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TWO NEW SMALL SPECIES OF *AMPHISBAENA* FROM THE FOSSIL DUNE FIELD OF THE MIDDLE RIO SÃO FRANCISCO, STATE OF BAHIA, BRASIL (REPTILIA, AMPHISBAENIA)

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ABSTRACT

Two new species of Amphisbaena, *both small and extremely slender, are described from the great field of fossil dunes crossed by the Rio São Francisco between 11° and 10° S in Bahia.* A. hastata, *from Ibiraba, west of the river, based on 6 specimens, has 4 preanal pores; body annuli 266-273; tail annuli 40; autotomy level on tail annuli 12-16, externally inapparent; no lateral or dorsal sulci; only one weak ventral sulcus; segments around midbody 35-37; color uniform white, with dilute aggregations of melanophores on the back.* A. ignatiana, *from Santo Inacio, on the opposite side of the river, based on 5 specimens, has 6 pores; body annuli 255-263; tail annuli 32-36, autotomy level on annulus 6, externally inapparent; lateral sulci well marked; 16 segments ventral and 20-22 dorsal to the sulci; dorsal segments with dark brown centers and light sutures, the pattern extending irregularly below the lateral sulcus; ventral parts creamy white. The two species, in spite of some suggestive similarites, are thought to be not closely related.*

INTRODUCTION

Between the approximate latitudes of 11° S and 10° S, the Rio São Francisco flows across extensive (ca. 8,400 sq km) Quaternary dune fields (Ab'Saber, 1969; Tricart, 1974). Miguel Trefaut Rodrigues, of the Department of Zoology, University of São Paulo, has been studying the highly peculiar herpetofauna of the area, which comprises remarkable endemisms characterized by adaptations to life in sand. He has forwarded to me for description the two new species of *Amphisbaena* here described. Further data on the area and its fauna, are available in Rodrigues (1990-1990c).

Amphisbaena hastata, sp.n.

(Figs. 1-3)

Holotype: MZUSP 68503, Brasil: Bahia: Ibiraba (10°48'S, 42°50'W), 3 October 1987, M.Rodrigues field 87.6434.

Paratopotypes: MZUSP 68504, same date as holotype, M.Rodrigues 87.6435; MZUSP 72611-72613, 9 February 1989, MRodrigues 88.7209-7211; MZUSP 72614, 27 August 1988, M.Rodrigues 88.6314.

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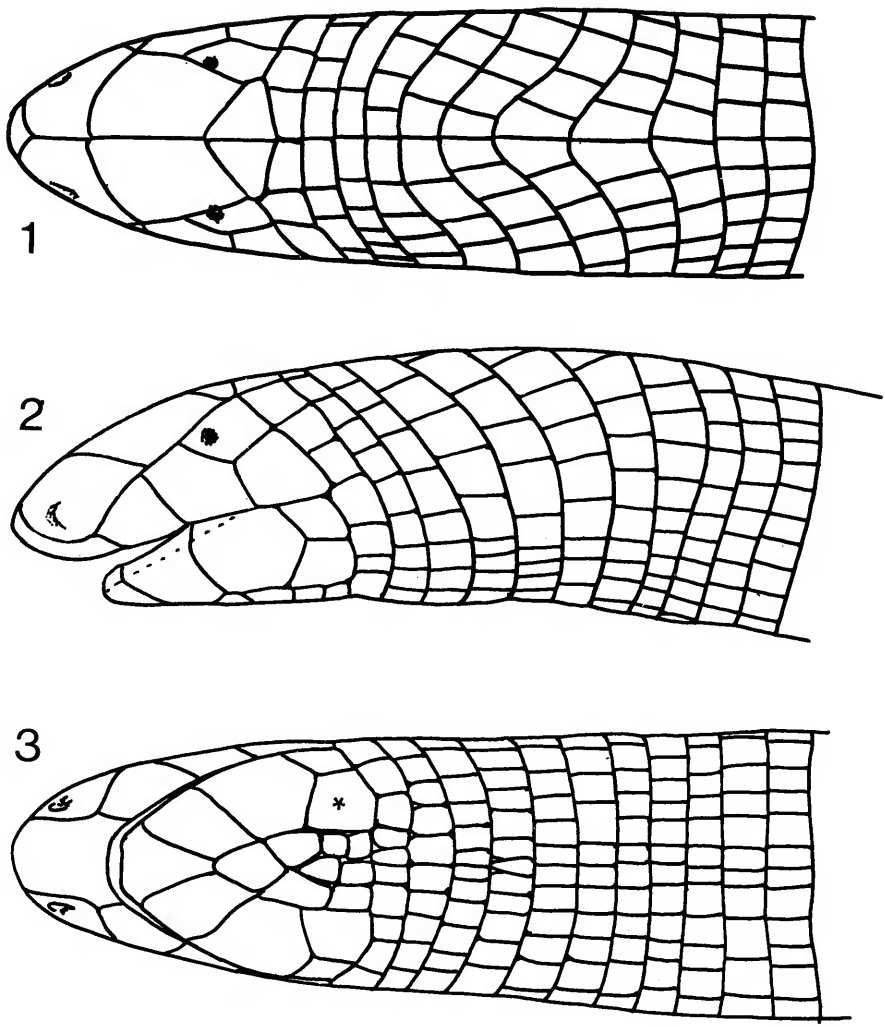


Figs. 1-3. *Amphisbaena hastata*, sp. n. MZUSP 68503, holotype. *, lateral genial scale.

ETYMOLOGY

The name refers to the pattern of the segments on the anterior dorsum.

DIAGNOSIS

A small slender elongate species (snout to vent 149mm; head width 1.8-2.1 mm). Preanal pores 4. Body annuli 266-273. Tail annuli (one specimen) 40. Autotomy level on annuli 12 to 16, externally inapparent. No lateral or dorsal sulci; one midventral sulcus, weakly marked, on the posterior 3/4 of the trunk. Segments around midbody 35-37. Color uniform white, with dilute aggregations of melanophores on the back.

A PARENTHESIS ON SCALE NOMENCLATURE

I adopt Gans's nomenclature for amphisbaenid head scales, as illustrated in Gans and Alexander (1962), with the few following exceptions.

I do not think that "malar" (i.e., zygomatic) should be used for a scale on the ventral side of the head. The region is normally named genial (from the Greak "geneion", chin); I call such scales "lateral genials" (Fig. 3). This compels me to call "median genials" Gans's "postgenials" and "postgenials" his "postmalars". To "mental" and "postmental" I have long preferred "symphysial" and "postsymphysial", an unambiguous usage dating back at least to Cope.

I also prefer not to use "cloaca", properly an internal organ, for the external aperture, which, however, has no current specific designation. I think "anus" can be harmlessly stretched to fill the void.

DESCRIPTION

Small, slender, long tailed. Head not distinct from neck, elongate, acuminate, snout prominent, mouth inferior. Only one longitudinal sulcus, midventral, lightly marked, becoming evident between approximately the 30th and the 70th body annulus, and ending at the pore-bearing row of scales. No external indication of an autotomy annulus; in three specimens with broken tails the break between the 12th and the 13th tail annuli, one specimen with a healed broken tail with 16 tail annuli.

Rostral little visible from above, extensively so from below. Of the median sutures on top of the head, that between the prefrontals largest, twice or more longer than the others. Anterior edge of frontals straight or slightly arcuate, converging in front into an obtuse angle; posterior edge of frontals straight or arcuate, transverse. Behind the frontals one row of scales; those of the median pair (parietals) widened, a little narrower than the frontals; laterally to these on each side one upper temporal, in full contact with the ocular; below, two scales behind the third upper labial. Nostril on the anterior half of the nasal scale. Ocular irregularly diamond-shaped, the eye sitting on the front half of the scale, touching or slightly transgressing the upper suture. Three upper labials, second very large, in point contact with the nasal (thus narrowly separating the first labial and the prefrontal), third in broad contact with the temporal. Symphysial elongate, wider in front, tapering and ending posteriorly in a narrow truncated tip, in contact with the anterior tip of the post-symphysial. Post-symphysial diamond- to pear-shaped, wider behind, the anterior tip meeting the symphysial. Three lower labials; the second largest, irregularly pentagonal; the third small, with four unequal sides. Lateral genials irregularly polygonal. Median genials regularily to irregularily arranged. In the former case, median genials in two rows, the anterior one with two elements, the posterior with three. Otherwise two or three irregular rows, with two or three scales each. One row of post-genials, with five scales on each side, increasing laterally.

Sulci between successive body annuli well marked. Sutures between segments of the same annulus thin, straight, well defined, not very well aligned. The anterior body annuli strongly oblique back and downward, causing much shortened dorsal segments and relatively elongate ventral ones. Progressively the middorsal segments becoming larger, finally becoming lens-shaped; the median sutures are marked and aligned, almost forming a sulcus. The sides of the

annuli bent in an S-shape, the ensemble of annuli 6 to 10 or 11 forming chevrons with rounded forward vertices and spreading basal angles (hence "hastate"). Posterior to this the annuli becoming normally transverse.

Preanal pores 4 in all specimens, large, rounded or elongate, functional (with plugs), sitting on the hind margin of moderately elongate segments. Preanal flap constituted of 8 segments, in palisade, continuous on the sides with a post-anal series radially arranged. The ensemble occupying the length of four lateral annulli.

No external evidence of an autotomy annulus. Tail annuli regular, the segments longer than those on the trunk, better aligned. Tip of tail smooth.

Color pattern uniform: the animals off-white, with a very discreet condensation of melanophores on the back.

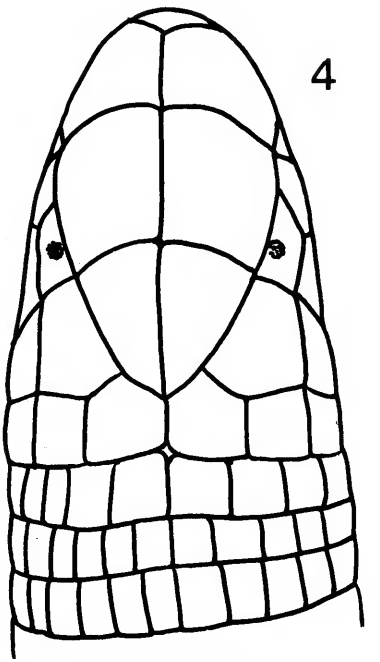
Discussion

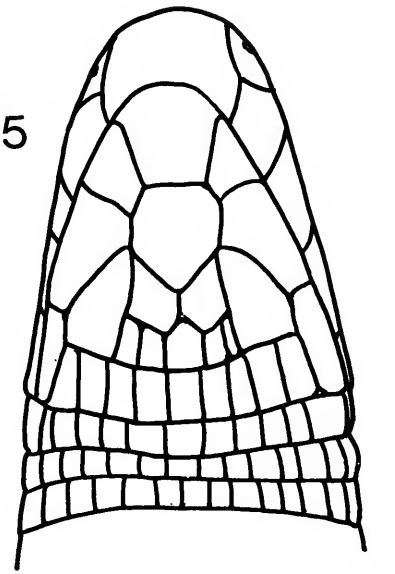
The species of *Amphisbaena* are relatively easy to sort, partly for having a comfortable number of quantitative characters with moderate variability, partly because most species have been well reviewed by Gans, who saw the types and reported on good series. (Relevant to the present issues are Gans, 1961, 1962, 1963, 1963a, 1963b, 1964, 1964a, 1965, 1966, 1967, Gans & Mathers 1977, Gonzalez S. & Gans, 1971.)

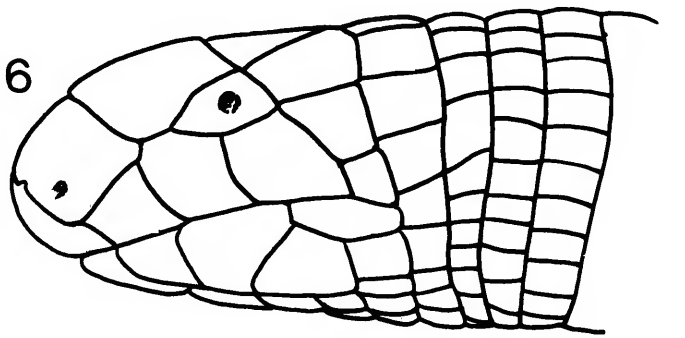
Things are different with regard to the structure of the genus. There is no accepted (in fact, no attempted) phylogenetic scheme, and a discussion of relationships is at present perforce reduced to the level of taxonomic validation, having for convenient starting points body shape, number of pores and scale counts, without further organization.

Amphisbaena hastata is an indisputable new species, indeed a striking one, displaying several unique characters. Such are the absence of lateral sulci and the arrangement of segments on the anterior dorsum. The combination of scale counts is also characteristic (in this respect we must limit the discussion to the informal group of "small" species, with snout to vent length of adults less than 200 mm.) Among small species with four preanal pores, overlapping numbers of body annuli with *A. hastata* are found in *A. occidentalis* Cope, 1876 (reviewed by Gans, 1961), from coastal Perú (261-279), *A. minuta* Hulse & McCoy, 1979, from Catamarca, Argentina (265-271) and *A. polygrammica* Werner, 1900, from Junin, Perú (270). These forms, however, have respectively 18-26, 22 and 20 tail annuli. Among the species with two pores only two show high counts of body annuli, *miringoera* Vanzolini, 1971, from Central Brasil (250-262) and *roberti* Gans, 1964, from the state of São Paulo (240-265). The former has 22-24 tail annuli; the latter's tail ends in a vertical keel and has 17-20 annuli.

Another species that must be considered is *A. heathi* Schmidt, 1936, from Rio Grande do Norte. Judging from Gans's review (1965), this species, also with four pores and of comparable length, has a similar body build. Its head, however, is flatter and more acuminate, the dorsal cephalic scales being proportionately longer than in *hastata*. The parietals together form an elongate triangle, in point contact with the frontals. In ventral view there is some similarity between the two forms, the symphysial and postsymphysial being elongate and pointed in opposite directions, meeting (or narrowly failing to meet) at a diminutive or punctiform suture. The ensemble of the two scales in *heathi* is, however, stretched out, narrower and more elongate than in *hastata*. The differences in scale counts are also large: *heathi* has only 183-187 body annuli, autotomy on caudal annuli 7-8, and 12 segments above, 18-20 below definite lateral sulci.







Figs. 4-6. *Amphisbaena ignatiana*, sp. n. MZUSP 72616, holotype.

Amphisbaena ignatiana, sp.n.
(Fig. 4-6)

Holotype: MZUSP 72616, Brasil: Bahia: Santo Inacio (11°06'S, 42°44'W), 7 February 1989, M.Rodrigues field 88.7157.
Paratopotypes: MZUSP 72615, 72617-72619, same data as holotype, M.Rodrigues field 88.7156, 88.7158-7160.

ETYMOLOGY

The name refers both to the type locality and to its patron saint.

DIAGNOSIS

A small, slender, elongate species (snout to vent 188 mm; head width 2.1-3.1 mm). Preanal pores 6. Body annuli 255-263; tail annuli 32-36. Autotomy level on tail annulus 6, externally inapparent. No dorsal or ventral sulci. Lateral sulci, weakly marked, on the posterior 3/4-4/5 of the trunk. Segments around midbody 16 above and 20-22 below the lateral sulci. Dorsal segments of the trunk dark brown with light sutures, the pattern extending to the lateral sulci or up to five segments below, the general outline crenelated.

DESCRIPTION

Small, slender, relatively long tailed. Head narrower than the body, without a sharp separation: the neck becomes progressively thicker to the sixth or seventh body annulus, behind which the trunk is fairly cylindrical. The profile of the head with a strong convexity from the prefrontals to the tip of the snout; snout blunt but prominent. Lateral sulci weakly marked, becoming apparent between the 48th and the 67th body annuli. No external indication of an autotomy annulus, but in two specimens with broken tails the break occurring between the sixth and the seventh annulus.

Rostral not or scarcely visible from above. Besides the three constant pairs of scales on top of the head (nasals, prefrontals, frontals), one pair of parietals, squarish to pentagonal. Median dorsal cephalic sutures sub-equal. The lateral sutures of the scales on the top and sides of the head forming a continuous, fairly smooth curve, from the parietals to the lip. Four upper labials; the first meeting the rostral in a definite suture; the second, the highest and largest, meeting above the nasal, the prefrontal and the ocular; the third meeting the ocular and the lower temporal; the fourth at the foot of the temporal row. Nostril on the antero-inferior quadrant of the nasal. Ocular roughly diamond-shaped; position of eye variable. One large upper temporal meeting the parietal, the frontal and the ocular, narrowly separated from the third supralabial (except on one side of one specimen, with point contact) by the lower temporal. Symphysial anvil-shaped, somewhat asymmetrical. Post-symphysial escutcheon-like, seven-sided, i.e., meeting the first upper labials at its anterior corners. Infralabials three, the second by far the largest, regular in shape or not. Lateral genials large, irregular. Median genials in two rows, respectively with two and with five or six scales. Two postgenial rows; the front one with eight scales, of which the outermost is much larger than the others.

Sulci between successive body annuli well marked. Sutures between segments of the same annulus straight, well defined, better aligned on the ventral than on the dorsal aspect.

Preanal pores 6 in all specimens, round, large, on the posterior half of the respective segments. Anal flap semicircular, with 8 scales; post-anal scales ca. 16, radially arranged, not in continuity with the anal flap.

No external evidence of an autotomy annulus. Tail annuli regular, segments elongate and narrow, both dorsally and ventrally. Sutures evident on tail tip.

Dorsum reticulate, the scales brown with light sutures. Belly creamy white, immaculate. The limit between the two areas varying from annulus to annulus, from the lateral sulcus to up to five segments below, the general outline being crenelated.

Discussion

Only one other small *Amphisbaena* has six pores, *A. stejnegeri* Ruthven, 1922, from Guyana (redescribed and figured by Gans, 1963). It resembles *ignatiana* in having high body scale counts, 243 to 247 (255-263 in the new form; number of tail annuli not known). There is similarity also in the convex profile of the head. Differences are, however, marked. In the two known specimens of *stejnegeri* the symphysial and postsymphysial are fused into an elongate scale with straight sides; in *ignatiana* they are distinct: given the sutures between the post-symphysial and the first infralabials, an eventual fusion with the symphysial would result in a very awkward scale. The first upper labial of *stejnegeri* is small (vs. large, almost reaching the prefrontal); the upper temporal is in full contact with the third labial (vs. well separated); the infralabials are two, the first obviously the result of extensive fusion (vs. four); the median genials are disorganized (vs. arranged in two rows, the anterior with two large, the posterior with five small scales). The color patterns have in common that segments are either brown on cream-colored, there being no parti-colored ones; they differ in that *stejnegeri* is variegated, while *ignatiana* shows irregularity only in the reach of dark segments down the flanks.

Amphisbaena minuta Hulse and McCoy, 1979, from Catamarca, Argentina, is a four-pored species which resembles *ignatiana* in the convex profile of the head, in the general arrangement of the chin scales, and in the large number of body annuli (265-271). On the other hand, besides the difference in pore number, tail annuli are fewer (22 vs. 32-36) and dorsal segments are more (19-20 vs. 16) in *minuta*. There are also differences in the cephalic scutellation, the main ones being the larger size of the frontals and temporals in *ignatiana* and the larger size of the first upper labial in *minuta*. The color patterns are similar.

Body proportions

I have studied two morphometric characters, both related to body elongation and attenuation: tail lenght and head width. The former is of couse taken against body (snout to vent) length. Head width is a proxy for body thickness (Schmidt, 1977); in a serpentiform animal it seems best to take it against total (body plus tail) length, and this I did whenever possible — less often than it would be desirable, due to the prevalence of tail autotomy in *Amphisbaena*. Thus the regresion of head width on body length was also studied, and turned out to be very interesting.

The intention of these comparisons is rather to be illustrative than exact; no analysis of variance was pursued aiming at quantifying the differences. On the contrary, in the cases where the regression was not significant, or the intercept did not differ significantly from zero, the species was still represented in the graph by the equation $y' = a + bx$ applied to the smallest and largest values of the independent variable; I think a least squares representation is better than the horizontal of the mean.

The raw data for this study are shown on Tables 1 and 2, or contained in the review papers by Gans and collaborators, or still in the original descriptions of the species not yet reviewed.

Abbreviations used to identify specimens are: AMNH, American Museum of Natural History; CM, Carnegie Museum; MZUSP, Museu de Zoologia, Universidade de São Paulo. The respective localities are shwon on the map.

Tail length (Table 3, Graph 1)

One regression was not significant, that for *A. neglecta*, represented by 4 specimens with a narrow range of body lengths. Graph 1 shows a broad spread of tail lengths relative to body length — from extremely short-tailed species, such as *A. leeseri* and *A. medemi*, to long-tailed ones, as *A. silvestrii*, *A. mitchelli* and *A. myersi*. None, however, have tails proportionally as long as the two new species, which seem not to differ between themselves in this respect.

Head width (Tables 4 and 5, Graphs 2 and 3)

The regression of head width on body length fails to be significant only in the case of *A. pericensis*, represented by only four specimens. The previously known species are all thicker than

Localities cited. 1, Perico. 2, Reservas INPA-WWF. 3, Manaus. 4. Juruá. 5, Belém. 6, Agrestina. 7, Barra do Tapirapés; Porto Velho. 8, Gurupi de Goiás. 9, Jacaré. 10, Ibiraba. 11, Santo Inacio. 12, Garapu. 13, Xavantina. 14, Anápolis. 15, Sooretama. 16, Alcatrazes. 17, 27 km S Andalgalá. 18, Sierra de Animas; Cerro Verdun; Parque Salus; Abra de Perdomo.

the two new ones, and vary from *miringoera*, relatively thin, to *carvalhoi*, the stoutest. *A. hastata* is the slimmest of all, followed by *ignatiana*.

It should be also noticed that, in the case of *A. ignatiana*, head width is not an optimal proxy for body thickness, owing to the peculiar conical shape of the anterior part of the trunk. No better substitute is at present available, but the fact should be kept in mind when making comparisons; in practice, *ignatiana* would be a little closer to the bulk of the species studied and farther apart from (stouter than) *hastata*.

Data sufficient to fit a regression of head width on total length are available for six species, *mitchelli, hogei, miringoera, munoai, silvestrii* and *slevini*. For *mitchelli* the regression is not significant (Table 5, Graph 3).

The ranking of the available samples is precisely the same for the two ways of treating the character, i.e., the coefficient of rank correlation is 1.0.

Comparison between *A. hastata* and *A. ignatiana*

It is striking that two closely parapatric species coincide in being the most slender and among the longest tailed in the genus. In contrast, however, there are some major differences between them: (i) number of pores; (ii) shape of the head, and (iii) probably as a consequence of the latter, scutellation of the chin region. The hastate pattern of the segments on the anterior dorsum is an impressive character, but so novel that it is hard to evaluate its importance in judging relationships. Other differences, in shape of cephalic scutes, in scale counts, in presence/absence and extent of trunk sulci and in color pattern, seem minor to me, but the major ones strongly suggest that the forms represent two separate stocks, not the result of modern speciation in the area. The resemblances would then very probably be due to convergence consequent to the extreme psammophilic habit.

What the closest relatives of these two species may be is a moot point. There is still much to learn about *Amphisbaena*, including many undescribed forms in collections; adequate series are available of only a few species. Analysis must wait for more information.

Table 1. *Amphisbaena hastata* and *A. ignatiana:* measurements and scale counts

MZUSP	Length	Head width	Annuli	Autotomy	Segments
A. hastata					
68503	140 + 27	2.1	268 + 40	—	35
68504	126 + x	2.0	271 + x	16	36
72611	149 + x	2.2	270 + x	12	36
72612	112 + x	1.7	273 + x	12	36
72613	130 + x	1.8	266 + x	12	37
A. ignatiana					
72615	143 + x	2.4	263 + x	6	16:21
72616	159 + 25	2.8	260 + 32	6	16:22
72617	188 + x	3.1	255 + x	6	16:20
72618	126 + 22	2.5	x + 34	—	16:20
72619	125 + 23	2.1	260 + 36	—	16:20

Table 2. Specimens used in morphometric comparisons

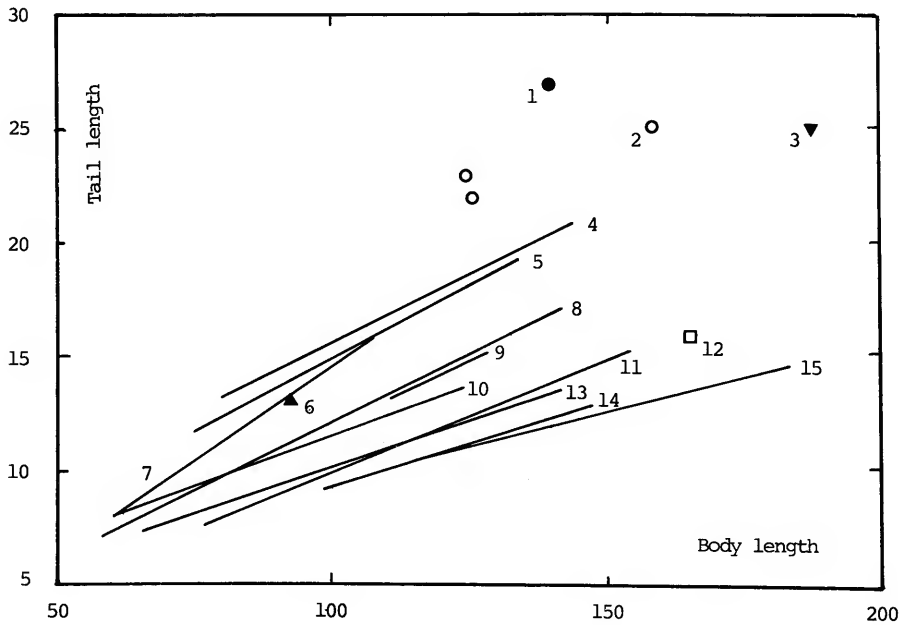
Locality			Length	Head width
A. carvalhoi (Brasil)				
MZUSP	22076	Agrestina, Pe	109 + 11	4.0
A. hogei (Brasil)				
MZUSP	6909	Ilha dos Alcatrazes, SP	130 + x	3.6
"	6907	"	121 + 13	3.3
"	6910	"	124 + 14	3.7
"	6912	"	125 + 13	3.6
"	6913	"	121 + 13	3.5
"	6914	"	69 + x	3.0
"	6915	"	119 + 14	3.7
"	6917	"	70 + 8	2.8
"	6918		110 + 12	3.8
"	6919	"	67 + 9	3.0
"	6920	"	60 + 8	2.7
A. minuta (Argentina)				
CM	65531	27 km S Andalgalá, Catamarca	165 + 15	3.1
"	65533	"	164 + x	3.1
A. miringoera (Brasil)				
MZUSP	13754	Barra do Tapirapés, Mt	66 + 7	2.0
"	13755	"	110 + 11	2.5
"	13756	"	111 + 11	2.5
"	13758	"	142 + 13	2.9
A. mitchelli (Brasil)				
MZUSP	7140	Belém, Pa	116 + 16	3.0
"	7141	"	131 + 20	3.6
"	67712	Juruá, Rio Xingu, Pa	135 + 18	3.0
"	67713	"	80 + x	2.7
"	67714		75 + 11	2.6
"	67715	"	158 + x	3.5
"	67716	"	105 + 17	3.0
"	67717	"	162 + x	3.9
"	67718	"	143 + x	3.3
"	67719	"	118 + x	3.1
A. munoai (Uruguay)				
MZUSP	7780	Sa. de Animas, Maldonado	119 + 15	2.9
"	8099	"	113 + 14	2.9
"	42899	Co. Verdun, Lavalleja	124 + 15	2.8
"	42900	"	110 + 15	2.5
"	42901	"	58 + 7	2.1
"	42902	Parque Salus, Lavalleja	143 + 18	2.9
"	42903	"	65 + x	2.4

Table 2. (Cont.)

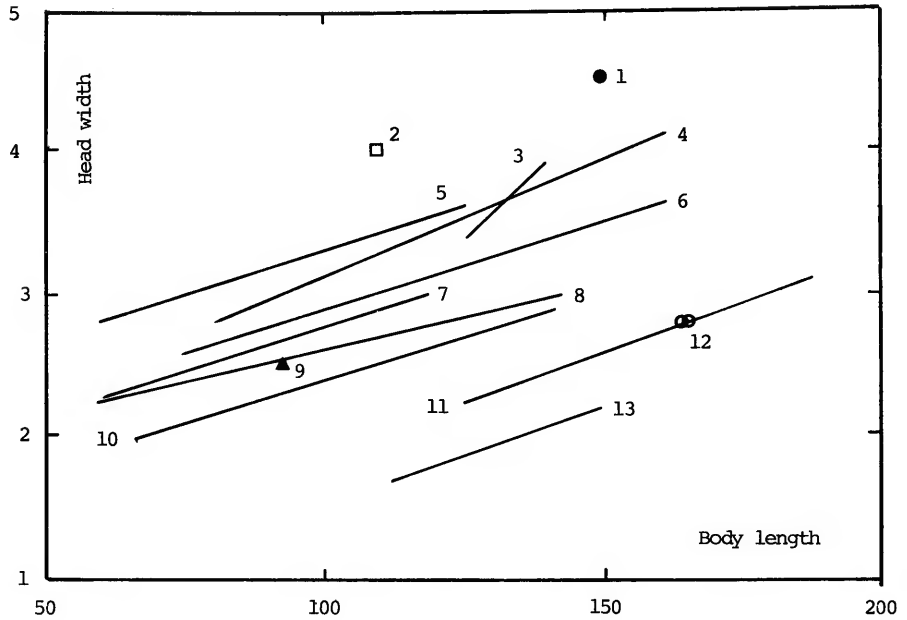
Locality			Length	Head width
"	45926	Abra de Perdomo, Maldonado	132 + x	2.7
"	54387	Pororó, Lavalleja	124 + 13	3.1
	A. neglecta (Brasil)			
AMNH	62155	Anápolis, Go	150 + x	4.5
	A. nigricauda (Brasil)			
AMNH	97205	Sooretama, ES	92 + 13	2.5
	A. pericensis (Perú)			
MZUSP	1059	Perico, Cajamarca	134 + x	3.5
AMNH	28501	"	127 + 13	3.5
"	28502	"	140 + 13	4.0
"	28503	"	126 + 11	3.4
	A. silvestrii (Brasil)			
MZUSP	3286	Garapu, Mt	129 + 11	3.2
"	3367	Xavantina, Mt	124 + 19	3.6
"	6409	Jacaré, Mt	97 + x	3.0
"	6410	"	91 + x	2.8
"	6411	"	109 + x	3.0
"	6412	"	120 + 19	3.1
"	6413	"	85 + 11	2.6
"	6414	"	120 + x	3.5
"	9010	Barra do Tapirapés, Mt	80 + 11	3.6
"	9011	"	82 + 11	3.3
"	9743	Porto Velho, R. Tapirapés, Mt	85 + 11	3.3
"	9757	"	145 + 20	4.3
"	10069	Barra do Tapirapés, Mt	113 + x	3.6
"	12329	"	132 + 17	3.5
"	12330	"	114 + 16	3.5
"	57037	Gurupi de Goiás, Go	162 + x	4.2
	A. slevini (Brasil)			
MZUSP	10913	Manaus, Am	104 + x	2.8
"	60905	Reservas INPA-WWF, Am	118 + x	2.8
"	60906	"	103 + x	2.7
"	66448	"	93 + 14	2.6
AMNH	64921	Manaus, Am	114 + 17	2.9
"	64921 C	"	103 + 15	2.7
"	64921 D	"	102 + x	3.0
"	64921 K	"	82 + x	2.5
"	64921 L	"	105 + x	3.0
"	64921 M	"	112 + x	2.8
"	64921 N	"	60 + 8	2.2
"	64929	"	108 + 17	3.2
"	64930	"	110 + x	3.0

Table 2. (Cont.)

Locality			Length	Head width
AMNH		Manaus, Am		
"	64931	"	104 + 15	2.8
"	64932	"	109 + 16	2.8
"	64934	"	114 + x	2.8
"	64935	"	104 + x	3.1
"	64936	"	104 + x	3.1
"	64937	"	109 + x	2.8
"	64938	"	111 + 15	2.9



Graph 1. Regression of tail length on body length. 1. *A. hastata*. 2, *A. ignatiana*. 3, *A. myersi*. 4, *A. silvestrii*. 5, *A. mitchelli*. 6, *A. nigricauda*. 7, *A. slevini*. 8. *A. munoai*. 9, *A. neglecta*. 10, *A. hogei*. 11, *A. pericensis*. 12, *A. minuta*. 13, *A. miringoera*. 14, *A. leeseri*. 15, *A. medemi*.



Graph 2. Regression of head width on body length. 1, *A. neglecta*. 2, *A. carvalhoi*. 3, *A. pericensis*. 4, *A. silvestrii*. 5, *A. hogei*. 6, *A mitchelli*. 7. *A. slevini*. 8, *A. munoai*. 9. *A. nigricauda*. 10, *A. miringoera*. 11, *A. ignatiana*. 12, *A. minuta*. 13, *A. hastata*.

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Table 3. Regression of tail length on body length

Species	N	R(x)	R(y)	b	a	F	r^2	y'_1	y'_2
carvalhoi	8	82-129	10-16	0.13±0.0083	-0.6±0.84	237.667 ***	0.9757	10.0	16.0
hogei	9	60-125	8-14	0.088±0.0062	2.5±2.07	133.368 ***	0.9501	7.9	13.6
leeseri	8	99-147	9-13	0.078±0.0136	1.3±1.76	33.132	0.8467	9.0	12.8
medemi	11	119-184	10-14	0.064±0.0061	2.7±0.97	111.667 ***	0.9254	10.4	14.6
miringoera	4	66-142	7-13	0.080±0.0064	1.9±0.70	158.473 ***	0.9875	7.2	13.3
mitchelli	5	75-135	11-20	0.13±0.031	1.9±3.54	17.340 *	0.8525	11.6	19.3
munoai	9	58-143	7-18	0.12±0.019	0.1±2.17	40.314 *	0.8521	7.0	17.1
neglecta	4	111-127	13-16	0.12±0.11	0.0	1.094 n.s.		13.1	15.0
pericensis	26	77-153	8-16	0.099±0.0065	0.0±0.80	229.974 ***	0.9055	7.6	15.1
silvestrii	10	80-145	11-20	0.16±0.016	-1.7±1.86	92.21 ***	0.9202	10.8	20.9
slevini	7	60-114	8-17	0.16±0.017	-1.7±0.93	35.558 ***	0.9448	8.0	16.8

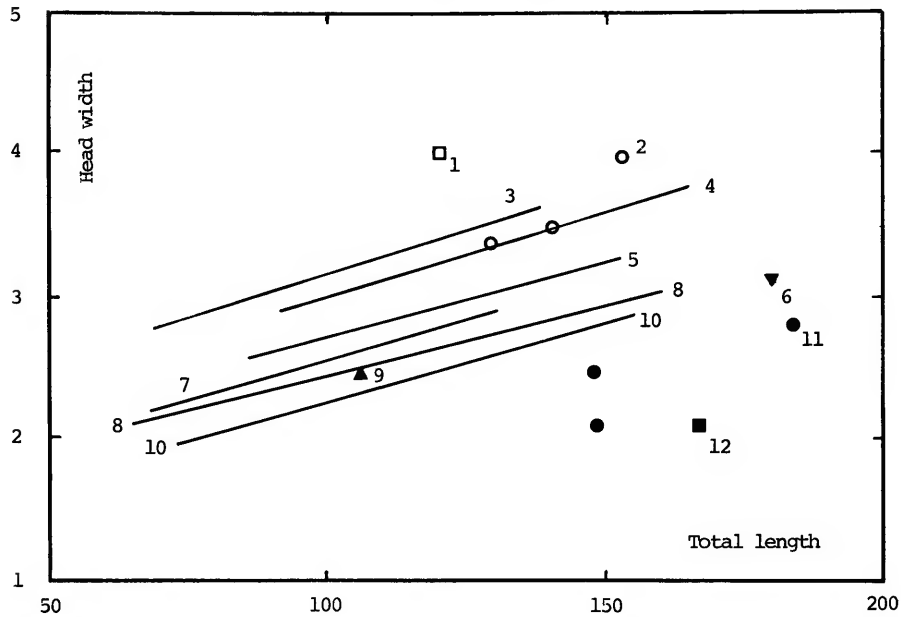
N, individuals in sample. *R (x), R(y)*, ranges of body length and tail length. *b*, coefficient of regression ± its standard deviation. *a*. intercept ± its standard deviation. *F*. ratio of variances (n.s., not sinificant at the 5% level; *, significant at the 5% level; **, at the 1% level; ***, at the 0.1% level). r^2, coefficient of determination. y'_1 y'_2, calculated values of tail length for the extreme values of body length.

Table 4. Regression of head width on body length (conventions as in Table 3)

Species	N	R(x)	R(y)	b	a	F	r^2	y'_1	y'_2
hogei	11	60-125	2.7-3.8	0.013±0.0020	2.06±0.214	36.364***	0.3097	2.81	3.63
miringoera	4	66-142	2.0-2.9	0.012-0.00037	1.21±0.0041	1034.896***	0.9981	1.99	2.88
mitchelli	10	75-162	2.6-3.9	0.012±0.0022	1.68±0.278	30.243***	0.7908	2.59	3.65
munoai	11	58-143	2.1-3.1	0.0091±0.00205	1.69±0.233	19.458*	0.6838	2.22	2.99
pericensis	4	126-140	3.4-4.0	0.037±0.0137	-1.21	7.087 n.s.	0.7800	3.39	3.90
silvestrii	16	80-162	2.6-4.3	0.016±0.0030	1.58±0.342	27.398***	0.6618	2.83	4.12
slevini	20	60-118	2.2-3.2	0.013±0.0027	1.51±0.286	21.327***	0.5423	2.27	3.00
hastata	5	112-149	1.7-2.2	0.013±0.0037	0.22±0.494	12.578*	0.8070	1.70	2.19
ignatiana	5	125-188	2.1-3.1	0.013±0.0034	0.60±1.18	15.784*	0.8403	2.27	3.11

Table 5. Regression of head width on total length (conventions as in Table 3)

Species	N	R(x)	R(y)	b	a	F	r^2	y'_1	y'_2
hogei	9	68-138	2.7-3.8	0.012±0.0023	1.9±0.27	28.664*	0.8037	2.78	3.65
miringoera	4	73-155	2.0-2.9	0.011±0.0004	1.2±0.048	747.980***	0.9973	1.99	2.88
mitchelli	5	86-153	2.6-3.6	0.010±0.0047	1.7	4.692 n.s.	0.6100	2.60	3.29
munoai	9	65-161	2.1-3.1	0.0099±0.0024	1.5±0.30	17.464*	0.7138	2.12	3.06
silvestrii	10	91-165	2.6-4.3	0.012±0.0039	1.9±3.73	8.844*	0.5251	2.92	2.79
slevini	8	68-131	2.2-3.0	0.011±0.0019	1.4±0.22	36.859***	0.8601	2.20	2.92



Graph 3. Regression of head width on total length. 1, *A. carvalhoi*. 2, *A. pericensis*. 3, *A. hogei*. 4, *A. silvestrii*. 5, *A. mitchelli*. 6, *A. minuta*. 7, *A. slevini*.8, *A. munoai*. 9, *A. nigricauda*. 10, *A. miringoera*. 11, *A. ignatiana*. 12, *A. hastata*.

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