

# ***Andiorrhinus (Amazonidrilus) motto* n. sp. and *Rhinodrilus appuni pavoni* n. subsp. (Oligochaeta, Glossoscolecidae) from the Venezuelan Amazonia**

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*Andiorrhinus (Amazonidrilus) motto* n. sp. and *Rhinodrilus appuni pavoni* n. subsp. (Oligochaeta, Glossoscolecidae) from the Venezuelan Amazonia.— The two species presented herein were collected in Venezuela, Amazonas State and studied by dissection and serial histological section. *Andiorrhinus (Amazonidrilus) motto* n. sp. is characterised by the size, male genital field and spermathecal apparatus. *Rhinodrilus appuni pavoni* n. subsp. has two pairs of peculiar prostatic glands united in a cushion on either side.

Key words: Oligochaeta, Glossoscolecidae, Venezuela, Amazonia, Anatomy, Taxonomy.

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## Introduction

The two species of earthworms presented here constitute the second and final part of a collection made by Dr. Maurizio Guido Paoletti (Università degli Studi di Padova, Italy) in the course of his agro-ecological research. The first part of the collection deals with earthworms from the Venezuelan Andes (RIGHI & ARAUJO, in press).

## Material and methods

The earthworms were collected in June 1995 in Venezuela, Amazonas State by Dr. Maurizio Guido Paoletti. They were obtained by digging and manual sorting, then fixed and preserved in alcohol 80%. The study was made by dissection, microscopic pieces were mounted in glycerine-water (1:1) and serial histological sections, 10  $\mu$ m thick, were stained using the Mallory triple method (PANTIN, 1964). The material, preserved in 10% formalin, is deposited in the Department of Zoology, University of São Paulo, Brazil.

### *Andiorrhinus (Amazonidrilus) motto* n. sp. (figs. 1-8)

#### Studied material

Venezuela, Amazonas State: Pato Guayabal, near a *Curatella* sp. tree, five clitellate (two fragmented), one mature a clitellate and two young specimens (ZU-1293A-B). Caño Tigre, forest soil, one fragmented clitellate and two young specimens (ZU-1294). Holotype ZU-1293A.

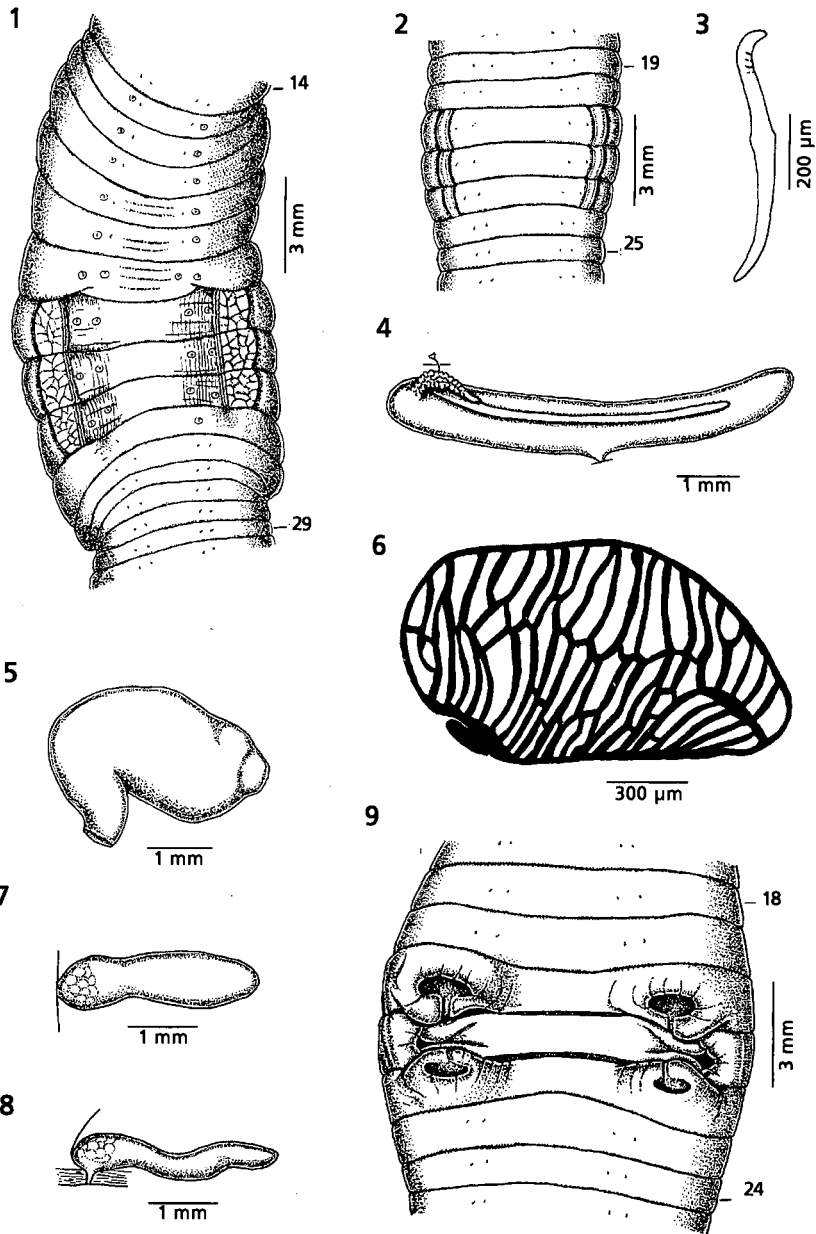
#### Description

Cylindrical body. Length 196-275 mm. Diameter of the middle-body 5-7 mm. Number of

segments 273-280. Dorsal colour pale brown (n° 705 of SÉGUY, 1936) and ventral colour whitish. The most distended tentacular prostomium is as long as the length of I+II segments. Setae, four pairs per segment arranged in regular longitudinal series. The ventral setae are seen from segments II-V and lateral setae from XI-XIX. The space *aa* increases from XIV-XXI; it is uniform in XXI-XXIV, decreases to XXVII, XXVIII and is regular backwards. The relations among the setae are in the mid-body (LXX-LXXX) *aa:ab:bc:cd:dd* = 5.2:1.0:8.4:0.7:13.8 (*ab* = 410  $\mu$ m) and in the posterior region (CC-CCX) = 3.9:1.0:7.1:0.7:11.4 (*ab* = 478  $\mu$ m). The common setae (fig. 3) are lengthened sigmoid with submedian nodule, unicuspidate apex and the subapical concave part has two alternate series of semilunar excavations, with two excavations per series. The length of the setae is similar throughout the body, varying from 449-771  $\mu$ m (*M* = 646  $\mu$ m); the lateral setae are the shortest. The ventral setae of XXI-XXIV change into genital setae. They are straight with slight proximal curvature and their distal 2/3 have four alternate series of semilunar excavations; the apex is simple. In XXI-XXIII the *a* and *b* setae differ in length and number of excavations per series: setae *a* 935-995  $\mu$ m long and 12-14 excavations/series; setae *b* 3,200-3,280  $\mu$ m long and 16-18 excavations/series. In XXIV the length of the setae is *a* = 1,052-1,058  $\mu$ m and *b* = 1,908-1,930  $\mu$ m and the number of excavations per series is 11-12 in both. In XV-XX the setae *a*, but not the *b*, are transformed in genital setae; they are 995-1,094  $\mu$ m long and have 8-9 excavations/series.

The clitellum lies on XVI-XXV (= 10 segments); it is whitish, a little turgid and saddle-shaped with undemarcated inferior border. The ventral surface of XXI-XXIII is flat and somewhat depressed with longitudinal striae in *ab* region. A deepish longitudinal furrow runs laterally to setae *b* on these seg-

Figs. 1-9. 1-8. *Andiorrhinus (Amazonidrilus) motto* n. sp.: 1. Ventral view of the segments XIV-XXIX, clitellate worm; 2. Ventral view of the segments XIX-XXV, a clitellate worm; 3. Seta of the mid-body; 4. Post-clitellar nephridium; 5. Calciferous gland of segment IX; 6. Mid-cross section of a calciferous gland of segment IX. 7. Spermatheca of 6/7, dorsal view; 8. Spermatheca of 6/7, lateral view. 9. *Rhinodrilus appuni pavoni* n. subsp., ventral view of the segments XVIII-XXIV.



1-8. *Andiorrhinus* (*Amazonidrilus*) *motto* sp. n.: 1. Vista ventral de los segmentos XIV-XIX, animal clitelado; 2. Vista ventral de los segmentos XIX-XXV, animal aclitelado; 3. Cerdá del medio del cuerpo; 4. Nefridio post-clitelar; 5. Glándula calcífera del segmento IX; 6. Corte transversal en la mitad de una glándula calcífera del segmento IX; 7. Espermateca de 6/7, vista dorsal; 8. Espermateca de 6/7, vista lateral. 9. *Rhinodrilus appuni pavoni* subsp. n., vista ventral de los segmentos XVIII-XXIV.

ments; the lateral margin of the furrow is double and crenulate. On its side there is a small tumid longitudinal band of corrugate surface with the margin of the clitellum on continuation (fig. 1). The corrugate bands are almost unrecognisable in two specimens. The mature acitellate worms present a pair of clear longitudinal bands with deepened medial border in XXI-XXIII, laterally to setae *b* (fig. 2). The nephridiopore lie just beyond the intersegmental furrows, aligned in the ventral half of *cd*. Three pairs of spermathecal pores occur in 6/7-8/9, a little below the nephridiopore line inside small whitish spindle-shaped areas. Female pores were not seen. The microscopical male pores open in 21/22, somewhat lateral to the *b* line.

The septa 6/7-9/10 are strongly muscular and resemble long interpenetrated cones. The following septa becomes successively thinner and less conic to 18/19, 19/20; the next septa are thin and flat. Milk-white glandular tufts surround the follicles of the ventral setae in XV-XXIV. More voluminous brownish glandular tufts are lateral to the former ones in XXI-XXIII; they are associated with the puberal marks. The gizzard is a short and thick muscular cylinder in VI. Three pairs of calciferous glands depart ventrally from the esophagus in VII-IX; they are directed outwards, forwards and upwards. The duct is wide and the glandular body is a flattened egg-shaped, ending in an ental appendix which is not always well demarcated (fig. 5). Cross sections in the mid-body of the glands enable visualisation of the 18-21 parallel lamellae with short and irregular interconnections (fig. 6). The intestine widens at XXIII and the typhlosole begins at XXIV. In the cross-section of the mid-body the typhlosole is a wavy thin dorsal blade as high as the intestinal diameter. Three pairs of thin lateral hearts are seen in VII-IX and four pairs of bulk intestinal hearts appear in X-XIII; the last two pairs being the largest. Each segment has a pair of holonephridia. The post-clitellar nephridia are formed from a simple pre-septal funnel and three post-septal loops (fig. 4). Loop I is very short; the ribbon-like loop II is a little shorter than loop III (= bladder) which extends for almost half the body circumference. The most ventral part of the bladder passes through a transverse peritoneal fold which sustains the sub-neural vessel and is attached to body wall a little below *a* setae.

The nephridial sphincter is very small. The VI and anterior nephridia intermingle at the sides of the anterior esophagus.

The testis sacs are peri-esophageal in X and XI; they surround the esophagus and hearts of these segments and the sacs of XI also surround the first pair of seminal vesicles. The seminal vesicles are fusiform with a smooth surface and restricted to XI and XII, or the vesicles of XII may continue in XIII. The two male ducts on either side run together on the ventral body wall to 1/2 XXI where they coalesce; the resulting short and wide duct pierces the body wall and opens through the corresponding male pore at 21/22, somewhat laterally to setae *b* line. One pair of wavy blade-like ovaries and female funnels are observed in XIII. There are three pairs of spermathecae in VII-IX. Each spermatheca (figs. 7-8) is elongated and sacciform; a slight constriction may occur between the duct and the ampulla. The wall of the ampulla is thick with many glandular inner folds. The intra-coelomic part of the duct is short and wide; its dorso-lateral wall contains numerous rounded seminal chambers which are scarcely or not at all prominent on the surface and are full of spermatozoa.

#### Remarks

*Andiorrhinus (Amazonidrilus) motto* has affinities with *A. (A.) mandauaka* (RIGHI & NEMETH, 1983) known in Venezuelan Amazonia. They are similar in number and position of spermathecae, organisation of the septa and proximities of male pores. The main distinctive characteristics of *mandauaka* are: length 55-76 mm; number of segments 151-167; falciform unornamented common setae; male genital field with a pair of puberal furrows lateral to *b* setae in XXI-XXII; spermathecal pores beside copulatory papillae associated with connective-glandular masses prominent in the body cavity. The name of the new species is that used by the local Indian community for these large earthworms.

#### *Rhinodrilus appuni pavoni* n. subsp. (figs. 9-17)

##### Studied material

Venezuela: Amazonas State: Puerto Ayacucho District: Pavoni Indian Community, Laja dela Lejanía, six clitellate and six young

specimens (ZU-1308A-C). Mahada (area to be fertilised by confined cattle) five clitellate and two young specimens (ZU-1309). Airport, two clitellate, two mature acitellate and four young specimens (ZU-1310). Holotype ZU-1308A.

#### Description

Cylindrical body; length 190-220 mm; diameter in the mid-body 8.5-9.5 mm; number of segments 237-265; colour on the back dark brown (n° 132 of Séguy, 1936) on the venter dirty white, the colours change suddenly in the nephridiopores line. Segments I and II are very small; I-1/2 III have flaccid walls and a highly wrinkled surface. The short tentacular prostomium is sometimes invaginated. There are four pairs of longitudinal series of setae; the ventral series start from X and lateral series from XIX-XXV. The *aa* distance increases from XVI-XXI, decreases to XXV and remains regular backwards. The relations among the setae in the mid-body region (LX-LXX) are *aa:ab:bc:cd:dd* = 14.2:1.0:14.2:0.7:32.2 (*ab* = 321 µm) and in the posterior region (CXC-CC) = 9.2:1.0:9.2:0.7:22.0 (*ab* = 481 µm). The common setae are elongated sigmoid with medial nodulus and unicuspidate apex. Their apical fifth is ornamented with four alternate series of wide semilunar excavations, there are 2-6 excavations per series; about 30% of the posterior setae are not ornamented. The length of the setae varies in the mid-body *a,b* = 707-797 µm (*M* = 751 µm); *c,d* = 642-707 µm (*M* = 681 µm) and in the posterior region *a,b* = 758-887 µm (*M* = 819 µm); *c,d* = 720-848 µm (*M* = 784 µm). The ventral setae of XX-XXII are transformed into genital setae. They are straight with small proximal curving and their apical half has four alternate series of semilunar excavations becoming deeper towards the tip; there are 12-14 excavations per series.

The clitellum is a little tumid, saddle-shaped without defined inferior limits and it extends over XVII, 1/2 XVII-1/2 XXV, XXV (= 8, 9 segments). The male genital field is situated in XX-XXII. For most specimens (fig. 9) segment XXI presents a pair of transverse invaginations in *ab* region; the outer lateral border of the invaginations is elevated and the setae are not seen from outside. Pairs of wide crater-like papillae in XX and XXII contain the two *a,b* setae with a posterior gutter in XX and an anterior gutter in XXII. The intersegmental

furrows 20/21 and 21/22 are very deep in this region and receive the gutters. Some specimens (fig. 10) present a pair of transverse slits in *ab* region of XXI; the setae are not visible from the exterior and the slit ends laterally in a curved thick band (puberal ridge). The papillae of XX and XXII are not so deep centrally and their gutter runs to the wide openings of the invaginations in 20/21 and 21/22. Other specimens (fig. 11) differ from the previous ones by absence of the pair of transverse slits in XXI; in their place there is a pair of low wide papillae containing the two *a,b* setae. Differentiated circular areas surround each *a* and *b* setae in XX-XXII; they may also occur around each ventral setae of XVII and XVIII. The side walls of 1/2 VII-1/2 IX are tumid and contain the setal papillae of VII and VIII, which may be in the middle of the segments or displaced towards the front or back. The nephridiopores lie immediately beyond the intersegments aligned in *c* or *cd*. Male, female and spermathecal pores are not visible.

The septa 6/7-8/9 are thick and muscular; the 9/10-14/15 are a little less thick and the following septa become successively thin to 18/19; the remaining septa are slender and fragile. Septa 6/7-18/19 are like interpenetrated cones; the other septa are flat. The dorsal insertion of 9/10-17/18, 18/19 is displaced one segment backwards. The ventrolateral part of the septa 18/19-23/24 is thick and muscular, more so in 19/20-21/22. The anterior esophagus makes a complete turn before enlarging into a wide crop. The gizzard is a short, wide and very muscular cylinder in VI. The three pairs of calciferous glands open dorsally into the esophagus at VII-IX. They are rounded or somewhat elongated (fig. 14) and become a little bigger backwards. Their structure is tubular-paniculate; the duct is short and there is no appendix. The intestine begins at XIV and widens from XXIII onwards. The typhlosole begins at XVII; it is a dorsal blade as high as the intestinal diameter; it becomes higher and coiled at XXIII. In cross sections of the mid-body the typhlosole forms three loops (fig. 15). There are no intestinal caeca. Three pairs of slender lateral hearts occur in VII-IX and two pairs of bulk intestinal hearts in X-XI. The VI and anterior nephridia intermingle at the sides of the anterior esophagus. The post-clitellar nephridia have a pre-septal funnel

and three post-septal loops (fig. 12). Short loop I is ca. 1/8-1/10 long as is loop II, which extends to a little above the nephridiopore line. The connection of these loops with the bladder (loop III) is glandular and ca. four times longer than loop I. The bladder is nearly as long as half the body circumference and its most ventral portion is attached to the transverse meso supporting the sub-neural vessel. The nephridiopore has a strong sphincter.

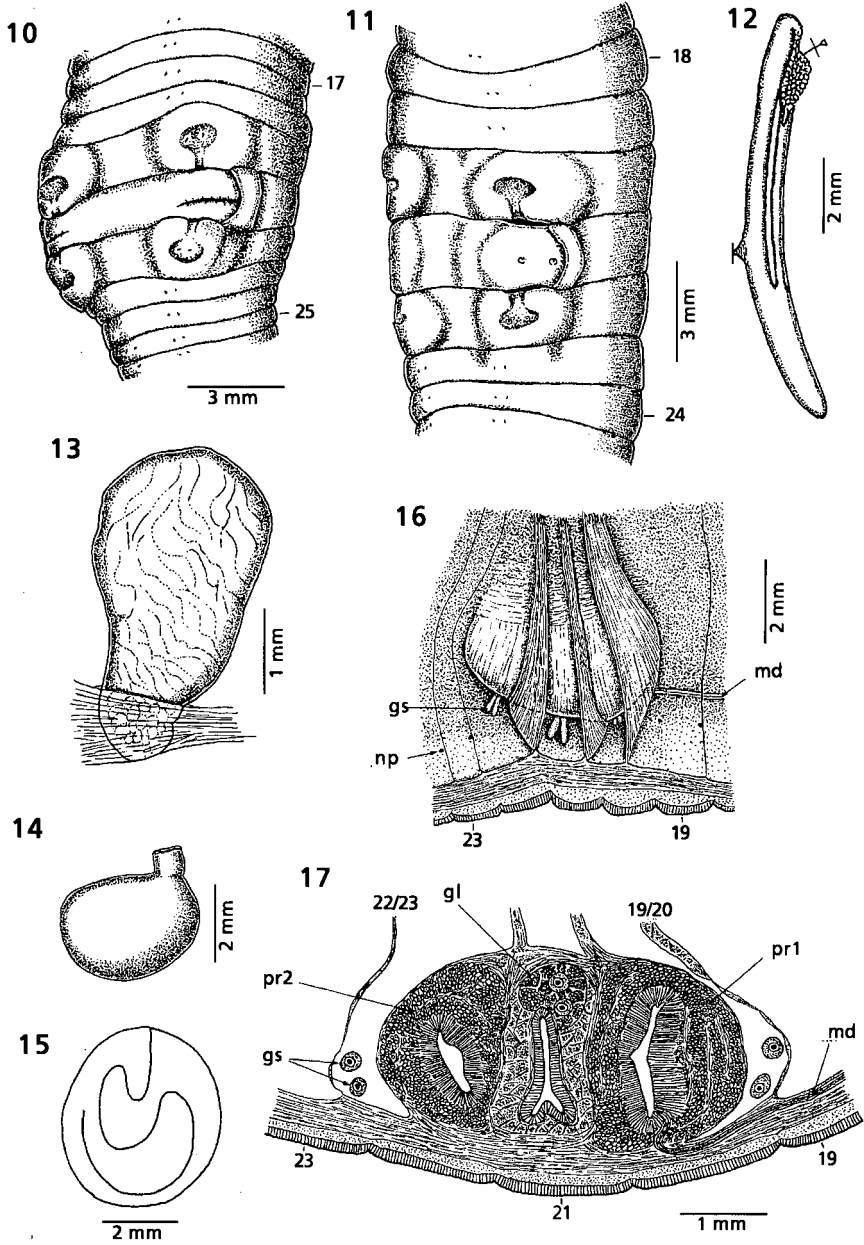
Peri-esophageal testis sacs occur in X and XI enveloping the esophagus, dorsal vessel, hearts and the seminal vesicles of XI. The seminal vesicles of XII are somewhat bigger than those of XI; the vesicles have a smooth surface and are confined to their own segments. The two male ducts on either side run together in the ventral body wall just below the peritonium towards a pair of cushions prominent in the body cavity in XX-XXII (fig. 16). The cushions are arcuated; their lateral margin is convex and abrupt; medially they decrease slowly to the body wall. In sagittal sections (fig. 11) each cushion consists of three parts with a common covering made by the peritonium plus a thin layer of longitudinal and circular musculature. The anterior and posterior parts (prostatoide glands) of the cushions are formed by high glandular cells which line the invaginations of 20/21 and 21/22 respectively; the gland cells are intermingled with some muscle fibres (fig. 17, pr1, pr2). The median part contains the invagination of XXI lined by a simple epithelium and a thick coat of muscle bands and connective tissue; its inner portion is formed by groups of gland cells (gl) associated with the follicles of *a* and *b* setae. Groups of gland cells associated with the ventral setae of XX and XXII lie on the front and back of the cushions. The two male ducts (md) on each side penetrate the floor and make a short ascending course in the anterior part

of the corresponding cushion. The ducts open side by side into the invagination of 20/21, laterally to line *b*. The cushions are highly prominent in the body cavity only in specimens of male genital field as in figure 9. They are scarcely or not at all prominent in the other specimens and their gland cells are intraparietal; these animals are probably not fully developed. The pairs of ovaries and female funnels are in XIII. The ovaries are flabellate of wavy surface and the maturing eggs are disposed in radial series. Two pairs of spermathecae (fig. 13) occur in VIII-IX; they open in 7/8-8/9 a little below the nephridiopores line. They have a short duct passing slowly to a flat pear-shaped ampulla. The duct is totally or partially intraparietal; it has many seminal chambers which are not prominent on its surface and are full of spermatozoa. The inner surface of the ampulla rises into multiple thick glandular folds. The spermathecae of IX are a little bigger than those of VIII.

#### Remarks

*Rhinodrilus appuni* (MICHAELSEN, 1892) was described from Venezuela, Carabobo State, Puerto Cabello and named after its collector, Appun. The type-material, one specimen belonging to Berlin Museum, was lost (REYNOLDS & COOK, 1976). There are doubts about the certainty of the collector and the type-locality because "Appun" is the native name of a small village between Puerto Cabello and San Esteban. The original description is meagre and mistaken in its identification of the segments. MICHAELSEN (1895) presented a new description based on two specimens belonging to the Hamburg Museum and collected by Sievers in Puerto Cabello. Omissions and fallacies about segmentation remained. ROSA (1896) corrected the segmentar position of the organs based

Figs. 10-17. *Rhinodrilus appuni pavoni* n. subsp.: 10, 11. Ventro-lateral view of two specimens, segments XVII-XXV and XVIII-XXIV; 12. Post-clitellar nephridium; 13. Spermatheca of 7/8; 14. Calciferous gland of segment VII; 15. Cross section of the intestine in the mid-body; 16. Inner view of the right male terminalia, segments XIX-XXIII; 17. Sagittal section of the same: gl. Glands associated with follicles of genital setae; gs. Genital setae; md. Male ducts; np. Nephridiopore; pr1, pr2. First and second prostatoide glands; 19/20, 22/23. Septa.



*Rhinodrilus appuni pavoni* n. subsp.: 10, 11. Vista ventro-lateral de dos especímenes, segmentos XVII-XXV y XVIII-XXIV; 12. Nefridio post-clitelar; 13. Espermateca de 7/8; 14. Glándula calcífera del segmento VII; 15. Corte transversal del intestino en el medio del cuerpo; 16. Vista interna de la parte final derecha masculina, segmentos XIX-XXIII; 17. Corte sagital de la misma: gl. Glándulas asociadas con folículos de las cerdas genitales; gs. Cerdas genitales; md. Conductos masculinos; np. Nefridioporo; pr1, pr2. Primera y segunda glándulas prostatoides; 19/20, 22/23. Septos.

on his anatomical knowledge of other Glossoscolecidae species; he did not see *appuni* specimens. The inadequacy of the descriptions and the errors in segmentation gave rise to different interpretations of the position and validity of the species (BEDDARD, 1895; MICHAELSEN, 1900; COGNETTI DE MARTIIS, 1906). Later, MICHAELSEN (1918) accepted ROSA's corrections and presented new observations based on his 1895 material. However, our knowledge is still insufficient with respect to the size and position of the setae, blood system, nephridia, intestine and details of the male genital system. The two pairs of male pores in 1/2 XXI (XX in MICHAELSEN, 1892) are probably the opening of genital setae follicles. Michaelsen was the only one to study the species, which has not been found in 100 years.

*R. appuni appuni* is distinguished from *R. a. pavoni* by its very delicate posterior setae, genital setae with 22 excavations/series, puberal papillae in XVIII-XX and XXII-XXIV and the absence of puberal ridges in XXI. The name of the new subspecies is that of the Indian community where it was collected.

## Resumen

*Andiorrhinus* (*Amazonidrilus*) *motto* sp. n. y *Rhinodrilus appuni pavoni* subsp. n. (*Oligochaeta*, *Glossoscolecidae*) de la *Amazonia Venezolana*

Dos especies de *Oligochaeta*, *Glossoscolecidae*, de Venezuela, Estado de Amazonas se estudiaron mediante disecciones y cortes histológicos seriados. *Andiorrhinus* (*Amazonidrilus*) *motto* sp. n. se caracteriza por el tamaño, por el campo genital masculino que presenta un par de surcos puberales laterales a las cerdas *b* en los segmentos XXI-XXIII (figs. 1, 2), y por el aparato espermatecal simple. *Rhinodrilus appuni pavoni* subsp. n. se destaca por la forma del campo genital masculino en los segmentos XX-XXIII (figs. 9-11), que corresponde internamente a dos pares de peculiares glándulas prostatoides unidas en una almohadilla por cada lado (figs. 16-17).

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