). Erosion bank with high variability of mixed substrates, very near to the main water current. Here the Ganga River has the narrowest bed with a total width less than 700 m during low water season (Feb. - Mar.). The bank is divided into different small bay-like zones by stony walls and the embankment is partially fixed with larger boulders. Substrates are clay, mud, silt, sand, and a variety of hard stone surfaces. Samples were collected from depths ranging from 0.1 - 1.0 m. Small groundwater streams from seeping springs are observable during the periods of low water.

2. Ruins of the Old Royal palace: right bank of the river at Patna (25° 37' 07" N, 85° 11' 18" E).

3. Badarghat: right bank of the Ganga River 4 km downstream (eastwards) from Mahendrughat (25° 36' 40" N, 85° 12' 35" E). The bank is shallow with a homogeneous mix of sediment consisting of clay, mud and less than 25% sand with a fine detritus layer. This substrate extends up- and downstream along each bank for a distance of more than 2 km from the sampling site. The riverbed has a total width of approximately 2000 m, with the main current shifted towards the left bank. Samples were collected from depths ranging from 0.1 - 0.3 m.

4. Zoo-pond: Sanjay-Gandhi Biological Park, southwestern Patna (25° 35' 50" N, 85° 06' 01" E). This manmade pond (250 × 70 m) is surrounded by mixed forest. The undisturbed banks are partially covered with rich submerged macrophytes during summer. The water is greenish brown, the shallow bottom consists of a compact sand overlain by mud and detritus 1 - 10 cm deep. There are only minor changes in water level. Samples were collected from depths ranging from 0.0 - 0.6 m. Leaf litter from the surrounding vegetation is a common component of the pond's substrate.

5. Secretariat pond, southwestern Patna (25° 36' 10" N, 85° 07' 07" E): Fish-pond similar to the Zoo-pond, a completely managed fish-pond. Samples were collected from depths ranging from 0.1 - 1.3 m.

6. Kumhrar ponds, south of Patna-City (25° 36' 00" N, 85° 11' 12" E): The Kumhrar Park area south of the railway (5 km east of Patna junction) includes the excavation site of ruins of Pataliputra, including the huge pillared hall of the Mauryan period (400 to 300 B.C.). There are two shallow ponds, several pools, and temporary flooded wetlands rich in submerged vegetation. Samples were collected from depths ranging from 0.1 - 1.3 m.

7. Pahari, south of Patna-City (25° 34' 22" N, 85° 11' 27" E): Small irrigation ditches and pools (width 0.2 - 3.0 m depth 0.1 - 1.0 m) in agricultural land. Samples were collected from all depths.

Results and species accounts

Thirty-nine species and subspecies of annelids representing ten families were collected during this study, including two polychaetes, twenty-seven oligochaetes, and ten leeches. Two naidids are reported for the first time from the Indian subcontinent, and one leech species is described here as new to science.

Class Polychaeta

Family Nereidae

Subfamily Namanereinae HARTMAN, 1959

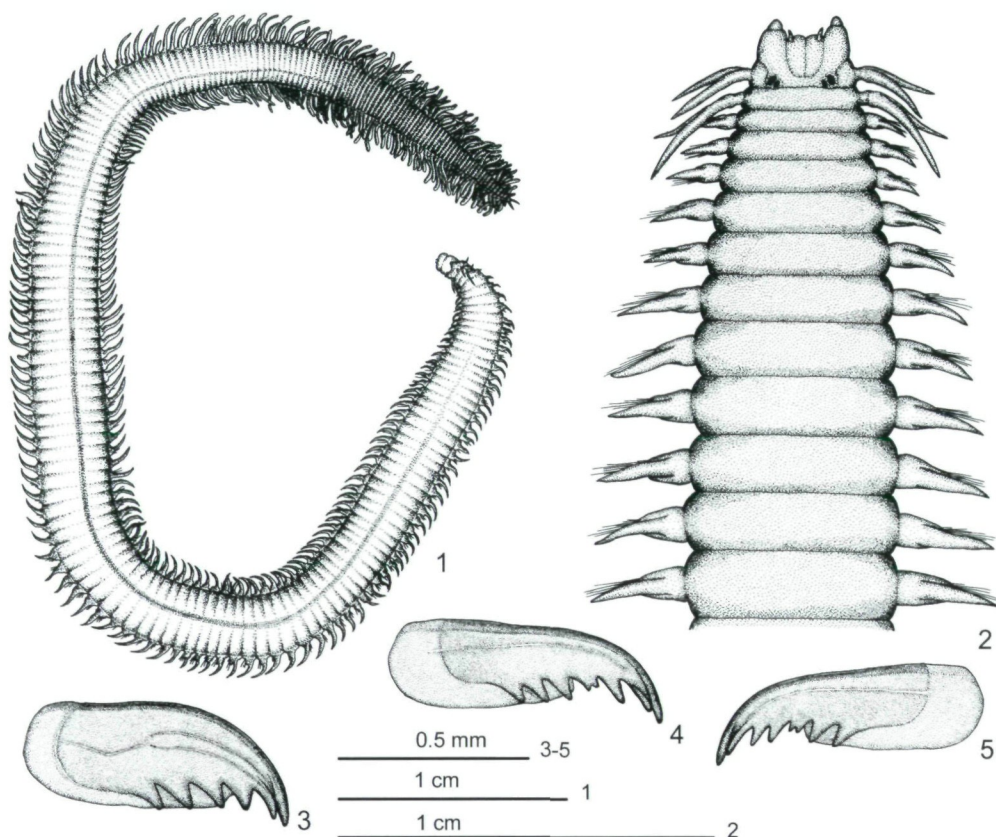
Namalycastis indica (SOUTHERN, 1921) (Figs 1 - 5)

Lycastis indica SOUTHERN, 1921: 578 - 582, fig. 2, Pl. 19, fig. 2a - j. - FAUVEL, 1953: 167 - 168, figs. 84 a, b, 85 a.

Namalycastis indica, - HARTMAN, 1959: 164. - MISHRA & al., 1983: 43. - DATTA MUNSHI & al., 1989: 104, figs. 5, 6.

Material examined (numerous specimens): Mahendrughat, Jan-Mar. 2002, (NHMW-EV 19701, 19773, ZS-RO-P 1422, SMF 12070, 12071).

Habitat and distribution: *Namalycastis indica* is a very common inhabitant of the mud, silt, and sand substrates of the Ganga River, occurring throughout the freshwater reaches of the Ganga and Yamuna rivers upstream to Allahabad. This species is also widespread in brackish waters of South and Southeast Asia (FAUVEL 1953, MISHRA & al. 1983, DATTA MUNSHI & al. 1988, SINHA 1989, ATHALYE & GOKHALE 1998, GLASBY 1999). Members of this genus have more successfully invaded freshwaters than any other polychaetes (HARTMAN 1959, GLASBY 1999) and they were recently found in oligo-



Figs. 1 - 5: *Namalycastis indica* (SOUTHERN, 1921), India, Ganga River, Patna, in (1) dorsal aspect, (2) anterior body with head and (3 - 5) jaws.

haline pools of the Socotra Archipelago at an altitude of 700 m above sea level (FIEGE & VAN DAMME 2002).

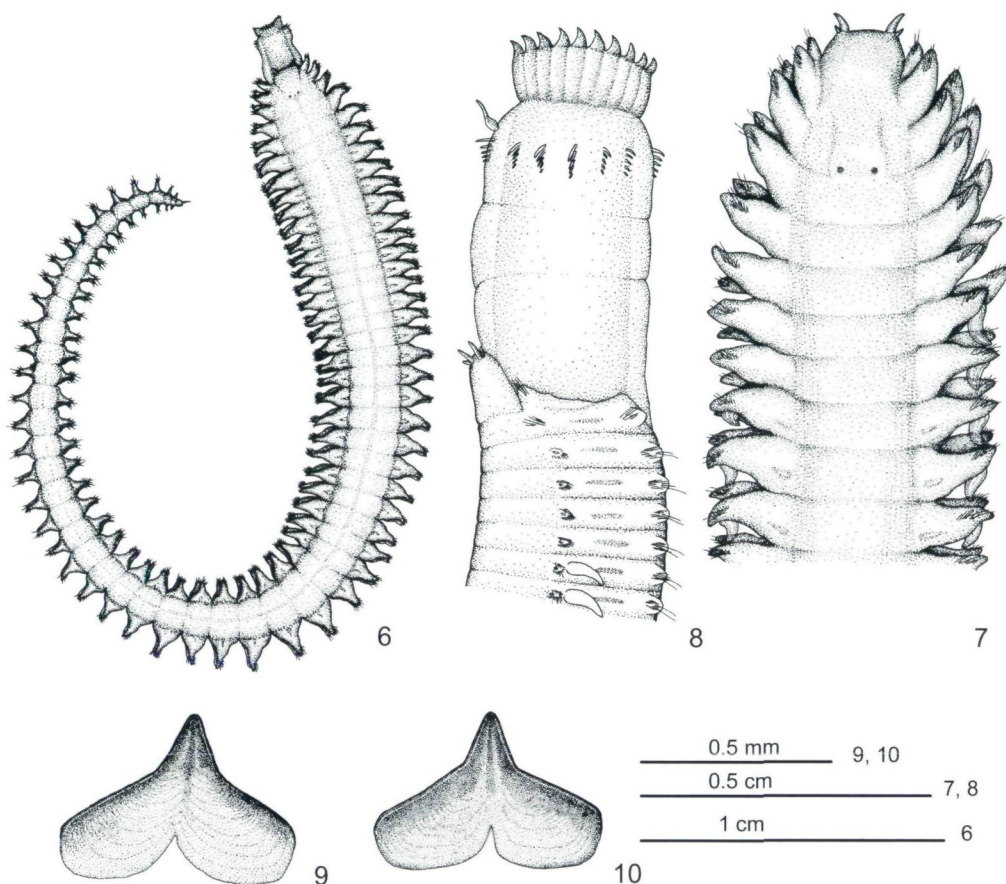
Morphological observations: Living male specimens of *Namalycastis indica* observed during this study are yellow or reddish in color; females are often greenish during reproduction period. This species reaches a length of 15 cm when fully extended.

Family Nephthydae

Nephthys oligobranchia SOUTHERN, 1921 (Figs 6 - 10)

Nephthys oligobranchia SOUTHERN, 1921: 610 - 611, Pl. 24, fig. 12a - c. - FAUVEL, 1953: 228, fig. 115 d - f. - MISHRA & al., 1983: 46. - DATTA MUNSHI & al., 1989: 104, figs. 1 - 4.

Material examined: Ganga River at Kahalgaon, Bihar, 2 specimens (NHMW-EV 19811), Badarghat, 15. - 17. Mar. 2002, 9 spec. (ZSRO-P1421), 12 specimens (SMF 12072).



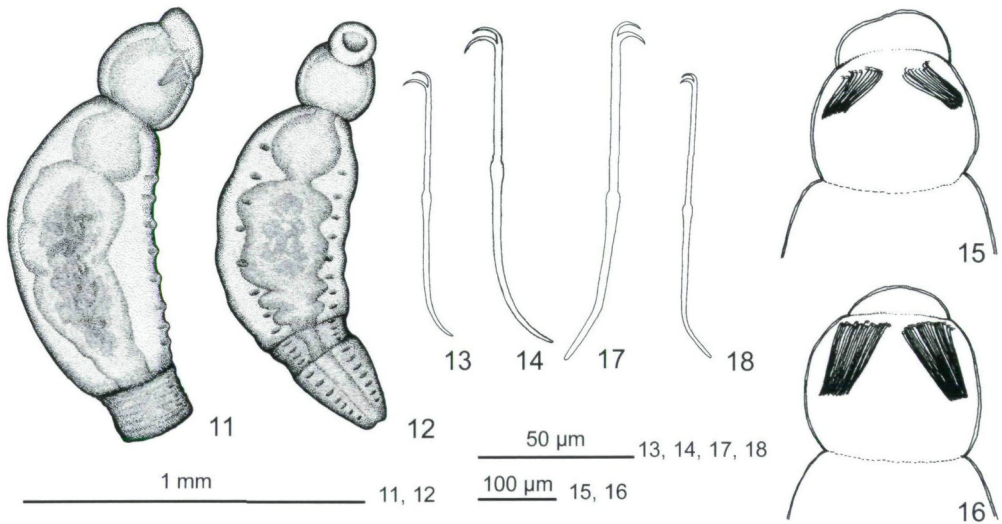
Figs. 6 - 10: *Nephthys oligobranchia* SOUTHERN, 1921, India, Ganga River, Patna, in (6) dorsal aspect, (7) anterior body with head, (8) extended pharynx in lateral aspect and (9, 10) jaws.

Habitat and distribution: *Nephthys oligobranchia* occurs in the silt and sand substrates of the Ganga River, occurring throughout the freshwater reaches of the Ganga and Yamuna rivers upstream to Allahabad. This species is also known from brackish waters of India (FAUVEL 1953, MISHRA & al. 1983, DATTA MUNSHI & al. 1988, SINHA 1989).

Morphological observations: Living male specimens of *N. oligobranchia* observed during this study are pale yellow or reddish in color, and reach lengths of 2 - 5 cm when fully extended.

Class Oligochaeta

The maximum lengths of the different types of setae are given in brackets.



Figs. 11 - 15: *Chaetogaster limnaei limnaei* VON BAER, 1827, India, Kumhrar pond, Patna, in (11) dorsal and (12) lateral aspect, ventral crotchet of (13) midbody and (14) segment II, (15) head with ventral setae bundles of segment II.

Figs. 16 - 18: *Chaetogaster limnaei bengalensis* ANNANDALE, 1905, India, Ganga River, Patna, (16) head with ventral setae bundles of segment II, ventral crotchet of (17) segment II and (18) mid-body.

Family Naididae

Chaetogaster limnaei limnaei VON BAER, 1827 (Figs. 11 - 15)

Chaetogaster limnaei, - STEPHENSON, 1923: 50 - 51. - SPERBER, 1950: 54, Pl. I, fig. 4.

Chaetogaster limnaei limnaei, - BRINKHURST & JAMIESON, 1971: 312 - 313, figs. 7.1 O, P.

Material examined (numerous specimens): Kumhrar ponds, 14. Nov. 2002, (NHMW-EV 19781, 19782, SMF 12075), 22. Nov. 2002, 23. Feb. 2003, 2. Mar. 2003.

Habitat and distribution: During our study, this epizoic species was found on the extended mantle inside the shell of the gastropod *Lymnaea acuminata* LAMARCK, 1822, collected from the macrophytes of shallow lentic waters. It is known from Europe, Asia, and North America (BRINKHURST & JAMIESON 1971) and (as *Chaetogaster limnaei*) from Africa (GRIMM 1987) and Australia (PINDER, 2001). In India, *Chaetogaster limnaei limnaei* was previously reported from Nainital, where it was observed to be associated with Lymnaeidae (collection by Annadale, as reported in STEPHENSON 1923).

Morphological observations: Small worms white in color. Length of single preserved individuals reaching 1.2 mm; chains of zooids up to 5 mm. Segment number 13. Segment II bears 12 (- 13) setae (length: 78 - 83 µm) per bundle; 8 - 12 (- 13) setae (length: 63 - 69 µm) with indistinct nodulus in the mid-body segments. Reproduction by budding is common.

***Chaetogaster limnaei bengalensis* ANNANDALE, 1905 (Figs. 16 - 18)**

Chaetogaster bengalensis ANNANDALE, 1905: 117 - 120, fig. 1, pl. III, figs. 1 - 4. - STEPHENSON, 1923: 49 - 50.

Chaetogaster limnaei bengalensis, - BRINKHURST & JAMIESON, 1971: 313.

Material examined (numerous specimens): Badarghat, Patna, 20. Feb. 2003 (NHMW-EV 19821). Zoo-pond, 25. Feb. 2003.

Habitat and distribution: During our study, this epizoic species was found abundantly on the body surface of the gastropods *Radix* aff. *persica* (ISSEL, 1865) in the Ganga River and *Radix luteola* (LAMARCK, 1822) in the Zoo-pond. It is known only from Asia (BRINKHURST & JAMIESON 1971). *Chaetogaster limnaei bengalensis* is widely distributed on the Indian subcontinent (STEPHENSON 1923). This is the most common and often dominant taxon observed during our study of the oligochaete fauna of Patna.

Morphological observations: Small worms of pale or transparent appearance; length of single preserved specimens to 0.8 - 1 mm, chains of zooids up to 5 mm in length. Segment number 9 or more. Segment II with 20 (- 21) setae (length: 118 - 149 µm) per bundle; setae in the mid-body segments (13 -) 15 - 17 setae (length: 84 - 104 µm), with prominent nodulus. Reproduction by budding.

Remarks: The validity of *Chaetogaster limnaei bengalensis* was often neglected (NAIDU 1962, 1966) or was regarded as a doubtful taxon. It is noteworthy that earlier observations by Annadale (1905) and STEPHENSON (1923) were confirmed during the present study by the collection of two forms in Patna – each of these taxa are clearly distinguishable from one another. These observations suggest that additional study of the two subspecies is warranted, perhaps leading to each being elevated to species rank. The taxa *C. l. limnaei* and *C. l. bengalensis* have the following differential characters in the body form (single individuals): *C. limnaei limnaei* is in general longer and more slender, the head bears a wider prostomium, the 12 (- 13) setae of segment II are small with a weak nodulus. *C. limnaei bengalensis* has a comparatively short and stout thick body, the head bears a smaller prostomium, the 20 (- 21) setae of segment II are large with a well marked nodulus and a thicker proximal part. Both taxa prefer different snail hosts, The ecology, taxonomy, systematics, and status of these and other subspecies of *C. limnaei* has been discussed elsewhere in the literature (e.g., SPERBER, 1948; GRUFFYDD 1965a, 1965b; BRINKHURST & JAMIESON, 1971).

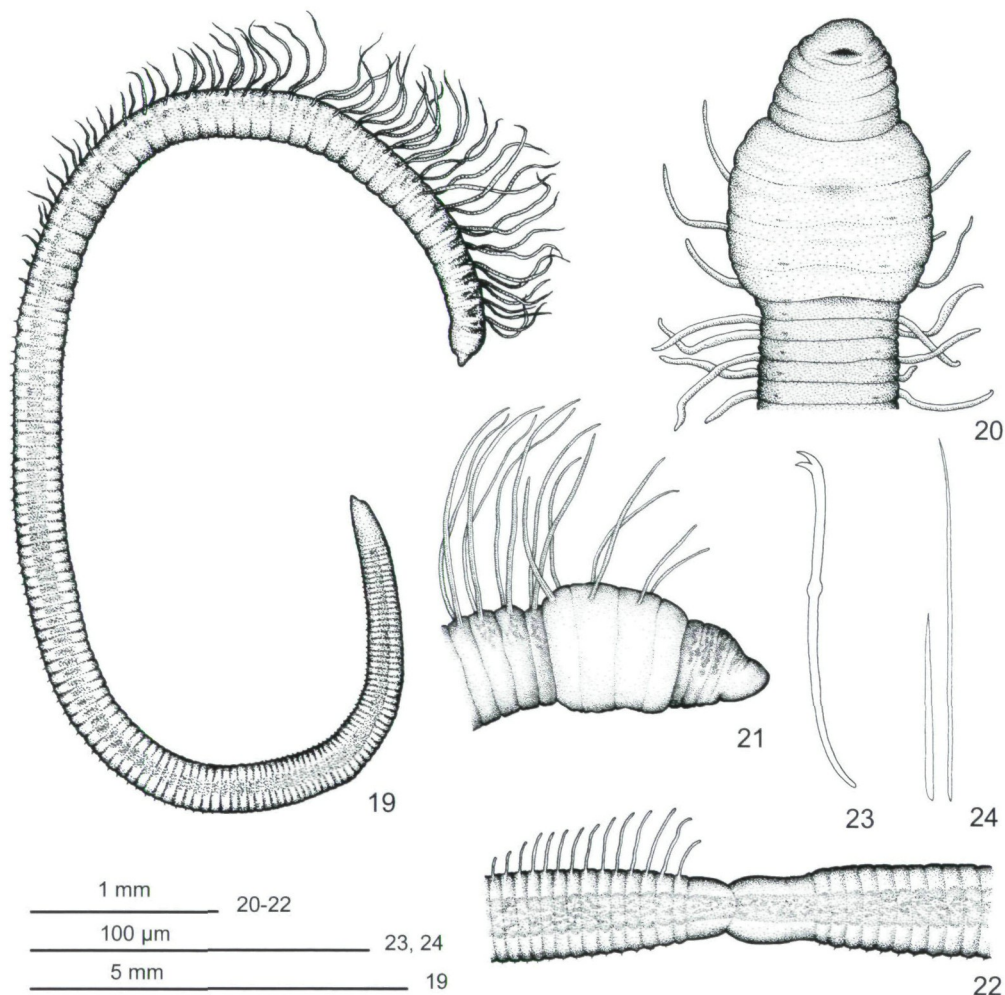
***Branchiodrilus semperi* (BOURNE, 1890) (Figs. 19 - 24)**

Branchiodrilus menoni STEPHENSON, 1912: 219 - 229, figs. 1 - 3, pl. XI, figs. 1 - 6. - STEPHENSON, 1923: 78, fig. 25.

Branchiodrilus semperi, - STEPHENSON, 1923: 75. - NAIDU, 1962: 526 - 527, figs. 11 A - F.

Material examined (numerous specimens): Mahendrughat, 9. Oct. 2002 (NHMW-EV 19791), 11. Oct. 2002, Nov. 2002, Zoo-pond, 24. Sep. 2002 (NHMW-EV 19792), Secretariat pond (1 specimen) 23. 11. 2002.

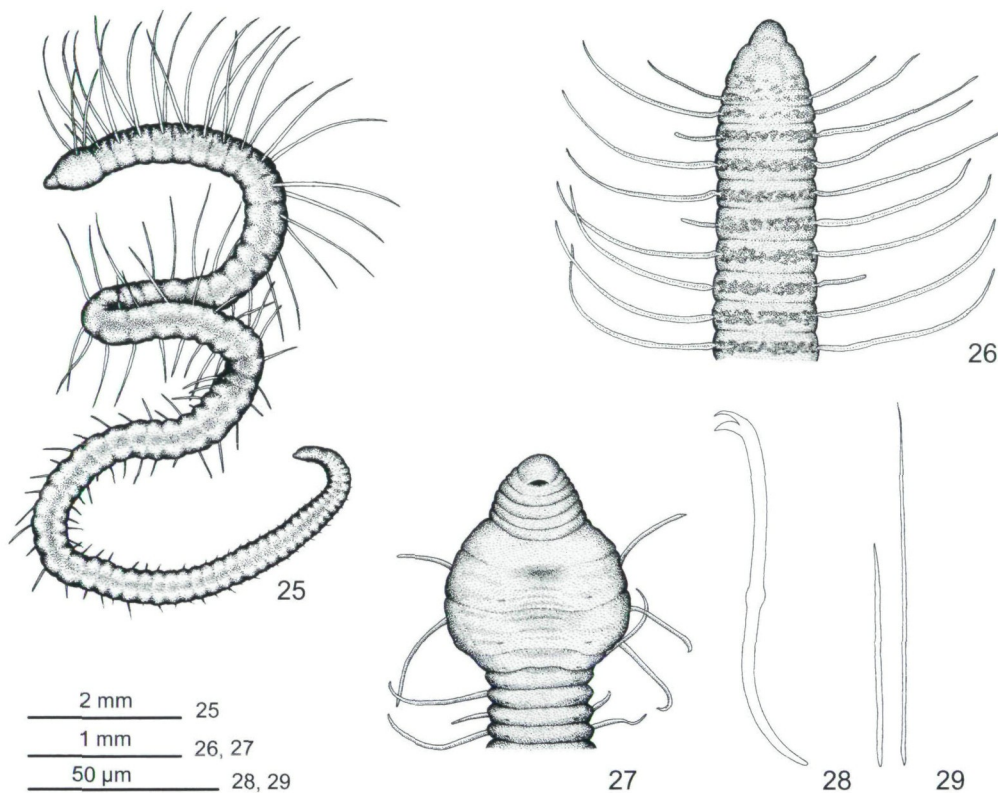
Habitat and distribution: *Branchiodrilus semperi* occurs in the mud, silt, and sand substrates of the Ganga River and in the large ponds. Together with *Limnodrilus hoffmeisteri* it is the second most abundant oligochaete in the river, where it was found to occur in very high numbers, concentrated in small areas with extensive organic



Figs. 19 - 24: *Branchiodrilus semperi* (BOURNE, 1890), India, Ganga River, Patna, in (19) lateral aspect, anterior body with head and clitellum in (20) ventral and (21) lateral aspect, (22) budding zone, (23) ventral crotchet and (24) dorsal needle and hair setae.

pollution. On the other hand, *Branchiodrilus semperi* was also the dominant species in Zoo-pond. There, it was collected most commonly from homogenous mud and clay substrate along the forested banks, areas that have diffuse sunlight and are devoid of aquatic macrophytes. *Branchiodrilus semperi* was collected most commonly from the deeper water (> 0.3 - 0.5 m). It was found to occur in large numbers during September to November, but was virtually absent from the same microhabitats during the spring season (March and April). Numerous mature worms with a clitellum were observed during the first half of November.

Prior to this study, *B. semperi* had been found only in South India (NAIDU 1962). It represents a new record for the fauna of the Ganga River system and Bihar.



Figs. 25 - 29: *Branchiodrilus hortensis* (STEPHENSON, 1910), India, Kumhrar pond, Patna, in (25) lateral aspect, (26) anterior body with dorsal pigment pattern, (27) head and clitellum in ventral aspect, (28) ventral crotchet and (29) dorsal needle and hair setae.

Morphological observations: Medium-sized worm dark red or brown in color; length of preserved specimens reaching 7 - 20 mm, living worms 45 mm. Segment number up to 145 + indifferent zone. One pair of long dorso-lateral gills present from VI to XXXV (- XXXVIII or XL). Dorsal setae beginning at VI, 1 hair, becoming progressively shorter in posterior region. All anterior dorsal setae enclosed in gills. Ventral setae 2 crotchets (105 µm) per bundle. Clitellum extending from V - VIII. Dark pigment arranged in transverse bands on anterior dorsal segments. Reproduction by budding observed in some individuals. Swimming not observed.

Remarks: *Branchiodrilus semperi* can be easily distinguished in the field from *Branchiodrilus hortensis* by the following characters: color (dark red: *semperi*, transparent: *hortensis*), locomotion (crawling: *semperi*, rapid swimming: *hortensis*) and shape of clitellum (rounded: *semperi*, heart-shaped: *hortensis*). *Branchiodrilus semperi* can be confused with small *Branchiura sowerbyi*, because they have similar body form, color, locomotion, and gills.

Branchiodrilus hortensis* (STEPHENSON, 1910) (Figs. 25 - 29)Lahoria hortensis* STEPHENSON, 1910: 59, figs. 1 - 3, Pl. VII, figs. 1 - 3.*Branchiodrilus hortensis*, - STEPHENSON, 1923: 77 - 78, fig. 26.

Material examined (numerous specimens): Kumhrar ponds, 9. Nov. 2002, 12. Nov. 2002 (NHMW-EV 19794), 14. Nov. 2002, 2. Mar. 2003, Secretariat pond 23. Nov. 2002 (NHMW-EV 19793), 30. Nov. 2002.

Habitat and distribution: *Branchiodrilus hortensis* occurs in some different stagnant water bodies from the smallest wetland pools to the large ponds. It was always found among floating or submerged macrophytes. The worms were presently observed from November to March in large numbers. Mature worms with clitellum were commonly observed in November as in case of *Branchiodrilus semperi*. The largest specimens of *Branchiodrilus hortensis* were collected in March from Kumhrar.

This species has a large distribution range in South and East Asia, Africa and Australia (BRINKHURST & JAMIESON 1971). Prior to this study, *Branchiodrilus semperi* had only been reported from Lahore and Agra (NAIDU 1962).

Morphological observations: Medium-sized worm of transparent appearance, length of preserved specimens reaching 5 - 18 mm, living worms with full extension reaching 25 - 40 mm. Segment number up to 90 + indifferent zone. One pair of long dorso-lateral gills present from segment VI to the posterior region. Dorsal setae starting from VI, 1 hair, becoming progressively shorter in the posterior region. Nearly all of the dorsal setae are enclosed in the gills. Some free short hair setae were recognized, but only in the posterior segments. Ventral setae 3 - 5 crotchets (97 µm) per bundle. Clitellum extending from V - VIII. Dark pigment arranged in transverse bands on the anterior dorsal segments. No reproduction by budding. Rapid swimming observed.

Nais communis* PIGUET, 1906 (Figs. 30 - 31)Nais variabilis* var. *punjabensis* STEPHENSON, 1909: 255 - 263, figs. 1 - 3, pl. XV, XVI, figs. 1 - 21.*Nais communis*, - SPERBER, 1950: 60, figs. 10 a - c. - NAIDU, 1962: 140 - 142, figs. 7 A - F.

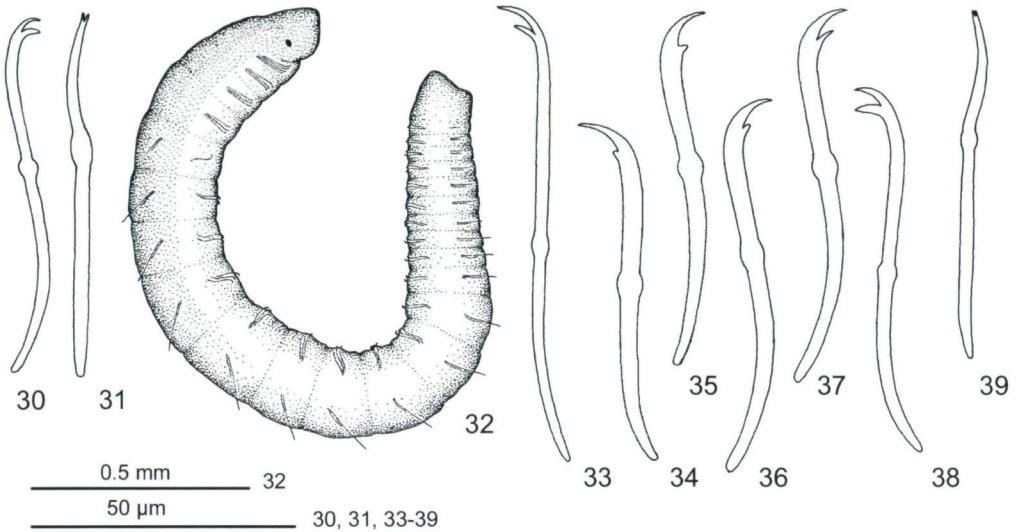
Material examined (3 specimens): Zoo-pond, 23. Feb. 2003.

Habitat and distribution: *Nais communis* was found on submerged grasses of the bank vegetation in stagnant water of an eutrophic pond. *Nais communis* is a cosmopolitan species with numerous records from the Indian subcontinent (STEPHENSON 1909, 1923, 1925, AIYER 1930, NAIDU 1962).

Morphological observations: Small worms white in color, anterior body light brownish, length of preserved specimens reaching 2.2 mm. One pair of lateral eyes present on the prostomium. Segment number 24 + indifferent zone. Dorsal setae starting from VI, 1 hair and 1 bifid needle (63 µm) with distal nodulus. Ventral setae 3 crotchets (70 - 72 µm) per bundle with median nodulus. All ventral setae have similar shape.

Nais bretscheri* MICHAELSEN, 1899 (Figs. 32 - 39)Nais bretscheri*, - SPERBER, 1950: 63, figs. 14 a - m.

Material examined: Badarghat downstream from Patna, 20. Feb. 2003, 2 specimens, (NHMW-EV 19829), Zoo-pond, 23. Feb. 2003, 1 specimen.



Figs. 30 - 31: *Nais communis* FIGUET, 1906, India, Zoo-pond, Patna, (30) ventral crotchet and (31) dorsal needle of the mid-body region.

Figs. 32 - 39: *Nais bretscheri* MICHAELSEN, 1899, India, Ganga River, Patna, in (32) lateral aspect, ventral crotchet of (33) segment II - V, (34) of VI, (35) of VII, (36) of VIII, (37) of X and (38) of the posterior segments, (39) dorsal needle.

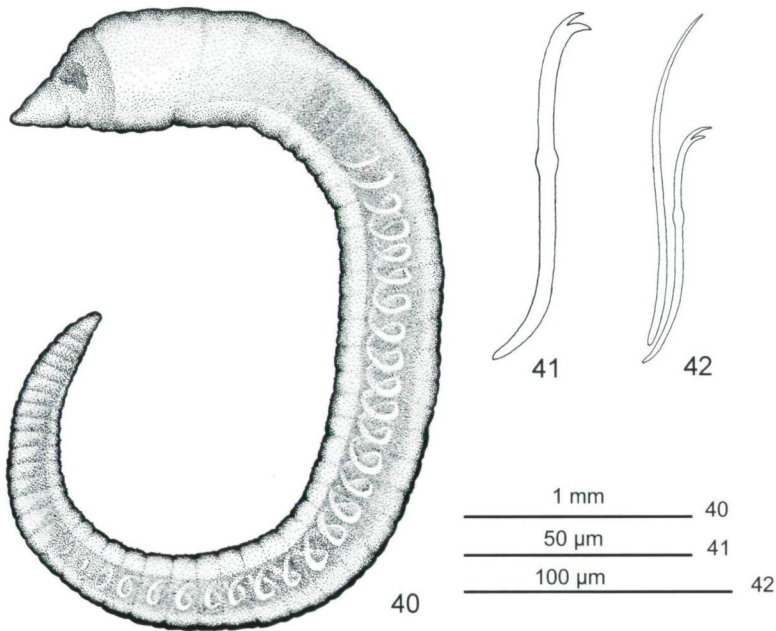
Habitat and distribution: *Nais bretscheri* was collected from algae epiphyton on the shell surface of *Radix luteola* and *Physa (Haitia) mexicana* PHILLIPI, 1841, in shallow eutrophic waters. This species is new to the fauna of India. *Nais bretscheri* is known from Europe to Central Asia. Although this species is similar and closely related to *Nais pardalis* Piguët, 1906, it has a wider distribution from North America and Europe to China (BRINKHURST & JAMIESON 1971), none of such worms were yet noticed from the Indian subcontinent (NAIDU 1966)

Morphological observations: Small worms, anterior body distinctly brownish in color, length of preserved specimens reaching 1.8 mm. One pair of lateral eyes present on the prostomium. Segment number 30 + indifferent zone. Dorsal setae starting from VI, 1 hair and 1 double-pronged needle (67 µm) with distal nodulus. Ventral setae of II - V 4 - 3 thin crotchets (88 µm) per bundle with proximal nodulus, the following segments bear 1 (VI) and 2 (VII, VIII), 2 or 3 (X) and 3 (XI - XIV) ventral setae (79 µm) with median nodulus. In the posterior body region on segments XV - XXV, there are 2 ventral crotchets (74 µm) per bundle. Mid-body of setae remarkable thick, with distal tooth 2 - 3 times as long as the proximal.

***Haemonais waldvogeli* BRETSCHER, 1900 (Figs. 40 - 42)**

Haemonais laurentii STEPHENSON, 1915: 769, figs. 1 - 5, Pl. LXXIX. - STEPHENSON, 1923: 79 - 80, fig. 27.

Haemonais waldvogeli, - NAIDU, 1962: 522 - 525, figs. 10 A - C.



Figs. 40 - 42: *Haemonais waldvogeli* BRETSCHER, 1900, India, Kumhrar pond, Patna, in (40) lateral aspect, (41) ventral crotchet and (42) dorsal bundle with hair and needle setae.

Material examined (numerous specimens): Kumhrar ponds 14. Nov. 2002, 22. Nov. 2002, 26. Nov. 2002, 2. Mar. 2003, Secretariat pond, 23. Nov. 2002, 30. Nov. 2002 (NHMW-EV 19783).

Habitat and distribution: *Haemonais waldvogeli* lives in different highly eutrophic or clear mesotrophic ponds and pools in detritus under floating vegetation or in leaf litter, which is covering the muddy bottom surface of shadowed waters. *Haemonais waldvogeli* is very common in some stagnant waters in Patna.

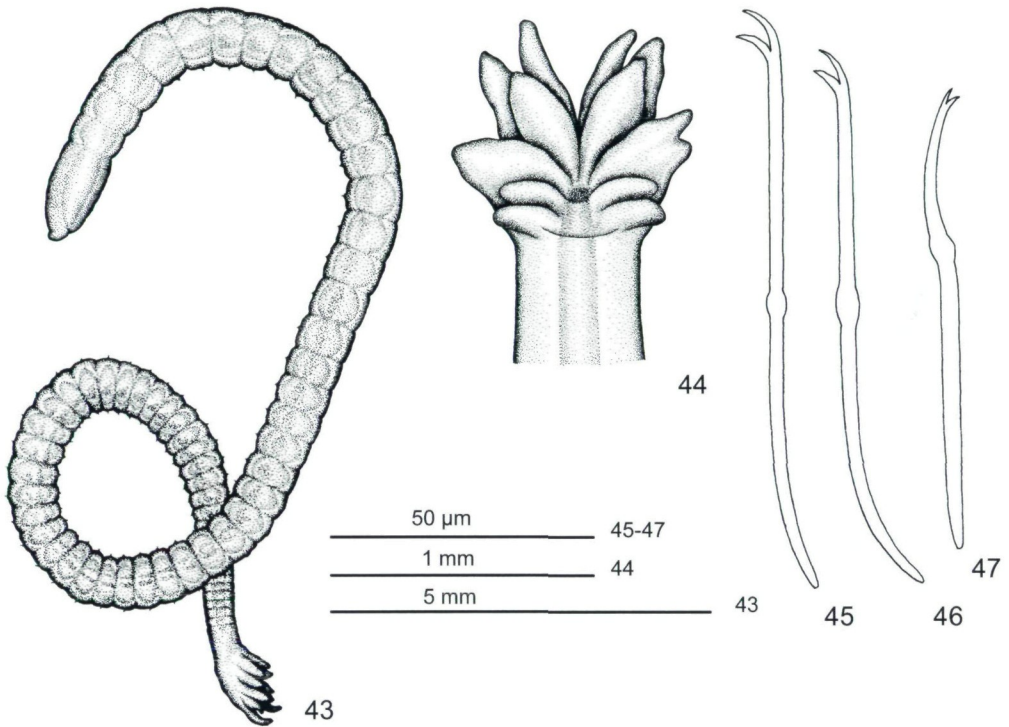
Distribution: Asia, Europe, North and South America (NAIDU 1962; BRINKHURST & JAMIESON 1971), Hawaii (BRITTON & WETZEL 1999), and from South India, the Indo-Gangetic plain, Western Himalayas, and Pakistan.

Morphological observations: Small worms yellow-brown or grayish in color, length of preserved specimens reaching 6 - 7 mm, living worms up to 18 mm. Segment number up to 60 + indifferent zone. Anterior part and mid-body region short and thick, posterior region more slender. One lateral pair of dark triangular fields in the head region on segments II - III. Dorsal setae starting from XVIII, 1 hair and 1 bifid needle (92 µm) per bundle. Ventral setae 3 crotchets (80 - 86 µm) per bundle. No swimming observed.

Dero dorsalis FERRONIERE, 1899 (Figs. 43 - 47)

Dero dorsalis, - SPERBER, 1950: 70 - 71, fig. 22. - NAIDU, 1962: 529 - 531, figs. 12 A - H.

Material examined (several specimens): Zoo-pond, 26. Sep. 2002 (NHMW-EV 19780), 28. Sep. 2002.

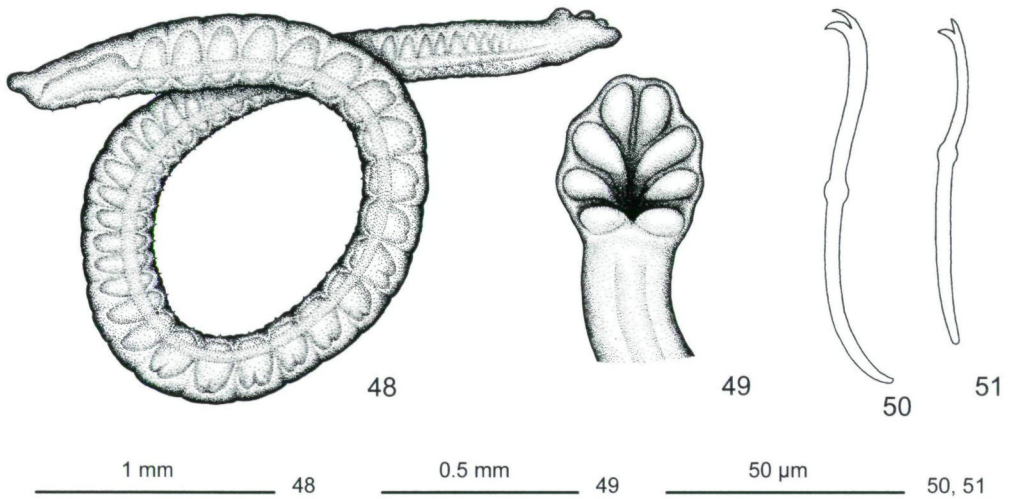


Figs. 43 - 47: *Dero dorsalis* FERRONIERE, 1899, India, Zoo-pond, Patna, in (43) lateral aspect, (44) branchial organ in dorsal aspect, ventral crotchet (45) of segment II - V, (46) of mid-body region and (47) dorsal needle.

Habitat and distribution: *Dero dorsalis* was found on submerged overhanging grasses and leaf litter at the confluence of a small drainage stream discharging into the pond of the Biological Park. The stream water is rich in nutrients, plankton and detritus from *Hippopotamus* that are held captive in the zoo just upstream of Zoo-pond. This very limited area is a running water habitat with loam, sand and mud substratum. The water body is visited by large quantities of fishes and the surrounding fauna is dominated by filter feeders. *D. dorsalis* occurs in the same microhabitat with *Aulophorus furcatus* and *Limnodrilus hoffmeisteri*.

Distribution: Europe, South and East Asia (NAIDU 1962, BRINKHURST & JAMIESON 1972). The species is new to the fauna of the Gangetic system and Bihar. *Dero dorsalis* was hitherto found only in South India (AIYER 1930, NAIDU 1963).

Morphological observations: Small worms light red in color, length of preserved specimens reaching 5 - 10 mm. Segment number up to 70 + indifferent zone. Dorsal setae starting from IV, 1 hair and 1 double-pronged needle (97 µm) per bundle. Ventral setae 3 - 5 crotchets (92 - 110 µm) per bundle. Branchial organ with 5 - 6 pairs of gills. Reproduction by budding was sometimes observed. Occasionally the worms were found in tubes made of various sized detritus and plant material.



Figs. 48 - 51: *Dero digitata* (O. F. MÜLLER, 1773), India, Kumhrar pond, Patna, in (48) lateral aspect, (49) branchial organ in dorsal aspect, ventral crotchet (50) of mid-body region and (51) dorsal needle.

***Dero digitata* (O. F. MÜLLER, 1773) (Figs. 48 - 51)**

Dero limosa, - STEPHENSON, 1923: 88 - 89.

Dero digitata, - NAIDU, 1962: 531 - 533, figs. 13 A - H.

Material examined (3 specimens): Kumhrar ponds, 22. Nov. 2002 (NHMW-EV 19812), 26. Nov. 2002 (NHMW-EV 19813).

Habitat and distribution: Wetlands of the Kumhrar Park, small clear groundwater-flooded pools with dense aquatic macrophytes and decomposing grasses, which are exposed to the direct sunlight. *Dero digitata* is a cosmopolitan species (BRINKHURST & JAMIESON 1971), but it was rarely found during this study.

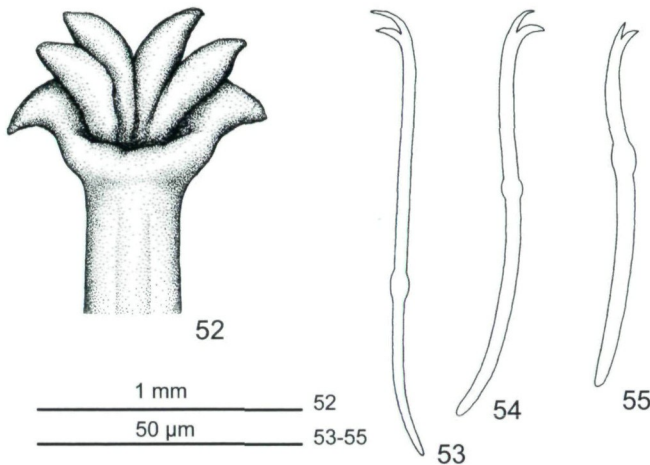
This species is new to the fauna of the Ganga River system and Bihar. *Dero digitata* was hitherto found only in South India (AIYER 1930, NAIDU 1962, 1963). In Europe, it was noticed as stenotope species of small pools in bogs and moors (UDE 1929, according to MICHAELSEN 1903, Schuster 1915).

Morphological observations: Small worms light red in color, length of preserved specimens reaching 3 - 4.5 mm. Segment number up to 47 + indifferent zone. Dorsal setae starting from VI, 1 hair and 1 bifid needle (62 µm) per bundle. Ventral setae 3 - 5 crotchets (75 - 92 µm) per bundle. Branchial organ sucker-shaped with 3 pairs of short gills.

***Dero cooperi* STEPHENSON, 1932 (Figs. 56 - 59)**

Dero cooperi, - NAIDU, 1962: 538 - 540, figs. 16 A - I.

Material examined (2 specimens): Kumhrar ponds, 26. Nov. 2002 (NHMW-EV 19826), 2. Mar. 2003 (NHMW-EV 19827).



Figs. 52 - 55: *Dero cooperi* STEPHENSON, 1932, India, Kumhrar pond, Patna, (52) branchial organ in dorsal aspect, ventral crotchet (53) of segment II - V, (54) of mid-body region and (55) dorsal needle.

Habitat and distribution: Wetlands of the Kumhrar Park, small clear groundwater-flooded pools with dense aquatic macrophytes and decomposed grasses, which are exposed to the direct sunlight. *Dero cooperi* is distributed in South America, Africa and South Asia with some localities in India (NAIDU 1962).

Morphological observations: Small worms light red in color, length of preserved specimens reaching 4 mm. Segment number up to 47 + indifferent zone. Dorsal setae starting from VI, 1 hair and 1 bifid needle (69 µm) per bundle. Ventral setae 4 crotchets (81 - 84 µm) per bundle. Branchial organ with 3 pairs of short foliate gills.

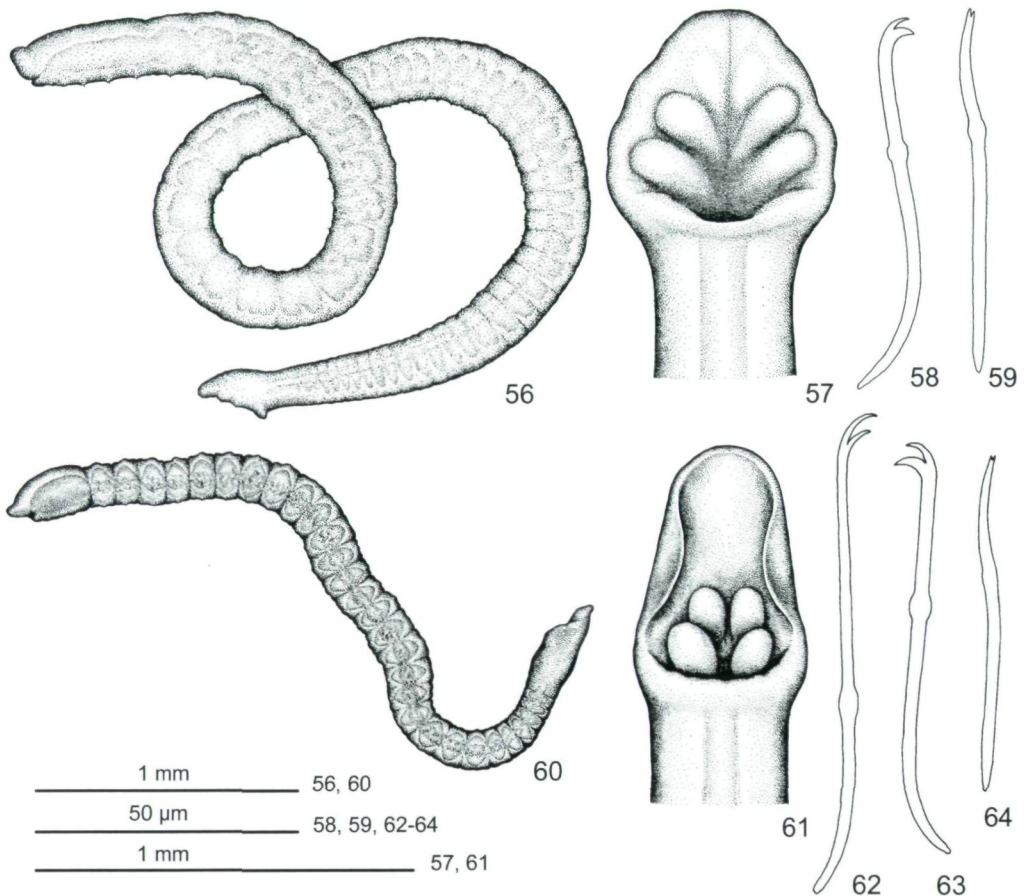
Dero sawayai MARCUS, 1943 (Figs. 56 - 59)

Dero sawayai, - NAIDU, 1962: 541 - 543, figs. 18 A - G.

Material examined (numerous specimens): Zoo-pond 15. Sep. 2002, 26. Sep. 2002 (NHMW-EV 19778), 28. Sep. 2002, Kumhrar ponds 22. Nov. 2002, 26. Nov. 2002 (NHMW-EV 19779), 2. 3. 2003.

Habitat and distribution: *Dero sawayai* lives in clear and shallow water bodies either at the subsurface of dense floating vegetation or in leaf litter (together with *Dero nivea*), which is covering the muddy bottom surface of habitats receiving indirect sunlight. Along the bank of the Zoo-pond, dense populations of *Dero sawayai* were collected from areas of floating green algae over sand substrate, all which were exposed to direct sunlight. Distribution: South America and South India (NAIDU 1962, BRINKHURST & JAMIESON 1971). This species is new to the fauna of the Gangetic system and Bihar.

Morphological observations: Small worms light red in color, length of preserved specimens reaching 3 - 4 mm. Segment number up to 60 + indifferent zone. Dorsal setae starting from IV, 2 hairs and 2 double-pronged needles (79 µm) per bundle. Ventral setae 5 crotchets (92 µm) per bundle. The proximal tooth is slightly longer than the distal. Branchial organ round sucker-shaped with 2 pairs of small gills in the concave dorsal cavity. Reproduction by budding was sometimes observed. Swimming observed.



Figs. 56 - 59: *Dero sawayai* MARCUS, 1943, India, Zoo-pond, Patna, in (56) lateral aspect, (57) branchial organ in dorsal aspect, ventral crotchet (58) of mid-body region and (59) dorsal needle.

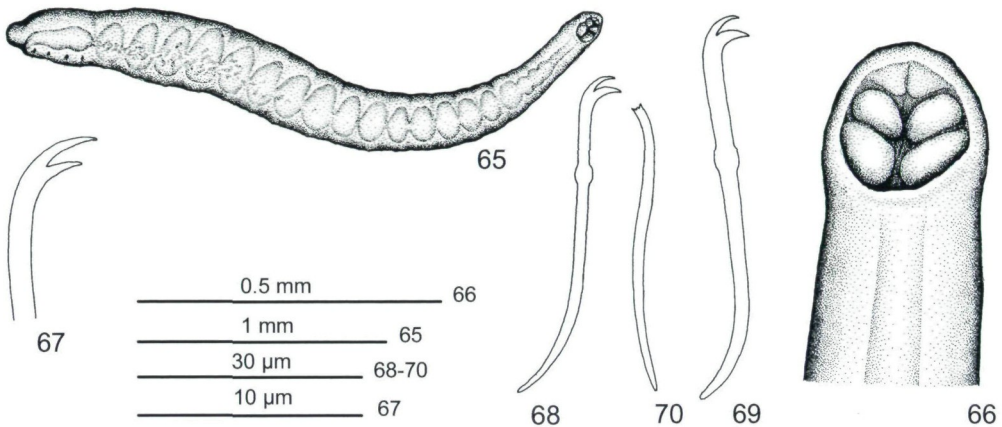
Figs. 60 - 64: *Dero nivea* AIYER, 1930, India, Kumhrar pond, Patna, in (60) lateral aspect, (61) branchial organ in dorsal aspect, ventral crotchet (62) of segment II - V, (63) of mid-body region and (64) dorsal needle.

***Dero nivea* AIYER, 1930 (Figs. 60 - 64)**

Dero nivea AIYER, 1930: 40, figs. 16, 17. - NAIDU, 1962: 540 - 541, figs. 17 A - C.

Material examined (several specimens): Kumhrar ponds, 12. Nov. 2002 (NHMW-EV 19777), 22. Nov. 2002, 26. Nov. 2002, 2. Mar. 2003.

Habitat and distribution: *Dero nivea* is a fairly common species in the various-sized small ponds and pools of the wetland area in the Kumhrar Park. It occurs here in clear and shallow water bodies, either at the subsurface of dense floating vegetation or in leaf litter (together with *Dero sawayai*), that is covering the muddy bottom surface of shadowed waters. Distribution: Europe, Asia, Australia, Africa, America (BRINKHURST &



Figs. 65 - 70: *Dero pectinata* AIYER, 1930, India, Ganga River, Patna, in (65) lateral aspect, (66) branchial organ in dorsal aspect, distal part of ventral crotchet (67) of segment II - V, (68, 69) ventral crotchet of mid-body region and (70) dorsal needle.

JAMIESON 1971). *Dero nivea* was originally described and found only from South India (AIYER 1930, NAIDU 1962, 1963). It is new to the fauna of the Gangetic system and Bihar.

Morphological observations: Small worms light grayish to red in color, length of preserved specimens reaching 1.5 - 4 mm. Segment number up to 35 + indifferent zone. Intersegmental furrows well visible, giving the whole worm a perforated outline. Head region (segments II - V) oval. Dorsal setae starting from IV, 1 hair and 1 double-pronged needle (74 µm) per bundle. Ventral setae 3 - 4 in II - V (125 µm) and 4 crotchets (79 µm) per bundle from VI onwards. Proximal tooth slightly longer than the distal. Branchial organ is elongated sucker-shaped with 2 pairs of small gills in the concave dorsal cavity. Swimming observed.

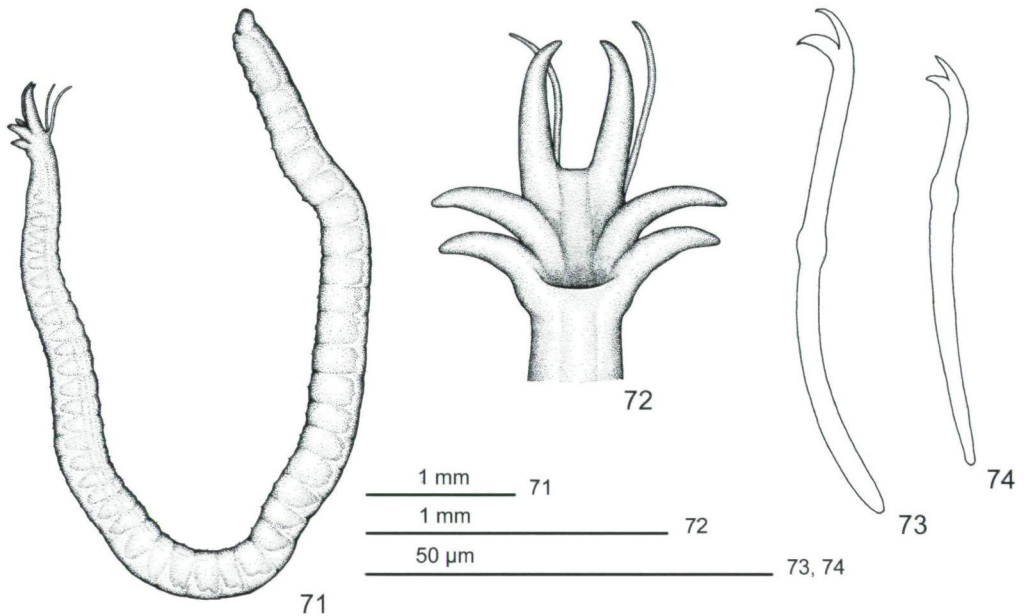
Dero pectinata AIYER, 1930 (Figs. 65 - 70)

Dero pectinata AIYER, 1930: 36, figs. 11, 12.

Material examined (>25 specimens.): Badarghat, downstream from Patna, Mar. 2002 (NHMW-EV 19828), Apr. 2002 (NHMW-EV 19815).

Habitat and distribution: *Dero pectinata* was found between detritus and green algae covering mud and fine sand in shallow and nearly stagnant pools of the Ganga River during the spring. *Dero pectinata* previously was known only from the original description and type locality in South India (AIYER 1930, NAIDU 1963, BRINKHURST & JAMIESON 1971). This species is now recorded for first time from the Ganga River basin and Bihar.

Morphological observations: Small and short worms transparent red in color, length of preserved specimens reaching 1 - 2.5 mm. Segment number up to 25 + indifferent zone. Dorsal setae starting from VI, 1 hair and 1 pectinate needle (36 µm) per bundle. Ventral



Figs. 71 - 74: *Aulophorus furcatus* (O. F. MÜLLER, 1773), India, Zoo-pond, Patna, in (71) lateral aspect, (72) branchial organ in dorsal aspect, ventral crotchet (73) of mid-body region and (74) dorsal needle.

setae 4 crotchets (40 - 75 µm) per bundle. All setae behind V have a distal nodulus, the proximal tooth longer than the distal. Branchial organ small rounded and sucker-shaped, not exceeding the maximum diameter of posterior body. Two pairs of very small gills and additional 1 pair of folds in the concave dorsal cavity.

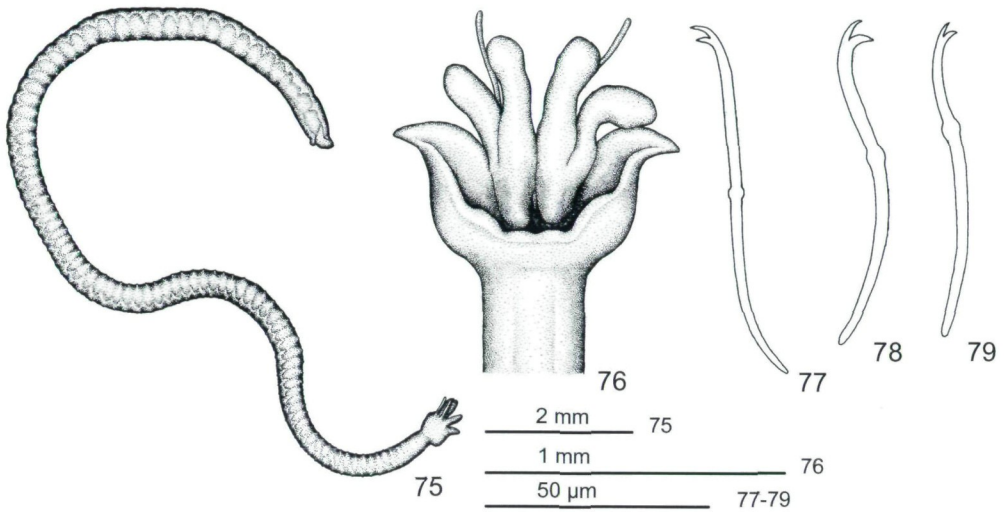
***Aulophorus furcatus* (O. F. MÜLLER, 1773) (Figs. 71 - 74)**

Aulophorus furcatus, - STEPHENSON, 1923: 92 - 93, fig. 34. - NAIDU, 1963: 899 - 902, figs. 20 A - G.

Material examined (several specimens): Kumhrar ponds, 22. Nov. 2002, 26. Nov. 2002 (NHMW-EV 19774), Kumhrar, small wetland pools, 2. Mar. 2003.

Habitat and distribution: In Patna *Aulophorus furcatus* was found only in stagnant water bodies - small ponds and clear groundwater-flooded pools with dense aquatic macrophytes. It prefers localities that are exposed to the direct sunlight. It occurs in the detritus cover of muddy sediments near submerged vegetation, sometimes on sandy bottom or in leaf litters. It is always accompanied by a diverse benthic fauna.

Cosmopolitan, widely distributed in freshwater habitats on all continents (BRINKHURST & JAMIESON 1971); primary distribution restricted to tropical, subtropical, and warm-temperate regions. STEPHENSON (1923) was the first to publish records of this species from India, but no localities were listed for the Indo-Gangetic plain area (NAIDU 1962).



Figs. 75 - 79: *Aulophorus hymanae* NAIDU, 1963, India, Kumhrar pond, Patna, in (75) lateral aspect, (76) branchial organ in dorsal aspect, ventral crotchet (77) of segment II - V, (78) of mid-body region and (79) dorsal needle.

Morphological observations: Small to medium-sized worms light red in color, length of preserved specimens reaching up to 10 mm and 15 - 30 mm in living individuals, when fully extended. Segment number up to 55 + indifferent zone. Dorsal setae starting from V, 1 hair and 1 bifid needle (50 µm) per bundle. Ventral setae 2 - 4 crotchets (57 µm) per bundle. Branchial organ with 3 pairs of long cylindrical gills and 1 pair of thin palps. The worms occasionally were found in light tubes of various sized detritus and plant material. No swimming observed.

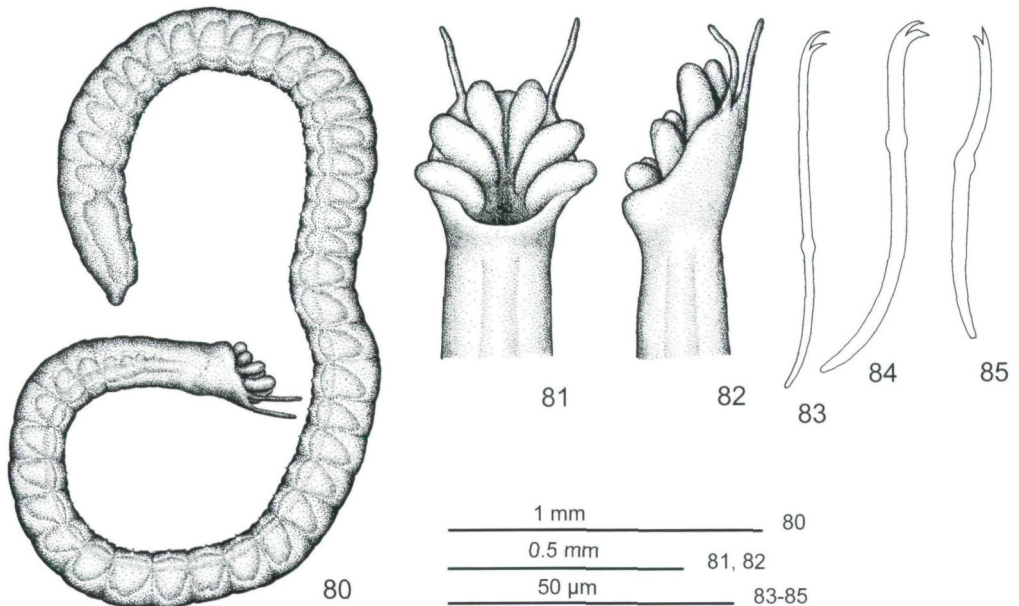
Aulophorus hymanae NAIDU, 1963 (Figs. 75 - 79)

Aulophorus hymanae NAIDU, 1963: 905 - 908, figs. 22 A - F.

Material examined (several specimens): Kumhrar ponds, 22. Nov. 2002 (NHMW-EV 19775), 26. Nov. 2002 (NHMW-EV 19776), 2. Mar. 2003.

Habitat and distribution: This species was collected from small, clear, groundwater-flooded ponds with dense aquatic macrophytes that are exposed to the direct sunlight. It occurs in the detritus cover of muddy sediments near submerged vegetation. Prior to this study, *Aulophorus hymanae* was known only from the original description and type locality in South India (NAIDU 1963, BRINKHURST & JAMIESON 1971). It is recorded for the first time from the Ganga River basin and Bihar. *Aulophorus hymanae* might be considered as a widespread species of the Indian subcontinent.

Morphological observations: Small to medium-sized worms deep red in color; length of preserved specimens reaching up to 13 mm. Living individuals with full extension may exceed 20 - 35 mm. Segment number up to 93 + indifferent zone. Dorsal setae starting from V, 1 hair and 1 thick bifid needle (83 µm) per bundle. Ventral setae 4 (- 5) thin



Figs. 80 - 85: *Aulophorus indicus* NAIDU, 1963, India, Ganga River, Patna, in (80) lateral aspect, branchial organ in (81) dorsal and (82) lateral aspect, ventral crotchet (83) of segment II - V, (84) ventral crotchet of mid-body region and (85) dorsal needle.

crotchets per bundle in II - V (85 µm), 3 crotchets (79 µm) from segment VI onwards and 2 crotchets in the posterior body. Branchial organ wide and cup-shaped, with 3 pairs of large foliate gills and 1 pair of thin palps. No swimming was observed.

Remarks: This is the longest species of the *Dero/Aulophorus*-group with the highest number of segments. The living worms bear a strong resemblance to the Tubificidae.

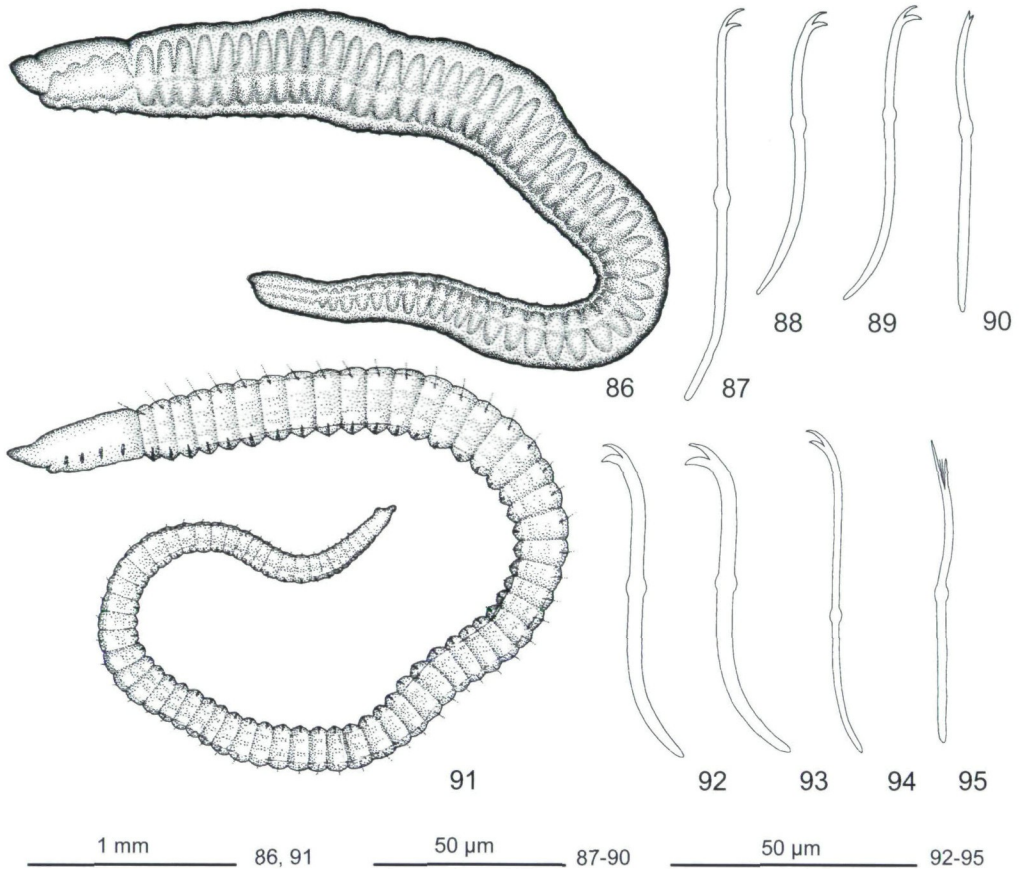
Aulophorus indicus NAIDU, 1963 (Figs. 80 - 85)

Aulophorus indicus NAIDU, 1963: 902 - 904, figs. 21 A - E.

Material examined (several specimens): Badarghat, Mar. 2002, (NHMW-EV 19820, 19824).

Habitat and distribution: *Aulophorus indicus* was found between detritus and green algae covering mud and fine sand in shallow and nearly stagnant pools of the Ganga River during spring period. Here it is closely associated with *Nephtys oligobranchia*, *Dero pectinata*, and the bivalve *Pisidium clarckeanum*. It is a running water species, being absent from the ponds. The species was known only from the original description and type locality in South India (NAIDU 1963, BRINKHURST & JAMIESON 1971). It is new to the fauna of the Ganga River basin and Bihar. *Aulophorus indicus* might be a more widespread species of the Indian subcontinent.

Morphological observations: Small worms transparent red in color, length of preserved specimens reaching up to 3 - 5 mm. Segment number up to 45 + indifferent zone.



Figs. 86 - 90: *Allonais paraguayensis* (MICHAELSEN, 1905), India, Ganga River, Patna, in (86) lateral aspect, ventral crotchet (87) of segment II - V, (88, 89) ventral crotchet of mid-body region and (90) dorsal needle.

Figs. 91 - 95: *Allonais inaequalis* (STEPHENSON, 1911), India, Kumhrar pond, Patna, in (91) lateral aspect, ventral crotchet (92, 93) of mid-body region, (94) of segment II - V and (95) dorsal needle.

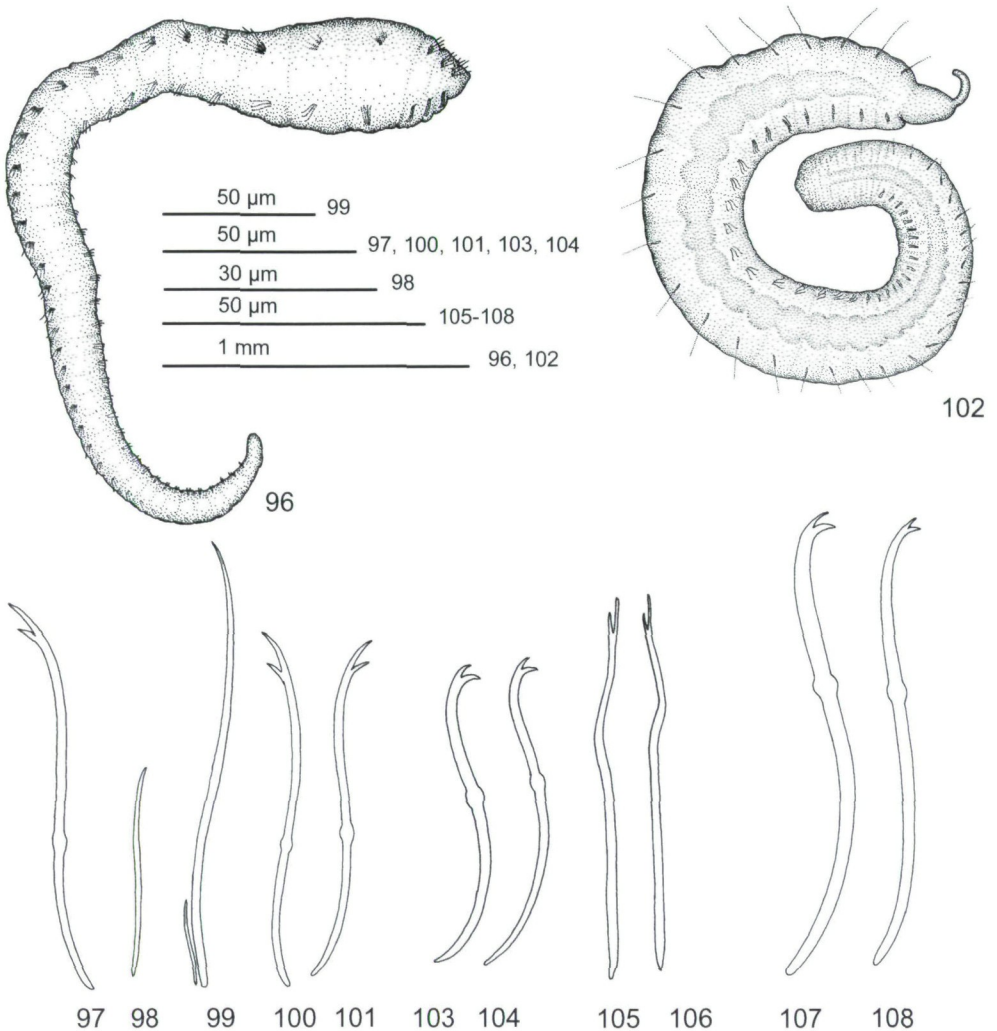
Dorsal setae starting from V, 1 hair and 1 thin bifid needle (53 µm) per bundle. Ventral setae 4 thin crotchets per bundle in II - V (69 µm), 4 crotchets (62 µm) from segment VI onwards and 3 crotchets in the posterior body. Branchial organ small and not distinctly separated from the posterior body region, with 3 pairs of short cylindrical gills and 1 pair of short palps. No swimming observed.

***Allonais paraguayensis* (MICHAELSEN, 1905) (Figs. 86 - 90)**

Nais paraguayensis, - STEPHENSON, 1909: 263 - 264, pl. XVII, figs. 22 - 24. - STEPHENSON, 1923: 61 - 63, figs. 15 - 18.

Allonais paraguayensis paraguayensis, - NAIDU, 1963: 915.

Material examined (several specimens): Mahendrugat, 11. Oct. 2002, 10. Nov. 2002 (NHMW-EV 19831).



Figs. 96 - 101: *Pristina acuminata* LIANG, 1958, India, Ganga River, Patna, in (96) lateral aspect, (97) ventral crotchet, (98) dorsal needle and (99) hair setae, (100, 101) ventral crotchet of mid-body region.

Figs. 102 - 106: *Pristina synclites* STEPHENSON, 1925, India, Zoo-pond, Patna, in (102) lateral aspect, (103, 104) ventral crotchet and (105, 106) dorsal needle setae.

Figs. 107 - 108: *Pristina cf. biserrata* CHEN, 1940, India, Ganga River, Patna, ventral (107) and dorsal (108) crotchet.

Habitat and distribution: *Allonais paraguayensis* occurs in muddy and mixed substrates of the Ganga River in permanently running water habitats together with *Branchiadrilus semperi*, *Limnodrilus hoffmeisteri* and *Aulodrilus pigueti*; however, it is not considered common in any of the sites from which it has been collected. According to NAIDU (1963), BRINKHURST & JAMIESON (1971), and KATHMAN & WETZEL 2003),

Allonais paraguayensis is known from South and Central America, Caribbean islands, Africa, South and East Asia, including China, India and Sri Lanka. Nevertheless, it has not been reported from the Indo-Gangetic plain area since STEPHENSON (1923), who listed a few localities from the northern part of the Indian subcontinent.

Morphological observations: Small worms fleshy reddish orange in color. Length of preserved specimens reaching up to 6 - 10 mm. Body very soft and sluggish, tube-shaped without any distinct segmental borders. Maximum body width in the mid-body region, head elongate; prostomium bluntly conical. Segments narrow and much shorter compared with the other Naididae discussed here. Posterior body region progressively slender. Segment number increasing up to 60 + indifferent zone. Dorsal setae starting from V, 2 hairs and 2 thin bifid needles (97 µm) per bundle. Ventral setae 4 (- 5) thin crotchets per bundle in II - V (127 µm), 3 - 4 crotchets (93 µm) from segment VI onwards and 3 crotchets in the posterior body.

***Allonais inaequalis* (STEPHENSON, 1911) (Figs. 91 - 95)**

Nais pectinata var. *inaequalis* STEPHENSON, 1911: 208 - 209, fig. 2. - STEPHENSON, 1923: 64 - 65, fig. 20.

Allonais inaequalis, - NAIDU, 1963: 915 - 916, figs. 25 A - C.

Material examined (2 specimens): Kumhrar, small wetland pools, 2. Mar. 2003 (NHMW-EV 19830).

Habitat and distribution: Wetlands of the Kumhrar Park, collected from a small clear groundwater-flooded pool with dense aquatic macrophytes, exposed to the direct sunlight. *Allonais inaequalis* occurs in Australia, South, Central, and North America, Africa and India (NAIDU 1962, BRINKHURST & JAMIESON 1971, KATHMAN & WETZEL 2003).

Morphological observations: Small worms gray reddish in color. Length of preserved specimens reaching 7 mm. Body very thin with distinct segmental borders and perforated outline. Head and the prostomium elongated. Segment number 81 + short indifferent zone. Dorsal setae starting from VI, 1 hair and 1 strong bifid needle (62 µm) per bundle, proximal tooth twice as long as the distal tooth, fine intermediate teeth are present. Ventral setae 3 (- 4) thin crotchets per bundle in II - V (74 µm), 3 - 4 rather thick crotchets (79 µm) from segment VI onwards and 2 - 3 crotchets in the posterior body.

***Pristina acuminata* LIANG, 1958 (Figs. 96 - 101)**

Pristina acuminata LIANG, 1958: 42, pl. III, figs. 26 - 32. - BRINKHURST & JAMIESON, 1971: 396, figs. 7.22 Q - S.

Material examined (12 specimens): Mahendrugat, Nov. 2002, 5 spec. (NHMW-EV 19816).

Habitat and distribution: *Pristina acuminata* is associated with *Limnodrilus hoffmeisteri*, *Branchiodrilus semperi*, and *Aulodrilus pigueti* in muddy and mixed substrates of the Ganga River in permanently running water habitats. The species is reported here as new to the fauna of India. It was known only from Nanking in China (NAIDU 1962, 1966, BRINKHURST & JAMIESON 1971).

Morphological observations: Small worms white or light yellowish in color. Length of preserved specimens reaching up to 2 - 3.5 mm. Body rather firm and cylindrical with

distinct segmental borders. Maximum body width in the anterior body region, head region bluntly conical with a very short triangular prostomium. Posterior body region progressively slender. Segment number up to 42 + short indifferent zone. Dorsal setae starting from II, 4 long s-shaped hairs (149 µm) and 4 thin simply pointed or bifid bayonet-shaped needles (28 µm) per bundle from II - XX, 3 hairs and 3 needles behind XX. Ventral setae 4 - 5 thin crotchets (92 µm) with proximal nodulus per bundle in II - VII, 3 crotchets from segment VII onwards. One larger specimen has a swollen clitellum, which is covering the segments V, VI and ½ VII.

***Pristina synclites* STEPHENSON, 1925 (Figs. 102 - 106)**

Pristina synclites STEPHENSON, 1925: 45 - 46, pl. III, fig. 1. - NAIDU, 1962: 208 - 210, figs. 30

A - D. - BRINKHURST & JAMIESON, 1971: 397, figs. 7.23 C - E.

Material examined (4 specimens): Zoo-pond, Sep. 2002, 2 spec. (NHMW-EV 19817).

Habitat and distribution: A few worms were collected from floating macrophytes in the stagnant water of the Zoo-pond. *Pristina synclites* previously was described and reported only from a few localities in South India by STEPHENSON (1925) and NAIDU (1963). Later, BRINKHURST & JAMIESON (1971) added its occurrence also in Africa, and it occurs in the eastern United States (KATHMAN & BRINKHURST, 1998). It is new to the fauna of the Gangetic system and Bihar.

Morphological observations: Small worms whitish in color. Length of preserved specimens reaching up to 1 - 2 mm. Body is firm, clindrical and head region with long proboscis. Segment number up to 25 + short indifferent zone. Dorsal setae starting from II, 1 very long hair and 1 thin bifid needle (75 µm). Ventral setae (3 -) 4 - 5 crotchets (79 µm) with distal nodulus per bundle. Budding observed.

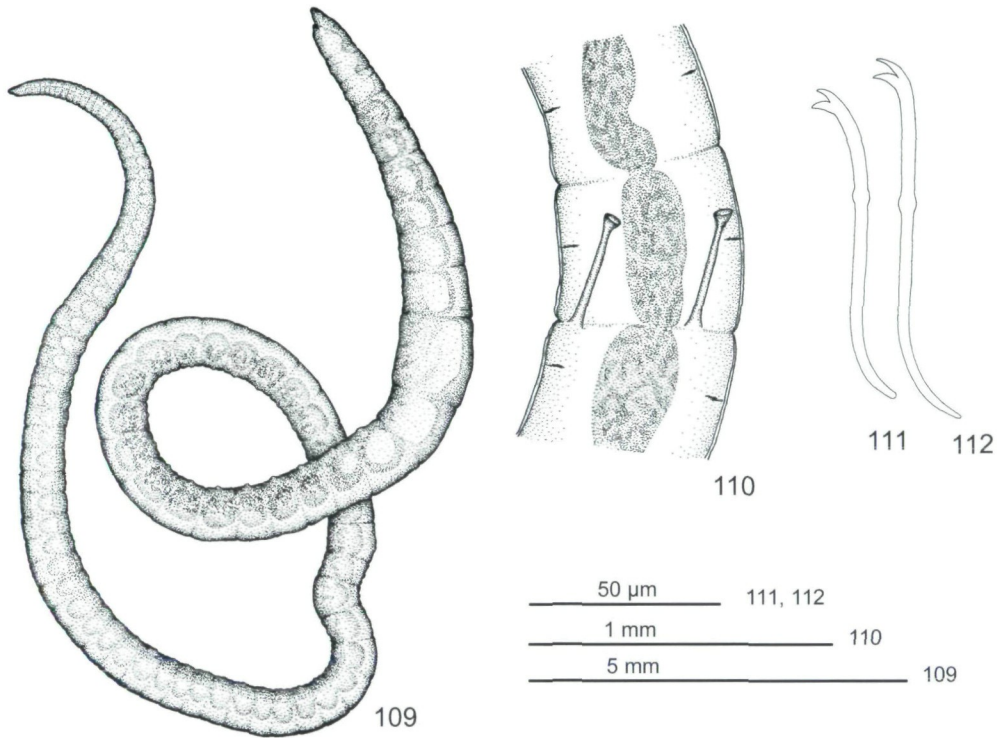
***Pristina cf. biserrata* CHEN, 1940 (Figs. 107 - 108)**

Material examined: Badarghat, Mar. 2002, 1 specimen (NHMW-EV 19825).

Habitat and distribution: Ganga River, muddy substrate, together with *Dero pectinata* and *Aulophorus indicus*. Since only a single specimen is available, further thorough collections are necessary.

Morphological observations: Small worm white in color. Length of preserved specimens reaching 2 mm. Body cylindrical, head region with elongated prostomium. Segment number 37. Dorsal setae starting from II, 3 - 5 thin bifid needles (79 µm), from IX onwards 2 needles and 5 long hair setae. Ventral setae 4 - 5 crotchets (88 µm) with distal nodulus per bundle, 3 and 2 crotchets in the posterior segments.

Remarks: The single specimen may be regarded as belonging to the genus *Pristina* with similarities to the Chinese *P. biserrata*. It differs in the shape and arrangement of dorsal setae and in the absence of a proboscis according to the descriptions and keys of NAIDU (1963) and BRINKHURST & JAMIESON (1971).



Figs. 109 - 112: *Limnodrilus hoffmeisteri* CLAPAREDE, 1862, India, Ganga River and Zoo-pond, Panta, in (109) lateral aspect, (110) penis sheaths in segment XI, (111) dorsal and (112) ventral crotchet.

Family Tubificidae

Limnodrilus hoffmeisteri CLAPARÈDE, 1862 (Figs. 109 - 112)

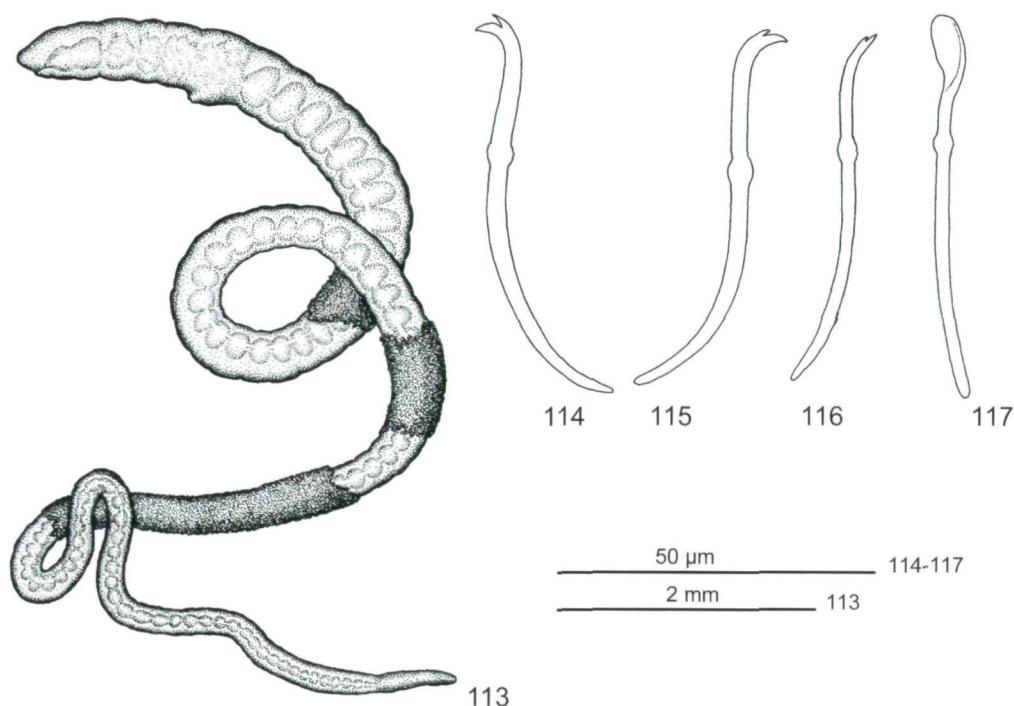
Limnodrilus socialis STEPHENSON 1912: 294 - 301, figs. 9 - 16. - STEPHENSON, 1923: 96 - 98, figs. 36, 37.

Limnodrilus hoffmeisteri, - NAIDU, 1965: 477 - 479, figs. 6 a - g.

Material examined (numerous specimens): Mahendrugat, Feb. - Mar. 2002, 6. May 2002, 11. Oct. 2002 (NHMW-EV 19790), Zoo-pond, on five sampling dates in September 2002, 11. Oct. 2002 (NHMW-EV 19789).

Habitat and distribution: *Limnodrilus hoffmeisteri* occurs in mud, silt, sand, mixed substrate with pebbles and stones all along the right bank of the Ganga River and in similar microhabitats of the larger ponds. The absence of *Limnodrilus hoffmeisteri* from all small stagnant water bodies and temporary ponds is noteworthy. This species also tolerates higher organic pollution, where it can be found in large quantities. It is the most common Tubificidae.

Limnodrilus hoffmeisteri a truly cosmopolitan species, is perhaps the most widely distributed freshwater tubificid in the world; it has already been reported from



Figs. 113 - 117: *Aulodrilus pigueti* KOWALEWSKI, 1914, India, Ganga River, Panta, in (113) lateral aspect, (114, 115) ventral crotchet, (116) dorsal needle of anterior body and (117) dorsal ear-shaped needle of posterior body.

numerous localities of the Indian subcontinent (STEPHENSON 1923, NAIDU 1965), the Indo-Gangetic plain area and the Ganga River at Patna (SINHA 1988). *Limnodrilus hoffmeisteri* is a dominant component of the oligochaete fauna of large European rivers, e.g. the Danube River in Austria (SPORKA 1998) and the Rhine River in Germany (FRENZEL 1983, WIEGAND & MATTHESS 1993, SAUTER 1995).

Morphological observations: Medium-sized worms of reddish orange or dark brownish variable color. The length of preserved specimens reaches up to 30 mm, living worms up to 60 mm with full extension. The body is cylindrical with distinct segmental borders. The maximum body width is in the segment XI, the head is bearing an elongate prostomium. The segment number increases up to 90 + indifferent zone. Dorsal and ventral setae starting from II, 2 - 6 crotchets per bundle (84 - 88 µm).

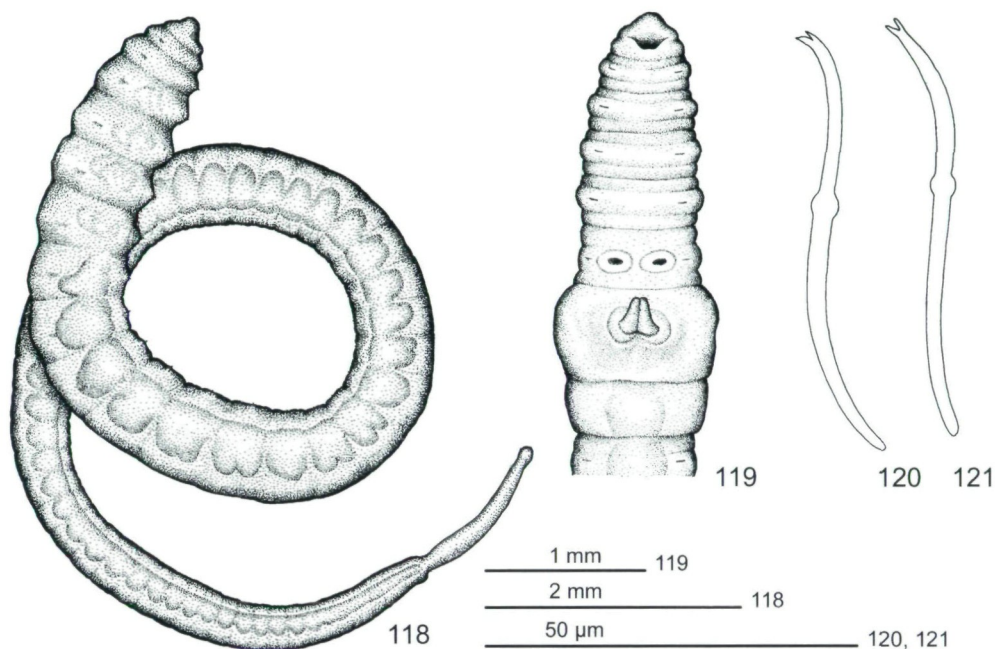
Remarks: The identification was based on the typical form of the chitinous penis sheaths in segment XI.

***Aulodrilus pigueti* KOWALEWSKI, 1914 (Figs. 113 - 117)**

Aulodrilus remex STEPHENSON, 1921: 753, figs. 2 - 6, pl. XXVIII. - AIYER, 1925: 35 - 36, figs.

5. - NAIDU, 1965: 470 - 473, figs. 3 a - e.

Aulodrilus pigueti, - BRINKHURST & JAMIESON, 1971: 526 - 527, fig. 8.23 I.



Figs. 118 - 121: *Aulodrilus plurisetus* (PIGUET, 1906), India, Pahari south of Patna, in (118) lateral aspect, (119) anterior body region with spermathecal pores in segment VI and male gonopores with pseudopenes in VII, ventral aspect, (120) ventral crotchet and (121) dorsal bifid needle.

Material examined (numerous specimens): Badarghat, downstream from Patna, Mar. 2002, Mahendrughat, 11. Oct. 2002 (NHMW-EV 19819), 10. Nov. 2002 (NHMW-EV 19823).

Habitat and distribution: *Aulodrilus pigueti* is a running water species, and was collected from mud and silt substrates along the right bank of the Ganga River. When collected, *A. pigueti*, always was associated with *Limnodrilus hoffmeisteri*, yet it never was observed in abundance, and was not reported from stagnant aquatic habitats. Although considered to be a cosmopolitan species and known from all large continents (BRINKHURST & JAMIESON 1971), the known distribution of *Aulodrilus pigueti* is scattered and insufficiently documented. In India, *Aulodrilus* species are relatively common and widespread (STEPHENSON 1923, AIYER 1930, NAIDU 1965, 1966). *Aulodrilus pigueti* is reported here as a new record for the area of the Gangetic plain and Bihar.

Morphological observations: Rather small and elongated worms transparent light orange-red in color. Length of preserved specimens reaching 9 - 15 mm. Head with short triangulate and conical prostomium. Posterior body region not segmented, forming a gill. Segment number up to 112 + indifferent zone. Dorsal setae starting from II, 4 hairs and 4 simply pointed to bifid needles (58 µm) per bundle in anterior segments, followed by 3 hairs and 3 oar-shaped needles (62 µm) behind X. Ventral setae 5 crotchets (62 µm) per bundle.

Aulodrilus pluriseta* (PIGUET, 1906) (Figs. 118 - 121)Aulodrilus trivandranus* AIYER, 1925: 36 - 39, figs. 6 - 9. - AIYER, 1930: 43.*Aulodrilus pluriseta*, - NAIDU, 1965: 466 - 468, fig. 2a - e.

Material examined (numerous specimens): Pahari 7 km south of Patna city, Apr. 2002, (NHMW-EV 19818).

Habitat and distribution: *Aulodrilus pluriseta* was found in shallow muddy drainage ditches and pools in agricultural areas. Small water bodies in these areas are commonly covered with dense stands of water hyacinths *Eichhornia crassipes* and other macrophytes; other annelids collected in these habitats include *Salifa lateroculata*, *Alboglossiphonia* sp., *Placobdelloides fulvus*, *Dero dorsalis* and *Aulophorus furcatus*. The widely distributed *Aulodrilus pluriseta* is reported from Eurasia, Africa, Australia and North America (BRINKHURST & JAMIESON 1971). This species is new to the area of the Gangetic plain and Bihar and was not found during earlier studies.

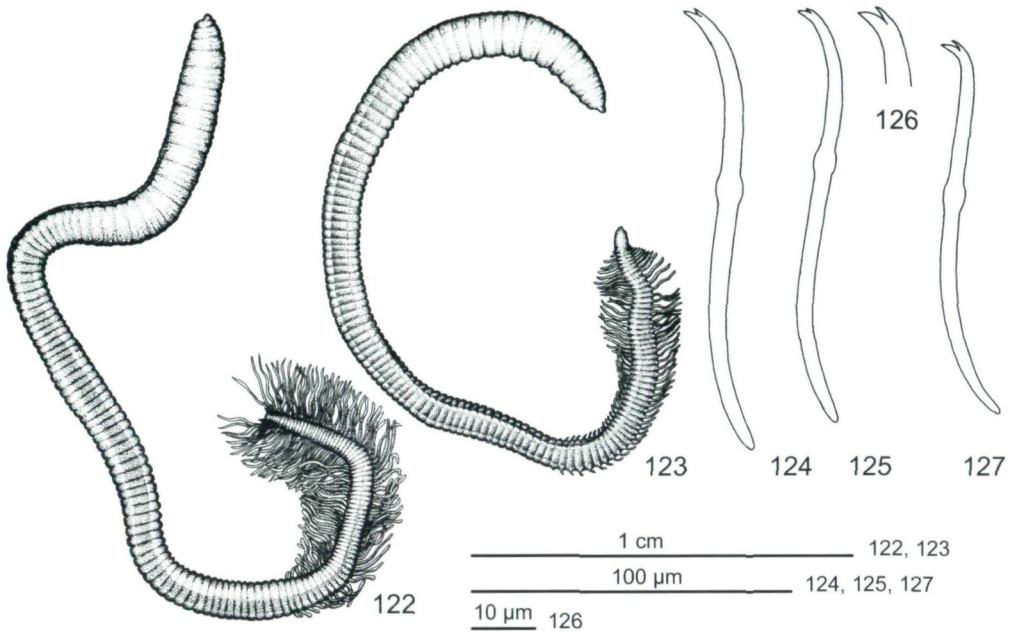
Morphological observations: Rather small and thick worms deep red in color. Length of preserved specimens reaching 7 - 13 mm. Head with short bluntly conical prostomium. Posterior body region unsegmented, forming a distinctly separated long gill. Segment number up to 75 + indifferent zone. Dorsal setae starting from II, 2 hairs and 4 - 5 bifid needles (55 µm) per bundle. Ventral setae are 7 crotchets (58 µm) per bundle with distal nodulus. Spermathecal pores on VI, male gonopores on VII, clitellum from VI - VIII.

Remarks: The specimens of the study area differ from those of temperate regions in the position of genital pores and the reduced number of setae. BRINKHURST & JAMIESON (1971) found the majority of mature specimens with male genital pores in the usual position in segment XI. According to the cited authors, forward shifting of the reproductive organs is frequently associated with asexual reproduction. There are up to 10 dorsal and 16 ventral setae in European specimens of *Aulodrilus pluriseta* (UDE 1929, WILCKE 1967, BRINKHURST & JAMIESON 1971), commonly 8 or more setae per bundle (SAUTER 1995).

Branchiura sowerbyi* BEDDARD, 1892 (Figs. 122 - 127)Branchiura sowerbyi*, - STEPHENSON 1912: 286 - 294, figs. 1 - 8. - STEPHENSON, 1923: 96 - 98, figs. 36, 37. - Naidu, 1965: 473 - 475, figs. 4 a - j.

Material (several specimens): Zoo-pond, 21. Sep. 2002 (NHMW-EV19786), 24. Sep. 2002, Secretariat pond, 30. Nov. 2002 (NHMW-EV 19787), Kumhar ponds (1 juvenile specimen), 9. Nov. 2002.

Habitat and distribution: *Branchiura sowerbyi* occurs in mud, silt, sand, and mixed substrate of the larger ponds. It is the only common Tubificidae collected in the pure sandy bottom of Secretariat pond. *Branchiura sowerbyi* has worldwide distribution in tropical and subtropical freshwaters (BRINKHURST & JAMIESON 1971), and is considered to be widespread in North America (KATHMAN & BRINKHURST, 1998). Its distribution range is now known to extend into the temperate regions of the northern and southern hemispheres, no doubt the result of human introductions. This invasion is still going on (LUDWIG & ZIEGLER 1963, KINZELBACH 1965, ZETTLER 1996). The supposed origin of *Branchiura sowerbyi* is located in South and Southeast Asia of the Oriental region. The occurrence of this species in freshwaters of the Indian subcontinent is described in



Figs. 122 - 127: *Branchiura sowerbyi* BEDDARD, 1892, India, Kachchi-talab and Zoo-pond, Patna, in (122, 123) lateral aspect, (124, 125) ventral and (126, 127) dorsal crotchet.

detail by STEPHENSON (1912, 1923) and NAIDU (1965). There are numerous additional records from Nepal and Meghalaya in the author's collection, suggesting that *B. sowerbyi* is a common species in hill-streams.

Morphological observations: Medium-sized worms dark red or pink brown in color, length of preserved specimens reaching 15 - 25 mm; live worms reaching a length of 50 mm, when fully extended. Segment number up to 135+ indifferent zone. One pair of short dorso-ventral gills along the posterior segments, length of gills variable in different habitats. Dorsal setae starting from II, 3 hairs and 3 - 4 crotchets (120 µm), ventral setae 5 crotchets (149 µm) per bundle.

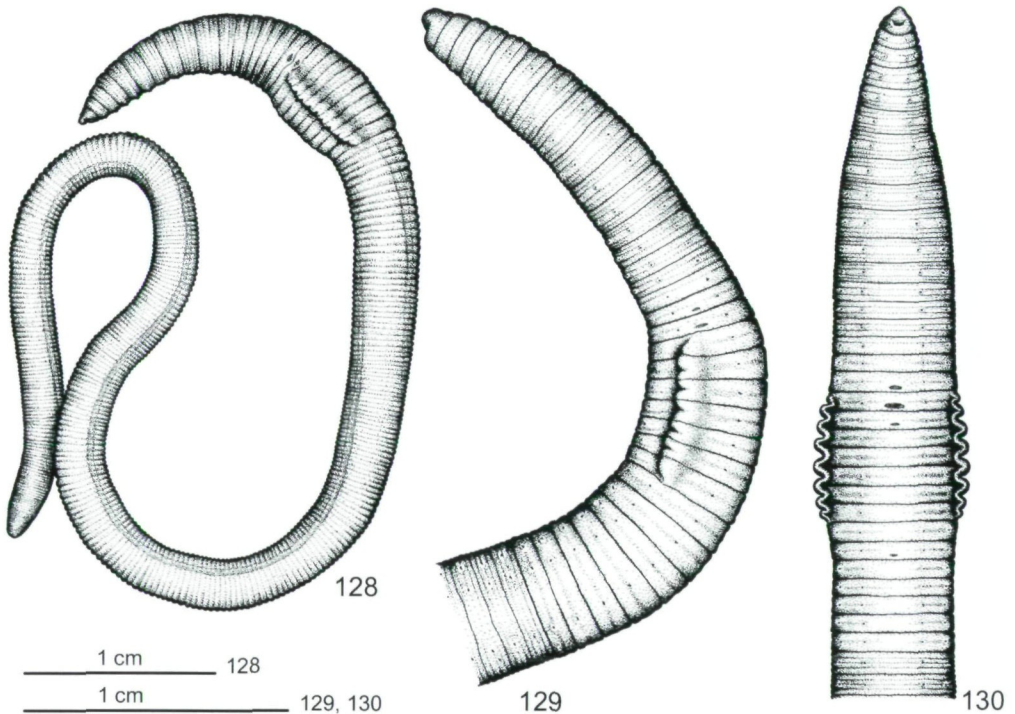
Remarks: *Branchiodrilus semperi* is sometimes confused with *Branchiura sowerbyi*; records of the latter species published elsewhere in limnological journals and reports need thorough revision.

Family Glossoscolecidae

Glyphidrilus gangeticus GATES, 1958 (Figs. 128 - 130)

Glyphidrilus papillatus (partim), - STEPHENSON, 1923: 493.

Glyphidrilus gangeticus GATES, 1958: 55. - BRINKHURST & JAMIESON, 1971: 758 - 759, figs. 15.1 H, 15.3 G, H.

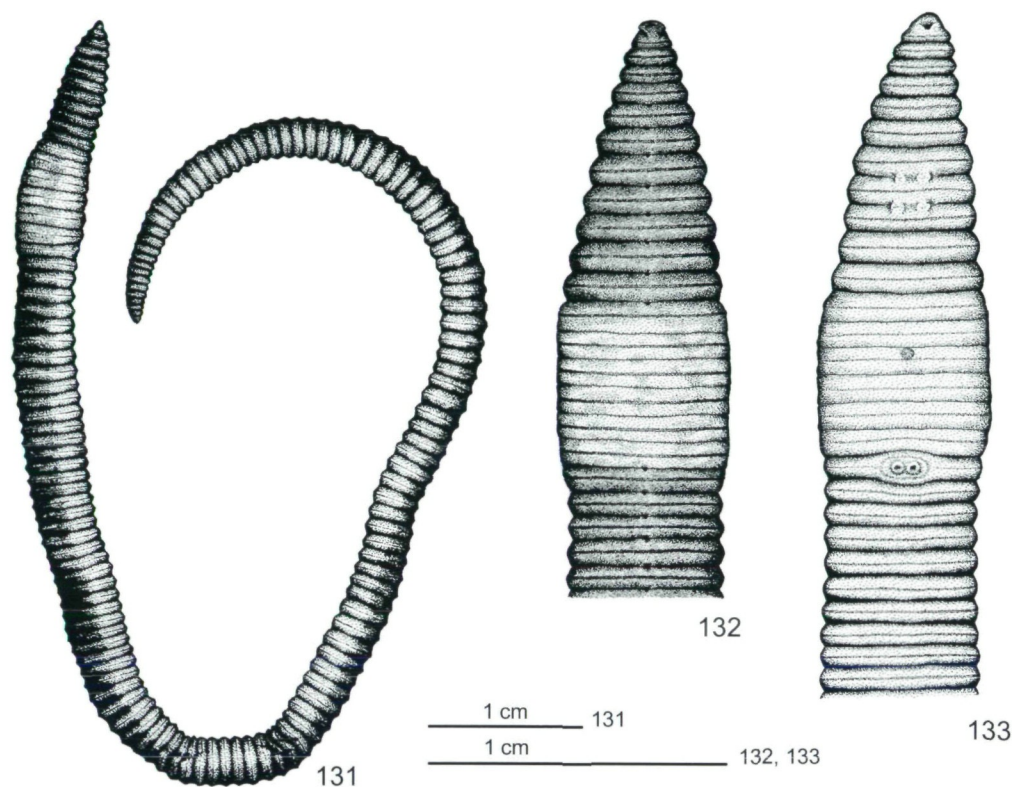


Figs. 128 - 130: *Glyphidrilus gangeticus* GATES, 1958, India, Ganga River, Patna, in (128) lateral aspect, anterior body region with annulation, clitellum, clitellar wings and genital markings in (129) lateral and (130) ventral aspect.

Material (numerous specimen): Ganga near the old palace (1 juvenile specimen) Mar. 2002, Mahendrughat (1 juvenile specimen) Dec. 2001 (NHMW-EV 19785), 7 and 8. May 2002, 11. Oct. 2002 (NHMW-EV 19788), 10. Nov. 2002 (SMF 12073), 7 Feb. 2003.

Habitat and distribution: This is the largest true aquatic oligochaete of the study area. *Glyphidrilus gangeticus* prefers compact mud, silt, sand and similar mixed substrates of the rivers. It was also collected commonly from the small streams along the right bank of the Ganga River, coming from seeping springs during low water periods. Here it occurs in habitat similar to that of *Perionyx excavatus*.

Glyphidrilus gangeticus is an endemic species of the Gangetic plain (GATES 1958, JAMIESON 1971). It previously was known to occur in several rivers in Uttar Pradesh and New Delhi. It is new to the fauna of the Ganga River and Bihar. Four other endemic *Glyphidrilus* species, each with rather limited distribution, occur on the Indian subcontinent: *Glyphidrilus spelaeotes* STEPHENSON, 1924 (Garo hills, subterranean waters), *Glyphidrilus tuberosus* STEPHENSON, 1916 (Eastern Ghats), *Glyphidrilus annandalei* MICHAELSEN, 1910 (Western Ghats), and *Glyphidrilus ceylonensis* GATES, 1945 (Sri Lanka). These four species differ from one another - and from *Glyphidrilus gangeticus* - in size, annulation, position of wings, and genital markings.



Figs. 131 - 133: *Perionyx excavatus* PERRIER, 1872, India, Ganga River, Patna, in (131) lateral aspect, anterior body region with clitellum, dorsal pores, spermathecal pores and male genital pores in (132) dorsal and (133) ventral aspect.

Morphological observations: Large worms light red or yellow-brown in color, length of preserved specimens reaching 120 mm, living specimens up to 20 cm, when fully extended. Segment number 200 - 245. Prostomium epilobous. Segments II - XV widened and subdivided into 3 - 5 (- 6) smaller annuli, similar to that in leeches. Clitellum including segments XVII - XXXII. Lateral wings of clitellar region only developed in mature specimens during reproduction period. They usually have the length over $6\frac{1}{2}$ - 7 segments from XIX - $\frac{1}{2}$ XXV or XXV. Ventral median male genital markings are placed on segments XVIII, XIX (enlarged) and XX. Two pairs of lateral genital markings are located on segment XVII and XVIII. In some individuals one smaller ventro-median marking is on the posterior half of XXVII. 8 widely paired setae per segment starting from II. Body form of preclitellar and clitellar region almost nearly cylindrical, the postclitellar region tends to a slightly quadrangular cross-section.

Remarks: The population structure was observed during various field studies in Patna. Our observations suggest that reproduction occurs during early winter. Adult (sexually mature) worms with fully developed wings and genital markings were found occasionally in May and commonly in the post-monsoon period in October and November. The

smallest juvenile worms were observed during spring season in February and March. Similar records were made from the lower part of the Yamuna River at Allahabad on 18 February 2003. Juvenile worms (2 - 3 cm length) were found to be very common together with some adults.

Family Megascolecidae

Perionyx excavatus PERRIER, 1872 (Figs. 131 - 133)

Perionyx excavatus, - STEPHENSON, 1923: 329 - 331. - GATES, 1972: 141 - 143.

Material examined (numerous specimens): Ganga, Badarghat (juvenile spec., fragment) Mar. 2002, Mahendrughat, 7. May 2002 (NHMW-EV 19784, SMF 12074), 11. Oct. 2002, 10 - 11. Nov. 2002, 7. Feb. 2003, Zoo-pond, from a small temporary flooded forest pond, 8. Dec. 2002.

Habitat and distribution: *Perionyx excavatus* lives along the banks of the Ganga River and various stagnant waters. This amphibious earthworm was always found very close to the water's edge or near to seeping springs emanating from the eroded bank of the river. The bottom of temporary flooded forest-ponds represents another microhabitat of this species, where it lives under rotten wood near the groundwater.

Perionyx excavatus is a very common earthworm in South Asia, including India, Sri Lanka, Burma, Thailand, Vietnam, Malay Peninsula, Sumatra, Java, Borneo, Philippines and several islands of the Indian Ocean (GATES 1972). It is known from banks of rivers, ponds, wetland and paddy fields, and appears restricted to freshwater-land ecotones.

Morphological observations: Large firm worms dark blue-brown or pinkish-brown in dorsal color, ventral side a light red-orange to yellow. Length of preserved specimens reaching up to 106 mm, living worms to 16 cm when fully extended. Segment number 125 - 146. Prostomium epilobious. Clitellum including 5 segments XIII - XVII, dorsally light red-blue in color. One row of dorsal median pores is present from the segmental furrow IV/V onwards. Male pores paired, ventral within a single distinctly demarcated field on XVIII. Spermathecal pores ventral in the furrows of VII/VIII and VIII/IX. One smaller ventro-median marking, observed in some individuals, is located on the anterior half of XIV. Numerous setae (36 - 60 per segment) arranged in almost closed circles, giving the body surface a rough appearance. Body form rounded and dorsoventrally depressed.

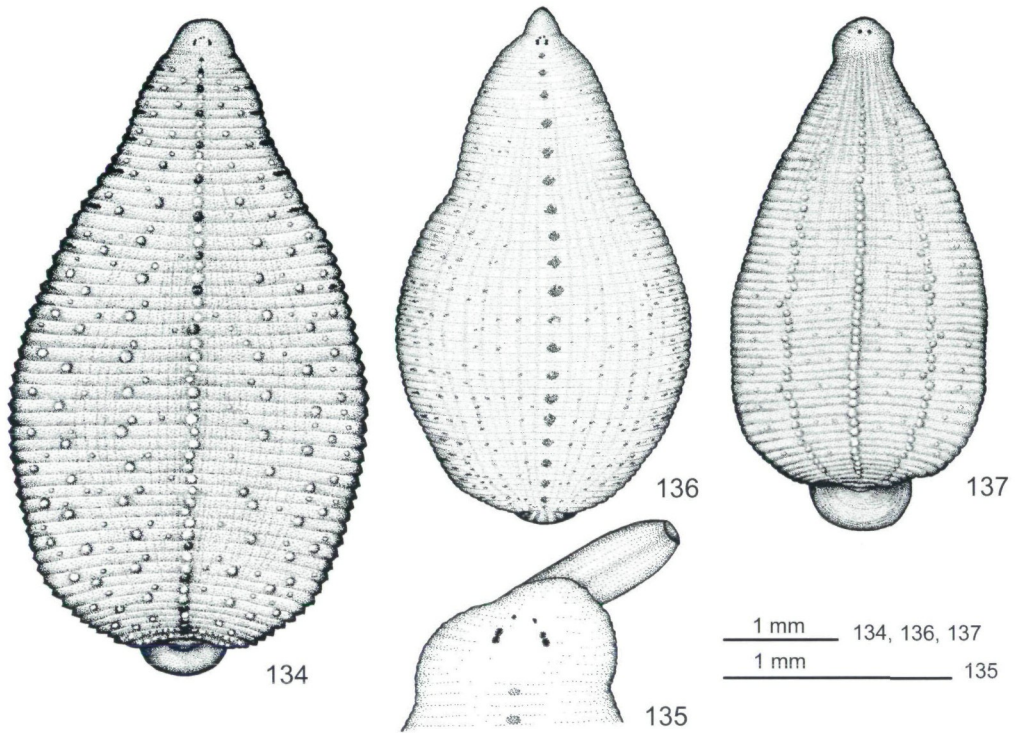
Class Hirudinea

Family Glossiphoniidae

Alboglossiphonia weberi (BLANCHARD, 1896) (Figs. 134 - 135)

Glossosiphonia weberi BLANCHARD, 1897: 332 - 333, Fig. 1.

Material examined (numerous specimens): Mahendrughat, sampling dates from Dec. 2001 - Feb. 2002 (SMF 11616), Feb. - Mar. 2002 (NHMW-EV 19758), 10. May 2002 (NHMW-EV 19832), 10. Nov. 2002



Figs. 134 - 137: Glossiphoniidae, India, Ganga River and Kumhrar pond, Patna, in lateral aspect, (134) *Alboglossiphonia weberi* (BLANCHARD, 1896) with (135) head and proboscis, (136) *Alboglossiphonia heteroclita* (LINNAEUS, 1761) and (137) *Placobdelloides fulvus* (HARDING, 1921).

(NHMW-EV, SMF 12076), old Royal Palace, 30. Mar. 2002 (NHMW-EV 19756), Apr. 2002 (NHMW-EV 19760), Mar. - April 2002 (NHMW-EV 19758, 19759), Badarghat, 10. Mar. 2002.

Habitat and distribution: *Alboglossiphonia weberi* is the only common Glossiphoniidae of the Ganga River, occurring commonly and in great abundance on different substrates wherever a rich molluscan fauna can be found. This species is widely distributed in southern and southeastern Asia (HARDING & MOORE 1927, CHANDRA 1983, SAWYER 1986). Two closely related taxa, *Alboglossiphonia lata* (MOORE, 1924) and *Alboglossiphonia disuqi* EL-SHIMY, 1990, are found in the adjacent regions of East Asia and the African Nile River.

Morphological observations: Small ovate to elongate rounded leeches reaching a maximum body length of 10 - 15 mm. Ground color of dorsum pale yellow to pale light orange-gray. Dark black spots on every third papillae of the mid-dorsal line and along the lateral margin. Head region commonly bulbous. The species generally has 3 pairs of eyes; the eyes of the front pair very close together, while the eyes of the following two pairs are spaced farther apart and often fused. The somites are triannulate. The genital pores are joined and open in a common pore in the furrow XII a1/a2. The dorsal side has one median row of prominent papillae on each annulus, one pair of inner paramedian

papillae on annulus a2, one pair of outer paramedian papillae on annulus a3, and one pair of paramarginal papillae on annulus a2. Additional and often numerous, minute, and irregularly arranged papillae also are observed.

Remarks: The leeches are either predators of small molluscs or they live as ectoparasites attached to the shell of larger gastropods. According to field observations, this leech species feeds on *Scaphula celox* BENSON, 1836, *Thiara scabra* (O.F. MÜLLER, 1774) and *Thiara lineata* GRAY, 1828. It was often collected from the shells of living *Bellamya crassa* (BENSON, 1836) and *Bellamya bengalensis* (LAMARCK, 1822).

***Alboglossiphonia heteroclita* (LINNAEUS, 1761) (Fig. 136)**

Glossiphonia heteroclita, - HARDING & MOORE, 1927: 60 - 62. - CHANDRA, 1983: 274.

Alboglossiphonia heteroclita, - NESEMANN & NEUBERT, 1999: 70 - 73, figs. 27 a - e.

Material examined (numerous specimens): Kumhrar ponds, 7, 11, 12, 14, 22 and 26. Nov. 2002 (NHMW-EV 19754, SMF 12080), 23. Feb. 2003.

Habitat and distribution: *Alboglossiphonia heteroclita* was found in some smaller ponds as ectoparasite attached to the shell of living *Bellamya bengalensis* (LAMARCK, 1822). This leech species is widespread in the Holarctic region, but also known southwards from Morocco, Turkey and the northern Indian subcontinent. Here *Alboglossiphonia heteroclita* was found in Kashmir, Punjab, Rajasthan, Nepal (unpublished record) and Bihar (BAUGH 1960a, 1960b, SINGHAL & al. 1985, SOOTA & SAXENA 1984).

Morphological observations: Small ovate to rounded leeches reaching a maximum body length of 4 - 8 mm. Ground color of dorsum white to pale yellow. One median line of dark black spots on every third annulus and numerous very small spots on the dorsal surface. Head region bulbous, bearing 3 pairs of eyes with the eyes of the front pair very close together. The somites are triannulate, the genital pores are joined and open in a common pore in the furrow XII a1/a2. Dorsum smooth, without papillae.

Remarks: The specimens are almost similar to European forms, except of their smaller size.

***Placobdelloides fulvus* (HARDING, 1921) (Fig. 137)**

Placobdella fulva HARDING, 1921: 489. - HARDING & MOORE, 1927: 78, pl. II, fig. 7. - CHANDRA, 1983: 277.

Placobdelloides fulva, - SAWYER, 1986: 657. - NESEMANN & SHARMA, 1996: 233 - 234.

Material examined (several specimens): Mahendrughat, Dec. 2001 - Mar. 2002 (SMF 11613), 10 May 2002 (NHMW-EV 19762), Ganga River near the old Palace, Mar. - Apr. 2002 (NHMW-EV 19761), Badarghat, Mar. 2002, Kumhrar ponds, 7 and 9. Nov. 2002 (NHMW-EV 19763, SMF 12083), 25. Nov. 2002 (NHMW-EV 19764).

Habitat and distribution: The leeches were found regularly in small numbers attached to stones, hard substrate or floating submerged macrophytes in the Ganga River and one of the smaller ponds in the Kumhrar Park area. The species is known from the Indian subcontinent, found in Bihar (CHANDRA 1983) and Nepal (NESEMANN & SHARMA 1996).

Morphological observations: Small ovate to elongate rounded leeches reaching a maximum body length of 4 - 8 mm. Ground color of dorsum transparent light greenish

brown, with the tendency to form longitudinal stripes on the anterior dorsal surface. Head region bulbous. The species generally has 1 (- 2) pairs of eyes, the first pair is smaller often fused with the second pair. The somites are triannulate, the genital pores are separated by two annuli. The male pore is in the furrow XI a3/XII a1, the female in XII a2/a3. The dorsal side has 3 rows of prominent papillae on each annulus, there are one median row and one pair paramedian papillae. Additional numerous irregularly arranged, very small papillae can be found. The gastrointestinal tract bears seven pairs of crop caeca.

Remarks: The crop of several specimens was filled with blood of vertebrates, giving the leech a thick, cylindrical and dark violet appearance. It can be assumed that *Placobdelloides fulvus* feeds as an ectoparasite on amphibians or fishes. Additionally, 7 young leeches were collected from the frontal carapace of the freshwater crab *Barytelphusa lugubris* (WOOD-MASON 1871) at the Gandak confluence. Their crops were empty and they obviously did not feed on the decapods. The crabs might be used by the leeches more as mode of dispersal than as a host.

There are striking similarities between *Placobdelloides fulvus* and the African fish-parasite *Batrachobdelloides tricarinatus* (BLANCHARD, 1897), which is distributed throughout South and East Africa and is present in an area from the Nile River to the Arabian peninsula (AL-SAFADI & EL-SHIMY 1993).

Family Ozobranchidae

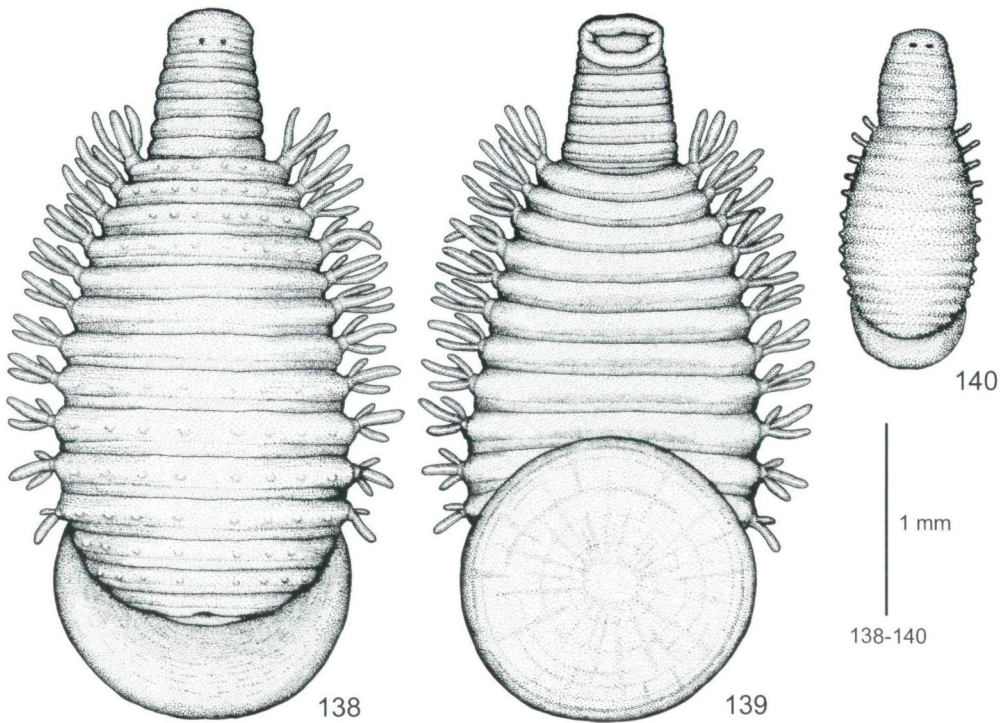
Ozobranchus shipleyi HARDING, 1909 (Figs. 138 - 140)

Ozobranchus shipleyi HARDING, 1909: 233. - HARDING & MOORE, 1927: 36 - 39, Fig. 10, pl. II, Figs. 4 - 6. - SANJEEVA RAJ, 1954: 476.

Material examined (13 specimens): Ganga River, confluence of the Gandak and Ganga rivers (opposite of the Old Royal Palace) at Patna, left bank, 23. Mar. 2001, leg. D. Kedia & G. Sharma, 2 specimens (SMF 11617), 3 specimens (NHMW-EV 19833).

Habitat and distribution: *Ozobranchus shipleyi* occurs in large rivers. This is the only true freshwater species of mainly marine and brackish water family Ozobranchidae. It is a widespread, but rarely recorded leech from continental rivers of India, Sri Lanka (type locality) and Pakistan. This is only the second record for this species in Bihar and from the Ganga River (HARDING & MOORE 1927, SANJEEVA RAJ 1954, 1966, 1974, TILAK & al. 1990).

Morphological observations: Small elongate rounded leeches reaching a maximum body length of 1.3 - 3.7 mm with enlarged caudal sucker disc of 1.4 mm diameter. Ground color of dorsum light gray-brownish. One pair of large eyes on somite V. The somites V - XII of the anterior body are biannulate, the midbody has inconspicuous somites with 3 annuli. The genital pores are joined and open in a common pore on XII. The dorsal side has 8 rows of small papillae on annulus a3. There are 11 pairs of lateral gill-branchiae from somite XIII - XXIII. In juvenile leeches, the annulation is incompletely developed, the branchiae are very short finger-shaped processes, and the dorsal papillae are not-yet formed.



Figs. 138 - 140: *Ozobranchus shipleyi* HARDING, 1909, India, Ganga River, Gandak confluence, Patna, in (138) dorsal and (139) ventral aspect, (140) juvenile leech in dorsal aspect.

Remarks: The leeches are permanent ectoparasites on turtles. They were found attached on the hard-shelled turtle's skin of *Kachuga tecta*.

Family Hirudinidae

Three species in the family Hirudinidae are represented in the fauna of Patna. Because these species have been already described and illustrated by NESEMAN & SHARMA (2001), only additional observations are presented here.

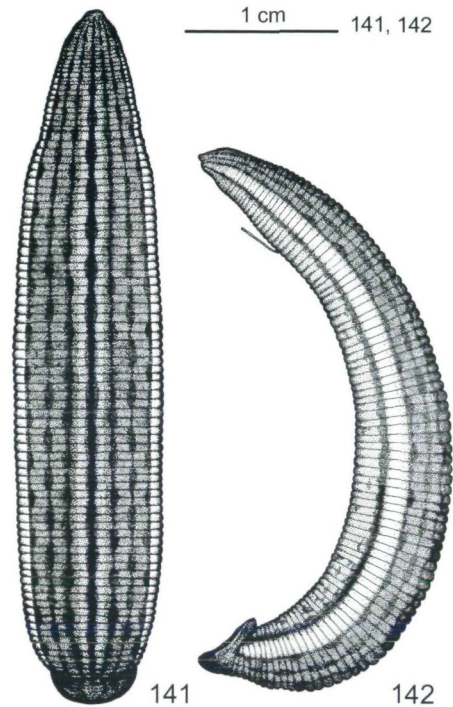
Asiaticobdella birmanica (BLANCHARD, 1894) (Figs. 141 - 142)

Asiaticobdella birmanica, - NESEMAN & SHARMA, 2001: 79 - 80, figs. 4, 5.

Material examined: Mahendrughat, 2. Dec. 2001, 1 specimen (SMF 11614), Jan. 2002, 1 specimen (NHMW-EV 19694), Nov. 2002, 1 spec. (NHMW-EV 19797), Zoo-pond area, from a small temporary flooded forest pond, 10. Feb. 2003.

Habitat and distribution: This South Asian species (MOORE 1927, SAWYER 1986, NESEMAN & SHARMA 2001) was found as a permanent member of the fauna in the Ganga River, burrowing in the sandy and muddy sediment under stones in the shallow water (0.1 - 0.4 m depth).

Figs. 141 - 142: *Asiaticobdella birmanica* (BLANCHARD, 1894), India, Ganga River, Patna, in (141) dorsal and (142) lateral aspect.



Morphological observations: The largest specimen (preserved) has a total length of 60 mm, width 8 mm, and diameter of caudal sucker 4.5 mm. The background color of the dorsal side is dark olive greenish with black pattern, of which a dark median line is most prominent. It is surrounded by brown pigment. The ventral side is gray-brown. There is a yellow-ochre pair of marginal stripes.

Remarks: *Asiaticobdella birmanica* is a temporary ectoparasite of vertebrates. In two specimens, the gut content was blood, but no leeches could be observed feeding. The form of the specimens collected from the Ganga River differs markedly in color and pattern from the very dark brown leeches described by NESEMANN & SHARMA (2001) from Nepal. Another yellow form with five longitudinal dorsal stripes was found in September 2001 near the Satluj River in Punjab (unpublished record). These specimens resemble the leech described as *Hirudo nipponica fuscolineata* by MOORE (1924). There might be some different taxa combined as *Asiaticobdella birmanica*.

***Poecilobdella granulosa* (SAVIGNY, 1822)**

Poecilobdella granulosa, - NESEMANN & SHARMA, 2001: 80 - 81, Figs. 6 - 8.

Material examined: Ganga River near Doriganj, 40 km upstream Patna, 31. Oct. 2001, 1 specimen.

A single leech (length 42 mm, width 7 mm, caudal sucker diameter 4 mm) was found in the river. It might be a species commonly known from swamps and wetlands in upper reaches of the Gangetic drainage that drifted downstream during flood conditions.

***Hirudinaria manillensis* (LESSON, 1842)**

Hirudinaria manillensis, - NESEMANN & SHARMA, 2001: 81 - 82, figs. 9, 10.

Material examined: Zoo-pond area, from a large basin, 18. Aug. 2002, 1 specimen, observations: 11., 18., 25., 27. Aug. 2002, 8. Sep. 2002.

Habitat and distribution: A small population of this rare South Asian leech (MOORE 1927, SAWYER 1986, NESEMANN & SHARMA 2001) was found together with twelve individuals of *Gavialis gangeticus*, the fish eating freshwater crocodile.

Morphological observations: The largest *Hirudinaria manillensis* has preserved a total body length of 142 mm, width 22 mm and diameter of cranial sucker 12 mm. Living specimens reaching up to 22 cm length, when fully extended. The dorsal ground color is brown or greenish-brown with black metameric pattern.

Remarks: The leeches were active during August and September, often swimming or attached to the water line. They were occasionally observed to be sucking blood from their host. One leech was observed attached on the ventral neck of a younger *Gavialis gangeticus*.

Family Salifidae***Barbronia weberi* (BLANCHARD, 1897) (Figs. 143 - 149)**

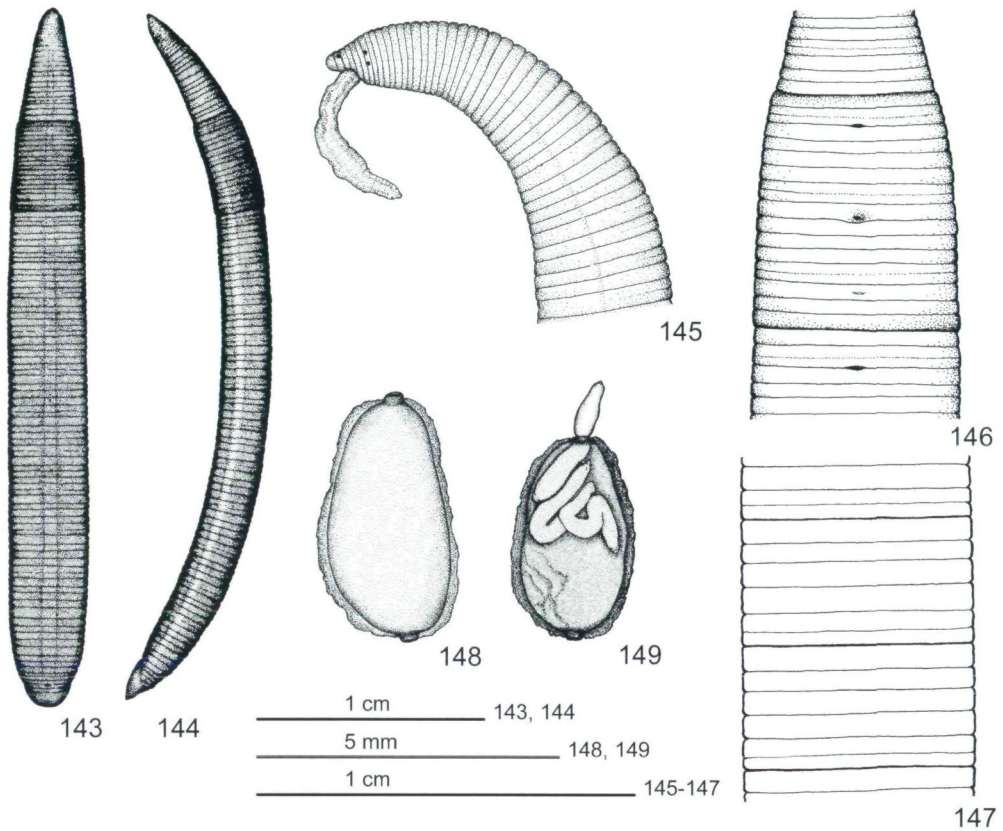
Dina weberi BLANCHARD, 1897: 353 - 355, Fig. 10 A - D.

Barbronia weberi, - MOORE in HARDING & MOORE 1927: 135 - 140, Figs. 39 - 42.

Material examined (numerous specimens): Mahendrughat, Dec. 2001 - Mar. 2002 (NHMW-EV 19822, SMF 11615, 12077, 12078), leeches and cocoons, Mahendrughat 5. May 2002, Nov. 2002 (NHMW-EV 19765) leeches and cocoons, Zoo-pond, 15. and 21. Sep. 2002 (NHMW-EV 19766-19767, SMF 12079).

Habitat and distribution: The leeches were collected from the subsurface of stones and shells of molluscs exclusively in zones rich in oligochaetes and polychaetes. The oriental *Barbronia weberi* is known from South and East Asia including the Indus River basin in the West (Afghanistan) towards Japan in the East and all Sunda islands in the South (MOORE 1927). It was originally described from Java (Buitenzorg), Sumatra (Manindjau) and Celebes (Botaeng). Introduced to European rivers and lakes in Austria, Germany and England (SAWYER 1986, NESEMANN 1997, NESEMANN & NEUBERT 1999). It is frequently known from the Indian subcontinent, where it was mainly found in hills and midmountains up to 1400 m, but no records have yet been published from the lowlands and the Gangetic plain (CHANDRA 1983, NESEMANN & SHARMA 2001). The populations described here from the Ganga River are the first records from Bihar.

Morphological observations: Small to medium sized leeches reaching body length of 31 mm, width of 1.9 mm and 1.5 mm diameter of caudal sucker. Pharynx with three pairs of small needle-shaped styli, showing in cranial direction. Head always with 3 pairs of eyes. Clitellum easily visible in mature specimens, extending from X b5 - XIII a2. The male accessory pore is in the furrow X c12/XI b1, the male pore in XII b1/b2, the female on XIII b1, the accessory female pore in XIII c12/XIV b1. Body surface covered by minute papillae. It is uniform colored red to dark red-brown, there are some individuals of nearly black appearance in the stagnant water of the Zoo-pond.



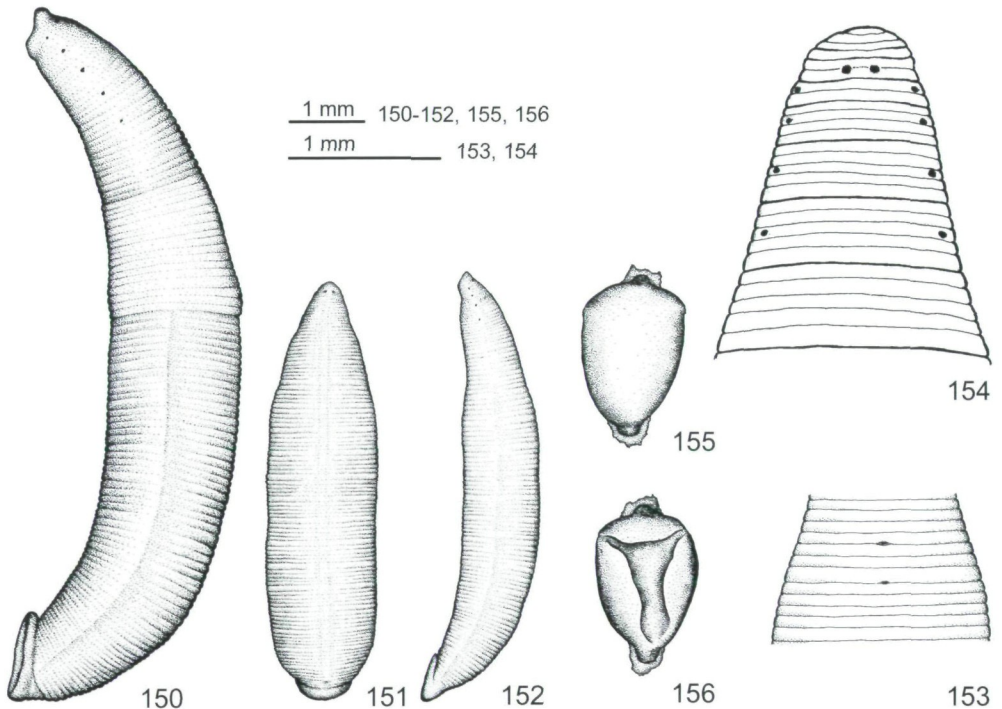
Figs. 143 - 149: *Barbronia weberi* (BLANCHARD 1897), India, Ganga River, Patna, in (143) dorsal and (144) lateral aspect, (145) anterior body region in lateral aspect while feeding on *Nais* sp., (146) clitellar region in ventral aspect with clitellum, accessory pores, male and female genital pores, dorsal aspect of (147) two mid-body somits with annulation, (148) empty cocoon and (149) cocoon with young leeches.

Remarks: *Barbronia weberi* was observed feeding on small Naididae. This species is normally associated with *Alboglossiphonia weberi*, as observed in Nepal (NESEMANN & SHARMA 1996). In the Ganga River the medium-sized adult leeches were found during December for the first time, maximum abundance of larger adults was observed during January and February and a juveniles occurred from March to May. The elongated ovate cocoons are attached to stones, shells and leaves of grasses.

***Salifa (Herpobdelloidea) lateroculata* (KABURAKI, 1921) (Figs. 150 - 156)**

Herpobdelloidea lateroculata KABURAKI, 1921: 705 - 706, Fig. 4. - HARDING & MOORE, 1927: 141 - 143, pl. VI, figs. 13 - 14. - CHANDRA, 1983: 281.

Material examined (numerous specimens): Mahendrughat, 13. Jan. 2002 (SMF 11612), 10. Nov. 2002 (NHMW-EV 19771), Kumhrar ponds, 7, 9 and 26. Nov. 2002 (NHMW-EV 19769, 19770, SMF 12082)



Figs. 150 - 156: *Salifa (Herpobdelloidea) lateroculata* (KABURAKI, 1921), India Kumhrar pond, Patna, in (150) lateral aspect, (151) dorsal and (152) lateral aspect of juvenile leech, (153) clitellar region with male and female genital pores, (154) anterior body region and head with position of eyes in dorsal aspect; (155, 156) cocoon which was attached to floating vegetation.

Habitat and distribution: *Salifa lateroculata* is nowhere common or abundant; only small numbers of leeches were found together with large quantities of *Barbronia weberi*. In the Ganga River, *Salifa lateroculata* was collected from the subsurface of *Musa X paradisiaca*-leaves from the muddy bank in 0.1 m depth. In a pond of the Kumhrar park, the leeches were found in roots of floating *Eichornia crassipes*. Distribution: India, Nepal, Myanmar (Burma), southern China. It was described from Bushampur and Saugor in Madhya Pradesh, India. Outside of Patna, this species was collected in small lowland streams and old stagnant meanders of the terai region in Nepal (Sunsari district, Jhapa district) at altitudes between 100 and 160 m, where it lives associated with *Barbronia weberi*, *Batrachobdelloides reticulatus*, *Alboglossiphonia weberi* and *Hirudinaria manillensis*. Two additional localities in the mid-hills (Nepal: Dhulikhel 1450 m, Meghalaya: Shillong 1700 m) were investigated yielding the highest records of *Salifa lateroculata*. There, this species occurs with *Asiaticobdella birmanica*, *Poecilobdella granulosa*, *Alboglossiphonia weberi*, *Alboglossiphonia* spp., *Placobdelloides fulvus* and *Barbronia* cf. *weberi* sensu MOORE (1927: 138).

Morphological observations: Small, short and cylindrical leeches reaching a body length of 7 - 12 mm. Pharynx with three pairs of small needle-shaped styli, showing in

cranial direction. Color uniform transparent yellow to amber without any dark pigmentation. Body surface smooth. Head with 5 pairs of eyes: first pair dorsal on IV, and 4 pairs of lateral eyes on V, VI, VII and VIII. Additional single eyes were occasional visible on IX. Mid-body somites quinqueannulate, annulus b6 is slightly widened. The clitellum is visible in mature specimens and it extends from X b5–XIII a2. The genital pores are separated by 3 annuli. The male pore is in the furrow XII b2/a2, the female in XII b6/XIII b1.

Remarks: *Salifa lateroculata* preys on *Branchiodrilus semperi* and *Nais* sp. in the Ganga River, and on *Branchiodrilus hortensis* in the Kumhrar ponds. The ovate small cocoons of this species are irregularly formed and attached to macrophytes.

Subgenus *Nematoboddella* KABURAKI, 1921

Salifa (Nematobdella) biharensis sp.n. (Figs. 157 - 163)

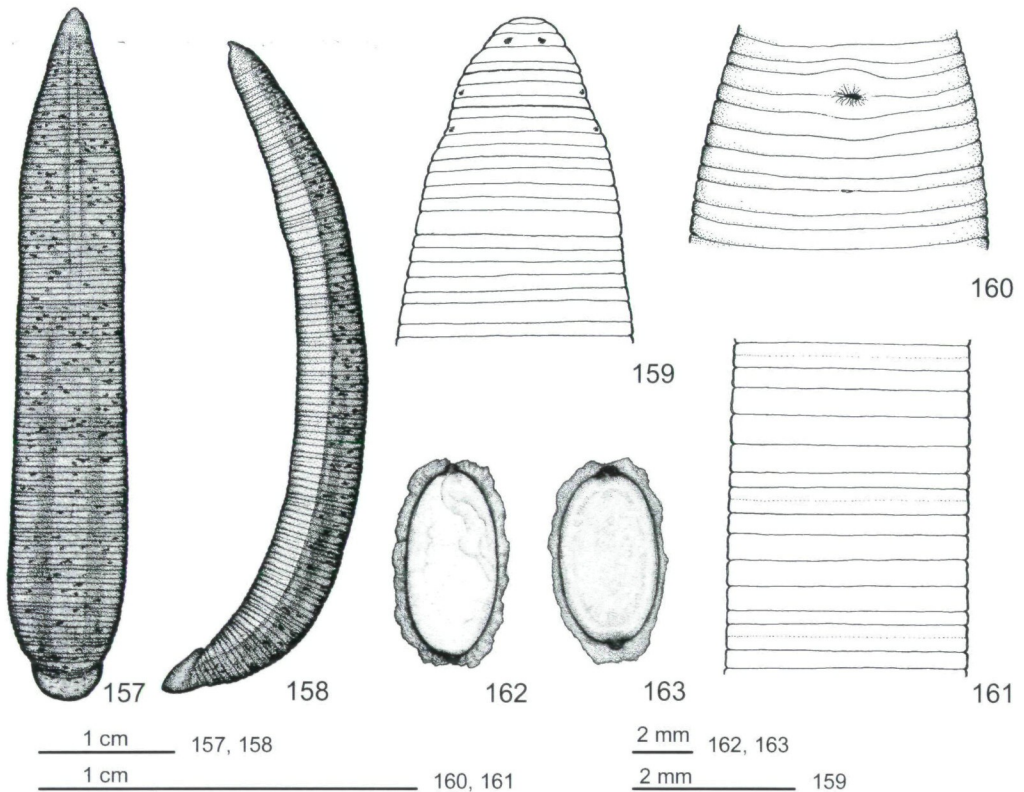
Type material: Holotype NHMW-EV 19834, January 2002, Paratypes: 6 specimens (NHMW-EV 19810) October 2002, 11 specimens (NHMW-EV 19795) 10. 3. 2003, 3 specimens (SMF, 11618, SMF 11619, SMF 11620) 01 December 2001, 8, and 15 January 2002, 8 specimens (SMF 12081), October and November 2002, numerous specimens (NHMW-EV 19809) leg. G. Sharma & H. Neseemann, Patna, Ganga River at Mahendrughat.

Type locality: India, Bihar, Ganga River at Patna, right bank, Mahendrughat, 53 m. (25° 37' 19" N, 85° 09' 18" E)

Etymology: *biharensis*, for Bihar, the state from which it was first collected, and the oldest persisting country of the ancient Magadhan empire.

Diagnosis: Medium-sized, elongate Salifidae with firm body consistence. Leech dorso-ventrally flattened, more cylindrical anteriorly; blunt lateral fringes located in posterior region. Head bears one to three pairs of very small, inconspicuous eyes. Three pairs of needle-shaped styli present in pharynx, arranged in tandem and cranially directed forward. Body length of holotype 50 mm, width 5.0 mm; diameter of caudal sucker 3.3 mm. Body length of smallest paratype 16.5 mm, width 2.5 mm; diameter of the caudal sucker 1.3 mm. Annulation of the mid-body somites is heteronomous with six annuli of different width: $b1 > b2 < a2 = b5 = c11 > c12$. Thus there are three wide rings, followed always by one narrow, one wide, and one narrow ring. Annulus b1 homonomously subdivided by shallow furrows in large adult specimens. The total number of annuli per somite is I - III: 1, IV: 2, V: 3, VI: 4, VII: 5, VIII - XXIII: 6, XXIV: 5, XXV - XXVI: 3 and XXVII: 2. Clitellum easily visible in mature specimens, extending from X b5 - XI-II a2. Male genital pore in furrow XII b1/b2; female pore in XII c12/XIII b1. Distance between gonopores is five annuli (b2, a2, b5, c11, c12). Head with one pair of eyes located on dorsal surface of somite III, directed forward; two pairs of eyes on lateral surfaces of somites V and VI.

Body surface smooth. Color of dorsum yellow-brown to red-brown, with numerous irregular black spots and a bright median stripe without dark pigment. Color of ventral surface a uniform light gray-yellow.



Figs. 157 - 163: *Salifa (Nematobdella) biharensis* sp.n., holotype in (157) dorsal and (158) lateral aspect, (159) anterior body region in lateral aspect with position of eyes, (160) clitellar region in ventral aspect with male and female genital pores, dorsal aspect of (161) two mid-body somits with annulation, (162) empty cocoon and (163) cocoon.

Habitat and distribution: The adults of *Salifa biharensis* sp.n. are burrowing in the substrate and occur frequently in the semiaquatic zones of the riverbank near to numerous seeking springs, but they are mostly confined to this microhabitat. Here they live in association with the above listed aquatic earthworms, but more closed to the waterline, than *Perionyx excavatus*. Occasionally single leeches were collected from shallow water inside the river, where *Salifa biharensis* was rarely found on the subsurface of stones and shells together with the common *Barbronia weberi* in depth of 0.4 m.

Morphological observations: The living extended leeches reach a total length of 7 - 9 cm. The cocoons are rather flattened and rounded ovate in shape, length 13 mm, width 6.7 mm. They are fixed on stony substrate during the post-monsoon period in October and November.

Remarks: *Salifa biharensis* sp.n. was observed while feeding on *Limnodrilus hoffmeisteri* in the natural habitat. In captivity, the leeches were also observed attacking small specimens of *Glyphidrilus gangeticus*.

Differential diagnosis: Seven species in the genus *Salifa* BLANCHARD, 1897, are known from South Asia and Africa. They were originally described with different generic positions. Recognizing only minor differences between the four genera, Sawyer (1986: 696) combined the species of *Herpobdelloidea* KABURAKI, 1921, *Foraminobdella* KABURAKI, 1921, and *Trematobdella* JOHANSSON, 1913, into the single genus, *Salifa*, the oldest valid name. Incidentally, MOORE (1927: 140 - 141) previously had proposed *Salifa* for *Herpobdelloidea*. *Salifa biharensis* sp.n. is the largest species in the suborder Erpobdelliformes known to occur in India. It is distinguished from *Salifa indica* (KABURAKI 1921) by the dorsal color pattern of diffuse black spots and by the number, size, and form of eyes. The latter species has one dorsal pair of eyes on III and five lateral pairs on V - IX. *Salifa biharensis* sp.n. differs from *Salifa perspicax* BLANCHARD, 1897, *Salifa lateroculata* (KABURAKI, 1921), *Salifa elongata* MOORE, 1939, *Salifa africana* (MOORE, 1939) and *Salifa delicata* (MOORE, 1939) by its annulation and position of genital pores. The two species *Salifa heptamerata* (KABURAKI, 1921) and *Salifa johanssonia* SAWYER, 1986 have a remarkable dorsal gastropore near somites XIV/XV or XV/XVI. *Salifa biharensis* sp.n. resembles *Salifa indica* in the position of the genital pores; the dorsal pigment pattern of *Salifa biharensis* is very similar to that of *Salifa perspicax*. The less developed eyes in adult specimens of *Salifa biharensis* sp.n. are similar to those of *Salifa heptamerata*.

Discussion

The preliminary list of annelid species (Table 1) does not reflect the complete faunal inventory, because small Oligochaeta, Aeolosomatida, and Archiannelida were not covered by the sampling techniques in field. Of the thirty-nine species collected during this study, 22 species were collected from both lentic and lotic habitats while 17 were collected only from stagnant water bodies. Eleven of the twenty-two species sharing both habitats were apparently lotic in nature at Patna and represent new records for North India.

Twenty-seven species were collected from lentic habitats (Zoo-pond, Kumhrar ponds, Secretariat-pond). There are sixteen species forming the stagnophilic group, not observed in the river. The noticeable gill-bearing annelids (*Namalycastis*, *Branchiodrilus*, *Dero*, *Aulophorus*, *Branchiura*, and *Ozobranchus*) were often the dominant component of the fauna at our sites. The presence of large polychaetes in continental freshwaters is a unique feature of the Gangetic River basin and the Ponto-Caspian basin, occurring more than 1300 - 2400 km upstream of the sea coast (Kothé, Mordukai-Boltowskoi).

Prior to this present study, our knowledge of the leech fauna of the Patna region was limited, although approximately fifty aquatic taxa are known from the Indian subcontinent (CHANDRA 1983, SINGHAL & al. 1985, SAWYER 1986). Leeches have an insignificant role in the Ganga ecosystem compared to that observed in large European rivers (SOÓS 1967, SCHÖNBORN 1985, NESEMANN 1989, NESEMANN & NEUBERT 1999). The leech fauna of the Ganga River has a closer relationship and similarity to that known from the Egyptian Nile fauna (HUSSEIN & al. 1988, AL-SAFADI & EL-SHIMY 1993) than to the fauna associated with the Palaearctic region. The few Salifidae known to be predators seem to be highly specialized feeders on small Naididae. *Salifa biharensis* n. sp. may in fact be endemic to the Ganga River.

Table 1: Association of Annelida in the studied water bodies of Patna (India: Bihar): Ganga River at (M) Mahendrughat and (B) Badarghat, (G) other localities, (Z) Zoo-pond of the Biological Park, (K) Kumhrar Park, ponds and wetland pools, (S) Secretariat pond.

| taxon | locality | | | | | |
|---|----------|----|-----|----|----|---|
| | M | B | G | Z | K | S |
| <i>Nephtys oligobranchia</i> | | + | | | | |
| <i>Namalycastis indica</i> | + | + | | | | |
| <i>Chaetogaster limnaei limnaei</i> | | | | | + | |
| <i>Chaetogaster limnaei bengalensis</i> | | + | | + | | |
| <i>Branchiodrilus semperi</i> | + | | | + | | + |
| <i>Branchiodrilus hortensis</i> | | | | | + | + |
| <i>Allonais paraguayensis</i> | + | | | | | |
| <i>Allonais inaequalis</i> | | | | | + | |
| <i>Haemonais waldvogeli</i> | | | | | + | + |
| <i>Nais communis</i> | | | | + | | |
| <i>Nais bretscheri</i> | | + | | + | | |
| <i>Dero dorsalis</i> | | | | + | | |
| <i>Dero digitata</i> | | | | | + | |
| <i>Dero cooperi</i> | | | | | + | |
| <i>Dero sawayai</i> | | | | + | + | |
| <i>Dero nivea</i> | | | | | + | |
| <i>Dero pectinata</i> | | + | | | | |
| <i>Aulophorus furcatus</i> | | | | + | + | + |
| <i>Aulophorus hymanae</i> | | | | | + | |
| <i>Aulophorus indicus</i> | | + | | | | |
| <i>Pristina acuminata</i> | + | | | | | |
| <i>Pristina synclites</i> | | | | + | | |
| <i>Pristina cf. biserrata</i> | | + | | | | |
| <i>Limnodrilus hoffmeisteri</i> | + | + | | + | | |
| <i>Aulodrilus pigueti</i> | + | + | | | | |
| <i>Aulodrilus pluriseta</i> | | | + | | | |
| <i>Branchiura sowerbyi</i> | | | | + | + | + |
| <i>Glyphidrilus gangeticus</i> | + | | | | | |
| <i>Perionyx excavatus</i> | + | | | + | | |
| <i>Alboglossiphonia weberi</i> | + | + | | | | |
| <i>Alboglossiphonia heteroclita</i> | | | | | + | |
| <i>Placobdelloides fulvus</i> | + | + | | + | + | |
| <i>Ozobranchus shipleyi</i> | | | + | | | |
| <i>Asiaticobdella birmanica</i> | + | | | + | | |
| <i>Hirudinaria manillensis</i> | | | | + | | |
| <i>Poecilobdella granulosa</i> | | | + | | | |
| <i>Salifa lateroculata</i> | + | | | | + | |
| <i>Salifa biharensis</i> | + | | | | | |
| <i>Barbronia weberi</i> | + | | | + | | |
| number of species | 14 | 11 | (3) | 15 | 14 | 5 |

Although the Ganga River supports a diverse molluscan fauna, only one common glos-siphoniid, *Alboglossiphonia weberi*, was observed feeding on various Mollusca in the lotic habitats surveyed during this study. The sanguivorous leech species collected during this study *Ozobranchus shipleyi* and *Hirudinaria manillensis* - both commonly associated with large reptiles - were the most notable of the leeches collected during this study.

The oligochaete fauna differs significantly from that of the Palaearctic region, e.g., the large European rivers such as the Danube (SPORKA 1998) and Rhine (WIEGAND & MATTHESS 1993). In the Gangetic plain, the Naididae are the most dominant group of oligochaetes; the family Tubificidae is poorly represented by only three species. Oligochaete species occurring in Oriental, South Asian, Afro-Asian, and Pan-tropical areas are present in the taxa collected from the Gangetic plain during this study. Several oligochaete taxa are recorded here for only the second time since their discovery in South India by Aiyer (1925 - 1930) and Naidu (1962 - 1966); these include: *Branchiodrilus semperi*, *Aulophorus hymanae*, *A. indicus*, *Dero sawayai*, *D. nivea* and *D. pectinata*. Two "northern elements" are new to the Indian fauna: *Nais bretscheri*, known from Europe and Central Asia, and *Pristina acuminata*, known from eastern China. The lesser-known *Glyphidrilus gangeticus* is endemic to the Gangetic plain.

Acknowledgements

Support of Prof. Dr. K. Prasad, Department of Geology, Patna University, Patna, is duly acknowledged. We are very much thankful to Dr. Dilip K. Kedia, Samir K. Sinha, Kavindra K. Sinha, Ram Anush Yadav, R. Singh, Director of Sanjay Gandhi Biological Park, Patna, and S. D. Singh, Honorary Secretary of the Society for Conservation of Flora & Fauna (SCFF), Patna, for providing material and other help. Thanks are due to M. J. Wetzel (Illinois Natural History Survey, USA) for valuable comments, critical reading, and linguistic review during the preparation of this manuscript.

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Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Annalen des Naturhistorischen Museums in Wien](#)

Jahr/Year: 2004

Band/Volume: [105B](#)

Autor(en)/Author(s): Nesemann Hasko, Sharma Shailendra, Sinha R.K.

Artikel/Article: [Aquatic Annelida \(Polychaeta, Oligochaeta, Hirudinea\) of the Ganga River and adjacent water bodies in Patna \(India: Bihar\), with description of a new leech species \(Family Salifidae\). 139-187](#)