

AMERICAN MUSEUM *Novitates*

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, NY 10024

Number 3456, 6 p., 13 figures

October 28, 2004

Two New Species of Salifid Leeches (Arhynchobdellida: Erpobdelliformes: Salifidae) from South Africa and Madagascar

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ABSTRACT

Two new species of salifid leech are described. *Linta be*, n.gen., n.sp., from Madagascar, is the first record of a freshwater leech on that island. Its possession of characteristics both of the Erpobdelliformes and the Hirudiniformes suggests it is a morphologically significant link between these two lineages. *Barbronia gwalagwalensis*, n.sp., looks externally similar to the widespread *Barbronia weberi*, but internally exhibits features more similar to other African species of the genus.

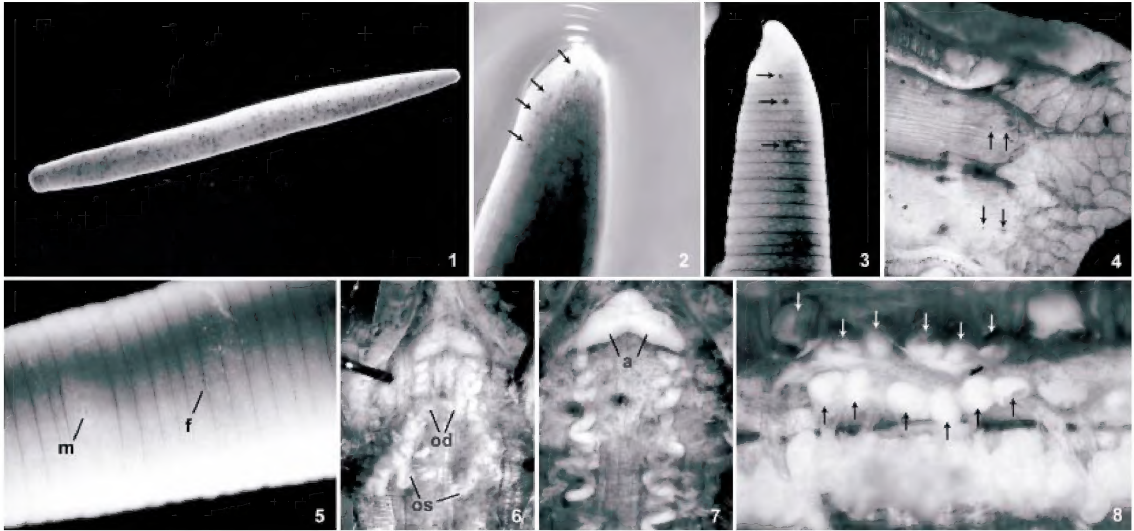
INTRODUCTION

Salifidae Johansson, 1910, is an Old World family of carnivorous leeches, occurring in Africa, southern Asia, and several Pacific islands. Salifids have been characterized by their possession of pharyngeal stylets and it appears that most feed on aquatic invertebrates such as chironomid larvae and oligochaetes (Moore, 1946; Young and Ironmonger, 1979; Anholt, 1986; Seaby et al., 1995). Salifidae has been found to be sister to the

genus *Erpobdella* Blainville, 1918, in prior phylogenetic work (Trontelj et al., 1999; Siddall et al., 2001), but those included only a single species for the family, *Barbronia weberi* (Blanchard, 1897). The type species of the type genus of the family Salifidae is *Salififa perspicax* Blanchard, 1897. Sawyer (1986) listed eight genera in Salifidae. The genus *Barbronia* Johansson, 1918, for which *Barbronia rouxi* is the type species, is the most speciose salifid genus and has the broadest geographic distribution.

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Figs 1–8. *Linta be*, n.gen., n.sp. 1. Dorsal surface. 2. Anteriolateral view of head showing first four eyespots of left side (arrows). 3. Lateral view of head showing third, fourth, and fifth eyespots of left side. 4. Internal surface of pharynx with 2 of 3 pairs of stylet pores (arrows) on myognaths. 5. Ventral region of clitellum with male (m) and female (f) gonopores. 6. Median reproductive apparatus with paired ovaries including separate short oviducts (od) and irregularly lobate ovisacs (os). 7. Median reproductive apparatus with ovaries removed revealing posteriolaterally directed male atria (a) with an anteriorly glandular region between them. 8. First of five sets of six pairs of testisacs (arrows) of XV/XVI.

Recent collections revealed two species of leeches new to science that appear to fall into the family Salifidae (each possessing pharyngeal stylets), one from South Africa and one from southern Madagascar.

MATERIALS AND METHODS

In September of 2001, leeches were collected at Gwalagwala, a tented-camp near Hoedspruit South Africa. In February and March of 2003, leeches were collected in the vicinity of Tolagnaro, Madagascar. Leeches were found on the undersides of submerged rocks and debris in still water, were relaxed in 5% ethanol, and fixed either in 95% ethanol or in 10% buffered formalin. Specimens were examined, dissected, and photographed under a Nikon SMZU stereoscope with a SPOT-RT digital camera. Morphological character variation was scored from the newly collected specimens and from others in Jan Oosthuizen's collection now incorporated into the American Museum of Natural History (AMNH) holdings. As is the convention for annelids, body somites are referred to by

Roman numerals (e.g., prostomium and peristomium are I and II) and annuli receive alphanumeric designations.

ARHYNCHOBDELLIDA BLANCHARD, 1894

SALIFIDAE JOHANSSON, 1910

Linta, new genus Figures 1–8

DESCRIPTION: Body cylindrical, vermiform (fig. 1). Anterior somites with five pairs of eyespots arranged in parabolic arc (figs. 2, 3). Eyes dorsal on II and III (fig. 2), lateral on IV, V, and VI (fig. 3). Pharynx terminating in XIV with three myognaths (muscular jaws) separated by triangular paragnaths (fig. 4); each myognath with a pair of stylets parallel to body axis (fig. 4). Male and female gonopores ventral in XII and XIII (fig. 5). Accessory copulatory pits absent. Ovarian tissue consisting of ovisacs and oviducts, paired, caecate, without common oviduct (fig. 6). Male median reproductive apparatus large with pair of atrial horns directed posteriolaterally (fig. 7); “prostate” glandular

tissue situated anterior at junction of atria (figs. 6, 7). Sperm ducts thick, in loose coil from atria to XV (fig. 7). Testisacs paired, arranged interganglionically in paramedial rows of six (fig. 8); first group at XV/XVI.

TYPE SPECIES: *Linta be*, n.sp.

ETYMOLOGY: "*Linta*" is a Malagasy word in the Antanosy dialect for "leech", commonly used for the aquatic as opposed to the terrestrial varieties (*limatika*); originally from the Indonesian *lintah* for leech.

Linta be, new species

Figures 1–8

DESCRIPTION: One holotype, AMNH Annelida 5258, fixed in 10% buffered formalin and stored in 70% ethanol. Forty-two paratypes, AMNH Annelida 5259, fixed in 10% buffered formalin and stored in 70% ethanol. Fifty-eight paratypes, AMNH Annelida 5260, fixed and stored in 95% ethanol. With characters of the genus. Adults up to approximately 35 mm in length. Body cylindrical, vermiform (fig. 1). Dorsum reddish brown to dark gray in life; pale gray and random mottling postfixation. Annulation formula of midbody somites: b1, b2, a2, b5, c11, c12 (figs. 3, 5). Anus dorsal on XXVII, four post-anal annuli anterior to caudal sucker. Caudal sucker ventrally directed in relaxed specimens. Eyes: faded considerably when fixed, especially in ethanol; first and second pair dorsal, on annulus, separated by two annuli; third pair lateral, on furrow, separated from second by two and one-half annuli; fourth lateral, on annulus, separated from third by two and one-half annuli; fifth lateral, at furrow, separated from fourth by four and one-half annuli (figs. 2, 3). Genital pores separated by six annuli (fig. 5). Male gonopore at XII b1/b2. Female gonopore at XIII b1/b2. Pharyngeal stylet pairs small, digitiform, often stylet pore only visible (fig. 4). Ovaries saccate from XII/XIII to XIV/XV (fig. 6). Male median reproductive apparatus large with pair of atrial horns directed posteriolaterally (fig. 7); "prostate" glandular tissue situated anterior at junction of atria (figs. 6, 7). Sperm ducts thick, in loose coil from atria to XV (fig. 7). Testisacs paired, arranged interganglionically in paramedial rows of six between XV and XVI, XVI and XVII, XVII

and XVIII, XVIII and XIX, and XIX and XX, for a total of 30 pairs (fig. 8).

TYPE LOCALITY: Esana, 5 km west of Tolagnaro, Madagascar, 25°1'18"S, 4°39'26"E.

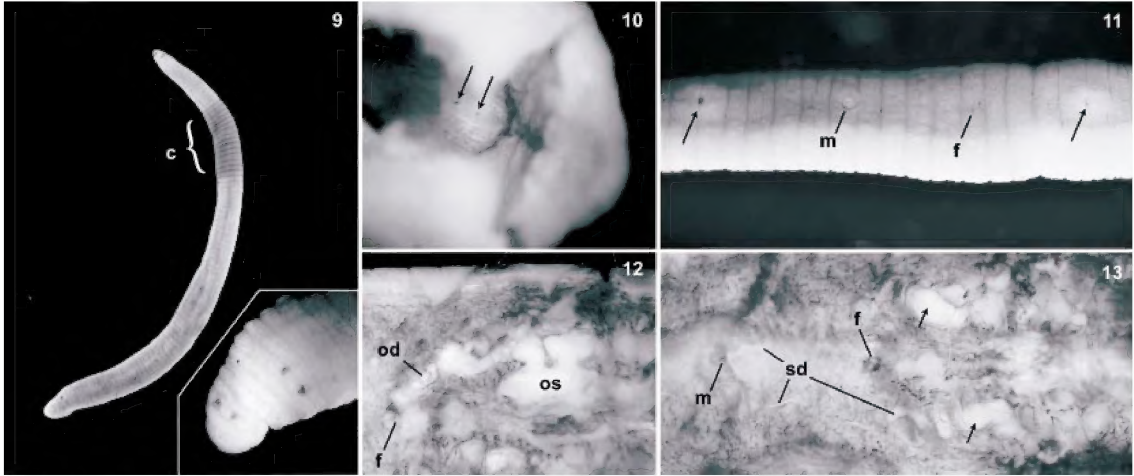
ETYMOLOGY: The species is named for the Malagasy word "be" (pron. bay) meaning "very many" or "very much" or "great" in light of this species being very much a leech and being found in large numbers notwithstanding that it had gone undiscovered for so long.

REMARKS: The new genus *Linta* possesses several characters of the family Salifidae. In particular the presence of pharyngeal stylets is diagnostic for the family. El-Shimy (1996) proposed a new family, Barbroniae, to accommodate *Barbronia* and *Vivabdella*, suggesting that the accessory copulatory pores merit a family separate from Salifidae. This change would present the problem of finding a new synapomorphy for Salifidae other than pharyngeal stylets, which are possessed by all of the current salifid genera. The midbody annulation formula for *Linta*, consisting of six annuli per somite, is similar to species in the genus *Barbronia* (e.g., El-Shimy, 1996; Blanchard, 1897b). However, *Linta* also is similar to *Salifa* in that it lacks accessory copulatory pores and in the position of gonopores at XII b1/b2 and XIII b1/b2 (e.g., Moore, 1939; Blanchard, 1897a). *Linta* is distinct from all other salifid genera in the size and shape of its atrium, the position of atrial horns, and the presence of glandular tissue on the atrium. Where atrial horns are present in other salifid species (e.g., Neseemann, 1995) they are directed anteriolaterally, as opposed to their posteriolateral position in *Linta*. In contrast to any other erpobdelliform leech, *Linta* also has five pairs of eyespots (not ocelli) arranged in a parabolic arc, in a characteristic manner that is otherwise precisely that seen among hirudiniforms. *Linta be* may be the "*Salifa cambouei*, [que] est encore inédite; elle habite Madagascar" as footnoted by Blanchard (1897c: 102). Now a nomen nudem, the species name remained without a description and no deposited specimens are known.

Barbronia gwalagwalensis, new species

Figures 9–13

DESCRIPTION: One holotype, AMNH Annelida 5261, fixed in 10% buffered formalin



Figs. 9–13. *Barbronia gwalagwalensis*, n.sp. **9.** Dorsal surface with obvious clitellum (c) and typical arrangement of eyespots (inset). **10.** Internal surface of pharynx showing one of three pairs of stylet pores (arrows) on a myognath. **11.** Ventral region of clitellum with male (m) and female (f) gonopores as well as the accessory copulatory pores (arrows). **12.** The right ovary including an oviduct (od) leading to the female gonopore (f) and an irregularly lobate ovisac (os). **13.** Median male reproductive apparatus showing the lack of a prominent atrium at the male gonopore (m) where the sperm ducts (sd) meet as well as the paired ejaculatory bulbs (arrows) just posterior to the female gonopore (f).

and stored in 70% ethanol. One paratype, AMNH Annelida 5262, fixed in 10% buffered formalin and stored in 70% ethanol. Two paratypes, AMNH Annelida 5263, fixed and stored in 95% ethanol. Adults up to approximately 25 mm in length. Body cylindrical, vermiform (fig. 9). Dorsum reddish brown in life, tan or pale gray postfixation. Annulation formula of midbody somites: c1, c2, c3, c4, a2, b5, c11, c12 (fig. 11). Anus dorsal on XXVII, two postanal annuli anterior to caudal sucker. Caudal sucker ventrally directed in relaxed specimens. Eyes: three pairs; first dorsal, on II; second and third pairs dorsolateral on IV, separated from anterior pair by four complete annuli exclusive (fig. 9 inset). Clitellum distinct, from X b5 to XII a2 inclusive (fig. 9). Genital pores separated by seven and one-half annuli (fig. 11). Male gonopore on XII c2. Female gonopore at XIII c1/c2. Two accessory copulatory pits present (fig. 11), one anterior to male gonopore at X/XI, one posterior to female gonopore at XIII/XIV. Ovisacs paired, caecate extending to XIV c4/a2 (fig. 12). No common oviduct. Male atrium extremely small, nearly absent where thin sperm ducts independently reach male gonopore (fig. 13). No common sperm duct. Ejaculatory bulbs on sperm

ducts at XIII/XIV (fig. 13). Testisacs 12 in total, six per side between XIV and XV. Pharyngeal stylet pairs on myognaths, small, digitiform, parallel to body axis. Often only stylet pore visible.

TYPE LOCALITY: Maia's Dam, Gwalagwala a tented-camp near Hoedspruit, South Africa.

ETYMOLOGY: For the type locality of the species: Gwalagwala. *Gwalagwala* is Zulu for the purple-crested lourie.

REMARKS: The genus *Barbronia* is defined as having two accessory copulatory pores on X/XI and XIII/XIV even though Moore (1939) described *Barbronia delicata* without the accessory pores. Sawyer (1986) placed the latter more appropriately into the genus *Salifa*. With the two copulatory pores and the paired pharyngeal stylets, *B. gwalagwalensis* clearly falls in the genus *Barbronia*. The external body patterns of *Barbronia gwalagwalensis* fall within the range of characteristics reported for *B. weberi*. However, the most-cited description for *B. weberi* is from India (Moore, 1927), and this differs considerably from the type description from Java (Blanchard, 1897b). For example, *B. weberi* sensu stricto has three postanal annuli, as clearly figured by Blanchard (1897b: 354); only two are reported by Moore (1927: 139).

Barbronia gwalagwalensis is more similar in this regard to the Indian *B. weberi* sensu lato. However, the Indian specimens show subdivision of annulus a2 into b3 and b4 (Moore, 1927), whereas *B. weberi* from the type locality and *B. gwalagwalensis* do not. In terms of internal anatomy, *B. gwalagwalensis* has ejaculatory bulbs located on the sperm ducts at XIII/XIV, which is not a characteristic of *B. weberi* regardless of locality. Rather, the internal male reproductive organs of *B. gwalagwalensis* closely resemble those of the Egyptian *Barbronia assuiti* (Hussein and El-Shimy, 1982; El-Shimy, 1996). All species of *Barbronia* possess testisacs in two groups of six on either side of the nerve cord but only *B. assuiti* and *B. gwalagwalensis* have ejaculatory bulbs on sperm ducts at XIII/XIV (Hussein and El-Shimy, 1982). *Barbronia gwalagwalensis* is distinct from *B. assuiti* in having four annuli between pairs of eyespots, subdivision of b1 and b2, and in the position of the male gonopore. No other species of *Barbronia* has ovisacs as long as those seen in *B. gwalagwalensis*. Unpublished research notes of the late Jan Oosthuizen reveal that he had putatively identified a new species of *Barbronia* from South Africa (AMNH Annelida 5028 through 5037) that he denoted "latebricola". It also possessed ejaculatory bulbs on the sperm ducts, differing from *B. gwalagwalensis* in that the male gonopore was invariably at the furrow of XII b1/b2. Several anatomical details would support "latebricola" as distinct from *B. assuiti* as originally described (Hussein and El-Shimy, 1982); however, after the correction of numerous errors (El-Shimy, 1996), there is nothing to distinguish "latebricola" from *B. assuiti*.

DISCUSSION

The genus *Linta* is distinct among salifids in its possession of hirudiniform eyespots. *Americobdella valdiviana* (Phillippi, 1872), which lacks stylets but nonetheless now is known to be the first diverging lineage in the Erpobdelliformes (Borda and Siddall, 2003), has likewise been reported as possessing the five pairs of eyespots (Moore, 1924). This suggests that *Linta be* may itself be an early lineage in the stylet-bearing family Salifidae,

and that these taxa together comprise a previously missing morphological link between the two principal lineages of Arhynchobdellida. The external morphological similarity of *B. gwalagwalensis* to descriptions of *B. weberi* underlines the need for clarification of the true nature of the type species for this genus (from Java) relative to the Indian counterpart which appears to have become a globally widespread invasive species (e.g., Moore, 1946; Mason, 1976; Pamplin and Rocha, 2000; Rutter and Klemm, 2001; Govedich et al., 2002, 2003; AquaSense, 2003).

ACKNOWLEDGMENTS

We thank Ann and Dorian Baldwin, Liz Borda, Evon Hekkala, Clara Imboule, and Raina Rakotondrainy for their assistance in collection of leeches. The repeated hospitality over several years of Ann and Dorian Baldwin, proprietors of Gwalagwala tented camp, has been invaluable to this research and to the general disposition of the second author. We thank Liz Borda, Rebecca Budinoff, Kirsten Jensen, Louise Crowley, Kenneth Macdonald, and Megan Harrison for their comments on drafts of the manuscript. This work was supported by grants from the National Science Foundation including the PEET (BIO-DEB 0119329) and REU Site programs (BIO-DBI 0097552) and through generous support from the Niarchos family.

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