

An annotated check list of the leeches (Annelida : Hirudinea) of the Kruger National Park with a key to the species

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The diagnosis, distribution and bionomics of the ten species of leeches occurring in the Kruger National Park and a key to the identification of the species are presented. Seven species belong to the family Glossiphoniidae, two to the family Hirudinidae and one species to the family Salifidae. The African fish leech *Batracobdelloides tricarinatus* and the reptilian parasite *Placobdelloides multistriatus* are the most common species in the park. Two of the three snail leeches occurring in the reserve, viz. *Alboglossiphonia disjuncta* and *Helobdella conifera*, the predaceous *Salifa perspicax* and the sanguivorous *Hirudo michaelseni* are widespread but not common. The snail leech *Alboglossiphonia conjugata* occurs only in the small Madzaringwi River and its tributaries located in the most northern part of the park. The amphibian parasite *Oosthuizobdella stuhlmanni* was found only at two adjacent localities in the most southern reaches of the park with the sanguivorous *Asiaticobdella buntonensis* limited to the southern half of the reserve. The host-specific parasite of hippopotami, *Placobdelloides jaegerskioeldi*, is restricted to habitats inhabited by its host.

Key words: Hirudinea, leeches, identification key, Kruger National Park.

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Introduction

Very little has been published on the leeches occurring within the confines of the Kruger National Park and this study represents the first comprehensive review of the group. The only report on leeches of this area is that by Sciacchitano (1962) on a limited sample. He listed two glossiphoniids, *Placobdella multistriata* (Johansson, 1909) and *Parabdella aspera* (Moore, 1939) and two hirudinids, *Hirudo michaelseni* Augener, 1936 and *Limnatis fenestrata* Moore, 1939. However, on the re-examination of the material I found that the specimens identified as *Parabdella aspera* and *Limnatis fenestrata* by Sciacchitano (1962) were incorrectly identified and are indeed *Placobdelloides multistriatus* and *Asiaticobdella buntonensis* (Meyer, 1951), respectively.

Other published information concerning leech species also occurring in the Kruger National Park and based, *inter alia*, on material collected in the park, are the accounts on the glossiphoniids *Batracobdella conjugata*

Oosthuizen, 1978 and *B. disjuncta* (Moore, 1939) (Oosthuizen 1978), *Placobdella multistriata* (Johansson, 1909) (Oosthuizen 1979), *Placobdella stuhlmanni* (Blanchard, 1897) (Oosthuizen 1982) and *Batracobdelloides tricarinata* (sic) (Blanchard, 1897) (Oosthuizen 1989).

Methods and materials

The bulk of the material on which this checklist is based was collected by me during 1961 and 1963 as part of an extensive survey on the group which covered the entire park. Since then, casual collecting by staff members of the Kruger National Park added a small number of specimens to this collection.

Collecting methods consisted basically of the scrutiny of any solid, non-living object which could be lifted from the water as well as aquatic plants, sweeping of aquatic vegetation with a dip-net (not only for leeches but also to catch other small animals such as insects, snails and amphibians which often harbour leeches) and examination of larger animals such as fish and terrapins which were caught with a trawl-net. The methods applied at a specific habitat were, of course, determined by factors such as the physical characteristics of the habitat and the presence or otherwise of crocodiles, hippopotami, terrapins and fish.

Leeches were narcotized with 15% ethanol, laid straightened and moderately extended in a petri dish and fixed in this position by covering them with either 70% ethanol, Schaudinn's fixative or 10% formalin in which they were left for 12 hours. Specimens were preserved in 70% ethanol or 5% formalin.

The dimensions provided are those of straight, moderately stretched, preserved specimens prepared as described above, indicating the length and widest region of the body, respectively. The measurements closely resemble the measurements of the living leeches in a relaxed, resting pose.

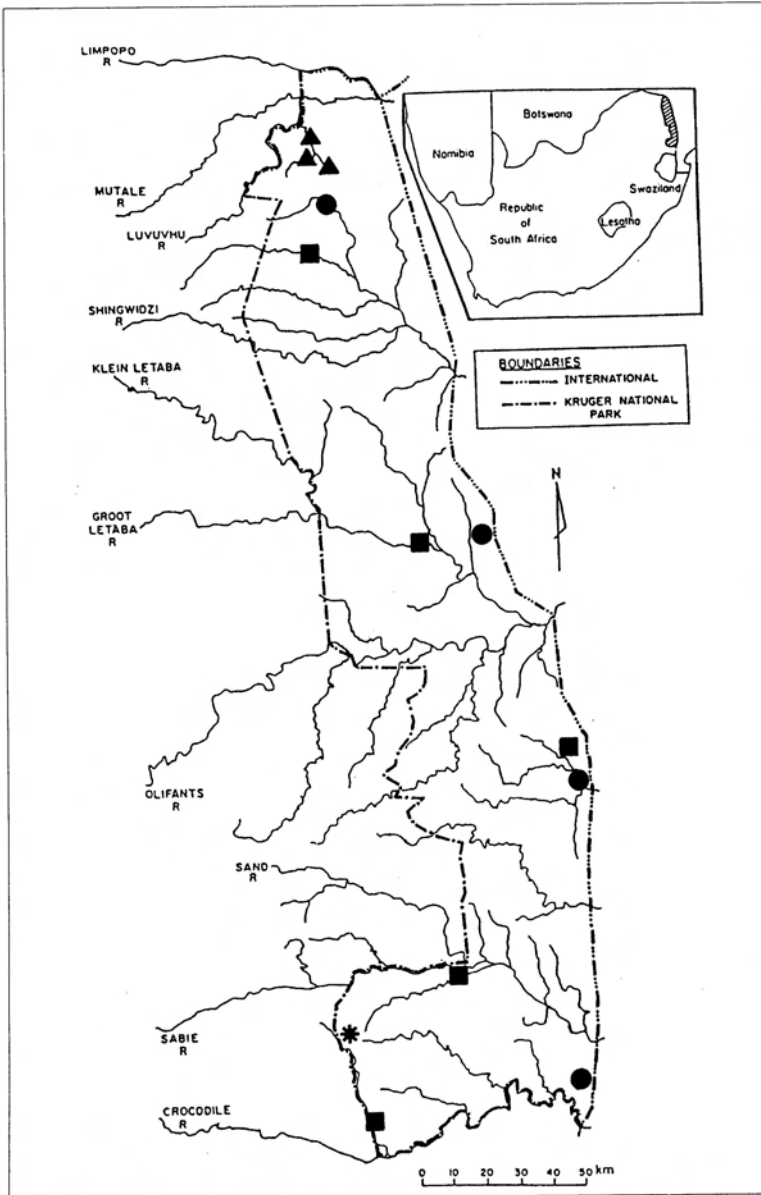


Fig. 1. Distribution of *Alboglossiphonia disjuncta* (●), *A. conjugata* (▲), *Helobdella conifera* (■) and *Oosthuizobdella stuhlmanni* (*) in the Kruger National Park. Inset: Location of the Kruger National Park.

List of species

Order Rhynchobdellida

With protrusible proboscis; mouth small, pore-like.

Family Glossiphoniidae

Mid-body segments three-annulate (except *Oligobdella biannulata* of North America); body depressed, convex above, not divided into distinct regions; young carried on ventral side of parent.

Genus *Alboglossiphonia* Lukin

Alboglossiphonia Lukin, 1976, *Fauna of the USSR* 1. Type-species: *Hirudo heteroclita* Linnaeus, 1761.

Three pairs of eyes, first pair close together or coalesced, in median field, members of each of the second and third pairs widely separated but the two eyes of each side close together or coalesced, the three pigment masses so formed thus correspond in position to the three corners of a triangle; mouth pore at centre of sucker; salivary glands diffuse; six or seven pairs of crop caeca; gonopores separated by 0-2 annuli; liquidosomatophagous.

1. *Alboglossiphonia disjuncta* (Moore)

Glossiphonia disjuncta Moore, 1939, *Proc. Acad. nat. Sci. Philad.* 90. **Type:** Lake Bunyoni, Uganda; British Mus. (Nat. Hist.).

Diagnosis: General colouration either flesh-coloured or green, all chromatophores irregularly distributed, or dorsal side with about 36 longitudinal stripes at widest region of body; gonopores separated by two annuli; seven pairs of crop caeca, first six pairs unlobed, post-caeca each with four small, lateral, secondary caeca.

Bionomics: Lives on body-fluids of freshwater snails and insect larvae (Oosthuizen 1978). Eggs are enclosed in membranous cocoons attached to a solid substrate and are covered by the parent's body. Maximum size recorded is 11,6 x 2,2 mm but it reaches

sexual maturity at an exceptionally small size, the smallest specimen reported with attached young measured 3,6 x 1,5 mm (Oosthuizen 1978). Widespread but not common (Fig. 1).

2. *Alboglossiphonia conjugata* (Oosthuizen)

Batracobdella conjugata Oosthuizen, 1978, *Madoqua* 11. **Type:** Daan Viljoen Game Park, Khomas Hochland, Namibia; British Mus. (Nat. Hist.)

Diagnosis: General colouration either green or brown, dorsal side with 34 to 36 dark, longitudinal stripes at widest region of body; gonopores separated by one annulus; walls of male and female atria fused over their entire lengths; seven pairs of crop caeca, first six pairs bilobed, post-caeca each with five or six short, lateral, secondary caeca.

Bionomics: Feeds on freshwater snails (Oosthuizen & Curtis 1990). The largest specimen reported measured 9,1 x 2,8 mm although it reaches sexual maturity at a relatively small size, the smallest individual recorded with attached offspring measured 5,2 x 2,2 mm (Oosthuizen 1978). Rare, encountered only in the Madzaringwi River and its tributaries in the most northern part of the park (Fig. 1).

Genus *Batracobdelloides* Oosthuizen

Batracobdelloides Oosthuizen, 1986, in: Sawyer, R.T. 1986. *Leech biology and behaviour* 2. **Type-species:** *Helobdella tricarinata* Blanchard, 1897. Two pairs of eyes; gonopores separated by two annuli; diffuse salivary glands; with oesophageal organ; seven pairs of lobed crop caeca; haematophagous.

3. *Batracobdelloides tricarinatus* (Blanchard)

Helobdella tricarinata Blanchard, 1897, in: *Mobius' Tierwelt Deutsch-Ost-Afrika* 4, Lief. 2, No 13. **Type:** Bubu Bach, Mbani (Ugogo), Tanzania; Berlin Mus.

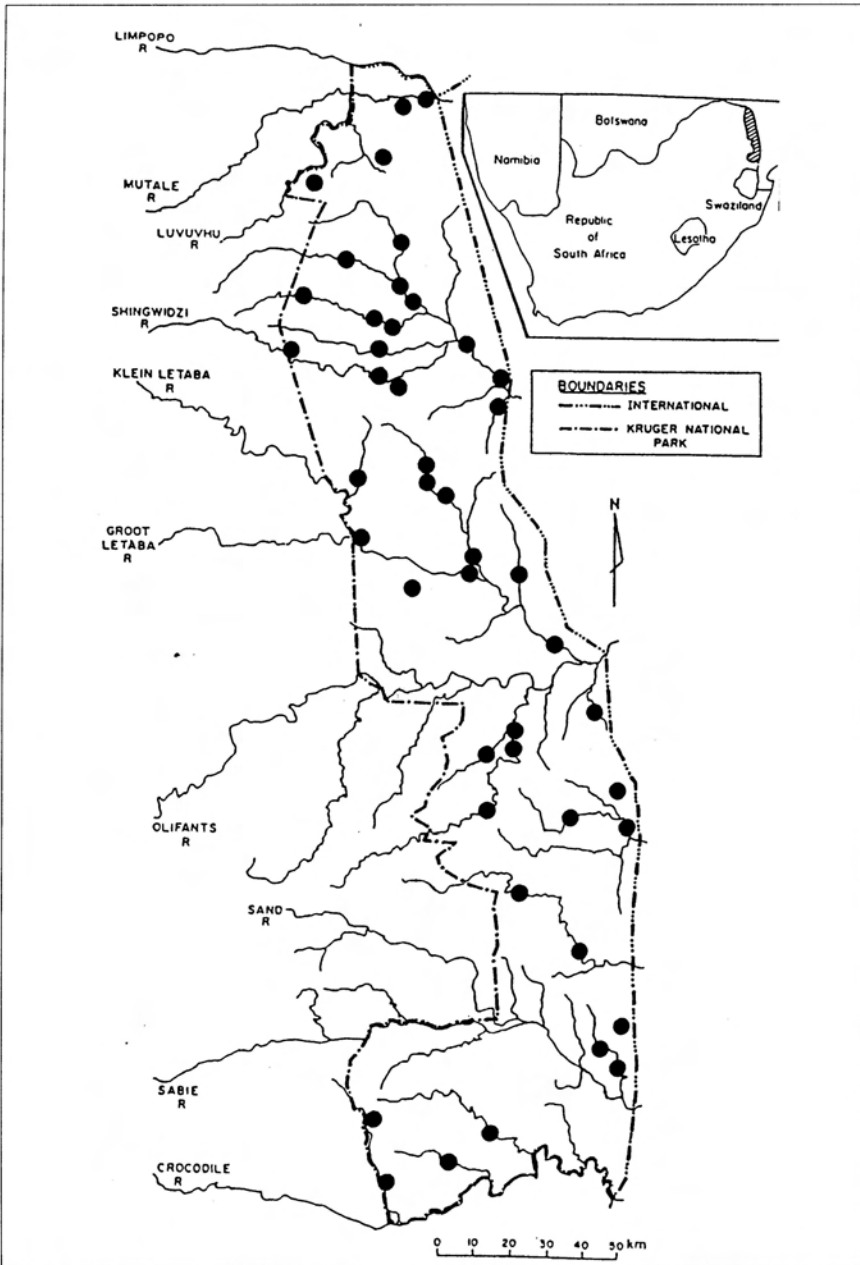


Fig. 2. Distribution of *Batracobdelloides tricarinatus* in the Kruger National Park.

Synonyms:

Clepsine nilotica Johansson, 1909, *Zool. Anz.* 35. **Type:** White Nile, Sudan; Zool. Reichsmuseum, Stockholm.

Batrachobdella amnicola Moore, 1958, *Ann.*

Natal Mus. 14. **Type:** Engamani River, Hluhluwe, Zululand, Republic of South Africa; U.S. National Mus.

Diagnosis: Predominantly green with brownish tinge, without striped pattern; first pair of eyes very small, situated deeper than second

pair, which are separated and much larger, between and in line with anterior corners of the latter, first pair often obstructed from surface view by second pair; mouth pore central in sucker; dorsum with three or five longitudinal ridges formed by tubercles occurring more or less in line on consecutive annuli.

Bionomics: Parasitic on freshwater fishes (Oosthuizen 1989) but will feed on tadpoles as well as adult anurans when fish is not available. The eggs are not deposited in cocoons nor attached to the substrate or to the parent's body, but kept together in a loosely arranged cluster and retained in a temporary brooding cavity on the ventral side of the parent (Oosthuizen 1989). Maximum size reported is 19,9 x 4,1 mm but it starts to breed at a very small size, the smallest specimen recorded with progeny measured 4,8 x 1,7 mm (Oosthuizen 1989). Very common and occurs all over the park (Fig. 2).

Genus *Helobdella* Blanchard

Helobdella Blanchard, 1896, *Boll. Musei Zool. Anat. comp. R. Univ. Torino* 11. **Type-species:** *Hirudo stagnalis* Linnaeus, 1758.

One pair of eyes; gonopores separated by one annulus; salivary glands diffuse; crop with five or six pairs of caeca; liquidosomatophagous.

4. *Helobdella conifera* (Moore)

Glossiphonia conifera Moore, 1933, *J. Linn. Soc. (Zoology)* 38. **Type:** Lake Bunyoni, Uganda; British Mus. (Nat. Hist.).

Diagnosis: Body semi-translucent; ground colour light brown, dorsally a fairly broad, light, median band bordered by prominent, continuous, dark brown or reddish brown stripes, lateral to these on each side five or six similarly coloured, discontinuous stripes; dorsum of each sensory annulus (every third annulus) in middle region of body with up to eight tubercles in a transverse row, tubercles dark coloured with yellow pigment at their bases, tipped with black; eyes large, well separated; mouth pore a transverse slit between centre and anterior rim of sucker; five pairs of crop caeca.

Bionomics: Feeds on freshwater snails and aquatic insect larvae (Oosthuizen & Curtis 1990). As many as eight, but usually six, membranous cocoons are formed, each containing any number up to 12 eggs, which are attached to the ventral side of the leech in two longitudinal rows (Oosthuizen & Curtis 1990). Maximum size reported is 13,7 x 4,3 mm but it reaches sexual maturity when still relatively small, the smallest individual recorded with offspring measured 5,1 x 1,5 mm (Oosthuizen & Curtis 1990). Widespread but not common (Fig. 1).

Genus *Oosthuizobdella* Sawyer

Oosthuizobdella Sawyer, 1986, *Leech Biology and Behaviour* 2. **Type-species:** *Glossiphonia garoui* Harding, 1932.

Four pairs of eyes, three pairs in two sub-parallel rows in paramedian position and one pair of buccal eyes at lateral margins of Va2; mouth pore at anterior margin of sucker; salivary glands compact; oesophageal organ present; seven pairs of crop caeca; haematophagous.

5. *Oosthuizobdella stuhlmanni* (Blanchard)

Glossosiphonia Stuhlmanni Blanchard, 1897, in: *Mobius' Tierwelt Deutsch-Ost-Afrika* 4(3). **Type:** Kasja (Karague), Tanzania.

Diagnosis: General colour varies - dark green, shades of greenish brown or dark brown, dorsal side with seven pairs of longitudinal, broken dark green or brownish stripes; posterior secondary furrow on ventral side of a3 of segments in middle body region separated from ensuing intersegmental furrow by one band of circular muscles; proboscis consists of stout basal part and slender terminal part with abrupt transition between two parts; first pair of caeca of full crop without anteriorly directed lobe.

Bionomics: Parasitic on amphibians and although it is often found on terrapins it does not feed on them but uses them only as a hiding place (Oosthuizen & Curtis 1990). Oosthuizen (1982) describes in detail the mating process in this leech and reports that it does not form cocoons but that the eggs are

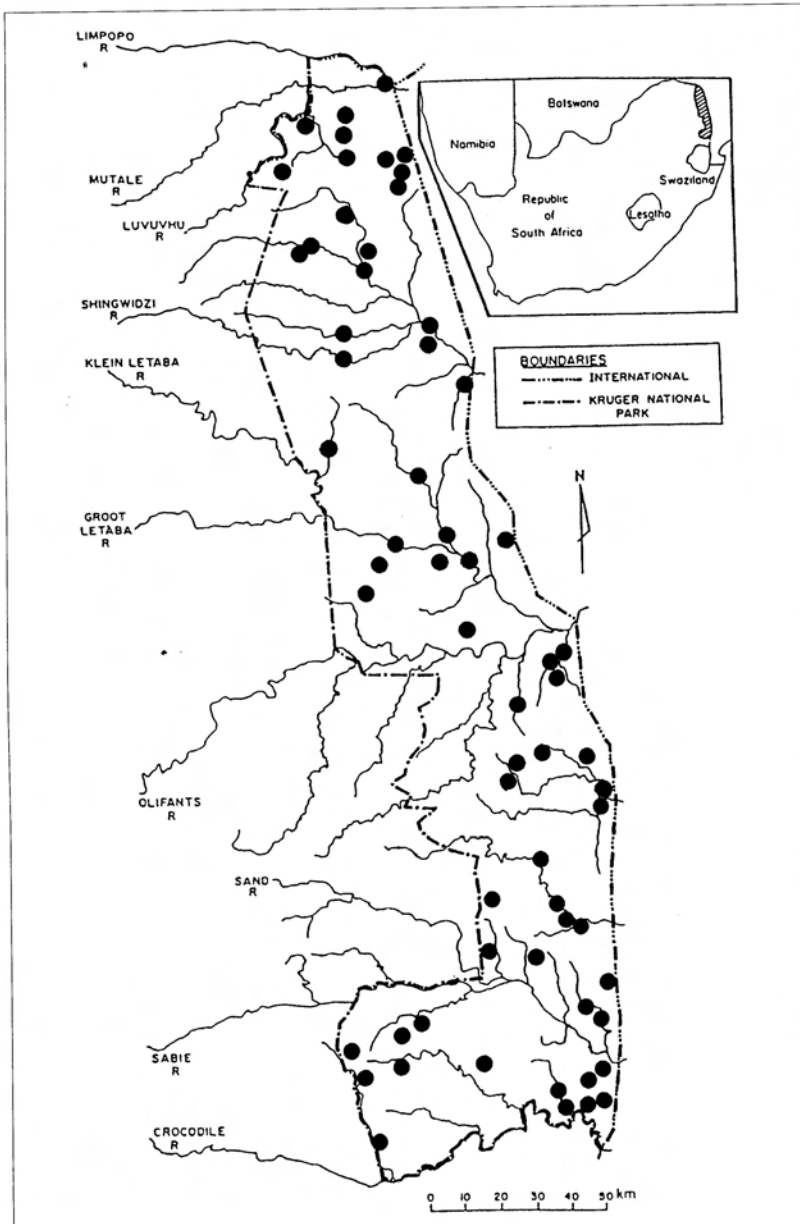


Fig. 3. Distribution of *Placobdelloides multistriatus* in the Kruger National Park.

embedded in a jelly-like adhesive substance by which they are glued to the venter of the parent. The largest specimen reported measured 33,2 x 6,6 mm and the smallest individual recorded with progeny was 17,8 x 4,3 mm (Oosthuizen 1982). Rare, encountered only at two adjacent localities in the most southern part of the park (Fig. 1).

Genus *Placobdelloides* Sawyer

Placobdelloides Sawyer, 1986, *Leech Biology and Behaviour* 2. **Type-species:** *Clepsine multistriata* Johansson, 1909.

One pair of eyes; mouth pore at anterior edge of sucker; oesophageal organ present; seven pairs of crop caeca; haematophagous.

6. *Placobdelloides multistriatus* (Johansson)

Clepsine multistriata Johansson, 1909, *Zool. Anz.* 35. **Type:** North of Gebel Ahmed, Sudan; Zool. Reichsmuseum, Stockholm.

Synonyms:

Placobdella aegyptiaca Harding, 1911, *Ann. Mag. nat. Hist.* (8), 7. **Type:** Cairo, Egypt.

Placobdella pulchra Moore, 1939, *Proc. Acad. nat. Sci. Philad.* 90. **Type:** Lake Tanganyika, Tanzania; British Mus. (Nat. Hist.).

Placobdella auroguttata Moore, 1939, *Proc. Acad. nat. Sci. Philad.* 90. **Type:** Kibero, Lake Albert, Uganda; British Mus. (Nat. Hist.).

Placobdella unita Moore, 1958, *Ann. Natal Mus.* 14. **Type:** Albert Falls, Natal, Republic of South Africa; Natal Mus.

Diagnosis: Ground colour light brown and, depending on amount of green pigment present, appears brown or green; dorsum with continuous or broken, golden yellow, median stripe extending anteriorly between eyes, five longitudinal series of dark, irregularly shaped blotches in median, paramedian and marginal fields, the latter alternating with large, golden yellow markings; salivary glands two pairs, compact; oesophageal organ pigmented; second to sixth crop caeca each with three lobes. **Bionomics:** A parasite of terrapins and crocodiles but will feed on freshwater snails when these vertebrates are not available (Oosthuizen 1979). It uses night-flying aquatic insects like the Giant Waterbug *Belostoma niloticum* and waterscorpions, *Nepa* spp., as transport hosts and is thus often found in small, temporary pools of rainwater (Oosthuizen 1979). Maximum size recorded is 40,0 x 8,7 mm and the smallest specimen reported with attached young measured 12,4 x 3,5 mm (Oosthuizen 1979). This is the most common leech in the park (Fig. 3).

7. *Placobdelloides jaegerskioeldi* (Johansson)

Clepsine jaegerskioeldi Johansson, 1909, *Zool. Anz.* 35. **Type:** Kaka, White Nile, Sudan; Zool. Reichsmuseum, Stockholm.

Diagnosis: Uniformly flesh-coloured, ventrally lighter than dorsally, large specimens olive brown dorsally due to numerous, very small, green, brown and aureate pigment granules uniformly distributed in integument, no striped pattern; segment VI biannulate ventrally; dorsum of large individuals extremely rough due to very large tubercles; salivary glands diffuse; oesophageal organ unpigmented; crop caeca extensively lobed.

Bionomics: This is the only known African glossiphoniid which can swim. It is a host-specific parasite of hippopotami and is restricted to habitats inhabited by this mammal (Fig. 4).

Order Arhynchobdellida

Mouth relatively large, opening into a buccal chamber with three muscular ridges terminating in three jaws (in a few there are only two jaws) or without jaws; no proboscis.

Family Hirudinidae

Mid-body segments five-annulate; with three jaws; crop caecate.

Genus *Hirudo* Linnaeus

Hirudo Linnaeus, 1758, *Classis Vermes : Systema Naturae*, 10th Ed. **Type-species:** *Hirudo medicinalis* Linnaeus, 1758. Monostichodont; no pharyngeal ridges terminating independently between jaws; jaws with few or no salivary papillae; male and female median organs myomeric, mesomorphic; no vaginal duct; haematophagous.

8. *Hirudo michaelsoni* Augener

Hirudo michaelsoni Augener, 1936, *Sber. Ges. naturf. Freunde Berl.* Jahrgang 1935.

Type: Farm Neitsas, Grootfontein District, Namibia.

Diagnosis: Dorsal ground colour yellowish brown, olive green or dark green with five longitudinal, yellowish stripes bordered with black; lateral sides yellowish bordered on

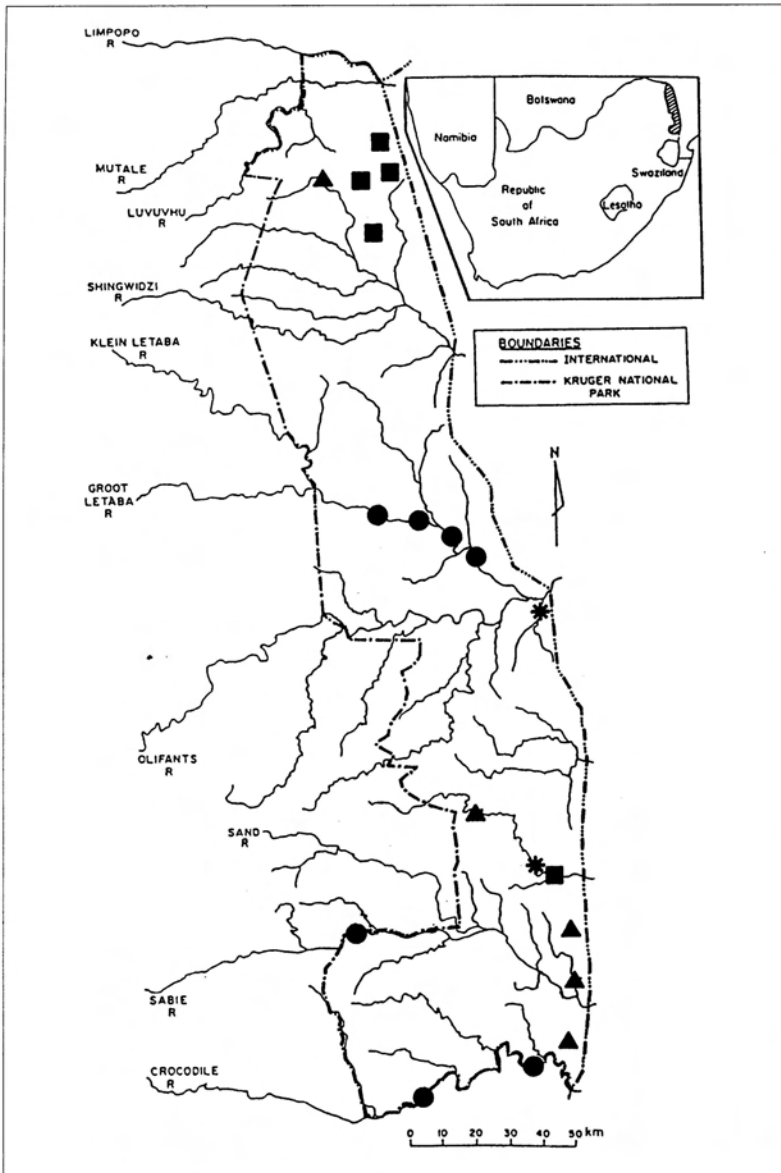


Fig. 4. Distribution of *Placobdelloides jaegerskioeldi* (●), *Salifa perspicax* (▲), *Hirudo michaelseni* (■) and *Asiaticobdella buntonensis* (*) in the Kruger National Park.

ventral side with black; venter olive brown and not marked except for submarginal black stripes bordering lateral, yellow sides; 43-53 teeth per jaw.

Bionomics: Although primarily parasitic on mammals, it also feeds on freshwater fishes, amphibians and freshwater snails (Oosthuizen & Curtis 1990). Largest specimen reported measured 65,0 x 15,0 mm (Au-

gener 1936). Widespread but not common (Fig. 4).

Genus *Asiaticobdella* Richardson

Asiaticobdella Richardson, 1969, *Acta zool. hung.* 15. **Type-species:** *Haemopsis birmanica* Blanchard, 1894. Monostichodont; no pharyngeal ridges terminating inde-

pendently between jaws; jaws with few or no salivary papillae; male and female median organs myomeric, macromorphic; vaginal duct longer than vagina; haematophagous.

9. *Asiaticobdella buntonensis* (Meyer)

Limnatis buntonensis Meyer, 1951, *Explor. Parc natn. Albert Miss. G.F. de Witte 1933-1935* 76. **Type:** Vitshumbi, Lake Edward, Zaire; Institut des Parcs Nationaux du Congo Belge, Brussels.

Diagnosis: Dorsal ground colour olive green to dark green with brownish tinge, with six longitudinal, yellowish stripes and median light brown stripe; dorsum irregularly mottled with small, black patches and dots; lateral sides orange; venter lead-grey with few small, black maculations mainly near posterior sucker and submarginal, interrupted, black stripes bordering lateral orange sides; 70-85 teeth per jaw.

Bionomics: Its natural hosts include freshwater fish and the hippopotamus and it is an active swimmer, often venturing from the littoral vegetation of its habitat to the open water (Appleton & Porter 1982). Maximum size recorded is 50,6 x 9,9 mm (Meyer 1951). Present only in the southern half of the park (Fig. 4).

Family Salifidae

With pharyngeal stylets; no jaws; sometimes with dorsal gastropore and/or postcephalic eyes.

Genus *Salifa* Blanchard

Salifa Blanchard, 1897, in: *Mobius' Tierwelt Deutsch-Ost-Afrika* 4(13). **Type-species:** *Salifa perspicax* Blanchard, 1897. With postcephalic eyes and/or dorsal gastropore; no accessory copulatory pits on venter at X/XI and XIII/XIV.

10. *Salifa perspicax* Blanchard

Salifa perspicax Blanchard, 1897, in: *Mobius' Tierwelt Deutsch-Ost-Afrika* 4(13). **Type:** Kiriwia, Tanzania; Berlin Mus. **Diagnosis:** One pair of large cephalic eyes on

IV and five or six pairs of lateral, postcephalic eyes on a2 of V to IX or X, respectively; gonopores separated by five annuli; mid-body segments basically five-annulate with annulus b6 longer than the other and incompletely subdivided.

Bionomics: Primarily a predaceous leech feeding on aquatic insect larvae, oligochaetes and other small invertebrates (Moore 1939) which it swallows whole, but it will scavenge when live prey is not available. Moore (1939) reported that the flattened, ellipsoidal cocoons, measuring 4,5 to 5,0 x 3,0 to 3,5 mm and containing two or three eggs, are attached to the underside of stones. The maximum size reported is 48,0 x 4,00 mm (Moore 1939). Widespread but not common (Fig. 4).

Discussion

Sawyer (1986) lists, in approximate order of significance, 11 environmental factors which determine the number and kinds of leeches in a given habitat. He places the availability of food as being of prime importance. My observations on leeches of southern Africa confirm and extend this view. Taking the vast variety of host/prey species occurring in the Kruger National Park into consideration it is very likely that the leech fauna of this area is indeed much richer than is reflected in the checklist presented herein. The same arguments hold for the distribution of the listed species and continued collection may eventually provide evidence of a much wider distribution of taxa currently regarded by me as being rare.

Given the characteristics of leeches it is quite possible that this checklist is in fact under-representative of the Kruger National Park leech fauna. For example, leeches are basically nocturnal, hiding in secure places during the day. In addition haematophagous species in need of food come into the open in daylight only when they become aware of a potential host in the immediate vicinity. Following feeding, leeches keep to the most hidden places available in the habitat and are consequently not readily observable. Due to these considerations it is quite possible that species in several habitats could have been

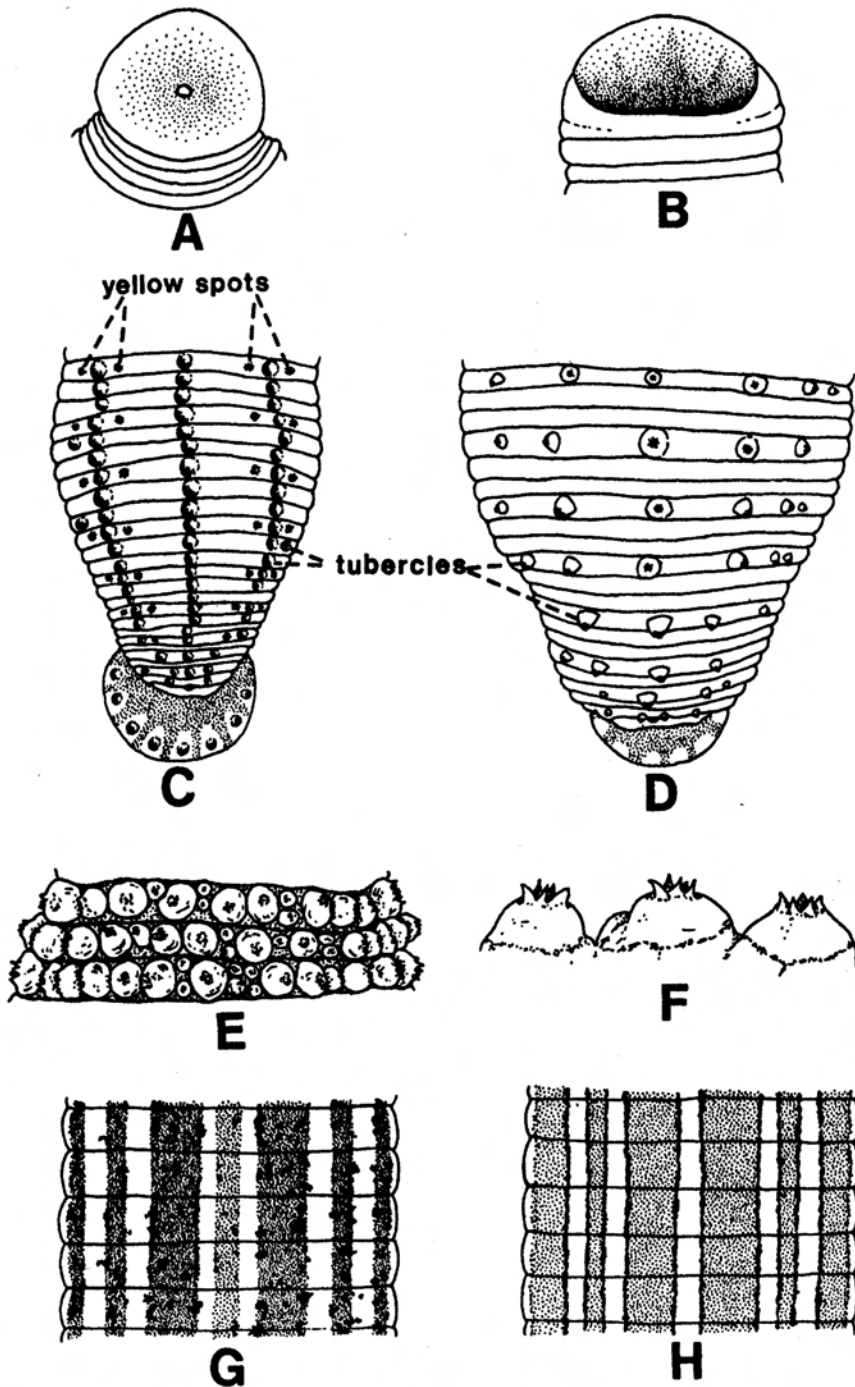


Fig. 5. A, Pore-like mouth of glossiphoniids. B, Capacious mouth of hirudinids and salifids. C and D, Posterior body-regions of *Batracobdelloides tricarinatus* (C) and *Helobdella conifera* (D), dorsal view. E, Dorsal view of three annuli of *Placobdelloides jaegerskioeldi*, and F, side-view of tubercles. G and H, dorsal colour patterns of *Asiaticobdella buntonensis* and *Hirudo michaelsoni*, respectively. Figures not drawn to scale.

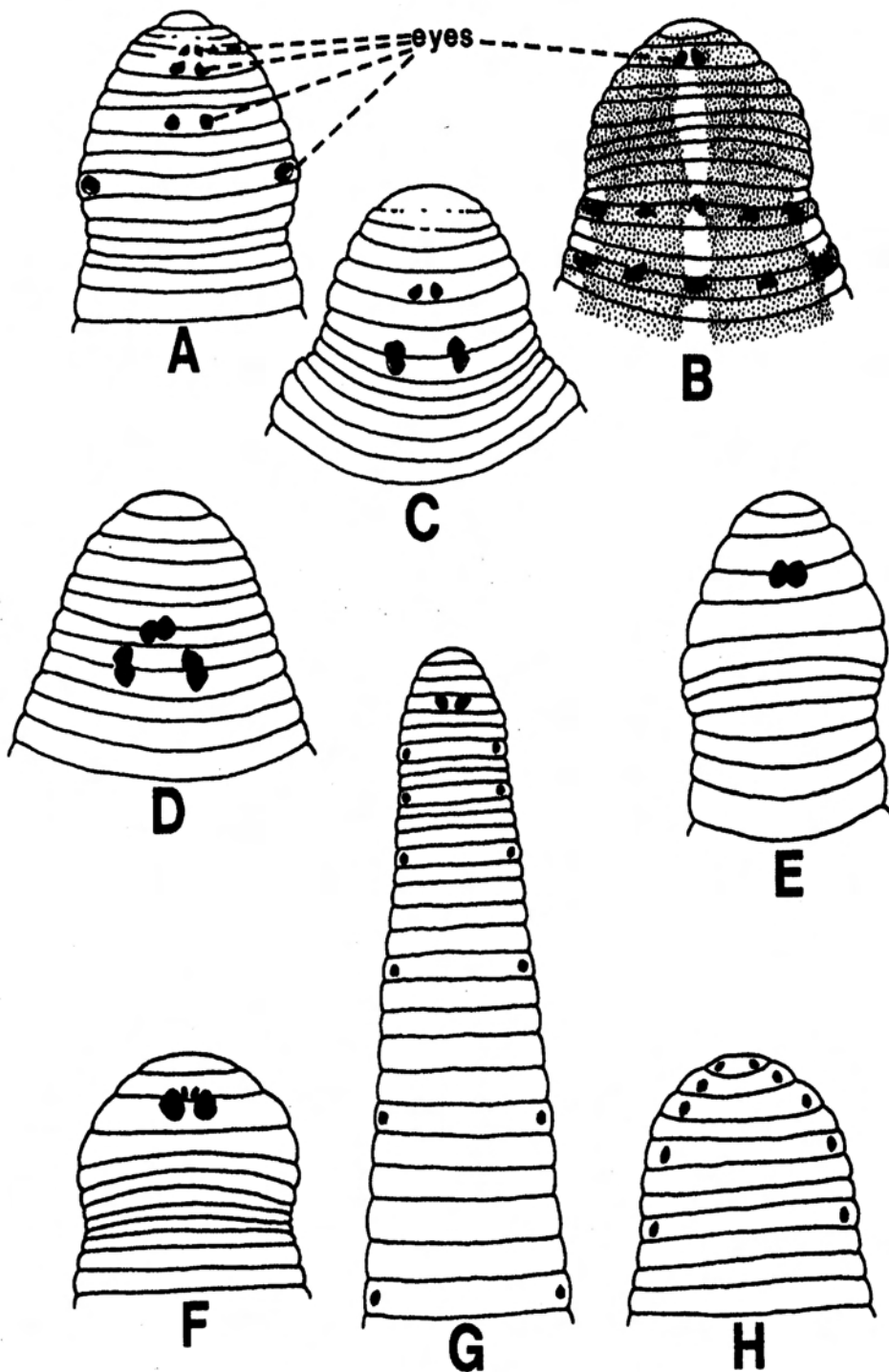


Fig. 6. Ocular patterns of the leeches of the Kruger National Park. Figures not drawn to scale.

overlooked during the survey, especially in cases where low numbers of taxa are present.

Identification key to the species of leeches occurring in the Kruger National Park.

The reader not familiar with the details of leech morphology should take note of the following before using the key. Leeches are characterized by the division of the body into 34 segments of which the last seven segments are fused to form a large, powerful posterior sucker and the ventral surfaces of the first few segments at the anterior end are fused to form a sucking disk. Leeches are furthermore characterized by external subdivision of the segments into rings or annuli. The number of annuli per segment in the middle region of the body is characteristic for different groups or even genera and species and are called complete segments. The number of annuli per segment becomes progressively reduced towards both ends of the body. Although leeches are known in which the complete segments consist of as many as 14 annuli, the known leeches of the Kruger National Park have either three or five annuli per complete segment. Leeches are hermaphroditic animals with separate male and female systems and in all the species occurring in the K.N.P. the systems open separately to the exterior, each by means of a small pore situated on the mid-ventral line and within the furrows separating two consecutive annuli. The gonopores are situated about midway between the anterior tip and the middle of the body with the male pore always anterior of the female pore.

- 1. Total number of annuli, counted on dorsal side, less than 80 (segments in mid-body region consist of three annuli); mouth a small pore (Fig. 5A); one to four pairs of eyes (Figs 6A-F) 2.
- Total number of annuli more than 80 (segments in mid-body region consist of five annuli); mouth capacious (Fig. 5B); five to seven pairs of eyes (Figs 6G,H) 8.
- 2. Eyes four pairs, first three pairs arranged

in two sub-parallel rows, fourth pair (buccal eyes) on lateral sides of head (Fig. 6A):

Oosthuizobdella stuhlmanni

- Eyes one (Figs 6B,E), two (Fig. 6F) or three (Figs 6C, D) pairs 3.
- 3. Eyes three pairs, arranged in three groups corresponding with the three corners of a triangle; eyes of second and third pairs of each side coalesced (Figs 6C, D) 4.
- Eyes one or two pairs 5.
- 4. Gonopores separated by two annuli:

Alboglossiphonia disjuncta

- Gonopores separated by one annulus :

Alboglossiphonia conjugata

- 5. Mouth pore in centre of sucker; dorsal side of body with three or five rows of tubercles which form ridges, especially distinct in posterior region of body (Fig. 5C); posterior dorsal region with four or six rows of bright yellow spots (Fig. 5C); eyes two pairs, first pair very small, close together, between and in line with front corners of second pair (Fig. 6F) and often completely obscured by them.

Batracobdelloides tricarinatus

- Mouth pore at or close to anterior margin of sucker; eyes one pair 6.
- 6. Gonopores separated by one annulus; eyes well separated; dorsal side of each third annulus with up to eight large, dark-coloured tubercles, tipped with black, in a transverse row (Fig. 5D):

Helobdella conifera

- Gonopores separated by two annuli 7.
- 7. Dorsal side with interrupted, golden yellow, median stripe from between eyes to just in front of posterior sucker and five, longitudinal series of dark, irregularly shaped blotches (Fig. 6B); eyes separated; dorsal side roughened by irregularly arranged papillae of various sizes:

Placobdelloides multistriatus

- Uniformly flesh-coloured to olive brown; eyes in contact (Fig. 6E); dorsal side of

each annulus extremely roughened by transverse row of large tubercles each with rosette of pointed papillae on summit (Figs 5E, F):

Placobdelloides jaegerskioeldi

- 8. Eyes six or seven pairs, one large median pair and six or seven smaller, lateral eyes (Fig. 6G); dorsum uniformly coloured without markings:

Salifa perspicax

- Eyes five pairs arranged in a parabolic arch (Fig. 6H); dorsum with longitudinally striped pattern 9.

- 9. Dorsum with seven dark stripes alternating with six light coloured stripes (Fig. 5G); venter with few small, black maculations, mainly in posterior region, between black stripes bordering lateral, light coloured sides:

Asiaticobdella buntonensis

- Dorsum with six dark stripes alternating with five light coloured stripes bordered with black (Fig. 5H); venter uniformly coloured without maculations between black stripes bordering lateral, light coloured sides:

Hirudo michaelsoni

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