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*SERRASALMUS HASTATUS*, A NEW SPECIES OF PIRANHA FROM  
BRAZIL, WITH COMMENTS ON *SERRASALMUS ALTUVEI* AND  
*SERRASALMUS COMPRESSUS* (TELEOSTEI: CHARACIFORMES)

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ABSTRACT.—*Serrasalmus hastatus*, a new species of piranha from Brazil, with comments on *Serrasalmus altuvei* and *Serrasalmus compressus* (Teleostei: Characiformes). *Occ. Pap. Mus. Zool. Univ. Mich.* 730: 1-18, 16 figs. *Serrasalmus hastatus*, a new species of piranha with a highly compressed, deep body is described from the Rio Branco and Rio Negro of Brazil. It is diagnosed by its nearly straight dorsal head profile in combination with a pigmentation pattern that includes thin, vertically elongate spots and thin stripes. *Serrasalmus altuvei* Ramirez and *S. compressus* Jegu *et al.* are compared with the new species, as well as with each other.

Key words: piranha, *Serrasalmus*, Rio Negro, Characidae, Serrasalminae

INTRODUCTION

Jegu and dos Santos (1987) noted a species of *Serrasalmus* characterized by a greatly compressed body, in the lower Rio Negro of Brazil. They identified it as *S. altuvei* Ramirez (1965), originally described from a tributary of the Rio Orinoco in Venezuela. In their paper they described the specimens and compared them with data from the original description by Ramirez. Although they attempted to examine type specimens of *S. altuvei*, those specimens were not available at that time. Subsequently, Jegu *et al.* (1991) described *S. compressus* from the Rio Madeira of Brazil, comparing it with specimens they considered to be *S. altuvei*. We have

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determined, however, that the Rio Negro species is not *S. altuvei* and we describe it here. *Serrasalmus compressus* is a valid species, similar to *S. altuvei* of Venezuela.

## MATERIALS AND METHODS

Counts and measurements follow Fink and Machado (1992) and Fink (1993). Body shape measurements are based on a truss as described by Strauss and Bookstein (1982). Lateral body shape was measured by the use of landmarks taken as coordinate values from digital images using tpsDIG32, ver.1.9 (Rohlf, 2000). The landmarks (Fig. 1, top) include: 1, snout tip; 2, anterior border of epiphyseal bridge (an insect pin was inserted into the top of the cranium to detect the border, and was left in place for digitization); 3, posterior tip of supraoccipital spine; 4, dorsal fin origin, not including anterior modified fin rays; 5, posterior end of dorsal fin base; 6, posterior end of adipose fin base; 7, posterior border of hypurals (identified as the bending axis of the caudal-fin base); 8, posterior end of anal fin base; 9, anal fin origin; 10, pelvic fin insertion; 11, pectoral fin insertion; 12, mandible/quadrato joint (usually marked by an insect pin placed in the middle of the joint); 13, posterior border of maxillary bone; 14, anterior border of orbit; 15, posterior border of orbit; 16, posterior border of operculum. Caliper measures of interorbital width and distance between pectoral fin insertions were also taken.

Euclidean distances,  $D(n)$ , were calculated from the coordinates (Fig. 1, bottom). These are: 1, standard length; 2, snout to epiphyseal bar; 3, snout to pectoral fin; 4, snout to mandible/quadrato joint; 5, epiphyseal bar to supraoccipital spine tip; 6, epiphyseal bar to pectoral fin; 7, epiphyseal bar to mandible/quadrato joint; 8, mandible/quadrato joint to pectoral fin; 9, supraoccipital spine to dorsal fin origin; 10, supraoccipital spine to pelvic fin; 11, supraoccipital spine to pectoral fin; 12, supraoccipital spine to mandible/quadrato joint; 13, pectoral fin to pelvic fin; 14, dorsal fin base; 15, dorsal fin origin to anal fin origin; 16, dorsal fin origin to pelvic fin; 17, dorsal fin origin to pectoral fin; 18, pelvic fin to anal fin origin; 19, posterior end of dorsal fin to posterior end of adipose fin base; 20, posterior end of dorsal fin to anal fin termination; 21, posterior end of dorsal fin to anal fin origin; 22, posterior end of dorsal fin to pelvic fin; 23, anal fin base; 24, posterior end of adipose base to end of caudal peduncle; 25, posterior end of adipose base to anal fin termination; 26, posterior end of adipose base to anal fin origin; 27, end of caudal peduncle to anal fin termination; 28, tip of snout to posterior border of maxillary bone (upper jaw length); 29, eye diameter; 30, tip of snout to posterior border of operculum (head length). Body width

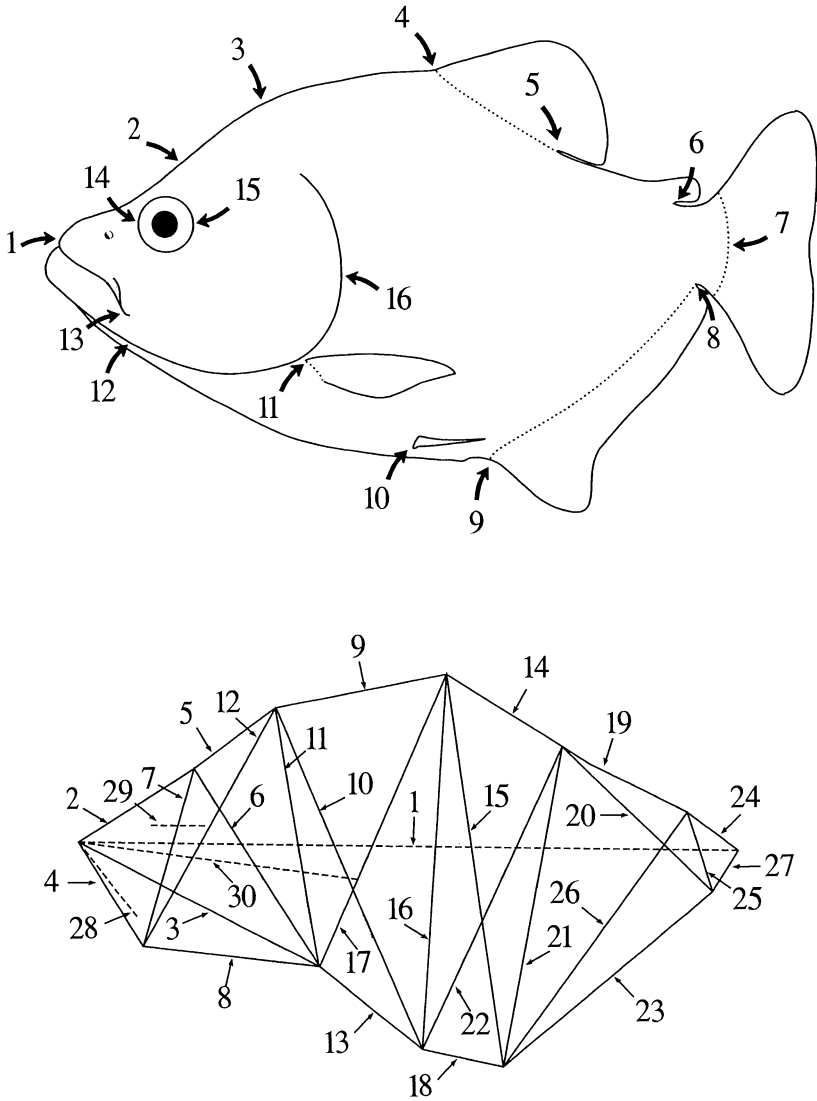


Fig. 1. Data for morphometric analysis. Top: anatomical landmarks for coordinate data. Bottom: distances computed from coordinate data. See text for details.

measurements taken with calipers are represented in the tables as 31, bony interorbital (head) width; and 32, distance between pectoral fin insertions.

Lack of distinct landmarks makes hypotheses of homology untenable for eye diameter, upper jaw length, head length, and interorbital width,

but these were taken in part because of traditional usage. These measures are indicated by dashed lines in Fig. 1. Snout length was calculated for a subset of the specimens, as snout tip to anterior border of orbit (using landmarks 1 and 14).

*Serrasalmus hastatus*, new species

**Holotype.** MZUSP 66893 (1, 154.5mm SL), Brazil, Rio Branco, Marara, beach. Collected by M. Goulding and party, 29 October, 1979.

**Paratypes.** MZUSP 66894 (7, 141.9-163.5mm SL), same locality as holotype. UMMZ 238358 (3, 154.4-155.7mm SL), same locality as holotype. MBUCV-V-29500 (1, 146.4mm SL), same locality as holotype. MZUSP 66896 (1, 135.5mm SL, Brazil, Rio Branco, Marara, beach. Collected by M. Goulding and party, 26 October, 1979. MZUSP 66895 (2, 140.3-152.2mm SL), Brazil, Rio Branco, Maguari, flooded forest, coll. M. Goulding and party, 8 May, 1979. MZUSP 66898 (1, 144.5mm SL), Rio Negro, Anavilhanas, flooded forest, coll. M. Goulding and party, Jan. 1980.

**Diagnosis.** A serrasalmin sensu Machado-Allison (1985) unique in its body shape and color pattern (Figs. 2-4). The profile of the predorsal region is only slightly curved, less so than in other serrasalmins, and this combined with the narrowness of the head and protruding lower jaw, presents a "spear-shaped" head. Color pattern in preservative consists of numerous vertically elongate spots, some combined into thin vertical lines.

**Description.** Morphometric features are summarized in Table 1; meristic features are summarized in Table 2. Pelvic fin rays are invariant (i,5) as are number of neural spines anterior to the first pterygiophore (4) and neither are included in the Table. Pectoral fin ray counts are 14-16 (avg. 14.7). The belly serrae are dorsoventrally elongate and narrow anteroventrally.

The dorsal body profile is straight to slightly concave dorsal to the eyes, then slightly convex to the dorsal fin origin.

Jaw teeth are tricuspid and interlocked, with the middle cusp much the longest, especially on the anterior teeth. The posterior premaxillary tooth is moderately elongated anteroposteriorly (Fig. 5). There are no maxillary teeth and no ectopterygoid teeth were found in the specimens available. Jegu *et al.* (1991) report up to 7 ectopterygoid teeth in specimens of about 60mm SL. The approximately 18 gill rakers on the anterior of the first gill arch are broad and blunt. There is a moderate space between the third infraorbital and the anterior border of the preopercle (Fig. 6).

The anterior and posterior chambers of the gas bladder (Fig. 7) are approximately equal in length. The anterior chamber has three extrinsic



Fig. 2. *Serrasalmus hastatus*, holotype, MZUSP 66893, 154.5 mm SL. Brazil, Rio Branco, Marara.

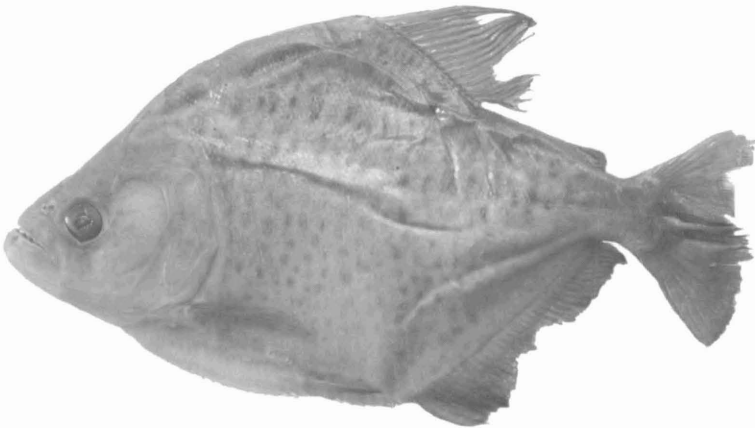


Fig. 3. *Serrasalmus hastatus*, MZUSP 66898, 144.5 mm SL. Brazil, Rio Negro, Anavilhanas. This specimen comes from black water and is more darkly pigmented than the Rio Branco specimens.



Fig. 4. *Serrasalmus hastatus*, uncatalogued, in life. Brazil, Rio Negro, just upriver from Barcelos. Collected and photographed by Michael Goulding. Used with permission.

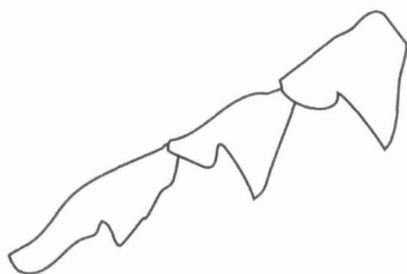


Fig. 5. Lateral view of the posterior premaxillary teeth, *Serrasalmus hastatus* (MZUSP 66894, 156.2mm SL), anterior to right.

muscles attached to the tunica externa, but the anterior two are not well differentiated. The posterior chamber has rows of intrinsic longitudinal muscles dorsally and ventrally. The posterior chamber extends posteriorly to the right of the hemal spines and the anal fin pterygiophores, terminating at approximately the 8th fin ray.

The stomach is large and muscular. There are numerous pyloric caecae extending posteriorly, both dorsally and ventrally, nearly equal to the

Table 1. Morphometric features of *Serrasalmus hastatus*. All but Standard Length are as percent SL.

Character	Distance	Holotype	Mean	Min	Standard	
					Max	Deviation
Standard Length	1	154.5	149.7	140.3	163.5	6.5
Snout-epiphyseal bar	2	14.7	13.7	11.9	14.8	0.9
Snout-pectoral fin	3	27.4	28.2	25.2	30.8	1.5
Snout-jaw joint	4	13.3	13.2	12.2	14.3	0.5
Epiphyseal-supraoccipital	5	26.8	26.5	26.9	20.6	18.0
Epiphyseal-pectoral fin	6	27.4	26.9	24.7	28.5	1.0
Epiphyseal-jaw joint	7	22.0	20.6	19.0	22.0	0.9
Pectoral fin-jaw joint	8	17.0	18.0	15.2	20.0	1.6
Supraoccipital-dorsal fin	9	26.8	26.4	24.4	28.4	1.0
Supraoccipital-pelvic fin	10	54.4	53.5	50.6	56.3	1.3
Supraoccipital-pectoral fin	11	41.8	40.8	39.1	42.9	1.0
Supraoccipital-jaw joint	12	45.8	44.5	41.7	46.3	1.3
Pectoral fin-pelvic fin	13	24.1	23.0	21.0	25.0	1.1
Dorsal fin base	14	21.4	22.6	20.0	24.9	1.3
Dorsal fin origin-anal fin	15	64.4	61.6	58.7	64.4	1.8
Dorsal fin origin-pelvic fin	16	62.0	60.5	56.3	63.3	1.9
Dorsal fin origin-pectoral fin	17	59.3	57.5	55.2	59.3	1.2
Pelvic fin-anal fin	18	18.4	19.3	16.9	21.7	1.4
Dorsal fin termination-adipose fin	19	19.7	18.5	16.6	19.7	1.0
Dorsal fin termination-anal fin t.	20	28.5	27.7	26.7	29.6	0.9
Dorsal fin termination-anal-fin o.	21	51.4	48.2	45.2	51.4	1.8
Dorsal fin termination-pelvic fin	22	55.0	54.1	51.5	57.0	1.6
Anal fin base	23	39.7	38.6	36.4	40.1	1.1
Adipose fin-caudal base	24	12.1	12.3	11.1	13.5	0.7
Adipose fin-anal fin termination	25	12.6	12.8	12.0	13.8	0.6
Adipose fin-anal fin origin	26	49.1	47.1	44.9	49.1	1.3
Anal fin termination-pelvic fin	27	10.3	9.8	9.0	11.0	0.6
Upper jaw length	28	9.8	9.5	8.0	10.8	0.7
Eye diameter	29	6.3	6.7	5.8	7.9	0.5
Head length	30	31.4	31.5	29.9	33.3	1.1
Head width	31	9.1	9.3	8.9	9.7	0.2
Pectoral fin-pectoral fin	32	9.1	8.8	8.4	9.2	0.2

length of the stomach. The intestine extends dorsal to the stomach and is curved as shown in Fig. 8.

**Color in preservative.** See Figs. 2, 3. As with many piranha species, color pattern in *Serrasalmus hastatus* is highly variable; the description below summarizes the most common pattern, then lists some of the variation. Ground color golden brown, darker dorsally, above the lateral midline. Numerous vertically elongate, narrow, short to long dark stripes on the lateral body, more numerous dorsal to the lateral line. These stripes tend to be darker and wider posteriorly on the body. Some

Table 2. Meristic features of *Serrasalmus hastatus*, *S. altuvei* and *S. compressus*.

<b>Vertebrae</b>	<b>36</b>	<b>37</b>	<b>38</b>	<b>Average</b>			
<i>altuvei</i>	10	13	1	36.6			
<i>compressus</i>	3	13	2	36.9			
<i>hastatus</i>	0	9	2	37.2			
<b>Pre-Pelvic Serrae</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>Average</b>
<i>altuvei</i>	1	4	7	8	4	0	19.4
<i>compressus</i>	1	0	5	5	6	2	20.1
<i>hastatus</i>	0	0	2	7	2	0	20.0
<b>Serrae</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>Average</b>		
<i>altuvei</i>	12	13	0	0	7.5		
<i>compressus</i>	0	6	11	2	8.8		
<i>hastatus</i>	4	7	0	0	7.6		
<b>Branched</b>							
<b>Anal Fin Rays</b>	<b>30</b>	<b>31</b>	<b>32</b>	<b>33</b>	<b>34</b>	<b>Average</b>	
<i>altuvei</i>	1	4	11	7	1	32.1	
<i>compressus</i>	4	3	5	3	1	31.6	
<i>hastatus</i>	0	1	2	5	2	32.8	
<b>Branched</b>							
<b>Dorsal Fin Rays</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>Average</b>			
<i>altuvei</i>	7	17	0	15.7			
<i>compressus</i>	12	7	0	15.4			
<i>hastatus</i>	2	7	2	16.0			

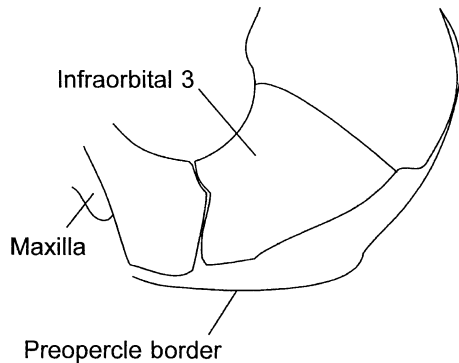


Fig. 6. Diagrammatic lateral view of the left side of the head of *Serrasalmus hastatus*, adult specimen (MZUSP 66894, 156.2mm SL), showing the extent of the space between infraorbital 3 and the preopercle.

specimens have no spotting ventral to the lateral line, but all have numerous scattered melanophores in that area. The paired fins are hyaline; some specimens have melanophores along the anterior pectoral



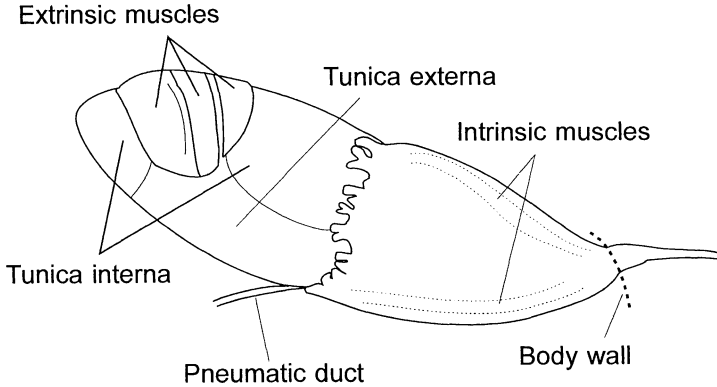


Fig. 7. Semi-diagrammatic view of the gas bladder of *Serrasalmus hastatus* (MZUSP 66894, 156.2mm SL) anterior to left.

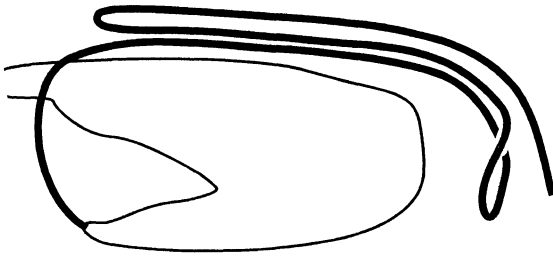


Fig. 8. Stomach and intestinal coiling pattern of *Serrasalmus hastatus* (MZUSP 66894, 156.2 mm SL), anterior to left.

fin rays. The vertical fins are dusky, with melanophores scattered along the fin rays and interradial membranes; in most individuals, there are concentrations of melanophores forming diffuse distal bands. The eye is golden-brown, with a dark vertical band dorsal and ventral to the pupil.

In some specimens the spots are very thin and light but very numerous, sometimes forming only a few stripes. In such individuals the spotting is prominent on the lateral body, including around the belly except at the pectoral fin. In specimen MZUSP 66898 from the Rio Negro (Fig. 3), the entire body is dark brown and pigmentation is darker overall than other specimens. The lateral body has broad, wide stripes, with round to dorso-ventrally ovoid spots; in this specimen the fins are quite darkly pigmented.

**Color in Life.** The entire body is bright silver, with bluish overtones. The eye is bluish silver, with darker grey-blue pigments dorsal and ventral

to the pupil. The vertical fins are hyaline, but with pigment as described in preserved specimens. A living specimen is shown in Fig. 4.

**Distribution.** Examined specimens come from three localities in the Rio Negro drainage (Fig. 9). Both the Marara beach and Maguari flooded forest localities are close together, about 10km upriver from the mouth of the Rio Branco. The living specimen shown in Fig. 4 is from the Rio Negro, just upriver from Barcelos (included on the map). Other materials, not seen by us, deposited in the INPA collections and identified as *Serrasalmus altuvei* presumably represent *S. hastatus*. These are primarily from lower Rio Negro localities but one is from the Rio Uraricoera, a tributary of the Rio Branco, north of Boa Vista; two lots are from Lago Janauaca, adjacent to the Rio Solimoes near Manaus. *Serrasalmus hastatus* is not a common species, as it does not show up with regularity in collections from localities where it is known to occur. Jegu *et al.* (1991) include a map with distributions of specimens they examined of *S. compressus* and *S. hastatus* (as *S. altuvei*).

**Comparisons.** *Serrasalmus hastatus* resembles several species of deep-bodied, compressed *Serrasalmus* that have dorsoventrally elongate belly serrae. These species include *S. altispinis* Merckx *et al.* (2000), *S. altuvei*, *S. compressus*, and *S. geryi* Jegu and dos Santos (1988). A phylogenetic analysis including these species is underway at this time.

*Serrasalmus hastatus* differs from all these species in having a much straighter dorsal head profile and in having thin, vertically elongate spots and stripes. The others species also have more rounded lateral body profiles. *Serrasalmus geryi* has a distinct dark stripe along the predorsal body midline across the mouth, and along the ventral midline of the lower jaw. Compared to *S. altuvei* and *S. compressus*, *S. hastatus* has a longer distance between the epiphyseal bar and the supraoccipital spine (D5, Fig. 10), although there is overlap with *S. compressus*. Also, the distance between the mandibular/quadrante joint and the pectoral fin insertion (D8, Fig. 10) is shorter in *S. hastatus* and serves to distinguish it from *S. altuvei* and *S. compressus*, but with much overlap. Some large adult specimens of *S. altuvei* have faint dorsoventrally extended spots forming short vertical stripes, but these are shorter and much less numerous than the vertical stripes of *S. hastatus*.

**Etymology.** The name is derived from the Latin, *hastatus*, spear-shaped, referring to the pointed and highly compressed snout.

#### A Comparison of *Serrasalmus altuvei* and *S. compressus*

The original misidentification by Jegu and do Santos (1987) of *Serrasalmus hastatus* as *S. altuvei* and the subsequent description of *S.*

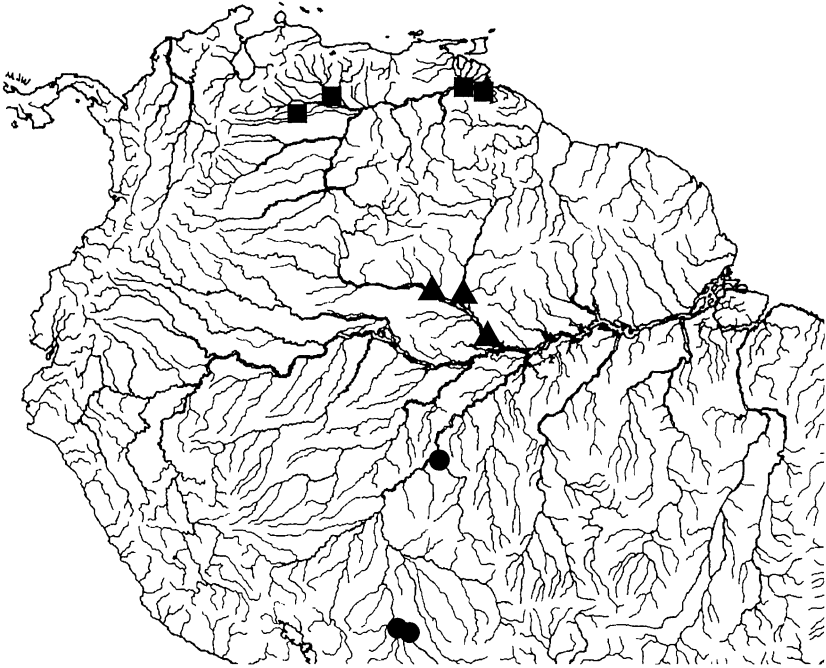


Fig. 9. Distribution of examined specimens of *S. hastatus* (▲), *S. altuvei* (■) and *S. compressus* (●). This includes the site for the specimen of *S. hastatus* in Fig. 4 collected near Barcelos.

*compressus* by Jegu *et al.* (1991) has led to a number of comparisons between *S. hastatus* and other species. But the real *S. altuvei* has not figured into these discussions. Here we take the opportunity to compare *S. altuvei* with *S. compressus*.

*Serrasalmus altuvei* was described in *Evencias*, a privately published journal with very limited distribution. The text is brief and there are no photographs. The figure of the species is a sketch, shown here in Fig. 11. The types of *S. altuvei* were originally deposited in MAC (Ministerio de Agricultura y Cria) collections, curated by A. Fernandez-Yepe. When he left MAC, the collection was moved to an aquacultural station near Caracas, where it was neglected and many specimens were lost or damaged. Curators from MBUCV were able to rescue several lots and among them was one paratype of *S. altuvei* (Fig. 12). We have visited the original collection locality of *S. compressus* and a specimen from that locality is shown in Fig. 13. Inspection of these images and comparison of them with *S. hastatus* clearly indicates that the two are dissimilar, as elaborated

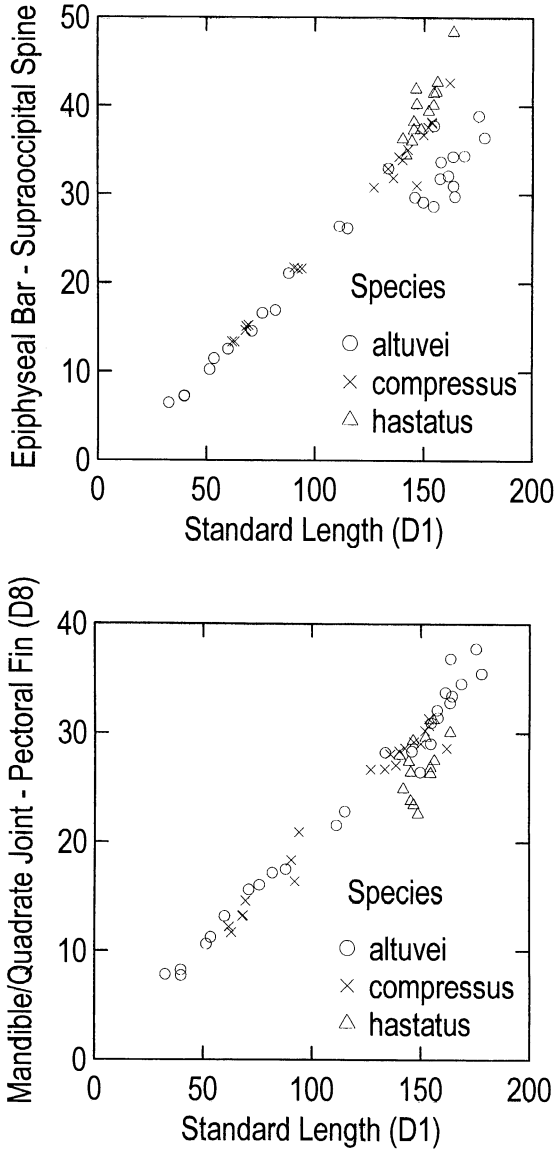


Fig. 10. (Top) Distance between the epiphyseal bar and supraoccipital spine tip (D5) plotted against SL. *S. hastatus* has a slightly longer distance than *S. altuvei* and *S. compressus*. (Bottom) Distance between the mandible/quadrate joint and pectoral fin insertion (D8) plotted against SL. *S. hastatus* has a slightly shorter distance than *S. altuvei* and *S. compressus*. All distances are in mm.

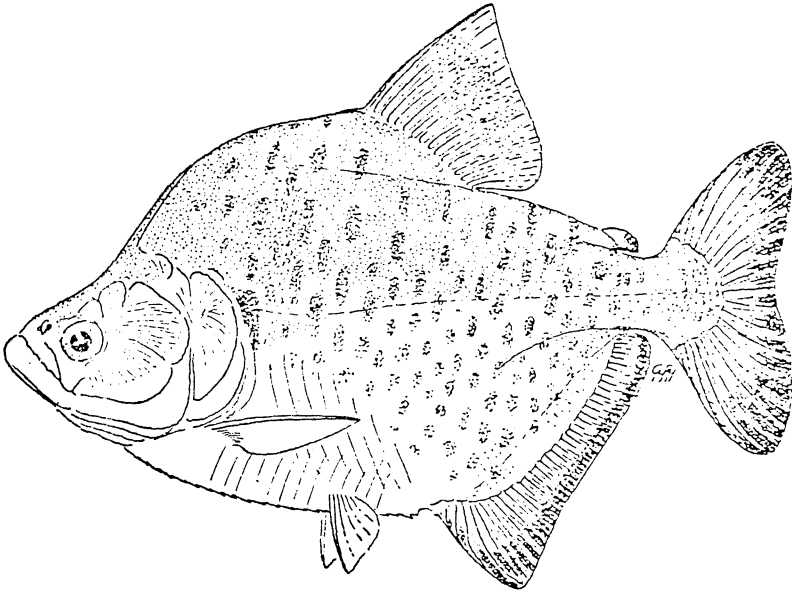


Fig. 11. *Serrasalmus altuvei*, holotype, from original drawing (Ramirez, 1965), 148 mm SL.

in the original description above. Jegu and dos Santos were unable to compare the specimens they identified as *S. altuvei* with the types, which had been misplaced.

We also show type specimens of *Serrasalmus compressus* (Figs. 14, 15) for comparison with those of *S. altuvei*. These two species look rather similar in body shape and color pattern but we find both morphometric and meristic differences between them. Morphometric features that help separate the two include the distance between the epiphyseal bar and supraoccipital spine tip (D5, Fig. 10) and, as shown in Fig. 16, distance between snout tip and epiphyseal bar (D2), distance between epiphyseal bar and mandible/quadrates joint (D7), and head width. In addition, numbers of pre-pelvic and post-pelvic serrae show mean differences, but with overlap (Table 2).

There are other, subtle shape differences that also aid in separation. Among these is the dorsal profile, which in *Serrasalmus compressus* is more concave in the supraorbital region and more convex posterior to the supraoccipital spine than *S. altuvei*. *Serrasalmus compressus* also has a more robust snout laterally than *S. altuvei*. The ventral profile of the belly of many specimens of *S. compressus* ventrally protrudes to a greater extent anteriorly than *S. altuvei*. All of these features are more pronounced in



Fig. 12. *Serrasalmus altuvei*, paratype, formerly MAC-65643, now MB-UCV 12144 (111.2 mm SL).

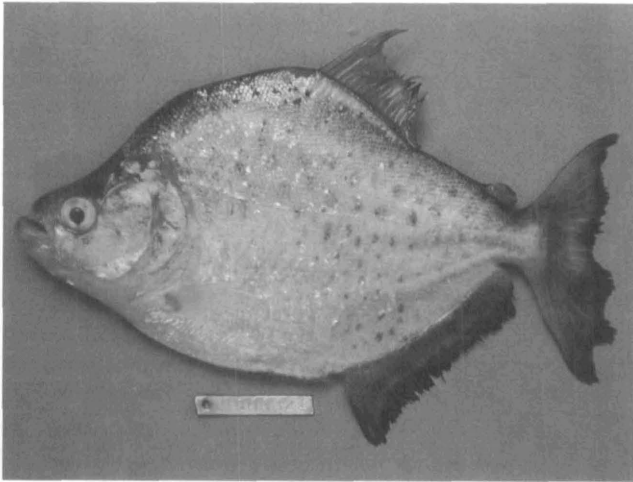


Fig. 13. *Serrasalmus altuvei*, UMMZ 215066, 133.7 mm SL, live specimen collected near the type locality in the Rio San Jose, near the confluence of Rio San Jose and Rio Guariquito. This specimen is shown in color in Fig. 30 of Machado-Allison and Fink (1996).

juveniles than in adults. For example, compare adults in Figs. 13 and 14 with the juveniles in Fig. 15, which shows a distinct head shape in *S. compressus* compared with *S. altuvei*.

Juvenile pigmentation patterns also separate *Serrasalmus compressus* and

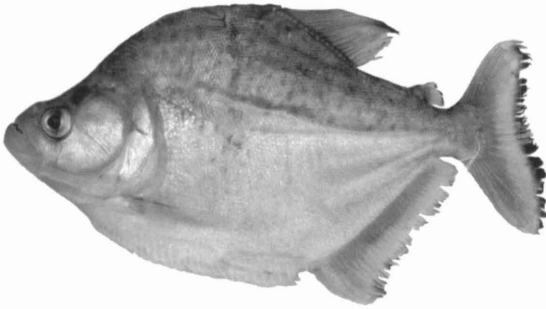


Fig. 14. *Serrasalmus compressus*, paratype, MHNH 1988-1703, 158.3 mm SL. Laguna Mocovi, Rio Mocovi, a tributary of the Rio Mamore.

*S. altuvei*. Young *S. compressus* have larger and denser spots that extend more fully over the ventral body and belly than in *S. altuvei*, where spotting is sparse below the lateral midline (Fig. 15).

Neither *Serrasalmus altuvei* or *S. compressus* are common species. *Serrasalmus altuvei* was described from the Rio Orinoco and is restricted to clear waters of the Venezuelan llanos. It is rare in collections and is apparently rare in the wild. Jegu *et al.* (1991) note that *S. compressus*, apparently restricted to the Rio Madeira and its tributaries, is likewise rare and collected only with great effort.

Material examined of *Serrasalmus altuvei* includes: (all from Venezuela), MBUCV 15848 (3, 32.6-39.8), stream about 500m from mouth of Cano Guarguapo, MO, coll., J. Baskin *et al.*, 1 Nov. 1979. MBUCV 15659 (11, 149.7-177.9), Rio San Jose, El Polvero, GU, coll. A. Fernandez-Yopez. MBUCV 15849 (1, 59.8), Rio Orinoco, small stream near nm 82, TFDA, coll. D. Stewart, 2 Nov. 1979. MBUCV 12144 (1, 111.2; Paratype), Rio San Jose, Rio Guariquito System, El Polvero, GU, coll. M. Ramirez and E. Chacon, Mar. 1960. UMMZ 215066 (4, 75.7-174.7), Rio San Jose, near confluence of Rio San Jose and Rio Guariquito, coll. Machado and Fink, 21 Feb. 1987. MCNG 10075 (2, 51.4-70.9), Rio Apure, Cano Maporal en el puente al lado del Modulo de la UNELLEZ, coll. D. Taphorn and L. Nico, Dec. 1983. MCNG 3619 (3, 53.4-145.9), Rio Apure, Modulos de la UNELLEZ, area adyacente al sur del dique y cano Caicara, coll. D. Taphorn, Feb. 1981. MCNG 11018 (1, 81.8), Rio Apure, Cano Maporal en el puente, coll. D. Taphorn, April 1981.

Material examined of *Serrasalmus compressus* includes:

MHNH 1988-1703 (3, 138.5-161.9), Bolivia, coll. Lauzanne and Loubens, 1985. MHNH 1986-0616 (6 of 8, 61.8-90.4), Bolivia, Rio Mocovi, coll. Lauzanne and Loubens, 1985.

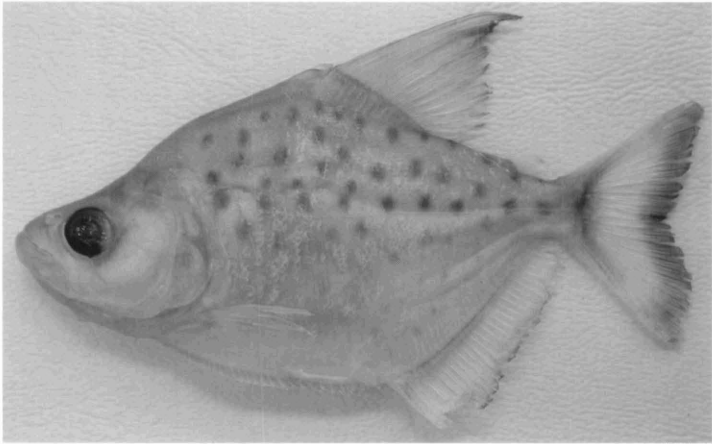
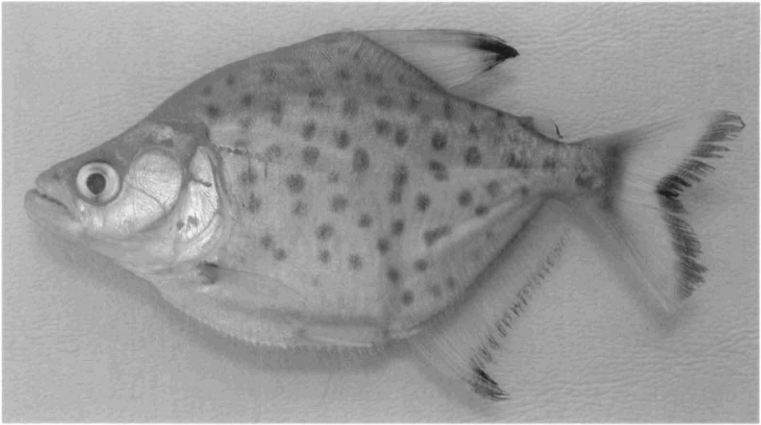


Fig. 15. Top: *Serrasalmus compressus*, paratype, MHNH 1986-0616, 67.9 mm SL.  
Bottom: *Serrasalmus altuvei*, MBUCV 15849, 59.8 mm SL.

MZUSP 66897 (3, 135.9-149.9), Brazil, Rio Madeira, Calama, flooded forest, coll. M. Goulding, May, 1980. MZUSP 66900 (1, 151.9), Brazil, Rio Madeira, Calama, flooded forest, coll. M. Goulding, June, 1980. MZUSP 66899 (3 93.9-146.8), Brazil, Rio Madeira, Calama, flooded forest, coll. M. Goulding, Aug. 1980. UMMZ 238386 (1, 92.1 [2332]), Brazil, Rio Madeira, Calama, flooded forest, coll. M. Goulding, Nov. 1980. UMMZ 238359 (3, 127.1-153.6), Brazil, Rio Madeira, Calama, flooded forest, coll. M. Goulding, Sept. 1980.



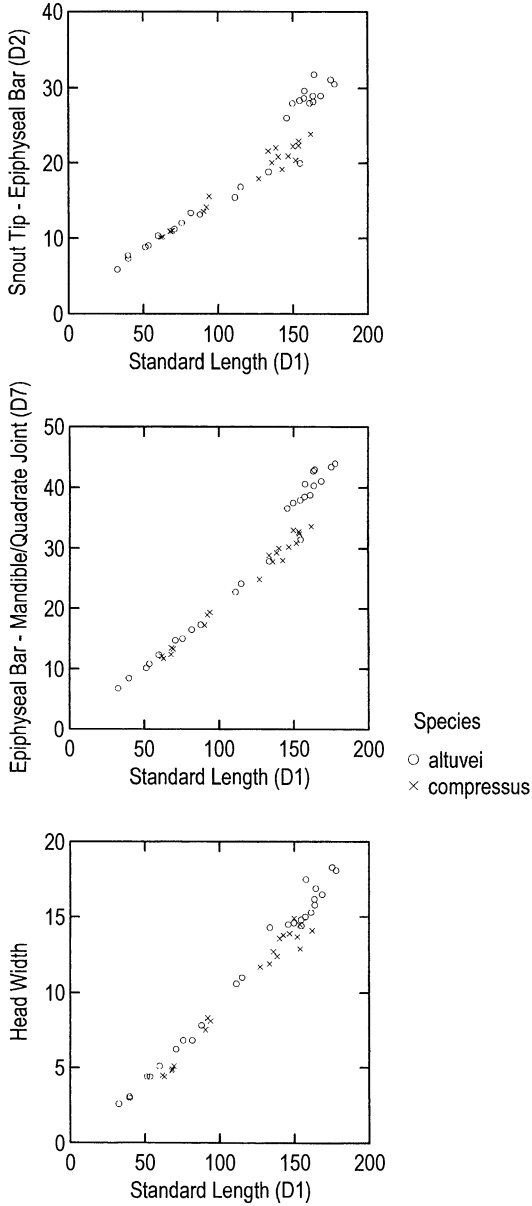


Fig. 16. (Top) Distance between snout tip and epiphyseal bar (D2) plotted against SL. Large specimens of *S. altuvei* have a longer distance than *S. compressus*. (Middle) Distance between epiphyseal bar and mandible/quadrate joint (D7) plotted against SL. Large specimens of *S. altuvei* have a longer distance than *S. compressus*. (Bottom) Head Width in *S. altuvei* and *S. compressus* plotted against SL. Note that *S. altuvei* has a slightly wider head than *S. compressus*. All distances are in mm.

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