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New Species of *Rhynchodoras* from the Río Orinoco, Venezuela, with Comments on the Genus (Siluriformes: Doradidae)

José L. O. Birindelli, Mark H. Sabaj, and Donald C. Taphorn

A new species of proboscoid thornycat, *Rhynchodoras castilloi*, is described from the Río Apure, Orinoco basin, Venezuela. The new species is distinguished from *R. woodsi* (Essequibo and Amazon basins minus Xingu and Tocantins basins) by having a simple gas bladder (vs. each posterior chamber of gas bladder expanded into elongate horn-like diverticulum) and tubercles punctate and abundant (vs. tubercles elongate, dash-like, and sparse). The new species is distinguished from *R. xingui* (Xingu and Tocantins basins) by having all three tympanal scutes weakly developed (vs. second and particularly third well developed, latter with medial carina), midlateral scutes modally 35 per side, range 34–36 (vs. 34, range 33–34), and anterior midlateral scutes relatively shallow, depth about one-fifth (vs. about one-third to one-quarter) of corresponding body depth, with weakly developed dorsal and ventral laminae lacking distinct serrations along posterior margins (vs. dorsal and ventral laminae of midlateral scutes well developed with conspicuously serrated posterior margins). The type species, *R. xingui*, is distinguished from *R. woodsi* by having a simple gas bladder (vs. with two posterior horn-like diverticula), midlateral scutes modally 34 per side, range 33–34 (vs. 35, range 34–37), and anterior midlateral scutes with conspicuous medial thorns (vs. thorns absent or weak, procumbent). Notable features of the genus are discussed, including jaw and gas bladder morphology, development of anterior nuchal plate, presence of multiple pores in skin beneath postcleithral process, and tubercle morphology and distribution. Shared derived characters suggest a sister-group relationship between *Rhynchodoras* and *Rhinodoras* plus *Orinocodoras*.

Se describe una especie nueva de bagre sierra con trompa probóscide, *Rhynchodoras castilloi*, del río Apure, cuenca del río Orinoco en Venezuela. La nueva especie se distingue de *R. woodsi* (de las cuencas de los ríos Essequibo y Amazonas con la excepción del ríos Xingu y Tocantins) en tener la vejiga de gas con una cámara simple y sencilla (vs. cámara posterior dividido y alargada en forma de cuernos de vaca) y en poseer tubérculos en forma de puntos redondos abundantes (vs. solo unos pocos tubérculos alargados en forma de guión). La nueva especie se distingue de *R. xingui* (del ríos Xingu y Tocantins) en tener las tres placas dermales timpanales pobremente desarrolladas (vs. la segunda y especialmente la tercera bien formadas, y ese ultimo con un gancho medial) escudetes mediolaterales modalmente 35 en cada lado del cuerpo, rango 34–36 (vs. 34, rango 33–34), y escudetes mediolaterales anteriores relativamente mas cortos verticalmente, su altura solo como la quinta parte (vs. la tercera a cuarta parte) de la profundidad correspondiente del cuerpo, con láminas (alas) dorsal y ventrales pobremente desarrolladas, sin el margen posterior conspicuamente aserrado (vs. laminas dorsal y ventrales de los escudetes mediolaterales bien desarrolladas y con el margen posterior conspicuamente aserrado). La especie tipo, *R. xingui*, se distingue de *R. woodsi* en tener una vejiga de gas simple (vs. con dos cuernos posteriores), los escudetes mediolaterales modalmente 34, rango 33–34, en cada lado del cuerpo (vs. 35, rango 34–37), y los escudetes mediolaterales anteriores con ganchos obvios en el medio (vs. ganchos ausentes o debiles y procumbentes). Se describen los aspectos notables del género, incluyendo la morfología de la mandíbula y la vejiga de gas, el desarrollo de la placa nucal anterior, la presencia de numerosos poros en la piel por debajo del proceso postcleitral, y la morfología y distribución de los tubérculos. Los caracteres compartidos derivados sugieren una relación filogenética de hermanas entre *Rhynchodoras* y *Rhinodoras* más *Orinocodoras*.

THE rare and bizarre genus *Rhynchodoras* was described by Klausewitz and Rössel (1961) based on two specimens from the upper Rio Xingu (Amazon basin), Brazil. Its ichthyological discovery dates back over 150 years and is attributable to the famous naturalist–explorer Alfred Russel Wallace. From 1850–1852 Wallace traveled up the Rio Negro to the sources of this

river and the Río Orinoco (Wallace, 2002), and he took notes on and prepared detailed drawings of the fishes collected. Although his collections were lost at sea, many of his notes and illustrations survived. Wallace's drawing of a species of *Rhinodoras* (originally labeled ''Doras'' and numbered 175) include the following comments: ''In a small specimen very closely resembling this [*Rhinodoras*] in all other particulars the head is higher towards the snout which turns down and is produced in a sort of proboscis which is received in a sort of trough formed by the produced lower lip—the teeth are similar but are also continued in a row round the margin of each lip. Perhaps this is the male and the above [*Rhinodoras*] being the female.'' (Wallace, 2002:332). This description was certainly based on a specimen of *Rhynchodoras*, the only doradid genus in which the snout ends in a vertically oriented, stiffened proboscis formed by the forceps-like upper and lower jaws.

Rhynchodoras includes two nominal species: the type species *R. xingui* described by Klausewitz and Rössel (1961) from the upper Rio Xingu, Brazil, and *R. woodsi* described by Glodek (1976) from the upper Amazon basin, Ecuador. The genus is diagnosed from other Doradidae by its modified jaws forming a vertical proboscis-like bill, relatively small eyes (diameter 5.6–8.6% of head length), dorsal-fin spine with proximal teeth retrorse, and ventral surface of coracoid without bony crest separating muscles used to move the pectoral-fin spine (i.e., *abductors superficialis* and *arrector ventralis*). *Rhynchodoras* is also distinguished by a number of non-exclusive characteristics: head, body, and fins variably roughened with minute tubercles, adipose fin thick and elongate (continuing anteriorly more or less to midpoint between posterior base of dorsal fin and that of adipose fin), presence of bony plates along the dorsal and ventral midline of caudal peduncle (''modified fulcra'' of Eigenmann, 1925:336), and absence of anterior nuchal plate in adults (not confirmed for *R. xingui*).

Bottom trawling in the channels of large rivers (e.g., Calhamazon Project led by John Lundberg) has obtained specimens of *Rhynchodoras* as deep as 35 m in the Rio Purus. These recent collections in the Amazon basin and similar efforts in the Orinoco have yielded a great deal of new material that has uncovered the presence of a third species. This paper describes a new species of *Rhynchodoras* from the Orinoco basin, discusses the taxonomy, morphology, and phylogenetic relationships of the genus, and provides a key to the three nominal species.

Materials and Methods

Measurements were made to the nearest 0.1 mm using dial calipers; methodology and terminology follow Sabaj (2005) with the following additions and exceptions: head length = distance from snout tip to dorsal-most point of gill opening; body depth at anal-fin origin = vertical distance through anal-fin origin to dorsal margin of adipose fin; caudal-peduncle length = distance from posterior base of anal fin to vertical through posterior margin of hypural plates (same point to which SL is taken); dorsal-spine length = distance from point on spine even with dorsal margin of body to distal tip when erect; snout length = from tip of snout to anterior margin of iris; eye diameter = horizontal diameter of iris (depigmented skin surrounding eye excluded); opercle width = distance between dorsal-most points of gill openings; nuchal shield width = minimum width of nuchal shield; maxillary-barbel length = from inferior base of barbel (where it meets labial tissue) to distal tip; mental barbel lengths = from base of inner (or outer) mental barbel to distal tip. Standard length (SL) is expressed in mm. All other measurements are expressed as percentage of SL, except subunits of head (expressed as percentage of head length).

Midlateral scute counts were taken on the left side of the body and began with the infranuchal (scute attached dorsally to posterior nuchal plate and internally to first rib). Osteological counts (i.e., branchiostegal rays, pleural ribs, and vertebrae) were restricted to cleared-and-stained specimens (abbreviated CS) prepared according to the procedures of Taylor and Van Dyke (1985). Vertebral counts included all vertebrae with compound caudal centra (PU1 + U1) counted as a single element. Museum abbreviatons follow Leviton et al. (1985) with the addition of MEPN for Museo de Zoología, Departamento de Ciencias Biológicas, Escuela Politécnica Nacional, Quito, Ecuador.

Rhynchodoras castilloi, new species

Figure 1, Table 1

Holotype.—MCNG 54510, 79.8 mm, Venezuela: Barinas: Caño Bravo, Apure–Orinoco Dr., about 60 km west-northwest of San Fernando de Apure, 8°0′N, 67°59′W, 7 March 2001, O. Castillo, G. Cortes, J. Escalona, and C. Montaña.

Paratypes.—Venezuela: Apure: MCNG 45977, 1, Río Apure, Orinoco Dr., in front of Las Vegas, downstream from airport in San Fernando de Apure, 29 Aug. 1986, O. Castillo et al., OC86-01; INPA 25826, 2, 31.5–32.5 mm, Caño Bucaral, Arauca–Orinoco Dr., south of San Fernando de

Fig. 1. Lateral, dorsal, and ventral views of *Rhynchodoras castilloi*, MCNG 54510, holotype, 79.8 mm SL (scale bar equals 1 cm). Photos by M. Sabaj.

TABLE 1. MORPHOMETRIC DATA FOR *Rhynchodoras castilloi*, NEW SPECIES.

	Holotype	*n*	Mean	Range	SD
Standard length (mm)	79.8	15	51.5	34.1–79.8	
Percentages of SL					
Predorsal distance	36.8	14	36.7	34.5–40.5	1.52
Prepectoral distance	26.6	14	25.6	24.0–28.1	1.1
Head length	30.1	14	29.0	27.7–30.5	0.76
Body depth at dorsal-fin origin	23.1	14	23.1	21.7–24.4	0.79
Body depth at anal-fin origin	17.2	14	17.6	16.6–19.4	0.8
Depth of caudal peduncle	6.1	14	6.5	6.1–7.0	0.24
Length of caudal peduncle	17.9	14	18.6	17.2–19.9	0.87
Dorsal-fin spine length	19.6	14	20	19.2–21.1	0.64
Pectoral-fin spine length	19.7	14	22.3	19.7–24.8	1.57
Anal-fin base length	12.7	14	13.3	12.2–14.7	0.84
Adipose-fin base length	25.1	14	24.2	19.0–27.0	1.99
Depth of the tenth midlateral scute	5.1	14	5.3	4.6–6.2	0.4
Percentages of HL					
Snout length	53.8	14	52.8	48–56.1	1.88
Eye diameter	7.5	14	7.9	6.6–8.6	0.64
Interorbital length	16.7	14	19.2	16.7–21.3	1.64
Opercle width	45.8	14	52.1	45.8–56.8	2.54
Nuchal shield width	25.4	14	28.6	25.4–33.1	2.02
Cleithral width	67.9	14	71.7	67.9–76.7	2.89
Mental barbel length	30.4	14	35.0	30.3–40.2	2.99

Apure, 7°37′6″N, 67°36′54″W, 9 March 2005, O. Castillo et al.; MCNG 52609, 11, 29.5–34.8 mm, MHNLS 18844, 2, 29.3–35.9 mm, UF 162301, 2, 31.3–32.5 mm, same data as INPA 25826. Barinas: ANSP 181181, 3, 47.0–56.9 mm, AUM 44237, 1, 51.6 mm, FMNH 117222, 2, 47.2–63.3 mm, MBUCV 32900, 2, 41.3–58.0 mm, MCNG 49338, 2, 34.1–41.7 mm, MCNG 49301, 2, and MZUSP 88604, 2, 39.1–60.6 mm, 1 CS, 45.5 mm, same data as holotype; MCNG 49400, 1, 47.6 mm, same locality as holotype, 29 March 2001, G. Cortes and J. Escalona; MCNG 49465, 1, same locality as holotype, 31 March 2001, G. Cortes and J. Escalona.

Non-type material.—Venezuela: Apure: MBUCV 15212, 1, Río Apure, Orinoco Dr., in front of the Fluvial Command of National Guard in San Fernando de Apure, 15 May 1985, O. Castillo, D. Taphorn, and L. Nico; MCNG 54511, 1, Río Apure, Orinoco Dr., San Fernando de Apure, 15 Feb. 1982, L. Astudillo, N. Ortia, and P. Jiménez, MAC-II-82-3; MCNG 54512, 1, Río Apure, Orinoco Dr., in front of Jarina, 18 June 1983, F. Provenzano, O. Castillo, L. Astudillo, C. Marrero, and D. Arana; MCNG 54513, 1, Río Apure, Orinoco Dr., in front of Jarina Lagoon, 14 May 1985, O. Castillo, D. Taphorn, and L. Nico.

Diagnosis.—*Rhynchodoras castilloi* (Fig. 1) is distinguished from *R. xingui* (Fig. 2A) by having all three tympanal scutes weakly developed (vs. second and particularly third well developed, latter with medial carina), midlateral scutes 34 (n = 2), 35 (10), 36 (2) (vs. 33 [1] or 34 [3]), and anterior midlateral scutes relatively shallow, depth about one-fifth of corresponding body depth, and with dorsal and ventral laminae weakly developed, lacking distinct serrations along posterior margins (vs. depth about one-third to one-quarter of corresponding body depth, and dorsal and ventral laminae well developed with conspicuously serrated posterior margins). *Rhynchodoras castilloi* is distinguished from *R. woodsi* (Fig. 2B) by having a simple swim bladder (Fig. 3B; vs. each posterior chamber of gas bladder expanded into elongate horn-like diverticulum, Figs. 3C, 3D), and tubercles punctate and abundant (vs. tubercles elongate, dash-like, and sparse).

Description.—See Table 1 for morphometric data. Body elongate, moderately compressed, greatest depth at dorsal-fin origin, gently tapering to slender caudal peduncle. Ventral surface weakly flattened to somewhat rounded (convex). Head elongate, laterally compressed, dorsal profile evenly oblique from dorsal spine to posterior nares, then curving abruptly downward as bluntly rounded snout that continues below ventral profile of head as vertically oriented premaxillae. Eyes very small (diameter 6.6–8.6% of head

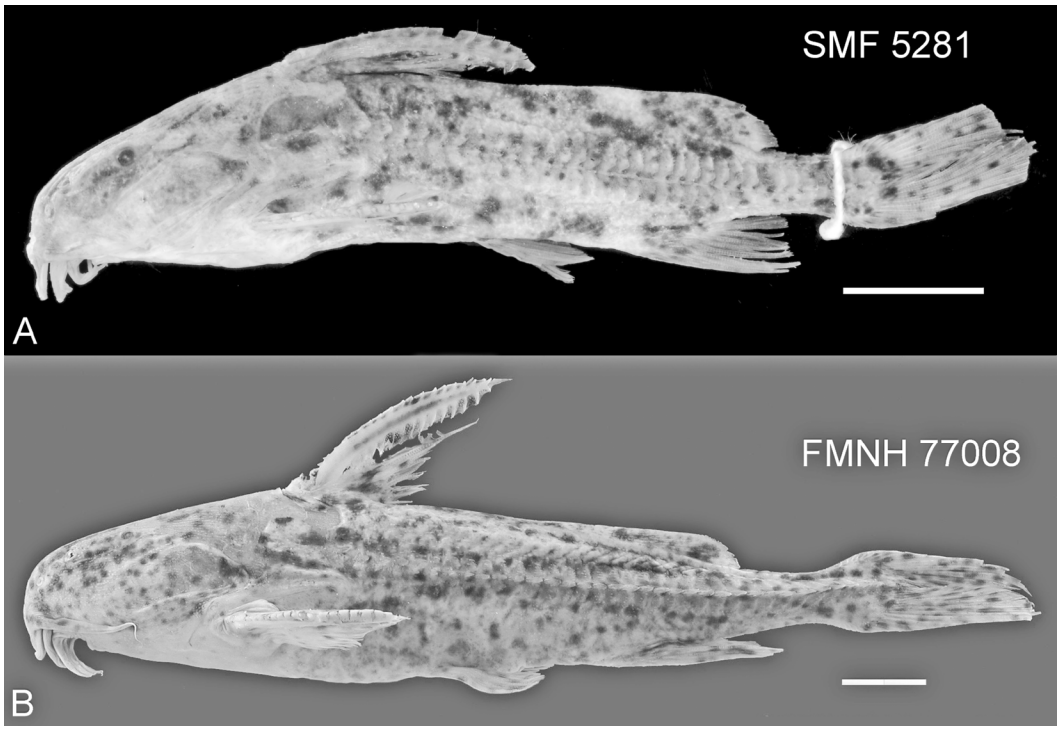

Fig. 2. Lateral views of previously described *Rhynchodoras*. (A) *R. xingui*, SMF 5281, holotype, 63 mm SL; (B) *R. woodsi*, FMNH 77008, holotype, 110.4 mm SL (scale bar equals 1 cm). Photos by S. Traenkner and M. Littmann, respectively.

length), covered by skin, positioned dorsolaterally and slightly anterior to midpoint between snout tip and dorsal-spine origin. Jaws elongate, vertically oriented, opening downward with long, narrow gape. In lateral view, premaxillae more or less straight, dentaries gently curved posteriorly away from premaxillae and finishing even with or slightly more ventral than dentaries (premaxilla length 88–100% of dentary length). In ventral view, lower jaw trough-shaped, opening towards planar upper jaw to form a hemicircular channel. Both jaws with tooth patches completely fused; small acicular teeth arranged in a series of parabolic rows decreasing in size and concentric with outer margins of jaws. Maxilla small, located aside base of premaxilla and supporting maxillary barbel. Labial tissue thick and fleshy, particularly around lower jaw.

Anterior and posterior nares surrounded by short tubular skin; anterior nares about equidistant between snout tip and posterior nares; posterior nares larger than anterior, located more or less at midpoint between snout tip and center of eye. Cephalic shield with shallow yet distinct medial groove that begins at or just posterior to transverse plane through anterior nares and finishes at posterior margin of middle nuchal plate (groove usually with brief hiatus at middle of supraoccipital). Single interorbital fontanel elongate, narrow oval shape, bordered by frontals posteriorly and laterally and mesethmoid anteriorly. Nuchal foramina absent. Anterior nuchal plate absent in cleared-and-stained adult (45.5 mm SL) leaving straight transverse suture between middle nuchal plate and supraoccipital (condition as in *R. woodsi*, Fig. 4A). Epioccipital with posterior process long and narrow, but not reaching infranuchal scute (tip finishes below center of tympanal area). Nuchal portion of cephalic shield transversely arched, triangular roof-shape in cross-section. Eight branchiostegal rays. Nine pairs of ribs, first pair conspicuously larger than others and laterally attached to medial face of infranuchal scute. Forty-one vertebrae, sixth and seventh fused into complex vertebrae.

Three pairs of barbels. Maxillary barbel simple, without fimbriae, but with narrow tapering flap along medial margin imparting dorsoventrally flattened shape to entire structure; surface with small papillae; distal tip reaching or falling just short of ventral-most point of gill opening. Mental barbels simple, inserted immediately posterior to base of vertically oriented dentary;

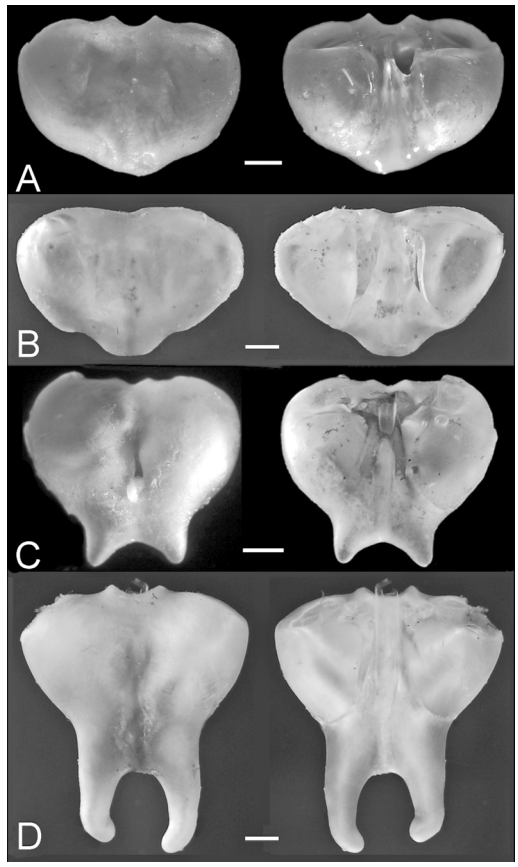

Fig. 3. Gas bladder morphology in *Rhynchodoras* (left column ventral view, right column dorsal view). (A) *R. xingui*, SMF 5282, paratype, 44.5 mm SL; (B) *R. castilloi*, ANSP 181181, paratype, 58.3 mm SL; (C) *R. woodsi*, ROM 62601, 44.2 mm SL; (D) *R. woodsi*, ANSP 181042, 72.5 mm SL (scale bar equals 1 mm).

proximal portions of mental barbels conjoined to point slightly beyond terminus of dentary; inner mental barbel finishing slightly beyond outer.

Postcleithral process narrow, elongate with pointed tip (lanceolate shape); surface flush with body (margins inconspicuous). Ventral portion of pectoral girdle (including posterior coracoid processes) not exposed, covered with skin; posterior coracoid processes short, extending to slightly beyond insertion of pectoral fin. Pectoral fin with elongate slit-like axillary pore. Skin beneath entire length of postcleithral process perforated with numerous smaller round pores.

Dorsal fin I,6; pectoral fin I,8; pelvic fin i,6; anal fin iii–iv,8–9; caudal fin i,7+8,i. Dorsal-fin origin located at about one-third body length from snout tip. Dorsal-fin spine strong, laterally compressed, and gently curved backward over entire length with distal cartilaginous (break-away) tip. Anterior margin of dorsal spine with moderate teeth; proximal teeth small, crowded, weakly retrorse; teeth becoming larger, well-spaced, and more antrorse distally. Posterior margin of dorsal spine with strong, well-spaced, retrorse teeth larger than those along anterior margin. Bony tip of adpressed dorsal fin reaches to slightly beyond vertical through pelvic-fin origin. Pectoral-fin spine strong, dorsoventrally flattened, gently curved backward along anterior margin with distal cartilaginous tip (spine length equal to or slightly greater than that of dorsal spine). Anterior margin of pectoral spine with moderate teeth becoming slightly larger and more antrorse distally; posterior margin with strong retrorse teeth larger than those along anterior margin. Pelvic fin triangular with weakly rounded tip and relatively straight posterior

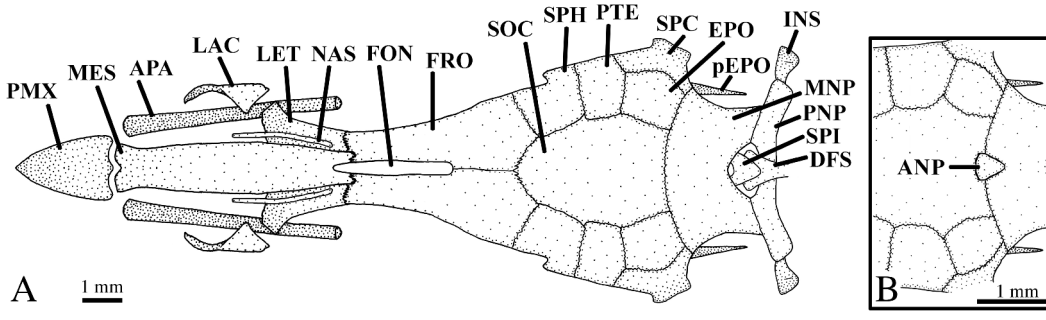

Fig. 4. Dorsal view of neurocranium in *Rhynchodoras woodsi*. (A) Adult, MZUSP 57316, 44.7 mm SL, anterior nuchal plate absent; (B) juvenile, MZUSP 56872, 23.1 mm SL, anterior nuchal plate present. ANP = anterior nuchal plate, APA = autopalatine, DFS = dorsal-fin spine, EPO = epioccipital, FON = anterior cranial fontanel, FRO = frontal, INS = infranuchal scute, LAC = lacrimal, LET = lateral ethmoid, MES = mesethmoid, MNP = middle nuchal plate, NAS = nasal, pEPO = epioccipital process, PMX = premaxilla, PNP = posterior nuchal plate, PTE = pterotic, SOC = supraoccipital, SPC = supracleithrum, SPH = sphenotic, SPI = dorsal-locking spine.

margin when extended; origin near midpoint of body, slightly posterior to vertical through tip of adpressed pectoral spine. Anal fin prominent, triangular with distal margin straight when extended and vertical to body axis (margin appearing weakly emarginate when fin partially folded); first branched ray usually longest (length greater than fin base). Caudal fin distinctly forked with moderately pointed lobes; lower lobe slightly larger than upper. Upper and lower procurrent caudal-fin rays grading into a series of flat, laterally expanded and weakly overlapping plates; dorsal plates finish at or near base of adipose fin and ventral plates finish slightly before anal fin. Total count of dorsal procurrent rays and plates 17–20 (mode 18 and 19); total count of ventral procurrent rays and plates 18–21 (mode 18). Adipose fin with long thick base, moderately deep and tapering anteriorly as fleshy keel to point slightly posterior to tip of adpressed dorsal spine; distal free margin thin and rounded.

Head, body, and fins covered by minute tubercles. Tubercles most abundant on dorsal portions of head and body and on adipose fin. Tubercles almost always punctate, appearing as minute dots (one specimen with a few tubercles appearing as longer dashes).

Lateral line ossified with complete series of scutes. First three scutes (tympanal, situated between nuchal shield, postcleithral process, and infranuchal scute) very small and inconspicuous, without medial thorns in adults (third tympanal scute may have medial thorn in small juveniles). Infranuchal scute (first midlateral scute) tall, without medial thorn in adults (thorn sometimes present in juveniles). Infranuchal scute contacting posterior nuchal plate dorsally and first rib internally, but not contacting postcleithral process ventrally. Postinfranuchal midlateral scutes taller than wide, each with distinct medial thorn (thorns largest on caudal peduncle), and shallow dorsal and ventral laminae (wings) lacking conspicuous serrations along posterior margins; depth of scutes nearly uniform (becoming slightly shallower posteriorly), covering about one-fifth of body depth anterior to anal-fin origin. Midlateral scutes (including infranuchal) per side: 34 (n = 2), 35 (10), or 36 (2).

Gas bladder (Fig. 3B) with abbreviated cordiform shape (width slightly greater than length), reduced size (posterior chambers smaller than anterior chamber), and occupying relatively small portion of body cavity. Posterior chambers without terminal horn-like diverticula.

Coloration in alcohol.—Dorsal and lateral surfaces of head and body with light brown ground color and heavily mottled with numerous dark brown spots small to moderate in size; mottling stronger on dorsal sides above midlateral scutes (Fig. 1). Dark mottling sometimes loosely patterned (particularly in juveniles), forming three wide incompletely pigmented bars on sides: first below dorsal fin (finishing midlaterally), second below adipose fin (finishing at anal-fin base), and third on caudal peduncle. First and second bars joined dorsally and laterally along dorsal laminae (wings) of midlateral scutes, leaving relatively pale lenticular patch on dorsal lateral side (above pelvic fin). Second bar continues dorsally across central portion of adipose-fin base (anterior-most base and distal free lobe of adipose fin relatively pale). Pale chevron (V-shaped saddle) on posterior margin of nuchal shield (middle and posterior nuchal plates) straddling anterior dorsal-fin base. Ventral surfaces of head and body either completely pale (some juveniles) or with few brown spots scattered on abdomen and sometimes gular region. Most specimens with a conspicuous dark oblique streak immediately below eye along infraorbitals from lacrimal to sphenotic bones. Maxillary barbels pale with dark brown spots near base; mental barbels completely pale or sometimes with a few light brown spots near base.

All fins with pale yellow ground color and highly mottled with dark brown spots, particularly in adults. Dark mottling heaviest on basal portions of dorsal, paired, and anal fins, becoming less pronounced distally (often leaving pale margin). Caudal fin darkly mottled, often with wide dark crescent-shaped vertical band on base (sometimes bordered posteriorly by a narrower pale band); central portions of upper and lower lobes mottled, distal margins relatively pale.

Distribution and ecology.—Known only from a few sites in the middle to lower Río Apure (Orinoco basin) in the llanos region of Barinas and Apure states, Venezuela (Fig. 5). All specimens were collected by bottom trawling. Carvajal (2005) reported diet composed completely of Trichoptera for two specimens.

Etymology.—Named in honor of Venezuelan biologist Otto E. Castillo G., who collected much of the type material, for his lifelong dedication to the study and stewardship of his country's rich diversity of freshwater fishes.

Discussion

Taxonomic comments on Rhynchodoras.—Klausewitz and Rössel (1961) proposed the genus *Rhynchodoras* for their new species, *R. xingui*

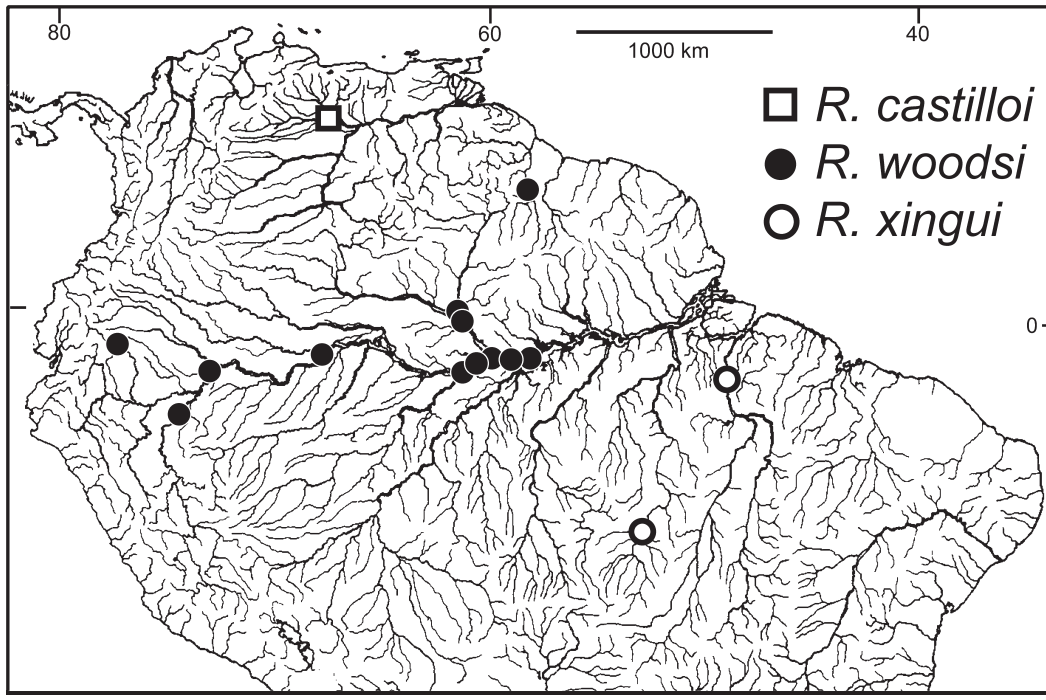

Fig. 5. Distributions of species of *Rhynchodoras*.

(Fig. 2A), based on two specimens (SMF 5281, SL 63 mm and SMF 5282, SL 45 mm) collected by anthropologist and fish hobbyist Harold Schultz from the upper Xingu basin, Brazil (Amazon drainage, precise locality not known, Fig. 5). They diagnosed the genus on the basis of its unique jaw morphology and a number of other features including head shape, eye size, fin and barbel morphology, midlateral scutes, and caudal-peduncle plates. The species was then diagnosed on the basis of its jaw morphology and coloration. Two additional specimens of *R. xingui* (INPA 26540) were recently discovered in a large collection of *Rhinodoras* from the lower Rio Tocantins, Brazil.

Glodek (1976) described a second species, *Rhynchodoras woodsi* (Fig. 2B), from the Marañon basin (Amazon drainage), Ecuador (Fig. 5). Glodek (1976:43–44) rediagnosed the genus on the sole basis of its ''forcep-like'' jaws. Although Glodek (1976:45) did not examine the types of *R. xingui*, he distinguished *R. woodsi* on the basis of its ''smaller eye, 16.4–24 in head length (vs. 12.5–13 in *R. xingui*), dentary projecting ventrally past premaxillary by slightly more than one eye diameter (vs. of approximately equal length in *R. xingui*)'', and two tympanal scutes (vs. three in *R. xingui*).

Two of the diagnostic characters reported by Glodek (1976) are not reliable for separating *R. xingui* and *R. woodsi*. The relative lengths of the jaws vary in both *R. woodsi* and *R. xingui* (e.g., jaws nearly equal in holotype vs. dentary projecting ventrally past premaxilla in paratype). Glodek (1976) also reported two tympanal scutes in *R. woodsi*. All specimens examined here have three tympanal scutes (the first is small and often covered with skin in all three species).

The difference in eye size does appear to distinguish the two Amazonian species. Specimens of *R. woodsi* examined here have a smaller eye: diameter 5.6–7.5% of head length (n = 23) vs. 8.3% in paratype of *R. xingui* (our measure) or 7.65–8% (as reported by Klausewitz and Rössel, 1961), and 8.0–8.2% in two specimens from the Tocantins. The number of midlateral scutes may also distinguish specimens of *R. woodsi* and *R. xingui*. Specimens of *R. woodsi* examined here have 34 (n = 3), 35 (13), 36 (10), or 37 (1) midlateral scutes (including infranuchal), whereas the four specimens of *R. xingui* have 33 (1) and 34 (3). The best character for separating the two Amazonian species is the morphology of the gas bladder: simple, without posterior diverticula in *R. xingui* (Fig. 3A) vs. each posterior chamber expanded into elongate horn-like diverticulum in *R. woodsi* (Figs. 3C, 3D).

Comments on Rhynchodoras *morphology.*—The complexity of gas bladder morphology in doradids was noticed early by Kner (1853) who

introduced six new species on the sole basis of illustrations of disembodied gas bladders. Later, Eigenmann (1925) gave special attention to gas bladder morphology in his remarkable monograph of Doradidae, and used it to propose a new genus, *Hoplodoras*. Risso and Morra (1964) also used gas bladder morphology to distinguish their new genus and species *Parapterodoras paranensis*. In both of these cases, however, the reported differences in gas bladder morphology are attributable to ontogenetic change (Higuchi, 1992; pers. obs.). Nevertheless, gas bladder morphology among doradids can be diagnostic at the level of genera (Eigenmann, 1925; Sabaj, 2005) and species, as it is in *Rhynchodoras*, even when ontogenetic changes are taken into account.

The gas bladder is reduced in all three *Rhynchodoras* (Fig. 3) and in *R. woodsi* each posterior chamber is expanded into a large straight horn-like diverticulum (Figs. 3C, 3D). A reduced gas bladder with similar pair of posterior diverticula also is found in *Leptodoras* (Sabaj, 2005) and some auchenipterids such as *Ageneiosus* (Britski, 1972; Walsh, 1990, as ceacae). In *Leptodoras* the gas bladder has additional anterolateral diverticula (absent in *Rhynchodoras*) and in *Ageneiosus* the gas bladder is encapsulated in bone (Walsh, 1990).

In Doradidae and Auchenipteridae (including ageneiosids) the anterior nuchal plate is primitively large and shares a narrow to broad suture with the epioccipital (Ferraris, 1988; Higuchi, 1992; pers. obs.). Alternatively, the anterior nuchal plate is variable in size, reduced (i.e., bordered by supraoccipital and middle nuchal plate) or even lost in some taxa. In Doradidae, reduction of the anterior nuchal plate occurs in a variety of fimbriate-barbel taxa: *Oxydoras eigenmanni, Nemadoras elongatus, N. hemipeltis*, some *Opsodoras, Hassar, Hemidoras, Anduzedoras oxyrhynchus*, and *Leptodoras praelongus*. The anterior nuchal plate is totally absent and apparently lost in *Nemadoras trimaculatus, N. humeralis* and *Opsodoras ternetzi*. Some doradids, such as *Oxydoras niger* and *Doras fimbriatus*, are polymorphic for this character with the anterior nuchal plate either fully developed or reduced.

As in adult *Rhynchodoras* (Fig. 4A), the anterior nuchal plate is absent in the doradid *Physopyxis* and several genera of auchenipterids. Higuchi (1992) and Sousa and Rapp Py-Daniel (2005) speculated that the anterior nuchal plate is fused to the middle nuchal plate in *Physopyxis*, whereas Soares-Porto (1998) speculated that it is fused with the supraoccipital in auchenipterids *Centromochlus, Glanidium*, and *Gelanoglanis*. In *Rhynchodoras woodsi* the anterior nuchal plate is present but small (Fig. 4B) in two cleared-and-stained juveniles (23.1 and 26.0 mm SL), whereas in two cleared-and-stained adults (44.7 and 47.6 mm SL) the anterior nuchal plate is absent (Fig. 4A). This suggests not fusion but ontogenetic reduction and loss of the anterior nuchal plate in *R. woodsi*. The anterior nuchal plate is absent in a cleared-and-stained adult of *R. castilloi* (45.5 mm SL). The condition of this plate could not be confirmed in juvenile *R. castilloi* and *R. xingui* due to lack of specimens for clearing and staining.

A remarkable feature that may be unique to doradids among siluriforms is the occurrence of numerous pores crowded in the skin below the postcleithral process (pectoral region) and imparting a sponge-like appearance. This porous pectoral patch of skin may be glandular, and it is conspicuously developed in several fimbriate-barbel doradids such as *Anduzedoras oxyrhynchus, Doras, Hassar*, some *Leptodoras*, most *Nemadoras, Opsodoras ternetzi*, and *Trachydoras* (Sabaj, 2002; pers. obs.). The porous pectoral patch is well developed in *Rhynchodoras* but absent in all other non-fimbriate taxa. It is uncertain whether these porous pectoral patches evolved more than once among doradids or have been lost multiple times.

The skin of *Rhynchodoras* is roughened with small pale mounds and ridges interpreted as the unculiferous tubercles described by Roberts (1982). The tubercles are evident in juveniles and adults, and are therefore unlikely to be associated with reproduction. Similar structures are reported for many other catfishes in a diverse array of families: Akysidae, Amphiliidae, Aspredinidae, Loricariidae, Mochokidae, Sisoridae (Roberts, 1982), Nematogenyidae, Pimelodidae, Trichomycterdiae (Arratia and Huaquin, 1995), Auchenipteridae (Ferraris and Vari, 1999), Erethistidae (Ng, 2005), and Heptapteridae and Pseudopimelodidae (pers. obs.). In *Rhynchodoras*, the surface of these tubercles may be keratinized to form a thin cuticle as in mochokid catfishes (Wiley and Collette, 1970). Among doradids (e.g., *Leptodoras, Rhinodoras*), the size, shape, distribution, and abundance of tubercles have taxonomic implications as in other catfishes such as mochokids (Roberts, 1989; Ng, 2004).

The jaw morphology of *Rhynchodoras* is the most striking and useful character for diagnosing the genus. The modifications involve not only the premaxillae and dentaries, but also the mesethmoid (i.e., narrow, elongate, with small anterior notch that articulates with the premaxillae) and the articular (elongate and curved ventrally). Such modifications appear to be unique among catfishes.

In *Rhynchodoras* the dorsal and ventral procurrent rays of the caudal fin grade into a series of flat, laterally expanded, and weakly overlapping plates that continue to (or very near to) the base of adipose and anal fin, respectively, thereby framing the caudal peduncle dorsally and ventrally. This condition is also present in *Agamyxis*, some *Anadoras, Franciscodoras, Orinocodoras, Platydoras*, and *Rhinodoras*. In *Agamyxis* the lateral margins of the procurrent plates are ornamented with raised spines (vs. absent in other taxa). The anterior procurrent caudal-fin rays are modified into plates to a lesser degree in a few additional doradids. For example, in *Astrodoras, Doras fimbriatus*, and some *Oxydoras eigenmanni*, the anteriormost dorsal and ventral procurrent ray may be slightly enlarged and moderately flattened to form a single lenticular plate that may or may not reach the base of the adipose and anal fin, respectively. In *Hypodoras*, the anteriormost dorsal and ventral procurrent elements reach the base of the adipose and anal fin, respectively, and are rounded, plate-like, and distinctly enlarged relative to the following elements that grade into procurrent rays. Plates also occur middorsally and midventrally on the caudal peduncle in *Lithodoras*; however, these plates are irregularly shaped, non-overlapping, and are not modified procurrent rays.

Comments on Rhynchodoras *relationships*.—Alfred Russel Wallace noticed a resemblance between *Rhinodoras* and *Rhynchodoras*, and questioned whether the differences were gender related (*Rhynchodoras* being the male). Higuchi (1992) hypothesized doradid relationships using a cladistic analysis of morphological characters. Although Higuchi (1992) did not include *Rhynchodoras* in his analysis, he did note that *Rhynchodoras* and *Rhinodoras* share similarities in the shape of the cephalic shield and in external postcranial morphology. Both genera also exhibit similar patterns of pigmentation (i.e., mottled with three dark bars on body and dark band on caudal-fin base).

We corroborate Higuchi's speculation and consider *Rhynchodoras* to be related to a clade composed of *Rhinodoras* plus the monotypic *Orinocodoras eigenmanni*. These taxa share two characters that appear to be uniquely derived in Doradidae: medial inferior crest present on ventral face of hyomandibula, and autopalatine long, reaching to but not beyond anterior margin of orbit. They also share a number of characters that are restricted to a few taxa in Doradidae: aortic channel partially or completely open, caudal peduncle framed with plates derived from procurrent caudal-fin rays, dorsal-fin spine strong, curved, and with large well-spaced teeth anteriorly and posteriorly, and adipose fin thick and prolonged anteriorly as fleshy keel.

In addition to its highly modified jaws, *Rhynchodoras* may be diagnosed by three characters that appear to be unique (autapomorphic) among doradids: proximal teeth on dorsal-fin spine retrorse, transition between ventral surfaces of posterior coracoid process and anterior limb of coracoid smooth, not marked by thin crest separating muscles *abdutors superficialis* and *arrector ventralis*, and eye extremely reduced, diameter 5.6–8.6% of head length.

Key to the Species of *Rhynchodoras*

1a. Posterior chambers of gas bladder not expanded into horn-like diverticula (Figs. 3A, 3B) 2

1b. Each posterior chamber of gas bladder expanded into elongate horn-like diverticulum (Figs. 3C, 3D; Essequibo and Amazon basins minus Xingu and Tocantins basins) ..... ***Rhynchodoras woodsi***

2a. Midlateral scutes (beginning with infranuchal) 34–36, anterior ones shallow (depth about one-fifth of corresponding body depth) with posterior margins of dorsal and ventral laminae (wings) lacking conspicuous serrations; all three tympanal scutes poorly developed and inconspicuous (Orinoco basin) ..... ***Rhynchodoras castilloi*, new species**

2b. Midlateral scutes 33–34, anterior ones deep (depth about one-third to one-quarter of corresponding body depth) with posterior margins of dorsal and ventral laminae (wings) well serrated; second and third tympanal scutes well developed, latter with medial carina (Xingu and Tocantins basins) ..... ***Rhynchodoras xingui***

Material Examined

Measurements refer to standard lengths.

Rhynchodoras woodsi: Brazil, Amazonas: ANSP 178547, 1, 33.7 mm, Rio Solimões, 6.2 km upstream from Santo Antônio do Içá, 35 km downstream from Gr. Rural Muiraquitã, 3°08′44″S, 67°53′58″W; ANSP 179122, 1, 42.5 mm, Rio Solimões, upstream of Vila de Careiro, 3°14′18″S, 59°54′21″W; ANSP 179123, 1, 34 mm, Rio Solimões, upriver of Vila de Careiro, 3°14′19″S, 59°54′28″W; ANSP 181050, 4, 30.6–35.6 mm, Rio Amazonas, 4 miles downriver of Novo Oriente, 30 miles upriver of Itacoatiara, 3°17′13″S, 58°56′01″W; ANSP 181051, 1,

37.6 mm, Rio Amazonas, 3 miles downstream of Novo Oriente, 31 miles upstream from Itacoatiara, 3°16′52″S, 58°56′27″W; ANSP 181052, 2, 29–30 mm, Rio Solimões, 9 km upiver from Santo Antônio do Içа, 36.8 km downriver from Gr. Rural Muiraquitã, 3°08′53″S, 67°53′29″W; ANSP 181053, 12, 26.0–33.7 mm, Rio Solimões, 9.5 km upriver of Santo Antônio do Içа, 38.1 km downriver of Gr. Rural Muiraquitã, 3°08′48″S, 67°53′56″W; ANSP 181054, 1, 31 mm, Rio Solimões, above mouth of Rio Negro, upriver of Vila de Careiro, 3°14′S, 59°54′W; ANSP 181059, 2, 36.4–38 mm, Rio Purus, Solimões Dr., 3°41′22″S, 61°28′19″W; ANSP 181060, 1, Rio Amazonas, 14 km upriver from Jatuarana, 28.5 km downriver of Manaus, 3°05′33″S, 59°46′15″W; ANSP 182853, 1, Rio Solimões, 9.5 km upriver of Santo Antônio do Içа, 38.1 km downriver of Gr. Rural Muiraquitã, 3°08′48″S, 67°53′56″W; INPA 15679, 2, Rio Branco, Negro Dr.; INPA uncat., 1, Rio Branco, Negro Dr., Parana Paracarica, 1°18′S, 61°42′W; MZUSP 53308, 4, 27.3–41.2 mm, Rio Amazonas, Paraná do Serpa, 3°19′S, 58°35′W; MZUSP 55819, 1, 35.1 mm, Rio Solimões, 3°09′S, 67°54′W; MZUSP 55820, 5, 29–36.3 mm, Rio Solimões, 3°09′S, 67°54′W; MZUSP 56173, 1, 38.6 mm, Rio Negro; MZUSP 56177, 1, 30 mm, Rio Negro, 1°58′S, 61°16′W; MZUSP 56845, 5, 33.7–49.3 mm, Rio Solimões, 3°14′S, 59°55′W; MZUSP 56848, 2, 23–32.8 mm, Rio Solimões, 3°36′S, 61°19′W; MZUSP 56853, 7, 21.6–31.2 mm, Rio Solimões; MZUSP 56856, 11, 24.6–40.3 mm, 1 CS, 26.0 mm, Rio Solimões; MZUSP 56859, 11, 24.6–29.9 mm, Rio Solimões, 3°35′S, 61°07′W; MZUSP 56862, 4, 26.6–29 mm, Rio Amazonas, 3°16′S, 58°57′W; MZUSP 56872, 20, 24–40 mm, 1 CS, 23.1 mm, Rio Amazonas near Madeira, 3°20′S, 58°36′W; MZUSP 56873, 7, 26.4–37.4 mm, Rio Amazonas near Madeira, 3°19′S, 58°35′W; MZUSP 57238, 10, 29.8–46.8 mm, Rio Amazonas below mouth of Rio Madeira, 3°20′S, 58°35′W; MZUSP 57241, 1, 30.7 mm, Rio Solimões; MZUSP 57242, 1, 31.8 mm, Rio Solimões, 3°49′S, 61°38′W; MZUSP 57248, 5, 26.3–32.3 mm, Rio Amazonas below mouth of Rio Madeira; MZUSP 57251, 1, 41.4 mm, Rio Solimões; MZUSP 57252, 1, 47.9 mm, Rio Amazonas above Madeira, 3°16′S, 58°57′W; MZUSP 57260, 1, 32.5 mm, Rio Solimões, 3°36′S, 61°21′W; MZUSP 57261, 6, 26.3–33.5 mm, Rio Amazonas above Madeira, 3°16′S, 58°57′W; MZUSP 57262, 3, 28.5–36.8 mm, Rio Solimões, 3°14′S, 59°54′W; MZUSP 57292, 1, 44.4 mm, Rio Amazonas near Madeira, 3°20′S, 58°36′W; MZUSP 57308, 4, 27.0–39.8 mm, Rio Solimões, 3°27′S, 60°45′W; MZUSP 57309, 1, 38.5 mm, Rio Solimões, 3°14′S, 59°54′W; MZUSP 57310, 1, 35.0 mm, Rio Amazonas above Madeira, 3°16′S, 58°56′W; MZUSP 57313, 2, 38.5–45.2 mm, Rio Amazonas near Madeira, 3°20′S, 58°35′W; MZUSP 57316, 1, 33.7 mm, 1 CS, 44.7 mm, Rio Amazonas below mouth of Rio Madeira, 3°20′S, 58°36′W; MZUSP 57319, 1, 51.5 mm, Rio Solimões, 3°27′S, 60°45′W; MZUSP 57328, 1, 47.9 mm, Rio Solimões, 3°26′S, 60°45′W; MZUSP 57980, 3, 33.7–40.9 mm, Rio Amazonas below mouth of Rio Madeira, 3°20′S, 58°36′W; MZUSP 57983, 4, 30.0–39.8 mm, Rio Amazonas below mouth of Rio Negro; MZUSP 57985, 2, 32.5–37.6 mm, Rio Amazonas below mouth of Rio Negro, 3°05′S, 59°47′W; MZUSP 57986, 3, 31.2–36.7 mm, Rio Amazonas below mouth of Rio Madeira, 3°20′S, 58°36′W; MZUSP 57987, 2, 31.7–33.5 mm, Rio Amazonas below mouth of Rio Negro, 3°05′S, 59°46′W; MZUSP 57992, 6, 33.4–67 mm, Rio Amazonas below mouth of Rio Madeira, 3°20′S, 58°35′W; MZUSP 58011, 1, 48.5 mm, Rio Amazonas below mouth of Rio Negro, 3°05′S, 59°47′W; MZUSP 58016, 2, 35.1–38.3 mm, Rio Amazonas below mouth of Rio Negro, 3°16′S, 58°56′W; MZUSP 58017, 2, 31.5–33 mm, Rio Amazonas below mouth of Rio Negro, 3°16′S, 58°56′W; MZUSP 58248, 2, 24.5–27.7 mm, Rio Solimões, 3°09′S, 67°54′W; MZUSP 86810, 1, 52.3 mm, Rio Amazonas above mouth of Rio Madeira, 3°35′S, 59°08′W; MZUSP 86811, 2, 33.7–62.6 mm, Rio Solimões near Purus, 3°36′S, 61°20′W; MZUSP 86815, 14, 28.8–47.9 mm, 1 CS, 47.6 mm, Rio Amazonas below mouth of Rio Madeira, 3°20′S, 58°36′W; MZUSP 86816, 5, 28.5–37.8 mm, Rio Solimões below mouth of Rio Purus, 3°27′S, 60°45′W; Roraima: MZUSP 56174, 1, 30.5 mm, Rio Branco, 1°17′S, 61°50′W. Ecuador: FMNH 77008, holotype, 110.4 mm, Río Bobonaza, tributary Río Pastaza, Marañon Dr., Moreta Bobonaza, between Sarayacu and Montalvo; MEPN no catalog number (?ex. FMNH 77009, 1 of 2 paratypes), 108.4 mm, same data as holotype (Ibarra and Stewart [1987] noted as missing the two paratypes cited by Glodek [1976:44] as FMNH 77009, 85.2–103.8 mm SL; it seems likely but remains uncertain whether this MEPN specimen originated from FMNH 77009). Guyana: ROM 62601, 1, 44.2 mm, Essequibo River at Kurupukari, 4°40′S, 58°40′W. Peru, Loreto Department: ANSP 181042, 5, 64.0–84.3 mm, Río Amazonas, vicinity of Iquitos; MZUSP 86809, 1, 64.7 mm, Río Amazonas, vicinity of Iquitos; UF 131106, 1, 25 mm, Caño Yarina–Rio Pacaya, Ucayali Dr., Reserva Nacional Pacaya Samiria, 5°19′05.5″S, 74°30′18.06″W.

Rhynchodoras xingui: Brazil: SMF 5281, holotype, 63 mm, upper Rio Xingu; SMF 5282, paratype, 44.5 mm, same data as holotype; Para: INPA 26540, 2, 62.8–64.2 mm, Rio Tocantins, Tucuruí, 3°42′S, 49°42′W.

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(JLOB) MUSEU DE ZOOLOGIA DA UNIVERSIDADE DE SÃO PAULO, CAIXA POSTAL 42494, CEP 04218-970, SÃO PAULO, BRAZII; (MHS) DEPARTMENT OF ICHTHYOLOGY, THE ACADEMY OF NATURAL SCIENCES, 1900 BENJAMIN FRANKLIN PARKWAY, PHILADELPHIA, PENNSYLVANIA 19103; AND (DCT) MUSEO DE ZOOLOGÍA, UNIVERSIDAD NACIONAL EXPERIMENTAL DE LOS LLANOS OCCIDENTALES EZEQUIEL ZAMORA, MESA DE CAVACAS, ESTADO PORTUGUESA, GUANARE 3310, VENEZUELA . E-mail: (JLOB) jbirindelli@yahoo.com.br; (MHS) sabaj@acnatsci.org; and (DCT) taphorn@gmail.com. Send reprint requests to MHS. Submitted: 17 March 2006. Accepted: 26 Dec. 2006. Section editor: J. W. Armbruster.