

REDESCRIPTION OF *PLACOBDELLA MULTISTRIATA*
(JOHANSSON, 1909) (HIRUDINEA:
GLOSSIPHONIIDAE)

J. H. OOSTHUIZEN

Department of Zoology
University of Pretoria
Pretoria
0002

Abstract – Study of a large number of specimens of *Placobdella multistriata* (Johansson, 1909) revealed the unsatisfactory nature of the information currently available on this leech. The reason is evidently the fact that previous workers had very limited and poorly prepared material at their disposal. In some instances, this even resulted in the description of non-existent species-taxa. In view of this unsound state of affairs, a redescription of *P. multistriata* is provided and evidence adduced for the amalgamation of *Placobdella pulchra* Moore, 1939, *P. auroguttata* Moore, 1939 and *P. unita* Moore, 1958 with *P. multistriata*.

Introduction

The original description of *Placobdella multistriata* was based on a single, small specimen (Johansson 1909). The same specimen was later used by Johansson to prepare serial sections in an attempt to learn more about the internal morphology of the leech. However, because of bad preservation of the specimen, Johansson (1913) was unable to add any more diagnostic detail to his previous account. Fortunately, enough features were originally described by him to enable one to recognise this taxon.

Augener (1936), Moore (1939, 1958), Meyer (1951) and Sciacchitano (1962) identified *P. multistriata* from various parts of Africa. Other than confirming those diagnostic features furnished by Johansson, the reports of these authors contained very little supplementary information contributing to the delimitation of this species. Moore (1939) and Meyer (1951) both made an important statement regarding the male reproductive system and which proved to be incorrect. Furthermore, the dramatic changes in the appearance of leeches which may be brought about by indifferent killing procedures and the effects of preservatives on the pigmentation, are illustrated by the fact that even a well-trained hirudinologist like Moore described new species-taxa based on artefacts (Moore 1939, 1958). However, I agree with Moore (1939) in considering *Placobdella aegyptiaca* Harding, 1911 a synonym for *P. multistriata*.

During a survey of the freshwater leeches of the Republic of South Africa and South West Africa, I obtained well over 900 specimens of *P. multistriata*, most of which were also observed when alive. This study not only enabled me to discover errors in previous accounts dealing with *P. multistriata* and show the non-existence of certain alleged species, but it also yielded so much supplementary information that a revision of the description of *P. multistriata* became necessary.

Unless stated otherwise, the measurements given in the text are those of straight, moderately stretched, preserved specimens and are very similar to their dimensions when they were alive and at rest. For the delimitation of segments, the neuromeric standard of segment limits has been adopted: the annulus bearing the segmental sensillae externally and the nerve ganglion internally is considered to be the middle ring of the segment.

SYSTEMATIC ACCOUNT

Placobdella multistriata (Johansson)

Figs. 1-5

Clepsine multistriata Johansson, 1909, *Zool. Anz.* 35:151 (type: north of Gebel Ahmed, Sudan; Zool. Reichsmuseum, Stockholm).

Placobdella aegyptiaca Harding, 1911, *Ann. Mag. nat. Hist.* (8), 7:388 (type: Cairo, Egypt).

Placobdella pulchra Moore, 1939, *Proc. Acad. nat. Sci. Philad.* 90:314 [type: Lake Tanganyika, Tanzania; British Mus. (Nat. Hist.)]. **Syn. nov.**

Placobdella auroguttata Moore, 1939, *Proc. Acad. nat. Sci. Philad.* 90:317 [type: Kibero, Lake Albert, Uganda; British Mus. (Nat. Hist.)] **Syn. nov.**

Placobdella unita Moore, 1958, *Ann. Natal Mus.* 14:320 (type: Albert Falls, Natal, Republic of South Africa; Natal Mus.). **Syn. nov.**

Material: BM(NH) 1979.4.1-30 (30 specimens). In the British Museum (Natural History), London. Underneath piece of wood in earth dam on the farm Nietverdiend, ca 59 km north of Zeerust, Transvaal, Republic of South Africa (25°02'S 26°08'E), collected by J. H. Oosthuizen, 26 March 1970.

Diagnosis

One pair of eyes, close to each other; median aureate stripe extending anteriorly between eyes; proboscis slender, of more or less uniform thickness, acuminate terminally; salivary glands two pairs, solid bodies; oesophagus long, narrow, surrounded by thick layer of glands (oesophageal organ) close to its proximal end; second to sixth crop caeca with three lobes each.

Description

Form: Ovate-cuneate, widest behind middle; venter flat, dorsum slightly arched, margins medium sharp. Head region perceptibly but not obviously marked off, anterior rim somewhat pointed. Anterior sucker without pronounced cavity. Posterior sucker circular, relatively large, diameter somewhat greater than half maximum body width.

Colour and pattern: Ground-colour light brown. When viewed dorsally with the naked eye, appears brown or green depending on the amount of green pigment present, with continuous or broken golden yellow median stripe, five series of dark, irregularly shaped blotches in median, paramedian and marginal fields, the latter the smallest and alternating with larger golden yellow markings. Blotches consist of superficial dark brown pigment and more deeply situated large, green chromatophores, median and paramedian series usually restricted to a1 and a2 and marginal series mainly on lateral parts of a2, median and marginal series commence on about VI and paramedians on IX or X. Lateral tips of a1 and a3 with golden yellow pigmentation, these areas of the two annuli of consecutive segments thus constituting a relatively large, conspicuous aureate patch between the dark lateral markings of the segments. The large paramedian and intermediate sensory papillae richly provided with golden yellow pigment, making them very conspicuous, nearly all other papillae similarly pigmented except for supra-marginal sensory papillae which are devoid of or with only very little golden yellow pigment. Large, dark green chromatophores sometimes abundantly present, not restricted to dark blotches but also profusely distributed outside these, resulting in a predominantly green appearance spotted with golden yellow markings of different sizes. Dorsum of posterior sucker with radiating rows of golden yellow papillae alternating with dark, maculated rays. Venter of body with very light greenish or brownish tint, sometimes feebly striped in paramedian field and then mainly in anterior half, less often with a few scattered, large, green chromatophores.

Annulation: I and II usually completely united with prostomium, forming a broad, undivided pre-ocular lip, sometimes with only faint signs of separating furrows, less often II (uniannulate) clearly separated. III biannulate, ($a_1 a_2$) or $(a_1 + a_2) = a_3$ or $= \pm 2a_3$. IV biannulate, ($a_1 a_2$) or $(a_1 + a_2) > a_3$. V triannulate dorsally, $a_1 < a_2 < a_3$ and usually $a_1/a_2 < a_2/a_3$, ventrally biannulate with a1 and a2 united to constitute buccal ring. VI forms slight nuchal constriction, dorsally invariably triannulate with $a_1 < a_2 = a_3$ or $a_1 < a_2 < a_3$ or $a_1 = a_2 = a_3$ and usually $a_1/a_2 < a_2/a_3$, ventrally usually triannulate with $a_1 = a_2 = a_3$ or $a_2 = a_3 = \pm 2a_1$ or $a_1 < a_2 < a_3$ and always with $a_1/a_2 < a_2/a_3$, sometimes biannulate with $(a_1 + a_2) > a_3$ with incipient furrow a_1/a_2 hardly discernible. V/VI markedly deeper than neighbouring intersegmental furrows, more obvious on ventral side. VII to XXIV complete, triannulate. XXV biannulate on both sides, dorsally mostly $(a_1 a_2) = \pm 2a_3$ but anterior annulus often

with incomplete dividing furrow. XXVI dorsally uniannulate with incomplete dividing furrow or biannulate with $(a1a2) = \pm 3a3$. XXVII unianulate with or without signs of division at margins. XXVI and XXVII merge ventrally into and form part of short peduncle of posterior sucker. Anus directly behind XXVII, followed by one annulus with or without incomplete dividing furrow, or with two post-anal annuli, the posterior one very small. Annuli of complete segments about equal in length, each with signs of a secondary furrow laterally on dorsal side, the furrow better developed ventrally on each annulus, more prominent on a1 and a3 than on a2 and usually visible right across the first two annuli mentioned. Greater depth of intersegmental furrows in middle body region often obvious, especially on ventral side and more often seen in smaller specimens, thus marking segmental limits very clearly.

Eyes: One pair, relatively large, close to each other, in posterior portion of anterior annulus of III, antero-laterally directed.

Nephridiopores: 15 pairs, in paramedian fields, on a2, between paramedian and intermediate sensory papillae, transversely in line with segmental papillae, in VIII–X and XIII–XXIV. Only nephridia of XIII–XXIII with nephrostomes.

Papillation: Dorsally three pairs of sensillae per segment, situated on summits of papillae, very small, more or less circular, colourless. Papillae bearing paramedian and intermediate sensillae the largest, conical; those bearing supra-marginal sensillae similarly shaped but much smaller. Apart from sensory papillae, each annulus with about 60 irregularly arranged papillae, one or two in median field of each annulus of approximately same size as large sensory papillae, others smaller, varying in size from minute to about the size of supra-marginal sensory papillae. Venter smooth, sensillae three pairs, very small and extremely difficult to locate, paramedian, intermediate and sub-marginal series.

Gonopores: Separated by two annuli, strictly within furrows, male at XI/XII, female at XIIa2/a3.

Digestive system: Proboscis pore just inside anterior rim of sucker. Proboscis cylindrical, slender, of more or less uniform thickness, only slightly enlarged towards base, tapered at distal end, basal region bends upwards. Base of completely retracted proboscis reaches backwards to about XI/XII. Protractor muscles two slender bands, attached laterally to base of proboscis, lie close alongside proboscis, diverge just posterior to circumpharyngeal nerve ring, enter body wall in VI. Retractor muscles two fairly stout bundles, attached to dorsal side of basal part of proboscis, enter dorsal body wall in XI. Salivary glands two pairs, compact bodies, each gland lies within a separate coelomic space, members of first pair usually the smallest, in IX, those of larger second pair mainly in X but reach into XI. Bundle of ducts from each gland passes through wall separating its part of coelom from median lacuna containing proboscis, bundle of ducts from each of anterior pair joins that from posterior gland of the same side on its way backwards, the single stout bundle of ducts from each side enters proboscis laterally near its base. Duct bundles within ventral lacuna covered

by salivary gland cells. Oesophagus long, slender, flattened, slightly muscular, joins crop in ventral aspect in anterior region of XIII, with marked constriction shortly behind its junction with proboscis, somewhat widened for short distance behind constriction, surrounded by sheath of gland cells (oesophageal organ) just short of its junction with crop, folds with retraction of proboscis. Oesophageal organ strongly pigmented, in XIIa1 – XIIIa1. Only part of oesophagus anterior to oesophageal organ not attached to body wall and freely moveable. Crop thin-walled, in XIII–XIX, seven pairs of lobed caeca, one pair in each of these segments. First pair bilobed, when filled with blood large anterior lobe extends anteriorly into XI, posterior lobe smaller, extends sideways, restricted to segment XIII. Second to sixth pair restricted to their respective segments, each bilobed terminally with a third, much smaller lobe on its anterior face close to its origin. Seventh pair or post-caeca originate in XIX, elongated, deflected posteriorly along sides of intestine into XXII, with three lobes in XIX similar to those of previous five pairs, bilobed secondary caeca in each of XX – XXII. Wall of crop with numerous large, branched, dark green chromatophores. Intestinal caeca four pairs, simple, tubular, overlying post-caeca on dorsal side, in XX – XXII, first and second pair directed antero-laterally, third initially directed antero-laterally, bends backwards to be directed postero-laterally, fourth pair directed postero-laterally, extends into XXIII. Wall of intestine and rest of digestive tract lack large chromatophores of crop. Hind gut and rectal region simple, tubular, not distinguishable from each other externally.

Reproductive systems: Male: Testes six pairs, intersegmental at XIII/XIV – XVIII/XIX. Vas deferens emerges from dorsal body wall in XIIa3 in a paramedian position and just in front of anteriorly directed lobe of first crop caecum of its side, expands immediately into much stouter sperm duct. Sperm duct forms posteriorly directed loop, may reach as far back as XXI when system is functioning with recurrent limb as well as greater part of descending limb then enlarged to function as seminal vesicle. Recurrent limb with few folds in XII, abruptly narrows in anterior region of XII to join muscular ejaculatory duct. The latter widens from point of junction, turns dorsally, and then obliquely in front of atrial cornu into anterior region of XI, folds ventrally back on to itself into anterior region of XII, narrows abruptly at its junction with atrial cornu on its inside. Atrial cornua short, ovoid, rather globoid when system is functioning. Atrium short, dome-shaped terminally. Female: Atrium very short, dome-shaped terminally. Ovisacs posteriorly directed, when filled with eggs may reach into XXII. Ligament attached to ovisac in XIII enters dorsal body wall in anterior region of XII.

Other material examined: The number in brackets following the museum registration number indicates the number of specimens constituting the sample.

British Museum (Nat. Hist.): BM(NH)1979.4.31 – 40(10);

1979.4.41–50(10); 1979.4.51(1); 1979.4.52–62(11); 1979.4.63–72(10); 1979.4.73–83(11); 1979.4.84–88(5).

Transvaal Museum, Pretoria: TM11072(3); 11166(6); 11517(2); 11518(1); 11519(9); 11520(15); 11521(9); 11522(3); 11523(1); 11524(3); 11525(1); 11526(1); 11527(2); 11528(96); 11529(1); 11530(15); 11531(2); 11532(2); 11533(1); 11534(7); 11535(12); 11536(4); 11537(4); 11538(4); 11539(12); 11540(32); 11541(1); 11542(1); 11543(1); 11544(1); 11545(22); 11546(27); 11547(1); 11548(2); 11549(3); 11550(2); 11551(7); 11552(5); 11553(4); 11554(4); 11555(10); 11556(23).

State Museum, Windhoek: SMN65755(6); 65756(4); 65757(1); 65758(4); 65759(2); 65760(6); 65761(1); 65762(1); 65763(12); 65764(1); 65765(1); 65766(19); 65767(61); 65768(2); 65769(5); 65770(4); 65771(3); 65772(2); 65773(3); 65774(6); 65775(1); 65776(7); 65777(1); 65778(1); 65779(6); 65780(2); 65781(1); 65782(2); 65783(8); 65784(1); 65785(3); 65786(4); 65787(2); 65788(3); 65789(1); 65790(4); 65791(4); 65792(13); 65793(8); 65794(6).

Kruger National Park Museum, Skukuza: ANL-NKW8(13); 9(2); 10(4); 11(3); 12(11); 13(15); 14(4); 15(14); 16(9); 17(1); 18(1); 19(5); 20(1); 21(3); 22(4); 23(4); 24(1); 25(3); 26(4); 27(1); 28(8); 29(5); 30(2); 31(4); 32(3); 33(4); 34(3); 35(9); 36(5); 37(5); 38(1); 39(1); 40(3); 41(6); 42(3); 43(5); 44(1); 45(7); 46(1); 47(1); 48(1); 49(2); 50(1); 51(3); 52(2); 53(1); 54(2); 55(4); 56(1); 57(1).

Department of Zoology, University of Pretoria: HIR7(33); 55(5); 75(12); 146(2); 148(1); 152(6); 222(1); 293(5); 318(1); 343(1); 344(1); 364(14); 380(12); 388(3).

Collection of the National Institute for Water Research, C.S.I.R., Pretoria: GEN.534A(5); GEN.552A(1); GEN.706B(4).

Range: Previously recorded from Sudan (Johansson 1909), Egypt (Harding 1911, as *Placobdella aegyptiaca*), South West Africa (Augener 1936; Moore 1958, as *P. unita*), Zaire (Sciacchitano 1936, as *Haementeria schoutedeni*, vide Sciacchitano 1952, p. 55; Moore 1939; Meyer 1951, also as *P. pulchra*), Liberia (Moore 1939), Tanzania (Moore 1939, as *P. pulchra*), Zambia (Moore 1939, as *P. pulchra*), Uganda (Moore 1939, as *P. auroguttata*) and Republic of South Africa (Moore 1958, also as *P. unita*; Sciacchitano 1962).

Sciacchitano (1963) doubtfully identified a single specimen (sample VAL. 132E from the Vaal Barrage, Republic of South Africa; collection of the National Institute for Water Research, Council for Scientific and Industrial Research) as this species. I found it to be *Batracobdella tricarinata*.

From field and laboratory observations made on *P. multistriata*, it would appear that this leech is a parasite of cold-blooded animals only. With one exception, all the vertebrates, either mentioned by previous authors as being hosts or those from which *P. multistriata* was collected during the present survey, were poikilotherms. The hosts were crocodiles *Crocodylus cataphractus*, *C. niloticus* and *Osteolaemus tetraspis* and terrapins *Pelusios sinuatus*, *Pelomedusa subrufa* and *Trionyx triunguis*. On a few occasions, I personally saw this leech taking blood from the first two species of terrapin mentioned. Some *P. multistriata* were once kept in an aquarium, where I observed them feeding on freshwater snails. I did not find any indication that freshwater snails are also preyed on in natural surroundings.

I handled hundreds of live specimens of *P. multistriata* over a period of several years and although even starved individuals were frequently given the opportunity to feed either on myself or on other live homoiotherms like white rats, they never attempted to do so. Thus, although I received two specimens found on the carcasses of two different hippopotami in the Kruger National Park (KNP), I doubt whether the leech actually parasitises this mammal. During 1978, I attended the culling of hippopotami in the Letaba River in the KNP and found 90% of the culled animals to be heavily infested with another leech, *Placobdella jaegerskioldi*. However, although known to occur in this river, not a single specimen of *P. multistriata* was located on hippopotami.

On several occasions, *P. multistriata* was found attached to waterscorpions (Nepidae) and waterbugs (Belostomatidae), often in relatively large numbers on individual insects. For example, 96 young leeches which, in preserved and markedly contracted condition, varied in size from 1,2 mm x 0,7 mm to 4,2 mm x 3,3 mm, were counted on a specimen of the Giant Waterbug *Belostoma niloticum*; and in another case 27 leeches which in preserved, contracted condition, measured from 3,0 mm x 1,8 mm to 5,6 mm x 3,8 mm, were recovered from a single waterscorpion (*Nepa* sp.). Although the leeches present on aquatic insects were mostly still young, sexually mature specimens, the largest of which was 13,1 mm x 3,7 mm, were also encountered. The occurrence of this leech on hemipterans should not be regarded as representing true host-parasite relations. Most leeches on the insects were well fed and judging by the appearance of the crop contents, the food consisted of vertebrate blood. The association with these insects and the habit of the latter of flying at night could, to some extent, be responsible for the wide-spread occurrence of this leech. It is, therefore, most likely that these insects act only as transport hosts. Whether it is an innate action or merely coincidence that this leech attaches itself to the insects after a meal, remains to be ascertained. It is, of course, well-known that terrapins move about, particularly during the rainy season, thus playing an important rôle in distributing the leech.

The following case is noteworthy if only because it is the only one recorded in southern Africa where leeches are alleged to have caused the death of domestic animals. During 1965, I received for identification some specimens of *P. multistriata* from the Veterinary Research Institute at Onderstepoort. They had been sent to the Institute by Dr. W. P. van Aardt, at that time Senior State Veterinarian in Grahamstown. Dr. van Aardt (*in litt.*) claimed that this leech caused mortality amongst cattle on a farm in the Adelaide district. He wrote that the animals died from anaemia as a result of internal haemorrhage following severe infestation by leeches. During post mortem examination, leeches were found in the mouth, nose, larynx, oesophagus, lungs and stomach and large quantities of blood were present in the lungs and stomachs of the dead hosts. The leeches van Aardt forwarded were not, unfortunately, those actually recovered from the victims but individuals collected from beneath stones in a dam and, according to van Aardt, of the same species as those that caused the death of the cattle. Since van Aardt was not able to distinguish between the different leech species occurring in that area, there was no proof that this particular leech was the one responsible for the death of the animals. I became more doubtful when I found specimens of *Placobdella stuhlmanni* and *P. garoui* amongst the *P. multistriata* material forwarded by van Aardt on subsequent occasions and stated by him to be the leech that had caused the death of the cattle. Van Aardt (*in litt.*) wrote also that *P. multistriata*, after being starved, fed on him and that it was also found in the nasal cavities of a duck. Some of these leeches were submitted to me and I found that some were indeed *P. multistriata* but others were *P. garoui*, the latter being notorious for its habit of feeding on mammalian blood. To complicate matters still further as regards the true identity of the leech(es) actually responsible for the death of the cattle, I should add that two hirudinids, *Hirudo michaelsoni* and *H. hildebrandti*, blood suckers *par excellence*, were also recorded from the region concerned.

Placobdella multistriata is a highly prolific species and breeds throughout the year, as shown by the presence of attached spermatophores, eggs or young in samples collected at different times of the year. The largest number of young counted on a single leech (34,5 mm x 8,9 mm) was 233. The number of offspring depends, of course, on the size of the parent. The smallest specimen found with attached young measured 12,4 mm x 3,5 millimetre. The largest and smallest (excluding attached young) specimens found during this survey measured 40,0 mm x 8,7 mm and 3,0 mm x 0,9 mm, respectively.

Both undischarged and empty spermatophores were encountered on leeches, most of them deposited on the dorsal side of the body and posterior to the genital segment. Only a few were found attached to the ventral side, anterior as well as posterior of the genital segment; in two cases amongst attached young. The spermatophore consists of the usual two tubular halves, each terminating in a finger-like projection, with a short, slender pedicel. The undischarged spermatophores are normally slender

sausage-shaped, tapered towards the pedicel and vary in size according to the dimensions of the leeches which produce them (Fig. 4E-I).

Discussion

This handsomely coloured leech may lose most of its pigmentation rapidly in preservatives, the green pigment being the first to be extracted. The most stable marking of the colour pattern is the diagnostic aureate median stripe on the dorsum which is, even in cases where all other markings have been destroyed, nearly always still recognisably present and thus a very handy external feature for identification purposes. Even when not detectable in surface view, the band of cells containing the golden yellow pigment is readily seen when the integument is cut away and viewed from the inside. Furthermore, this stripe is the first component of the colour pattern to develop in the young leech and is completely formed by the time the offspring leave the parent. This stripe is actually continuous from in front of the anus to the ocular annulus and its broken appearance in the fully developed pattern is simply the result of its being locally obscured by the darker, more superficially situated pigments of the median series of maculations. Apart from the median stripe, golden yellow pigment may be linearly arranged between the members of the paramedian and intermediate series of sensory papillae, thus forming narrow stripes connecting the yellow pigmentation of consecutive papillae, a condition often present in small specimens. The dark paramedian maculations may be similarly connected by brown pigmentation and the median series by two narrow stripes bordering the median yellow stripe. This striped pattern may be further supplemented by more, less developed, dark stripes, namely a very narrow one in an inner-paramedian position, one or two more broken narrow stripes between the intermediate and supra-marginal series of sensillae and often a narrow, yellow stripe between the inner-paramedian and paramedian dark stripes. This striped pattern becomes more pronounced with contraction (Fig. 1E) and agrees with the pattern described by Johansson (1913). Although the dorsal maculations may constitute a very symmetrical pattern (Fig. 1D), especially in the posterior half of the body, a more fragmentary arrangement (Fig. 1A) is more frequent.

The two eyes are generally clearly separated but the distance between them varies, at most being about equal to the diameter of the pigment cups. However, cases were encountered where the pigment cups were in contact; but they were never coalesced. In only one instance was pigmentation absent from one eye and in another specimen one of the eyes was exceptionally small. Pigmentation of the median stripe is often so dense in the ocular area that it may completely obscure large parts of the pigment cups situated underneath it.

Sudden killing may result in drastic changes in the appearance of the papillae. The normally dome-shaped papillae may become drawn out as spinous structures and complete collapse of the papillae is not uncommon.

The latter phenomenon was, in fact, often also experienced with properly treated material, that is, in leeches narcotized before fixation.

Although the members of the first pair of salivary glands are usually considerably smaller than those of the second pair, they may equal or even exceed the latter in size (Fig. 3B). A few specimens were encountered in which one member of the first pair was lacking. The glands are rather variable in shape, e.g. spherical, ovoid, fusiform or kidney-shaped. The number of gland cells surrounding the largest parts of the bundles of ducts within the ventral lacuna is extremely variable and in some cases form large clusters the same size as even the largest glands (Fig. 2C).

The typical lobation of the crop caeca (Fig. 2B) is best seen in well fed, relaxed specimens and less so in starved animals (Fig. 2A). The green pigment of the crop as well as that of the oesophageal organ is often completely lost in material preserved in alcohol.

The "... kleine seitliche Aussackungen ..." mentioned by Johansson (1909, 1913) are not genuine oesophageal pouches but simply the result of excessive bulging sideways of the widened portion behind the constriction. This is often caused by crowding of the organs when the proboscis is completely retracted. Following dissection of the single specimen identified by Moore (1958) as *P. multistriata* (Natal Museum: No. 22), I agree with his identification. There were no signs of the "Possibly oesophageal pouches which Johansson mentions ..." (Moore 1958, p. 320).

The gonopores are large and their location very obvious in individuals with active systems. The male pore is situated on the dome-like protruding terminal end of the atrium and is surrounded by a fairly deep, moat-like depression. The female pore is in the centre of a large, whitish, slightly swollen area, the external signs of a mass of glandular tissue surrounding the female atrium. The size and extent of posterior expansion of the terminal tubes of the male system and the ovisacs within the ventral lacuna are determined by the reproductive states of the respective systems. The ovisacs are initially, *i.e.* in sexually unripe condition, relatively short; but when packed with eggs, they may reach into XXII. The emptied, flattened ovisacs shorten again, although in several cases they were still relatively long and in some instances even still reached as far back as XIX. The changes observed with regard to the male tubes are even more remarkable (Fig. 3C and D) but it should be noted that the extent of their posterior expansion was nevertheless regarded as are of the diagnostic features separating the species now synonymised in this paper. Reproduction starts at a relatively early age, for comparatively small individuals with well-developed male systems were encountered. The smallest of these measured only 6,5 mm x 1,9 mm but had the tubes enlarged, the seminal vesicles greatly expanded with spermatozoa and extended to XXI/XXII. Activity of the female system is coupled with a drastic diminution of the male tubes and shortening of the posteriorly directed loop of the sperm duct. At the peak of female activity, *i.e.* when the ovisacs are filled with fully developed eggs, the male tubes are extremely slender and restricted to the genital and first one or two post-genital segments, with no signs of expanded seminal

vesicles (Fig. 3D). A stage of complete inactivity of both systems is characterized by the smallness of both sets of tubes. This state is particularly striking in large specimens, e.g. the largest specimen in such a condition measured 33,3 mm x 8,2 mm and had the sperm duct reaching to XIII/XIV and only one of the ovisacs extending to XV.

The amalgamation of *Placobdella pulchra*, *P. auroguttata* and *P. unita* with *P. multistriata* resulted from a thorough study of the types of the first three species mentioned. When I initially attempted to determine the specific identity of my material, I was surprised to find that the characters fitted in with the descriptions of all four species, differing only in one important feature from *P. pulchra*, which according to Moore (1939) has three pairs of salivary glands. Moore's description of the internal anatomy of *P. pulchra* was based on information "... gathered from a single cleared example" (Moore 1939, p. 315) which was either the type or the paratype (BM 1930.9.15.64/65). When I received them from the British Museum, neither specimen showed any sign of having been dissected. Due to their translucency, however, the two pairs of salivary glands and the ejaculatory ducts could easily be located when the leeches were viewed from the ventral side, a phenomenon generally experienced with my own material. It became obvious at that stage that Moore's conclusion that there were three pairs of glands was based on external observation. Permission was granted for me to open up both specimens to obtain the necessary evidence that Moore actually mistook parts of the ejaculatory ducts for a third pair of glands. This proved to be the case. On p. 316 of his 1939 paper, however, Moore stated when discussing additional material from Zambia: "Dissections and additional whole mounts confirm the observations on internal anatomy" and "In all examined there were found 3 pairs of salivary glands conforming to the earlier description except they may occupy the somites from VIII to XII". If "confirmation" of the number of salivary glands was obtained from whole mounts it is very likely that Moore could have made the same mistake by taking parts of the ejaculatory ducts to be a third pair of glands. If, however, confirmation was indeed actually obtained by dissection, there can be no doubt about the fact that his additional material represented a different species and was not "*P. pulchra*". I am inclined to believe that the first possibility is the correct one because some of the other data supplied by Moore in connection with the additional material are in accord with information on his type-material and wholly agrees with observations made on my specimens. Meyer (1951) also mentioned the presence of three pairs of salivary glands in leeches identified by him as *P. pulchra*. However, since his account is almost a literal reproduction of Moore's (1939) description, this leads one to assume that he, in some way convinced about the identity of his material, simply quoted Moore, *inter alia* on this matter. On the other hand he could, like Moore, have made an observational error.

In spite of his rejection of colours and colour patterns as depicted in preserved leeches as reliable criteria, Moore (1939, pp. 306 and 312), with the description of *P. auroguttata* in the same paper, surprisingly rendered him-

self guilty of the unacceptable practice of describing a new taxon mainly on grounds of colouration of preserved material. As he put it (p. 318): "The colour pattern is distinctive . . .". His description, concerning external features only, agrees in all essentials with my account of the relevant aspects. The differences in detail can be ascribed to indifferent treatment of Moore's material as far as killing and preservation are concerned and/or partial desiccation of the material at some stage (*vide* p. 304 in his list of *Batracobdella tricarinata* material. *P. auroguttata* is referred to in this list as *Placobdella auromaculata*). Examination of the type and only specimen (BM 1933.1.21.34), puts the conspecificity of *P. auroguttata* with *P. multistriata* beyond all doubt.

The ground colour of the type of *P. unita* (Natal Museum: No. 26) has changed drastically from "... a pale drab green . . ." as described by Moore (1958) to almost black, probably caused by cleaning in glycerine (*vide* Moore 1958, p. 322), a procedure which could also have been responsible for the present poor and apparently desiccated condition of the specimen. Although now changed to a light brown colour, the diagnostic median stripe, the stripes connecting the light-coloured sensory papillae (especially obvious in the intermediate series) and the marginal light coloured areas on a1 and a3, are still discernible. Four other specimens (paratypes) accompanying the type have the same peculiar colouration. It is evident that Moore (1939, 1958), in separating all his new species from *P. multistriata*, was basically misled by differences in colour pattern as seen in preserved material, especially the absence of the stripes described for the latter species (Johansson 1913); and in the case of *P. pulchra*, additionally because of erroneous observation with regard to the salivary glands. On comparing the original descriptions of Moore's new species with *P. multistriata*, one finds that no valid evidence for separation from each other is presented. The differences put forward proved to be either genuine infraspecific variations or artificial differences brought about by methods of killing and/or preservation. Meyer (1951) and Sciacchitano (1952) obviously followed Moore in recognising different species in material exhibiting such differences.

Augener's (1936) suggestion of a probable synonymy of *P. multistriata* with *Batracobdella algira* is rejected as there could not even be any doubt about the validity of the generic differences.

Placobdella multistriata markedly resembles *P. indica* described from India (Baugh 1960) in its general colouration (judging from the pattern described for *P. indica*), number and arrangement of eyes, appearance of the terminal tubes of the male system and especially the number, arrangement and appearance of the salivary glands. *P. multistriata* differs from *P. indica* in having less distinct secondary furrows on a2 and a3, in possessing a shorter proboscis and in that the crop caeca of *P. multistriata* are not trilobed terminally.

Acknowledgements

I wish to extend my sincere thanks to the following persons and authorities: Prof. F. C. Eloff, Head of the Department of Zoology, University of Pretoria, for research facilities and for promoting my D.Sc. dissertation, from part of which this paper is drafted; Dr. E. Joubert, Nature Conservation and Tourism Division, South West Africa Administration, who acted as my host and guide during collecting trips to South West Africa; Dr. U. de V. Pienaar and his colleagues at Skukuza, who did their utmost to take me to as many habitats as possible during my visits to the Kruger National Park; Mr. J. J. van Rensburg for inking over the drawings; Dr. M. B. Markus, Department of Zoology, University of the Witwatersrand, for arranging the loan of type-material and critically reading the manuscript; the National Parks Board of Trustees for the opportunity of carrying out a survey of leeches in the Kruger National Park; the Director of Nature Conservation and Tourism, South West Africa Administration, for permission to collect material in the different game parks and for making transport available; the Director, British Museum (Nat. Hist.) and Mr. R. W. Sims of the Department of Zoology, for the loan of type-material.

REFERENCES

- AUGENER, H. 1936. Hirudineen aus Deutsch-Südwestafrika. *Sber. Ges. naturf. Freunde Berl.* Jahrgang 1935: 381-397.
- BAUGH, S. C. 1960. Studies on Indian rhynchobdellid leeches. II. *Zool. Anz.* 165:468-477.
- HARDING, W. A. 1911. Note on a new leech (*Placobdella aegyptiaca*) from Egypt. *Ann. Mag. nat. Hist.* 7:388-389.
- JOHANSSON, L. 1909. Einige neue Arten Glossosiphoniden aus dem Sudan. *Zool. Anz.* 35:146-154.
- JOHANSSON, L. 1913. Hirudineen aus dem Sudan. In: JÄGERSKIÖLD, L. A. (Ed.) *Results of the Swedish Zoological Expedition to Egypt and the White Nile 1901.* *Upsala.* 5(24):1-43.
- MEYER, M. C. 1951. Hirudinea. *Explor. Parc natn. Albert Miss. G. F. de Witte.* 76:3-27.
- MOORE, J. P. 1939. Additions to our knowledge of African leeches (Hirudinea). *Proc. Acad. nat. Sci. Philad.* 90: 297-360.
- MOORE, J. P. 1958. The leeches (Hirudinea) in the collection of the Natal Museum. *Ann. Natal Mus.* 14: 303-340.
- SCIACCHITANO, I. 1936. Altre Sanguisughe del Congo Belga. *Revue Zool. Bot. afr.* 28: 161-163.
- SCIACCHITANO, I. 1952. Irudinei del Congo Belga. *Annls Mus. r. Congo belge Sér. 8vo (Scien. zool.)* 16:1-87.
- SCIACCHITANO, I. 1962. Su alcune sanguisughe del parco nazionale Kruger (Sud Africa). *Monitore zool. ital.* 69: 144-148.
- SCIACCHITANO, I. 1963. A collection of Hirudinea submitted by F. M. Chutter (National Institute for Water Research, Pretoria), and the Geographical distribution of Hirudinea in South Africa. *Ann. Transv. Mus.* 24:249-260.

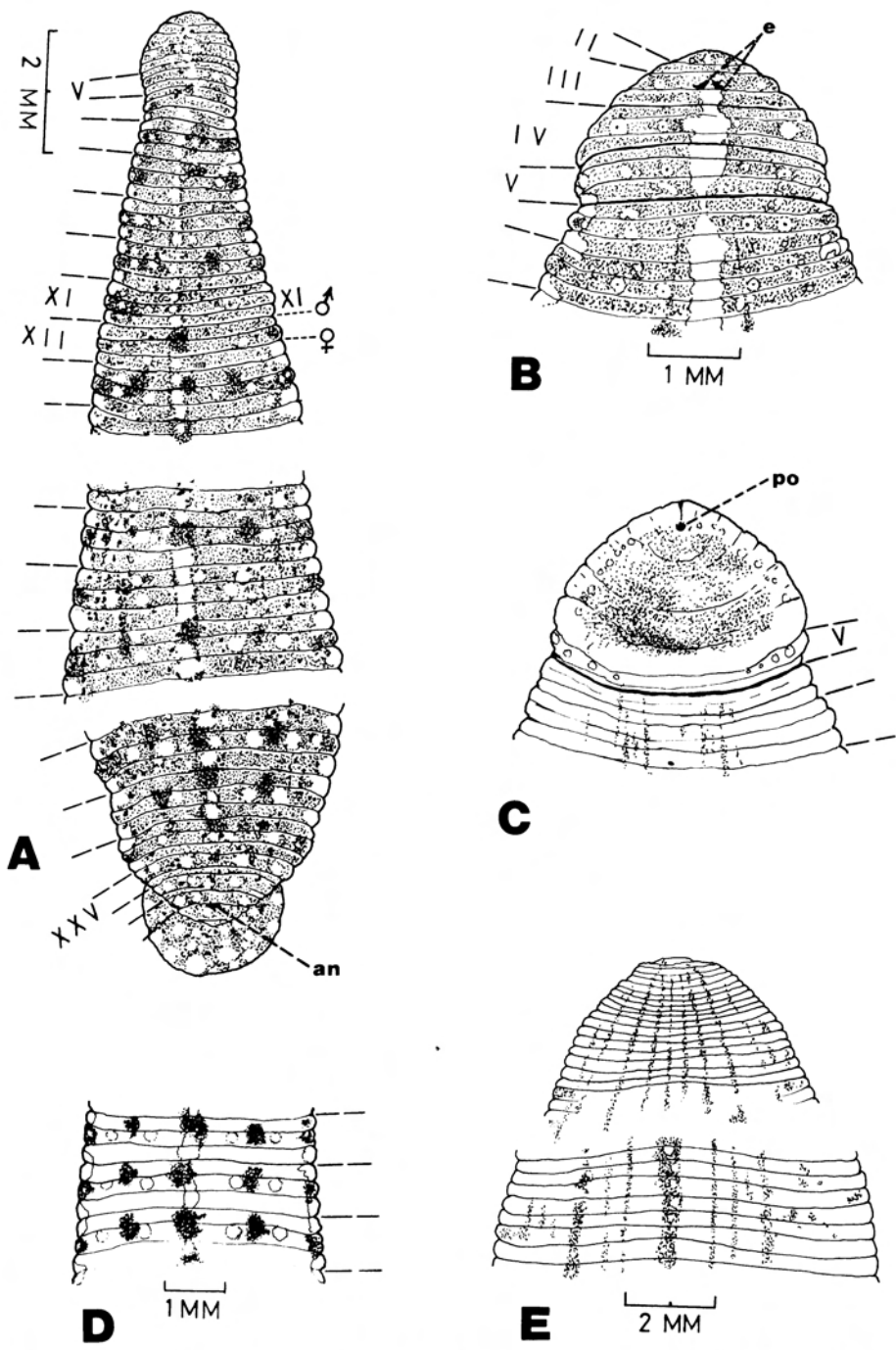


Fig. 1. *Placobdella multistriata*. A, Dorsal colour pattern and annulation posterior to head region. B, Annulation in head region. C, Cephalic sucker. D, Maculations of dorsal side. E, Striped version of dorsal pattern, emphasised as a result of contraction. B and C drawn to the same scale. (For abbreviations see page 79).

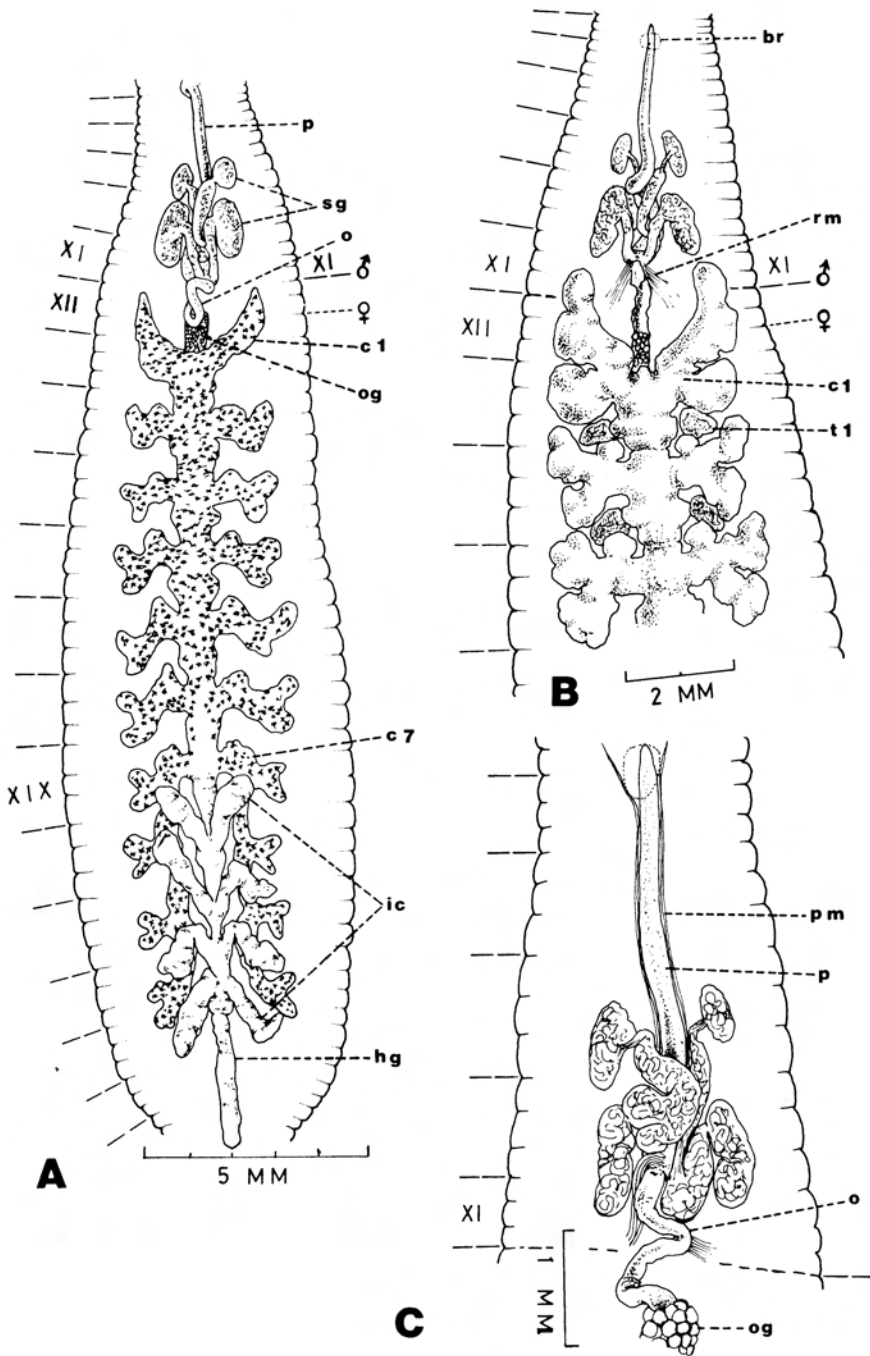


Fig. 2. *Placobdella multistriata*. A, Digestive system *in situ*, dorsal view; crop empty. B, Dorsal view of anterior region of a system having crop filled with blood. C, Salivary glands *in situ*.

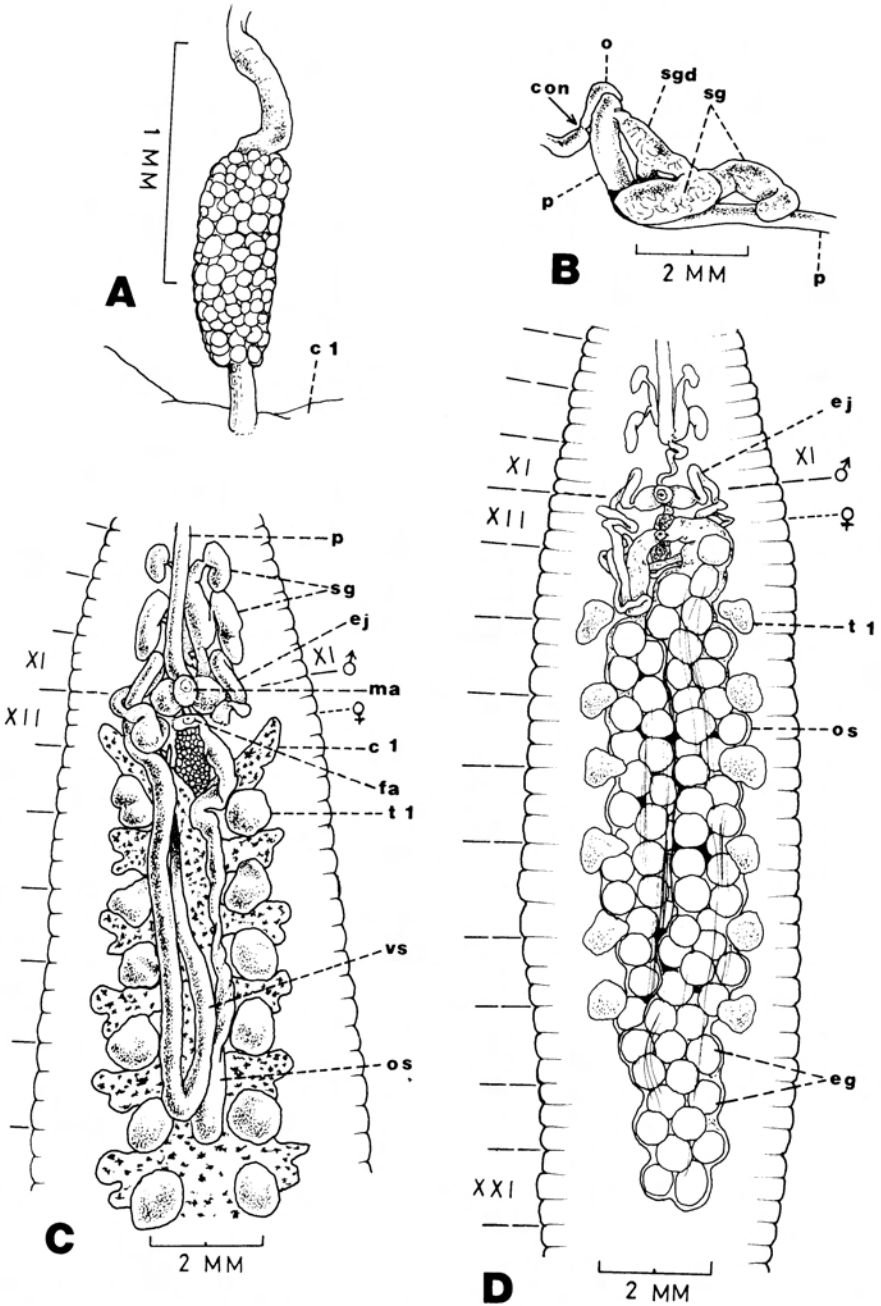


Fig. 3. *Placobdella multistriata*. A, Oesophageal organ and junction between oesophagus and crop, ventral view. B, Lateral view of posterior region of proboscis. C and D, Reproductive systems *in situ*, ventral views, with active male system in C and active female system in D. Note position of basal part of completely retracted proboscis in C. Right ovisac and left seminal vesicle omitted from C.

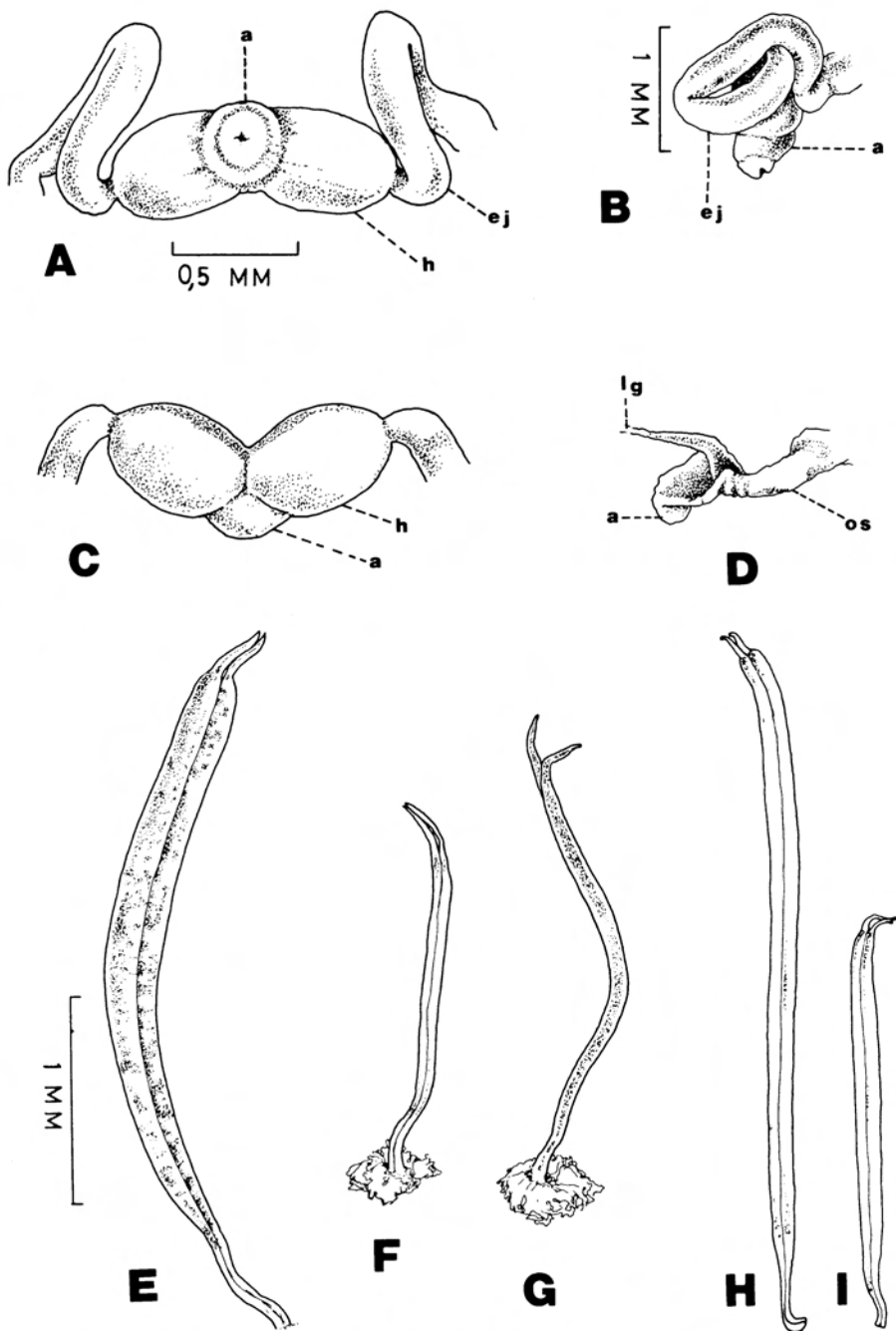


Fig. 4. *Placobdella multistriata*. A, Ventral, B, lateral and C, anterior views of terminal end of male system. D, Lateral view of terminal end of female system. E, Undischarged and F-I, empty spermatophores. A and C, B and D, and E-I, respectively, drawn to the same scale.

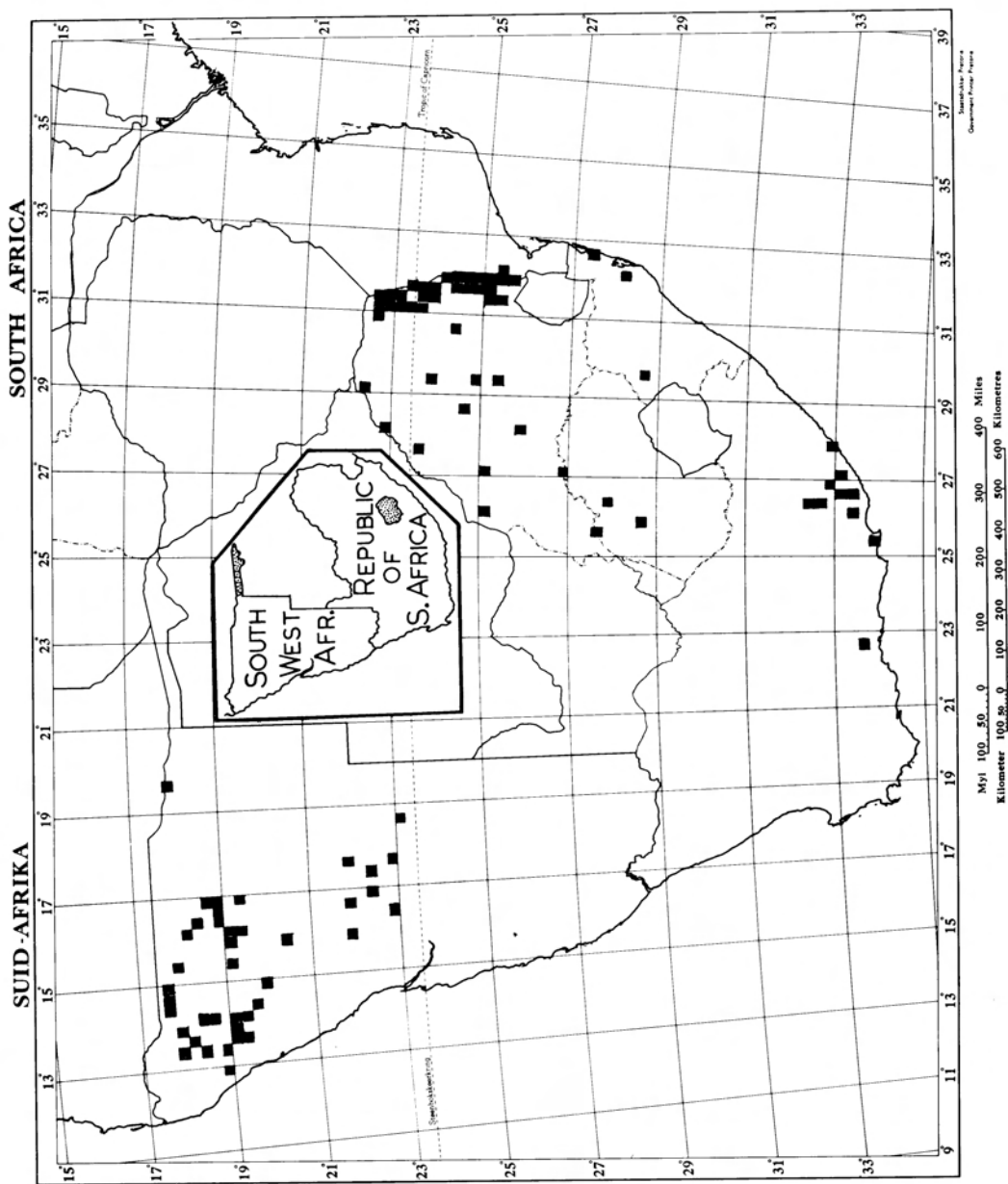


Fig. 5. Distribution of *Placobdella multistriata*. Inset: Boundaries of geographical area covered during survey (dotted areas excluded).

Abbreviations used in figures

| | |
|--------------|--|
| a | atrium |
| an | anus |
| br | oesophageal ganglionic mass or brain |
| cl, c2, etc. | first, second, etc. pairs of crop caeca |
| con | constriction in oesophagus |
| e | eyes |
| eg | eggs |
| ej | ejaculatory duct |
| fa | female atrium |
| h | atrial cornu(a) or horn(s) |
| hg | hind gut |
| ic | intestinal caeca |
| lg | ligament |
| ma | male atrium |
| o | oesophagus |
| og | oesophageal organ |
| os | ovisac |
| p | proboscis |
| pm | protractor muscles |
| po | proboscis pore |
| rm | retractor muscles |
| sg | salivary glands |
| sgd | salivary gland ducts |
| t1, t2, etc. | first, second, etc. pairs of testes |
| vs | seminal vesicle |
| ♂ and ♀ | indicate furrows in which the respective gonopores are situated. |