Papéis Avulsos de Zoologia

MUSEU DE ZOOLOGIA DA UNIVERSIDADE DE SÃO PAULO

ISSN 0031-1049

Papéis Avulsos Zool., S. Paulo 39(16): 293-305 29.IV.1996

ON SLENDER SPECIES OF *AMPHISBAENA*, WITH THE DESCRIPTION OF A NEW ONE FROM NORTHEASTERN BRASIL (REPTILIA, AMPHISBAENIA)

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Abstract

Amphisbaena lumbricalis *is described from the site of the hydroelectric dam at Xingó, on the Rio São Francisco, between the states of Alagoas and Sergipe. It has 4 cicatricial preanal pores (rarely 2, 5 or 6), 225-247 body annuli, 20-26 tail annuli and 12-14/16-20 segments to a midbody annulus. It is compared with four other slender species, three of which are relatively thinner.*

Keywords: *Amphisbaena*, Reptilia, Amphisbaenidae, Northeastern Brasil.

Introduction

This Museum received from the Companhia Hidro Elétrica do São Francisco, CHESF, through the courtesy of Dr. Nelson Jorge da Silva Jr., Universidade Católica de Goiás, a fine collection of amphisbaenians, made during the filling, in 1994, of a large dam at Xingó (09° 24' S, 37° 58'W), on the lower Rio São Francisco, where the river makes the border between the states of Alagoas and Sergipe. Three species were represented, *Leposternon polystegum* and two new species of *Amphisbaena*, one of which I describe here. It is a very slender form, that needs to be compared with similar species from northeastern Brasil, previously described by myself (Vanzolini, 1991), of which additional materials have recently become available, permitting a somewhat more detailed analysis.

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Trabalho recebido para publicação em 23.VIII.95 e aceito em 20.IX.95.

Amphisbaena lumbricalis, sp.n.

Holotype

MZUSP 79433, from the site of the hydroelectric plant of Xingó, on the lower Rio São Francisco, on the side of the state of Alagoas (left bank). Field number 3435, collected on June 17, 1994. Male, body length 129 mm, tail length 16 mm, head width 2.4 mm. Body annuli 232, tail annuli 22, segments 12/16.

Paratypes

From the same locality as the holotype, left (Alagoas) bank of the river, June 11 to June 28, 1994, 57 paratypes, MZUSP 79434-79490. From the opposite (Sergipe) bank of the river, June 11 to June 20, 1994, 14 paratypes, MZUSP 79419-79432.

Diagnosis

Very slender. Preanal pores cicatricial, usually 4, rarely 2, 5 or 6. Body annuli 225-247, tail annuli 20-26. Autotomy level not apparent in the intact tail, breaks on annuli 6-10. Segments to a midbody annulus 12-16/16-20. No major fusions of head scales. Prefrontals the largest scales on top of the head. Parietals very variable, irregular. Three upper and three lower labials, in both cases the second by far the largest.

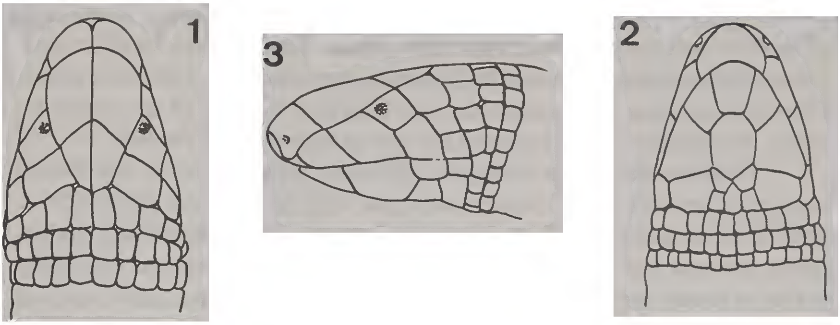
Etymology

The name refers to the wormlike slenderness of the species.

Description (Figures 1-3)

A small form, maximum rostro-anal length (72 specimens) 156 mm. Head slightly arcuate in profile, snout rounded in dorsal view. Tail relatively short, cylindrical proximally, becoming progressively a little thinner on the distal two thirds; terminal cap slightly acuminate, little incised. Autotomy level not noticeable on the intact tail, broken tails (19 specimens) with 5-9 annuli remaining.

Median dorsal sutures of the head in the following order of decreasing length: prefrontal, frontal, nasal. Prefrontals very large. Frontals forming together a rough diamond, with the front edges tending to a bow-like curve. Parietal series varying from a proper transverse row, with two larger polygonal scales on the center, to an irregular series, with diverse divisions and fusions, the latter occasionally extensive. Nasal scale large, the nostril near the front edge, a little below the middle. Three upper labials, the second by far the largest, the third high, narrowly meeting or missing the postocular. Ocular



Figs. 1-3. *Amphisbaena lumbricalis*, sp. n. Holotype.

diamond-shaped; the eye, sitting on the front half, varies from invisible to a very definite black spot. Postocular large, polygonal, meeting above the frontal and the parietal series. Below the postocular a short vertical row of two scales, the lower one in a post-labial position, corresponding to the post-genial row ventrally. Symphysial moderate, a little wider in front. Three lower labials, the second by far the largest. Postsymphysial large, seven- or eight-sided. Lateral genials (nomenclature as in Vanzolini, 1991) moderate. Anterior medial genials two, fairly regular, embracing from behind the postsymphysial. Second row of medial genials with three irregular elements. Postgenials four or five on each side, with diverse types of fusions.

On the body no ventral or dorsal sulci; lateral sulci always present, though varying in degree of expression.

Pores little marked, not definite and rounded, but scar-like, hard to see. Of 72 specimens, 67 with 4 pores, 1 with 2, 2 with 5 and 2 with 6. Preanal flap semicircular, with 8 scales.

Dorsal parts reddish brown, head a little lighter. Edges of segments very slightly lighter than the center, without, however, taking a reticulate appearance. Below the lateral sulci the borders of the segments become progressively lighter, resulting in 5-6 rows of light segments with a dark center. Ventral parts of the body immaculate, waxy yellow to light cream. Underside of tail with a variable area of light segments with dark spots on the middle.

Biometry

The excellent series at hand permits the undertaking of a reasonable biometrical analysis.

At the time of collection the specimens were labelled as to locality, 18 sites, on both sides of the river, being mentioned on the general list of materials.

The maximum distance between sites was a little less than 10 km, which is not much in terms of herpetological field "localities". However, since the two sides of the river were present, I tested the distributions of scale counts for differences among the localities represented in the sample and between the two river banks. There was no apparent heterogeneity, and I am here treating all specimens together. Incidentally, all the localities are now at the bottom of the lake.

I was unsuccessful in sexing the individuals. Some, however, had everted hemipenes, and others had been sexed in the field (method not disclosed). A study of these specimens did not indicate the presence of marked sex dimorphism, nor was bimodality perceived in the frequency distributions especially in that of caudal annuli, where dimorphism would be preferentially expected to occur.

Scale counts. Four scale counts were taken: number of body and of tail annuli, number of segments at midbody, above (dorsal) and below (ventral) the lateral sulci.

As a preliminary caution I tested, by analysis of regression, the presence of correlation between the two counts of annuli and between the two counts of segments. In both cases there were significant correlations. In the case of annuli Fisher's F was 6.387, for 1 and 50 degrees of freedom, significant at the 5% level. The coefficient of determination was quite low, however, 0.1148, and I think the two characters may be treated separately. In the case of segments, the regression was significant at the 0.1% level (F= 13.760, 1 and 70 degrees of freedom); the coefficient of determination was also low, 0.1622. In this case I treated the two variables both separately and as a sum, on account not only of the latter's enhanced power of discrimination, but also of the existence of related species without lateral sulci.

The relevant data on scale counts are shown on Tables 1 to 3. It is easy to see that the distributions are eminently usable, reasonably symmetrical, with low coefficients of variation. In Table 2 the most informative item is that two configurations (12/18 and 14/18 segments) occur in about 81% of the cases, and may be considered characteristic of the species.

Body proportions. Three body proportions were studied, the regression of head width (as a proxy for body thickness, Schmidt, 1977) on body (rostro-anal) length, head width on total length and tail length on body length. The regressions (Table 4) are not very good. The coefficients of determination are rather low, around 0.5 or less, but the regressions are still usable in the comparisons to be made below with other slender *Amphisbaena* species.

Table 1. Data on the distributions of frequencies of the number of body and tail annuli of five slender species of *Amphisbaena*

	N	R	M	s	V	I (M)
Body annuli						
A. hastata	15	264-277	269.1 ± 0.98	3.8	1.4	267.0-271.2
A. ignatiana	5	251-260	255.6			
A. lumbricalis	72	225-247	238.1 ± 0.20	5.1	2.1	236.9-239.3
A. heathi	4	186-194	191.5			
A. minuta	2	265-271	268.0			
Tail annuli						
A. hastata	9	39-44	41.3 ± 0.50	1.5	3.6	40.2-42.5
A. ignatiana	5	32-36	33.8			
A. lumbricalis	53	20-26	22.8 ± 0.16	1.2	5.2	22.4-23.1
A. heathi	2	21-32	26.5			
A. minuta	1	22				

N, individuals in sample. R, range of the variable. M, mean and its standard deviation. s, sample standard deviation. V, coefficient of variability. I (M), confidence interval of the mean (t standard deviations of the mear. on each side).

Table 2. *Amphisbaena lumbricalis.* Distributions of frequencies of the number of segments on a midbody annulus

Dorsal			Total			Combinations		
	f	%		f	%		f	%
12	25	34.7	28	5	6.9	12:16	5	6.9
14	44	61.1	30	22	30.6	18	20	7.8
16	3	4.2	32	38	52.8	14:16	2	2.8
Ventral			34	5	6.9	18	38	52.8
16	7	9.7	36	2	2.8	20	4	5.6
18	59	81.9				16:18	1	1.4
20	6	8.3				20	2	2.8

Table 3. Distributions of frequencies of the total number of segments to a midbody annulus in five slender species of Amphisbaena

	A. hastata	*A. ignatiana*	*A. lumbricalis*	*A. heathi*	*A. minuta*
28			5		
29			-		
30			22	2	
31			-	-	
32			38	2	
33			-		
34			5		
35	1		-		
36	8	3	2		
37	3	-			1
38	4	2			-
39		-			1
40		1			
	16	6	72	4	2

Discussion

The scale counts normally used to characterize amphisbaenids by themselves fully diagnose this species (Table 1). Compatible counts of body annuli are found in 14 other species (Vanzolini, in press), 13 of which differ widely from *A. lumbricalis* in number of tail annuli, of segments to a midbody annulus, or both. The only species that approaches *A. lumbricalis* in all scale counts is *A. carvalhoi* Gans, 1965, which is, however, much more robust (Vanzolini, 1991: Graph 2).

To date four slender species of *Amphisbaena* were known: *A. heathi* Schmidt, 1936, from mesic situations in the state of Rio Grande do Norte, Brasil; *A. minuta* Hulse and McCoy, 1979, from the desertic Bolsón de Pipanaco, in Catamarca, Argentina; *A. hastata* Vanzolini, 1991, and *A. ignatiana* Vanzolini, 1991, both from the fossil dunes of the São Francisco valley. These species are easily told apart. There are a few very characteristic scutellation features, such

Table 4. Data on regressions in three slender species of *Amphisbaena*

Tail length x body length

	N	R (x)	R (y)	b	a	F	r^2
A. hastata	8	61-152	12-32	0.21 0.011	-1.02 2.258	380.186***	0.9845
A. ignatiana	5	125-159	21-25	0.095 0.0369	9.73 0.861	6.652 ns	0.6892
A. lumbricalis	53	103-156	13-19	0.085 0.0116	4.84 0.212	19.913***	0.5185

Head width x body length

	N	R (x)	R (y)	b	a	F	r^2
A. hastata	15	61-152	1.0-2.2	0.016 0.0018	0.35 0.080	61.764***	0.8261
A. ignatiana	6	125-188	2.0-3.1	0.016 0.0017	0.12 0.170	81.748***	0.9745
A. lumbricalis	70	98-156	2.2-3.1	0.011 0.0018	1.22 0.032	34.377***	0.3357

Head width x total length

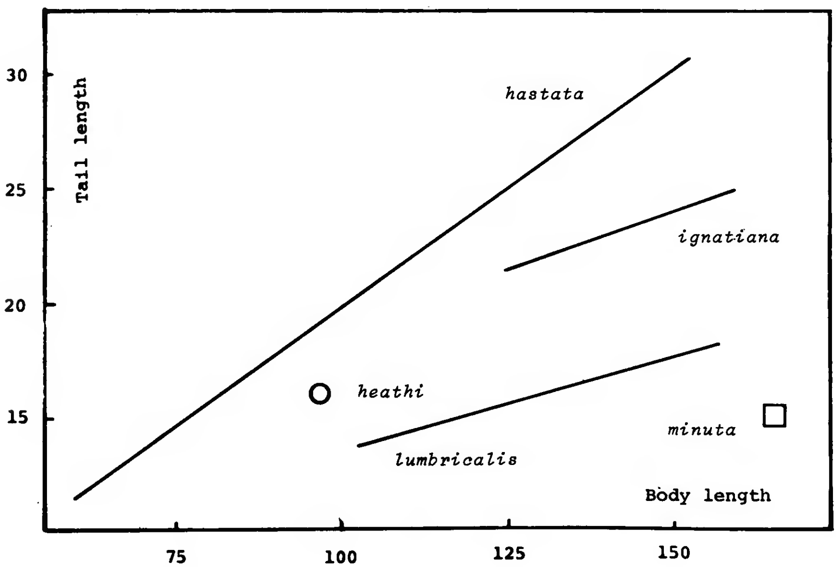
	N	R (x)	R (y)	b	a	F	r^2
A. hastata	8	73-184	1.0-2.2	0.0094 0.0014	0.33 0.147	45.605***	0.9012
A. ignatiana	5	148-184	2.0-2.5	0.011 0.0027	0.46 0.092	6.895*	0.8493
A. lumbricalis	57	116-174	2.2-3.1	0.011 0.0019	0.91 0.036	34.812***	0.4154

N, individuals in sample, R (x), R(y), ranges of the variables b, coefficient of regression (slope). a, regression constant (intercept). F, Fisher's quotient of variances (significance of the regression). r^2, coefficient of determination.

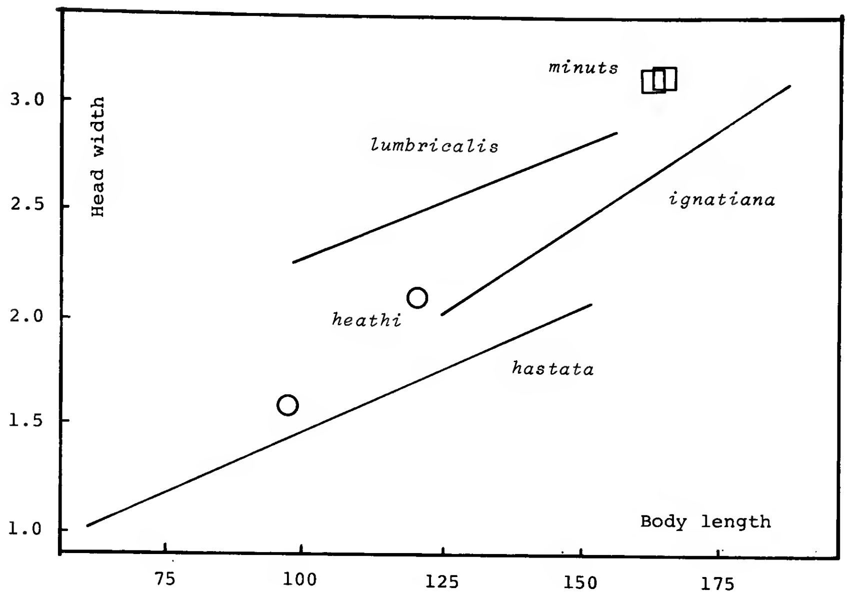
as the separation, in *A. heathi*, between symphysial and postsymphysial by the contact between first lower labials, or the open loop formed by the annuli in the anterior part of the dorsum in *A. hastata*. However, the scale counts are again quite sufficient to diagnose the five forms (Tables 1, 3).

They differ also in degree of slenderness, a character not necessary for diagnostic ends, but potentially important in the systematics of the group. Slenderness results from two two relative features, elongation and attenuation. Elongation is best measured by the regression of tail length on body length. Graph 1 shows that *A. hastata* has a relatively longer tail than the other species, *A. ignatiana* and *A. heathi* are intermediate, and *A. lumbricalis* and *A. minuta* are relatively short-tailed.

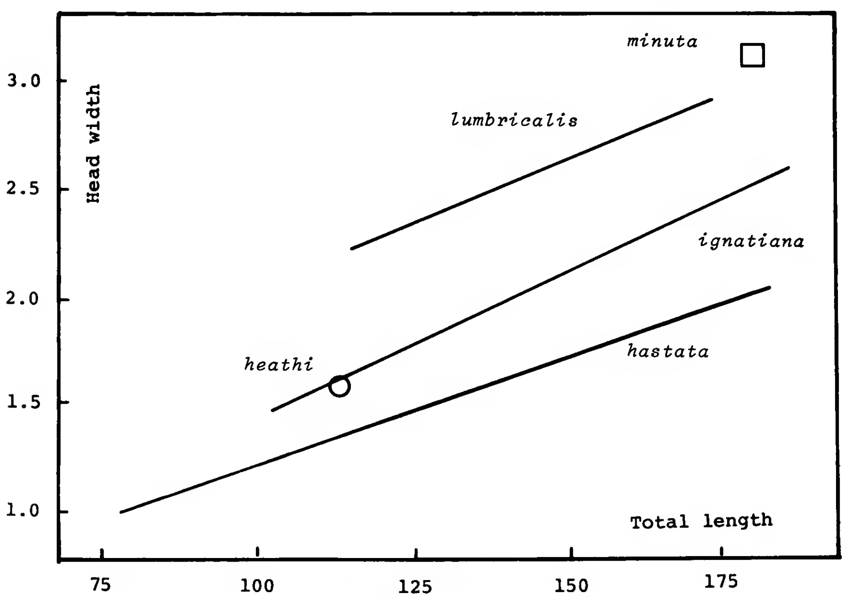
As to attenuation, a convenient proxy is head width. This is ideally taken against total length, given that body and tail in amphisbaenids are in perfect continuity and mechanically function as an unit. The frequent occurrence of tail autotomy, however, forces the use of the regression of head width on body (rostro-anal) length; in fact both methods mostly agree. Graphs 2 and 3 show that *A. hastata*, *A. minuta* and *A. heathi* have the thinnest bodies, and that *A. lumbricalis* is relatively thicker. Thus both criteria of slenderness fully



Graph 1. Regression of tail length on body length.



Graph 2. Regression of head width on body length.



Graph 3. Regression of head width on total length.

Map 1. 1, Baixa Verde, now João Câmara, type locality of *A. heathi* (0532, 3548). 2, Rio do Fogo (locality; 0516, 3523). 3, Xingó, type locality of *A. lumbricalis* (0924, 3758). 4, Queimadas (1037, 4236). 5, Ibiraba, type locality of *A. hastata* (1048, 4250). 6, Santo Inácio, type locality of *A. ignatiana* (1106, 4244). Latitudes South, longitudes West.

coincide, and *A. lumbricalis* is seen as less extreme from that viewpoint.

A note on speciation

Of the approximately 50 species of *Amphisbaena* currently regarded as valid (Vanzolini, in press), four are very slender. In spite of the chancy nature of amphisbaenid collecting and of the steady flow of new species still being described, it is impossible to ignore that three of these four species occur in the caatingas of the lower São Francisco, in close proximity or partial sympatry. It is necessary to consider, at least briefly, scenarios of speciation inside the area.

This is, as said, part of the morphoclimatic domain of the caatingas

(Ab'Saber, 1977). Miguel Trefaut Rodrigues, of the University of São Paulo, who has led a program of intensive herpetological exploration of the area, has published a very good description of the landscape (Rodrigues, 1991a). He has also (Rodrigues, 1991a, b, c, d) described significant new species from the area, and discussed possible patterns of speciation. Especially relevant to the present case are the psammophilous microteiids of the genus *Calyptommatus*. Rodrigues (1991a), drawing on the geomorphological history of the region, reached the parsimonious conclusion that changes in the main course of the river, resulting in alternate dissection and rejoining of areas inhabited by the ancestral form, were responsible for the speciation patterns seen. It would have been a Holocene process, linked to the last glacial.

Against the application of this type of explanation to our case there is the fact that present populations on both sides of the São Francisco at Xingó show no differentiation whatsoever.

Rodrigues's time frame agrees well with that first posed cogently by Haffer (1969). There is however, very strong evidence, from biochemical (Heyer and Maxson, 1982a, b), paleontological (Baez and Gasparini, 1979), and geological (Räsänen et al., 1995; Webb, 1995) data pointing out to the Miocene as another time of fast species multiplication, the products being, at least in the former case, indistinguishable from those of more modern cycles.

A final difficulty in dealing with amphisbaenid phylogenies (even short term ones) is the reticulate nature of the systematics at the species level. Given their despoiled external anatomy, the best diagnostic features are scale counts, known to be hard to handle in phylogenetic studies. Thus, I would not say final, but significant progress in the understanding of these problems of speciation in limited areas of caatingas, will come from molecular studies. Morphological systematics will, of course, continue to be indispensable in describing and geographically mapping the diversity of the group.

Specimens examined

Besides the type series of *A. lumbricalis* I have used the following specimens:

A. hastata: MZUSP 68503 (holotype), 68504, 72611-72614 (paratypes), all from Ibiraba, Bahia. MZUSP 73003-73005, 74257-74259, 75319-75322, from Queimadas, Bahia. MZUSP 76242, from Santo Inácio, Bahia.

A. ignatiana: MZUSP 72616 (holotype), 72615, 72617-72619 (paratypes), all from Santo Inácio, Bahia. MZUSP 73006 and 76241, also from Santo Inácio.

A. heathi: MZUSP 78356-78357, from Rio do Fogo, Rio Grande do Norte.

A. minuta: during a trip to the United States in 1990, I had access to the types.

ACKNOWLEDGMENTS

CHESF, Companhia Hidro Elétrica do São Francisco, and Dr. Nelson Jorge da Silva Jr., Universidade Católica de Goiás, are to be thanked for the specimens. Miguel Trefaut Rodrigues, Universidade de S.Paulo, and his graduate students have steadfastly provided excellent materials from (among many others) the São Francisco area in Bahia. Dr. Eliza Maria Xavier Freire, Universidade Federal de Alagoas, donated the specimens of *A. heathi*. The late C.J. McCoy and Dr. Helen Censky gave me access to the types of *A. minuta*. F.Val once more illustrated the description.

W. Ronald Heyer and C.W. Myers have kindly read (and much improved) the manuscript.

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Credenciamento e Auxílio Financeiro do Programa de Apoio às Publicações Científicas Periódicas da USP. Comissão de Credenciamento.