

## Leeches of the suborder Hirudiniformes (Hirudinea: Haemopidae, Hirudinidae, Haemadipsidae) from the Ganga watershed (Nepal, India: Bihar)

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### Abstract

New records of three families of arhynchobdellid leeches (Hirudinea, Hirudiniformes) from Nepal, including two localities from India (Bihar), are presented. The sinojapanese *Whitmania laevis*, family Haemopidae, is found for the first time from the Himalayan region. The family Hirudinidae was found with *Poecilobdella granulosa* and *Hirudinaria manillensis*. A further leech, *Myxobdella nepalica* sp.n., is described. The terrestrial family Haemadipsidae has three taxa in the Nepalese Himalaya; *Haemadipsa zeylanica agilis*, *H. zeylanica montivindicis* and *H. sylvestris*.

### Zusammenfassung

Aus Nepal werden Neunachweise von drei Familien der Egel (Hirudinea, Arhynchobdellida, Hirudiniformes) vorgestellt, die auch zwei Fundstellen in Indien (Bihar) einschließen. Die ostasiatische Art *Whitmania laevis*, Familie Haemopidae, wird erstmalig aus der Himalayaregion nachgewiesen. Es wurden drei Arten der Familie Hirudinidae gefunden: *Poecilobdella granulosa* und *Hirudinaria manillensis*; *Myxobdella nepalica* sp.n. wird neu beschrieben. Die landlebenden Haemadipsidae sind durch drei Taxa *Haemadipsa zeylanica agilis*, *H. zeylanica montivindicis* und *H. sylvestris* in Nepal vertreten, die sich bevorzugt an Gewässerufem aufhalten.

### Introduction

In addition to the knowledge of the class Hirudinea from Nepal (NESEMANN & SHARMA 1996) new records of leech species collected from 1996 to 2001 are presented. The present paper deals with three families of Hirudiniformes. Short descriptions on their morphology are given supported by detailed figures. The aim of the study is to provide readers with additional characteristics for the identification of the taxa in the field, using the keys of MOORE (1927), CHANDRA (1983) and SAWYER (1986).

Although there are several information and detailed descriptions of mostly faded preserved specimens available, good figures are still lacking. This fact is a result of the work of the former hirudinologists, who never got the possibility to visit such leech habitats personally and to study living specimens in the field. Therefore, microhabitats and ecological preferences of the discussed taxa are poorly known as well as its colour alive.

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## Material and Methods

Leeches were collected qualitatively by hand or using a hand net. Collected materials were relaxed in 15% ethanol and preserved in 70% ethanol. The figures were prepared as ink drawings by H. N. The specimens are deposited in the reference collection of the Biological Department of the Kathmandu University in Dulikhel (KU) and voucher material is placed in the collection of the Natural History Museum in Vienna, Austria (NHMW-EV).

## Results

Eight species and subspecies of three families belonging to six different genera were found. The family Haemopidae is reported for the first time from the Himalayan region. A new species of the genus *Myxobdella* OKA, 1917 is described from Nepal.

### Family Haemopidae

#### *Whitmania laevis* (BAIRD, 1869) (Figs 1-3)

*Hirudo laevis* BAIRD, 1869: 315.

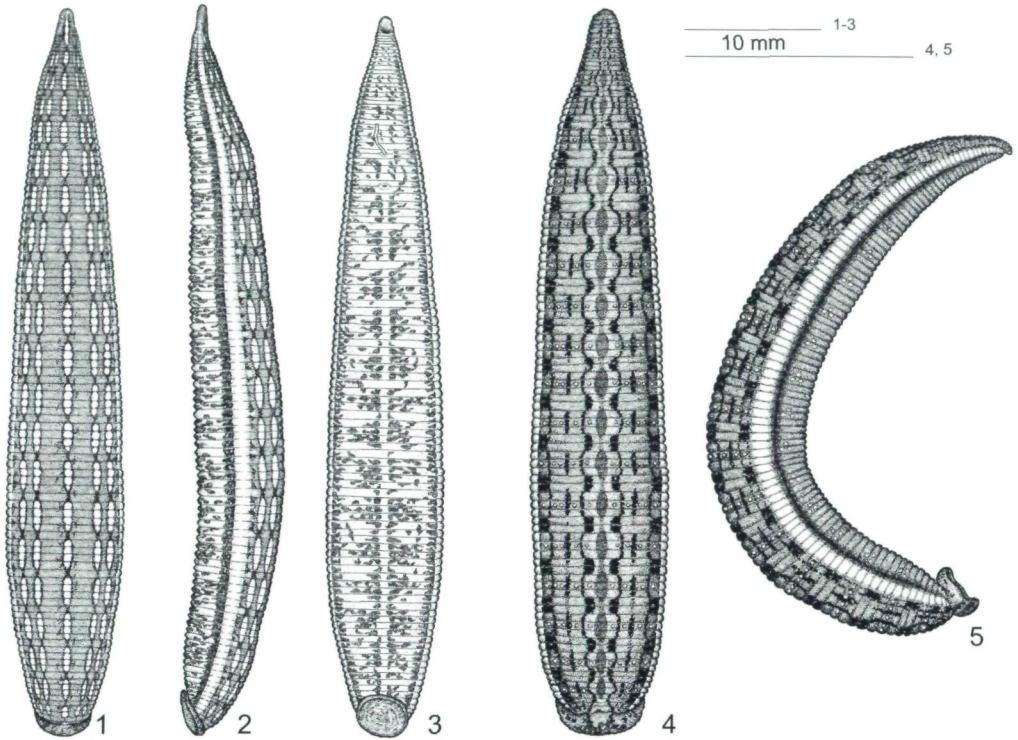
*Whitmania laevis*, - BLANCHARD, 1896: 326-328, fig. 6.

**Material:** Nepal, Central Zone, Kavre district, leg. H. Neemann: 1 spec. (NHMW-EV 17167), Dhobi Khola (left tributary of the Punyamati) between Dhulikhel town and the Kathmandu University, 22. 10. 2000. – 7 spec. (KU), Kheti Khola SW of Dhulikhel, small irrigation channel, 1450 m, 6.+7. 3. 2001.

The finding is new to the fauna of the Gangetic watershed and Nepal. It is a predator feeding on small invertebrates. Adult specimens were abundantly found crawling on the muddy bottom of pools in the upper reaches of small streams of Nepalese Himalayan midmountains. The species prefers dense macrophytes. They are good swimmers. The largest preserved leech has a total length of 59 mm and a maximum width of 8 mm. Ground colour of the dorsal is olive green with five segmentally arranged longitudinal bands, the ventral side is light grey with irregular black dots. The midbody is nearly cylindrical, the head is very small and attenuated. The body consistence is sluggish and soft with smooth surface. The male genital pore is situated on annulus b6 near to the furrow XI b5/b6, the female on annulus b6 near to XII b5/b6. The genital pores are separated by five annuli.

*Whitmania laevis* is widely distributed in southeast Asia, known from Assam, Burma, China to the Amur basin in the Russian far east and from Japan (KABURAKI 1921, MOORE 1927, SAWYER 1986). In the Indian territory it was hitherto found only from streams in Manipur, which are tributaries of the Irrawaddy River. The new record from Nepal expands the distribution area to the West direction. The colour pattern is very similar to the form from Pagla Nadi (Moore 1927: 174, Pl. VII, Fig. 21), whereas Russian specimens differ slightly (LUKIN 1976: 387-390, figs 216, 217).

In Nepal *Whitmania laevis* is associated with the following other leech species. *Asiatocobdella birmanica* (BLANCHARD, 1894), *Poecilobdella granulosa* (SAVIGNY, 1820), *Alboglossiphonia weberi* (BLANCHARD, 1897), *Placobdelloides fulvus* (HARDING, 1924), *Batracobdelloides reticulatus* (KABURAKI, 1921) and *Barbronia* cf. *weberi* (BLANCHARD, 1897) sensu MOORE (1927: 128). It was found in the postmonsoon period.



Figs 1-5: *Whitmania laevis* (BAIRD, 1869), Nepal, Dhobi Khola, in (1) dorsal, (2) lateral, and (3) ventral aspect. *Asiaticobdella birmanica* (BLANCHARD, 1894), Nepal, Dhobi Khola, in (4) dorsal and (5) lateral aspect

### Family Hirudinidae

#### *Asiaticobdella birmanica* (BLANCHARD, 1894)

(Figs 4-5)

*Hirudo birmanica* BLANCHARD, 1894: 115-117.

*Asiaticobdella birmanica*, - RICHARDSON, 1969: 103-104.

**Material:** Nepal, Central Zone, Kavre district, leg. H. Neseemann: Dhobi Khola (left tributary of the Punyamati) between Dhulikhel and the Kathmandu University, 1450-1470 m, 4 spec. (KU), 22. 2. + 8. 3. 1998; 4 spec. (KU), 5.-8. 9. 1999, 5 spec. (KU), 18. 10. 2000. – From paddy fields closed to Dhobi Khola, 1 spec. (KU), 5.-8. 9. 1999, 8 spec. (KU), 17. 10. 2000. – Small stream (right tributary of the Punyamati) 500 m north of Naikintar, 1455 m, 1 spec. (KU), 8. 11. 2000. – Small right tributary of the Sundi Khola south of Batase (Rosi Khola system) 1440 m, 1 spec. (KU), 22. 10. 2000. – Kheti Khola SW of Dhulikhel, small irrigation channel, small temporary ponds, 6 spec. (NHMW-EV 17171), 1 spec. (NHMW-EV 17172), 6.+7. 3. 2001, 1450 m.

New to the fauna of Nepal. Bloodsucking parasitic species, feeding on vertebrates, most probably mainly on amphibians. It was found frequently during the monsoon and post-monsoon periods in the fauna of temporary water bodies and paddy fields as well as in small streams of the Himalayan midmountains. During winter season only a few specimens could be observed remaining burrowed in muddy banks of the streams under boulders. A large part of the population of stagnant water bodies seems to survive the dry season in deeper substrate.

The living specimens have a dark brown dorsal side with a black segmentally arranged pattern, the ventral side is a little bit lighter with black stripes and a dark greyish intermediate field. The body is dorsoventrally slightly compressed and cylindrical. The largest preserved leech reaches a total length of 44 mm and a maximum width of 5 mm. The body consistence is soft with a rough surface and deep furrows between the annuli. The male genital pore is situated in the furrow XI b5/b6, the female in XII b5/b6. The genital pores are separated by five annuli. The leeches are very good and active swimmers which can be easily attracted by splashing in the water. It is the most common hirudinid leech of the paddy fields and agricultural used water bodies in Nepal.

*Asiatocobdella birmanica* is widely distributed on the Indian subcontinent and also known from Burma (MOORE 1927, SAWYER 1986).

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

(Figs 6-8)

*Sanguisuga granulosa* SAVIGNY, 1822: 115; 1826: 457.

*Poecilobdella granulosa*, - SAWYER, 1986: 687.

**Material:** Nepal, Central Zone, Kavre district: Dhobi Khola (left tributary of the Punyamati) between Dhulikhel and the Kathmandu University, 1450-1470 m, 3 spec. (KU), leg. H. Neseemann 5.-8. 9. 1999. – From paddy fields closed to Dhobi Khola, 2 spec. (KU), leg. H. Neseemann 5.-8. 9. 1999. – Gosaitan Khola (left tributary of the Punyamati) between Bakhundol and Banepa, 1455 m, 1 spec. (NHMW-EV 17168), leg. H. Neseemann 5. 9. 1999. – From paddy fields closed to Gosaitan Khola, 1 spec. (KU), , leg. S. Khanal 4. 6. 2000.

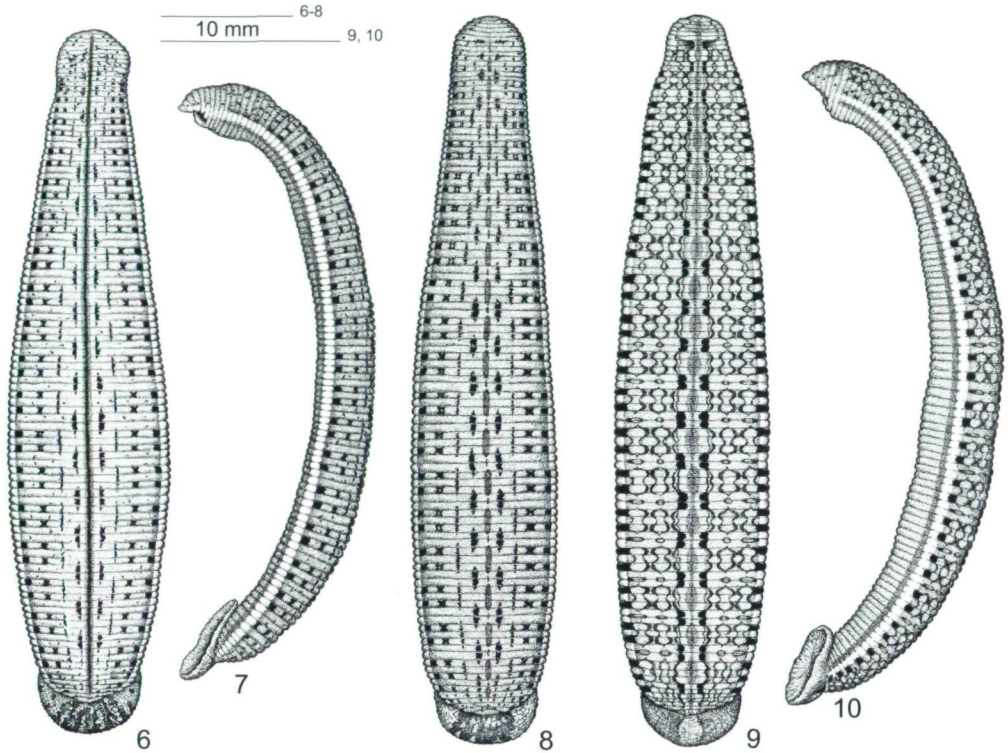
India, Bihar, leg. H. Neseemann & G. Sharma: paddy field near Naichaur, Lal Pokhra, north of Patna, 55 m, 1 spec. (KU), 29. 10. 2000. – Swamps at Pahari, fishing area, southeast of Patna, 55 m, 1 spec. (KU), 28. 10. 2000.

The occurrence of this leech species in Nepal was already mentioned by MOORE (1927) and CHANDRA (1983). During our research, different populations could be investigated from the Nepalese Himalayan midmountains as well as from the Gangetic plain in India.

This is a bloodsucking parasitic species, feeding most probably mainly on amphibians. It was found only during monsoon period in the fauna of paddy fields and was only occasionally collected from small streams. It seems that the leeches survive during dry season deeply burrowed in the soil substrate, with similar life cycle and habitat as *Asiaticobdella birmanica* (BLANCHARD, 1894).

The dorsal side of living specimens from Nepal is olive greenish with a dark blackish pattern, comprised of metamERICALLY arranged x-formed elements and black squares. A dark median line is always present, in some specimens it is segmentally interrupted. The pattern of the juvenile leeches fully match that of the adults. The body is dorsoventrally flattened. The body consistence is firm with a very rough surface due to the presence of numerous large papillae. The male genital pore is situated in the furrow XI b5/b6, the female in XII b5/b6. The genital pores are separated by five annuli. The largest preserved specimen was found in September and has a total length of 57 mm and is 9.5 mm wide. The smallest juvenile leech collected in the beginning of June is 20 mm long and 3.0 mm wide.

The Indian specimens have an almost identical dark pattern, except for a slightly darker greenish-brown ground colour and larger size. They inhabit much warmer shallow water bodies, being active only during the monsoon period (observation of fishermen). The specimens collected from the surroundings of Patna during the postmonsoon period



Figs 6-10: *Poecilobdella granulosa* (SAVIGNY, 1820), Nepal, small temporary pond near Dhobi Khola, in (6) dorsal and (7) ventral aspect; (8) dorsal aspect of specimen with segmentally interrupted dorsal median line. *Hirudinaria manillensis* (LESSON, 1842), Nepal, Panipiya Khola, in (9) dorsal and (10) lateral aspect.

were found in the muddy sediments. Their main activities were observed during the monsoon and summer periods with the highest water temperature, when leeches can be found actively swimming in the flooded areas. One preserved specimen reaches 120 mm length, extended living more than 17 cm.

*Poecilobdella granulosa* has a very large distribution area all over the Indian subcontinent including major adjacent areas in South Asia (MOORE 1927, SAWYER 1986).

***Hirudinaria manillensis* (LESSON, 1842)**  
(Figs 9-10)

*Hirudo manillensis* LESSON, 1842: 8.

*Hirudinaria manillensis*, - MOORE, 1927: 218-226, fig. 53, plate 3, fig. 2.

Material: Nepal, Eastern Zone: Sunsari district, Panipiya Khola near Tarahara 140 m, 1 spec. (KU), leg. M. Pfeiffer 15. 12. 1996. - Jhapa district, Deune Khola near Deune 104 m (Bhadrapur), leg. S. Khanal, H. Neseemann, M. Pfeiffer & S. Sharma, 3 spec. (NHMW-EV 17169), 1 spec. (KU), 12.+17. 2. 1998; 1 spec. (KU), 30. 8. 1999.

New to the fauna of Nepal. Bloodsucking parasitic species, found attached to the body of buffaloes in the Panipya Khola. Nearly all records were made during winter. The species is a rare but typical member of lowland streams of the natural sal forests (*Shorea robusta* GAERTN.) in the eastern Terai. In this respect it differs completely from *P. granulosa*. The two localities in Nepal are slowly running small streams, characterised by permanent discharge and a rich and dense benthic fauna with numerous aquatic molluscs.

The leeches are very similar in size and form to *Poecilobdella granulosa*, but differ in some aspects of colour and dorsal pattern. The dorsal side of living specimens is brownish with colourful red lateral margins and the ventral side is lighter with an orange tint. The dorsal dark blackish pattern comprises of metamericly arranged beautiful ornaments and black squares. A greyish median line is always segmentally interrupted. The pattern of the juvenile leeches fully match with the adults, there is nearly no variability. The body consistence is firm with a very rough surface due to the presence of numerous large papillae. The male genital pore is situated in the furrow XI b5/b6, the female in XII b5/b6. The genital pores are separated by five annuli. The largest preserved specimen has a total length of 70 mm and is 15 mm wide.

### Genus *Myxobdella* OKA, 1917

Leeches of the family Hirudinidae (SAWYER, 1986: 682, 685), subfamily Praobdellinae. Segments imperfectly five-annulate. Annuli typically in groupings of 3-2, 2-1-2 or 1-2-2, annular furrows of unequal depth. Small jaws, a few pairs of teeth per jaw. Gonopores separated by five annuli, mouth with a small trifold pore. Aquatic leeches, microphagous and parasites of (!) invertebrates. South and East Asia, Central and South Africa.

Type species: *Myxobdella annandalei* OKA, 1917.

### *Myxobdella nepalica* sp.n.

(Figs 11-17)

?Hirudinidae, - NESEMANN & SHARMA, 1996: 246-248, figs. 39,40 (damaged specimen).

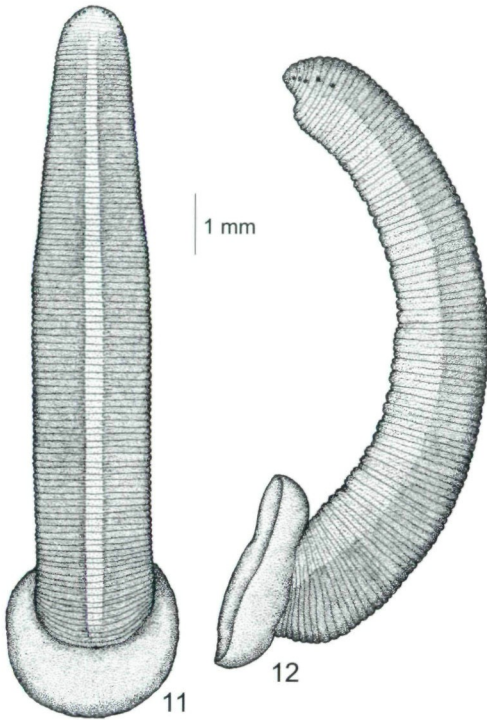
**Type material:** Holotype NHMW-EV 17165. Paratypes: 10 spec. (NHMW-EV 17166), 30 spec. (KU). Kavre district, small stream (right tributary of the Punyamati) 500 m north of Naikintar, 1455 m, leg. B. Kaufmann & H. Nesemann 8.-10. 11. 2000.

**Additional Material:** Nepal, Central Zone, Kathmandu district, Mahadev/Dhobi Khola at Budhanilkantha, 1470 m, , leg. B. Pradhan Nov.-Feb. 1995-1996, 1 spec. (KU).

**Type locality:** Nepal, 27°36'42"N, 85°31'40"E, small stream coming from pine and *Rhododendron* forest, 500 m N of Naikintar, 1455 m.

**Etymology:** The species is named according to its occurrence in the Nepalese Himalayan midmountains.

**Diagnosis:** Small elongated and dorsoventrally flattened Hirudinidae with a very soft body consistence and a smooth body surface. The distinct caudal sucker disc is very large and always exceeds the maximum body width. Head with ten eyes. Gonopores very small and inconspicuous, separated by five annuli. Male porus in the furrow XI b5/b6, female porus in the furrow XII b5/b6. Anus very small and situated in the furrow between the last annulus and the caudal sucker. Body length of holotype 12.0 mm,



Figs 11-12: *Myxobdella nepalica* sp.n., holotype, (11) dorsal and (12) lateral aspect.

maximum body width 2.0 mm, diameter of caudal sucker 3.1 mm. Body length of the smallest paratype 7.4 mm, maximum body width 1.8 mm, diameter of caudal sucker 1.9 mm. Number of annuli per somite: I-III: 1, IV-V: 2, VI-VII: 3, VIII: 4, IX-XXIV: 5, XXV:4, XXVI + XXVII: 3. Number of complete segments 16. The annulation of the dorsal side differs from the ventral part. The midbody somites are basically quinqueannulate, homonomously subdivided into five rings b1, b2, a2, b5, b6 of equal width on the dorsum. Ventrally the annulation is heteronomous:  $b1 < (b2 = a2) = (b5 = b6)$ . Annuli and furrows of unequal depth, b1 of each midbody somite always remarkably narrower. Thus the true segmentation of the leech is externally visible.

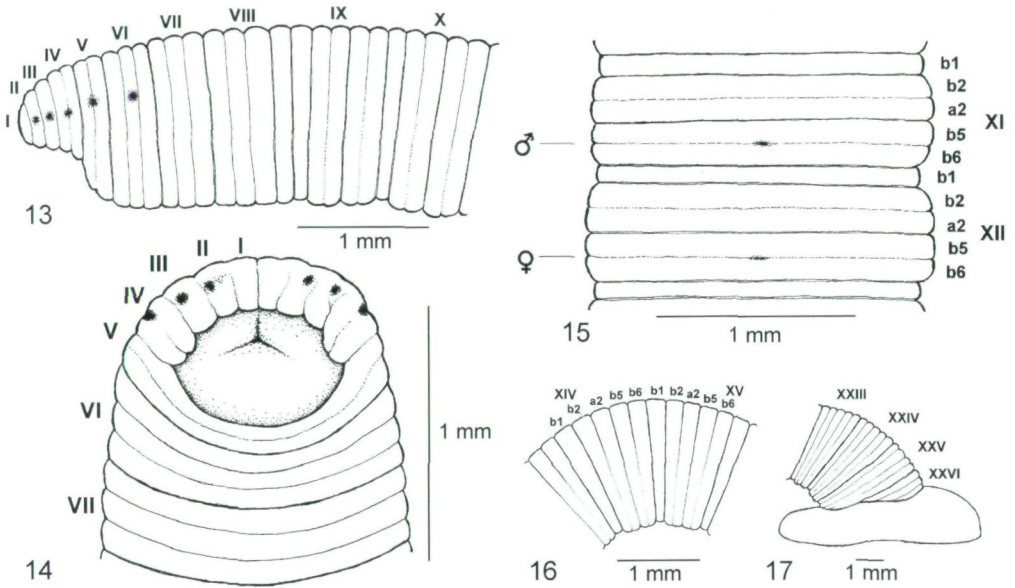
Colour of the living leeches unicoloured dark without any metameric pattern. Dorsal

side variably pale greyish, dark reddish to brown. There is always one bright median longitudinal stripe present. The ventral side is paler than the dorsal side.

Living leeches were observed and studied in larger numbers at the type locality. The animals prefer stony bottom of the small stream, where they occur in the fast flowing riffles. They are moving actively even in stronger water current (riffles of the stream), but they were never found outside of the water or living on the banks, like other Hirudinidae. The large caudal sucker may be a helpful adaptation to the habitat. The leeches do not like to swim. When removed from their substrate, they hardly swim for very short distances. Taken out from the water, *M. nepalica* sp.n. starts to move very fast and the leeches like to set up the head and cranial sucker, resembling a little bit the movement of *Haemadipsa* species. Fully extended living specimens reach 22-25 mm body length.

*Myxobdella nepalica* sp.n. inhabits clean and unpolluted streams, which have an estimated water quality class around I-II according to saprobic system. The leech is associated with *Barbronia* cf. *weberi* (BLANCHARD, 1897) sensu MOORE (1927: 138), *Asiaticobdella birmanica* (BLANCHARD, 1894), and *Alboglossiphonia weberi* (BLANCHARD, 1897). Freshwater crabs (family Potamidae) are fairly common, aquatic molluscs are represented by *Gyraulus convexiusculus* (HUTTON, 1849), *Tricula montana* BENSON, 1843, and the bivalves *Pisidium annandalei* PRASHAD, 1925 and *Pisidium atkinsonianum* THEOBALD, 1876.

**Systematic position and differential diagnosis:** The genus *Myxobdella* OKA, 1917 was previously added to the hirudinid leeches by RICHARDSON (1969) without any family position. MOORE (1958) and SOÓS (1969) regarded the genus *Myxobdella* as a family member



Figs 13-17: *Myxobdella nepalica* sp.n., holotype, (13) lateral aspect of preclitellar region, ventral aspect of (14) head region with cranial sucker and mouth porus, (15) clitellar region with position of male and female genital pores; lateral aspects of (16) two midbody somites with annulation and (17) posterior somites with caudal sucker.

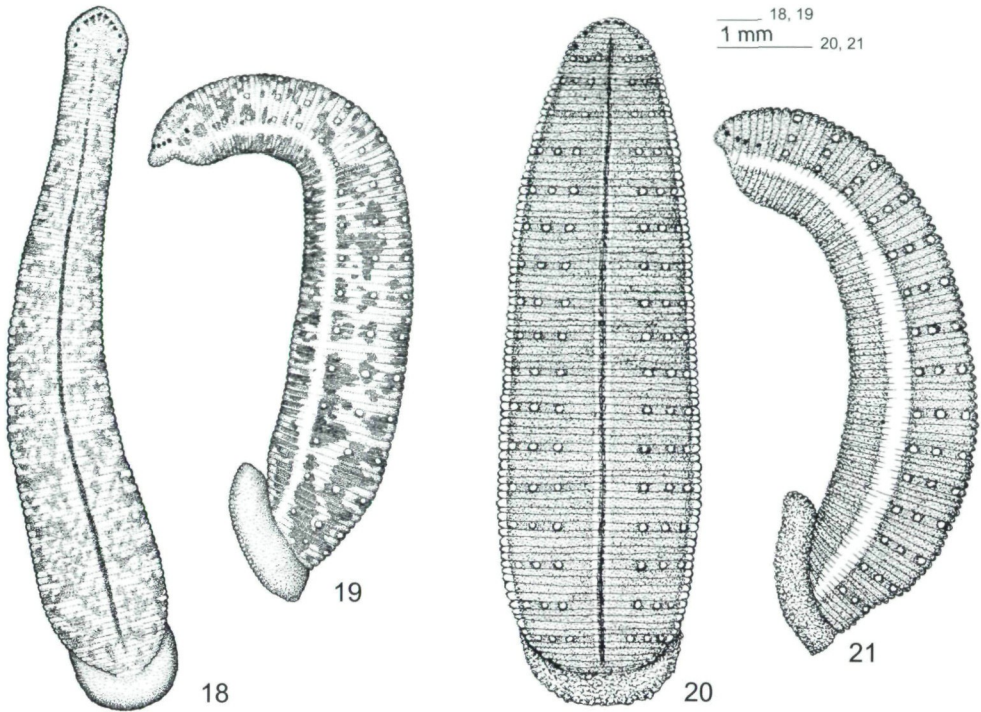
of Hirudinidae and listed the species *M. annandalei* OKA, 1917, *M. africana* MOORE, 1939, *M. sinanensis* OKA, 1925, *M. maculata* MOORE, 1939 and *M. radiata* MOORE, 1958. Later on, the two species *M. maculata* MOORE, 1939 and *M. radiata* MOORE, 1958 were placed into the African genus *Praobdella* BLANCHARD, 1896 by SOÓS (1969) and SAWYER (1986).

Thus, four species of the genus *Myxobdella* OKA, 1917 are presently accepted (for detailed references see SAWYER 1986): *Myxobdella annandalei* OKA, 1917 (type species) is widely distributed in south Asia, occurring in Hongkong, the Malayan Peninsula, Burma, south India, western Himalayas, Afghanistan and Georgia; *Myxobdella africana* MOORE, 1939 was found in Kenya, Zaire, Natal, Ethiopia and Rwanda; while *Myxobdella sinanensis* OKA, 1925 may be restricted to Japan. The taxonomic position of "*Myxobdella*" *weberi* (BLANCHARD, 1897) from Sumatra is still uncertain.

*Myxobdella nepalica* sp.n. differs from all other known species of this genus by the small size, the body form, the large caudal sucker and by the dorsal colour pattern, respectively. There are differences in the annulation of the caudal segments XXIV-XXVI, and the reduced width of the annulus b1 of each midbody somite.

*Myxobdella nepalica* sp.n. is much smaller than *M. annandalei*, *M. africana*, *M. sinanensis* and "*M.*" *weberi*. The caudal sucker is comparatively larger than in the hitherto known species. The genital pores are situated in the same position as in the other *Myxobdella* species. *Myxobdella nepalica* sp.n. is distinguished by the unique dorsal colour pattern (longitudinal mid-dorsal light stripe) from the other species; *M. annandalei* is dorsally





Figs 18-21: *Haemadipsa zeylanica agilis* MOORE, 1927, Nepal, Naikintar, in (18) dorsal and (19) lateral aspect. *Haemadipsa zeylanica montivindicis* MOORE, 1927, Nepal, Boskom Gumba, in (20) dorsal and (21) lateral aspect.

covered with distinct dark spots; *M. africana* (with a velar mouth) has a dark mottled dorsal side; *M. sinanensis* is characterised by a metamerically arranged pattern, whereas "*M.*" *weberi* is unicoloured greyish. The annulation of the midbody somites of *M. annandalei*, *M. sinanensis* and *M. africana* is imperfectly quinqueannulate with furrows of unequal depth, forming groups of 2-1-2 or 2-3 rings per segment. The midbody somites of *M. nepalica* sp.n. form groups of 1-2-2 rings per segment.

### Family Haemadipsidae

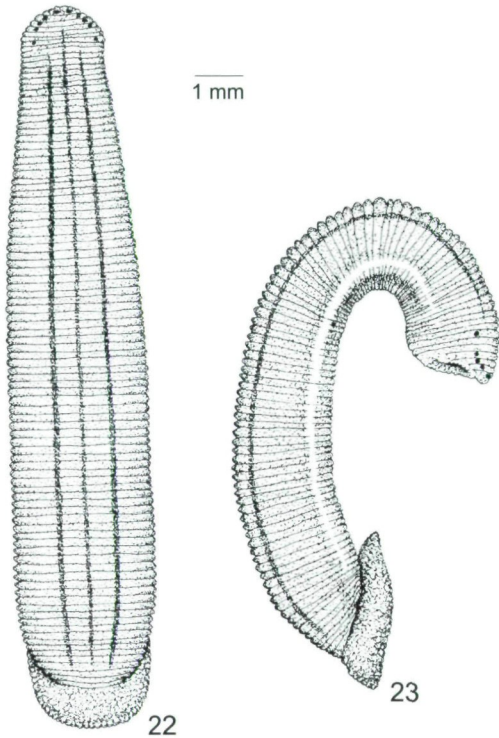
#### *Haemadipsa zeylanica agilis* MOORE, 1927

Figs 18-19

*Haemadipsa zeylanica agilis* MOORE, 1927: 266-267, Plate 4, fig. 6.

**Material:** Nepal, Central Zone, Kavre district, leg. B. Kaufmann & H. Neseemann: Dhobi Khola (left tributary of the Punyamati) between Dhulikhel and the Kathmandu University, 1450-1470 m, 2 spec. (KU), 6. 9. 1999. – Small stream (right tributary of the Punyamati) 500 m north of Naikintar, 1455 m, 4 spec. (NHMW-EV 17170), 9 spec. (KU), 8. 11. 2000.,.

This subspecies is a new record for the fauna of Nepal. The western Himalayan leech, originally described from the Kumaon Mountains near Nainital, was found to be the



Figs 22-23: *Haemadipsa sylvestris* BLANCHARD, 1894, Nepal, Taudah pond, in (22) dorsal and (23) lateral aspect.

most common terrestrial leech in Nepal. It occurs as far eastwards to Dhulikhel and the forested hills of the upper Koshi river system. Leeches were observed mainly close to small streams and forests, where dense vegetation and high humidity is always present. During the dry season, many specimens seem to move actively to running waters. *Haemadipsa zeylanica agilis* is characterised by the dorsal colour pattern with dark spots. The male genital pore is situated in the furrow XI b5/b6, the female in XII b5/b6. The genital pores are separated by five annuli. Adults and juveniles were observed during autumn. The preserved leeches reach a maximum body length of 15,5 mm and a width of 3,6 mm.

### *Haemadipsa zeylanica montivindicis* MOORE, 1927

Figs 20-21

*Haemadipsa zeylanica montivindicis* MOORE, 1927: 267-268, Plate 5, fig. 8, plate 9, fig. 37.

**Material:** Nepal, eastern Region, Solukhumbu district (near Boskom Gumba), 1 spec. leg. G. Hutter.

This subspecies is a new record for the fauna of Nepal. The record published earlier under the name *H. zeylanica* (MOQUIN-TANDON, 1826) (NESEMANN & SHARMA 1996: figs. 37-38) now could be identified as belonging to the eastern Himalayan subspecies. It occurs in eastern Nepal, where it was collected from the Solukhumbu district near Boskom Gumba. Thus the distribution border of the two allopatric taxa can be precisely placed near the Koshi/Arun River valley. It was originally described from Darjeeling.

### *Haemadipsa sylvestris* BLANCHARD, 1894

Figs 22-23

*Haemadipsa sylvestris* BLANCHARD, 1894: 114-115.

**Material:** Nepal, Eastern Zone, Sunsari district, Kheti Khola in Itahari, 105 m 3. spec. (KU), leg. S. Khanal, H. Nesemann, M. Pfeiffer & S. Sharma 15. 12. 1996.

An additional third locality (NESEMANN & SHARMA 1996) is listed for the Sunsari district. In contrast to the previous species, which prefers forested areas, *H. sylvestris* is

always associated with waters. It occurs in the Nepalese Terai and in the Kathmandu valley, where it was found in the bank vegetation of rivers, streams and ponds. *Haemadipsa sylvestris* often lives very near to waterbodies and it survives temporary flood periods in the water. During winter season, adults were found as well as juveniles. The male genital pore is situated in the furrow XI b5/b6, the female in XII b5/b6. The genital pores are separated by five annuli. The preserved leeches reach a maximum body length of 27.5 mm, width of 4.2 mm.

#### Acknowledgements

For many help, kind hospitality and field assistance we are indebted to Dr. Sanjay Khanal (Kathmandu University, Dhulikhel, Nepal), Dipl.-Biol. Michael Pfeiffer (Laos), Prof. Dr. Ravindra K. Sinha and Dr. Gopal Sharma (Patna University, India).

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