



Four new species of *Hisonotus* (Siluriformes: Loricariidae) from the upper rio Uruguay, southeastern South America, with a review of the genus in the rio Uruguay basin

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Abstract

Four new species of *Hisonotus* are described from the upper course of the rio Uruguay basin in Brazil: *Hisonotus iota* from the rio Chapecó drainage; *Hisonotus leucophrys* from rio Rancho Grande and rio Ariranhas; *Hisonotus megaloplax* from the rio Passo Fundo drainage; and *Hisonotus montanus* from the rio Canoas drainage. The species *Epactionotus aky*, described from the arroyo Yabotí-Guazú drainage in Argentina, is transferred to *Hisonotus* and rediagnosed. *Hisonotus candombe* is considered a junior synonym of *H. ringueleti*. The new taxa, together with *H. nigricauda*, *H. ringueleti*, *H. charrua*, and *H. aky* represent the genus *Hisonotus* in the rio Uruguay basin. A taxonomic key for *Hisonotus* in the rio Uruguay basin is provided. Their distributions are discussed under biogeographic patterns previously proposed for the rio Uruguay basin.

Key words: Catfishes, Hypoptopomatinae, Neotropical, Taxonomy, Biogeography, Endemism, *Epactionotus*

Resumo

Quatro novas espécies de *Hisonotus* são descritas do curso superior do rio Uruguai no Brasil: *Hisonotus iota* da drenagem do rio Chapecó; *Hisonotus leucophrys* dos rios Rancho Grande e Ariranhas; *Hisonotus megaloplax* da drenagem do rio Passo Fundo e *Hisonotus montanus* da drenagem do rio Canoas. A espécie *Epactionotus aky*, descrita da drenagem do arroyo Yabotí-Guazú na Argentina, é transferida para *Hisonotus* e rediagnosticada. *Hisonotus candombe* é considerado sinônimo junior de *H. ringueleti*. Os novos taxóons, junto com *H. nigricauda*, *H. ringueleti*, *H. charrua* e *H. aky* constituem o gênero *Hisonotus* na bacia do rio Uruguai. Uma chave de identificação para as espécies de *Hisonotus* da bacia do rio Uruguai é fornecida. As suas áreas de distribuição são discutidas dentro dos padrões biogeográficos previamente propostos para a bacia do rio Uruguai.

Introduction

The rio Uruguay is the smallest of the three major tributaries to the Río de la Plata. The river extends over 1,838 km, with a drainage area of about 365,000 km² (Di Persia & Neiff, 1986), rising in the Serra Geral formation of southern Brazil, and flowing into the Río de la Plata estuary between Uruguay and Argentina. Its main tributaries are the Río Negro in Uruguay, rio Quarai (Río Cuareim) on the border between Brazil and Uruguay; and the rio Ibicuí and rio Ijuí in Brazil. The basin can be divided in three portions (upper, middle, and lower) by its geographical and ichthyofaunal attributes. The upper course is situated upstream to the remarkable Saltos do Yucumã (Saltos del Moconá in Argentina) a 10-meters high, longitudinal waterfall situated above the mouth of the arroyo Yaboty-Guazú. The middle and lower courses are downstream to Saltos do Yucumã and separated from each other by the Salto Grande, site of the homonymous hydroelectric dam.

The distributional patterns of the ichthyofauna in the rio Uruguay basin were previously discussed by Lucena & Kullander (1992), Winberger *et al.* (1998), Aquino *et al.* (2001), Miquelarena & Lopez (2004), and Rican & Kullander (2006 and 2008). These studies agreed that the rio Uruguay presents endemic ichthyofaunal components, mostly in its upper portions. Lucena & Kullander (1992: 157), suggested five general distributional patterns of fishes in the rio Uruguay basin based on the distribution of several taxa: 1) endemism in the upper Uruguay; 2) endemism within the Uruguay; 3) Paraguayan species reaching to the middle Uruguay; 4) species restricted to the coast of Uruguay and Rio Grande do Sul state in Brazil plus the Uruguay drainage; and 5) species absent from the middle-lower Uruguay, but present along the upper rio Uruguay and along the Rio Grande do Sul and Uruguayan coast. According to Lucena and Kullander (1992) almost all species from that basin could be included in one of these patterns.

Hisonotus along with *Otocinclus arnoldi* Regan, 1909; *Eurycheilichthys pantherinus* Reis & Schaefer, 1992; and *Epactionotus aky* Azpelicueta, Casciotta, Almirón & Körber, 2004 are the known representatives of the Hypoptopomatinae in the rio Uruguay basin. Until recently, studies on the genus *Hisonotus* were almost inexistent for that region, and the first species of *Hisonotus* from the rio Uruguay basin was described in 2001, *Hisonotus ringueleti* Aquino, Schaefer & Miquelarena, 2001. The number of papers on the Hypoptopomatinae from the rio Uruguay basin have greatly increased in the last years, and several species have been described since then (Azpelicueta *et al.*, 2004, Almirón *et al.*, 2006, and Casciotta *et al.*, 2006).

In this work we describe four new species of *Hisonotus* from the upper rio Uruguay basin. Also, the generic allocation of *Epactionotus aky* is revised, and therefore included in the genus *Hisonotus*. *Hisonotus candombe* Casciotta, Azpelicueta, Almirón & Litz, 2006 is demonstrated to be a junior synonym of *Hisonotus ringueleti*. At last, the implications of the species distribution in the biogeographic context of the rio Uruguay basin are discussed.

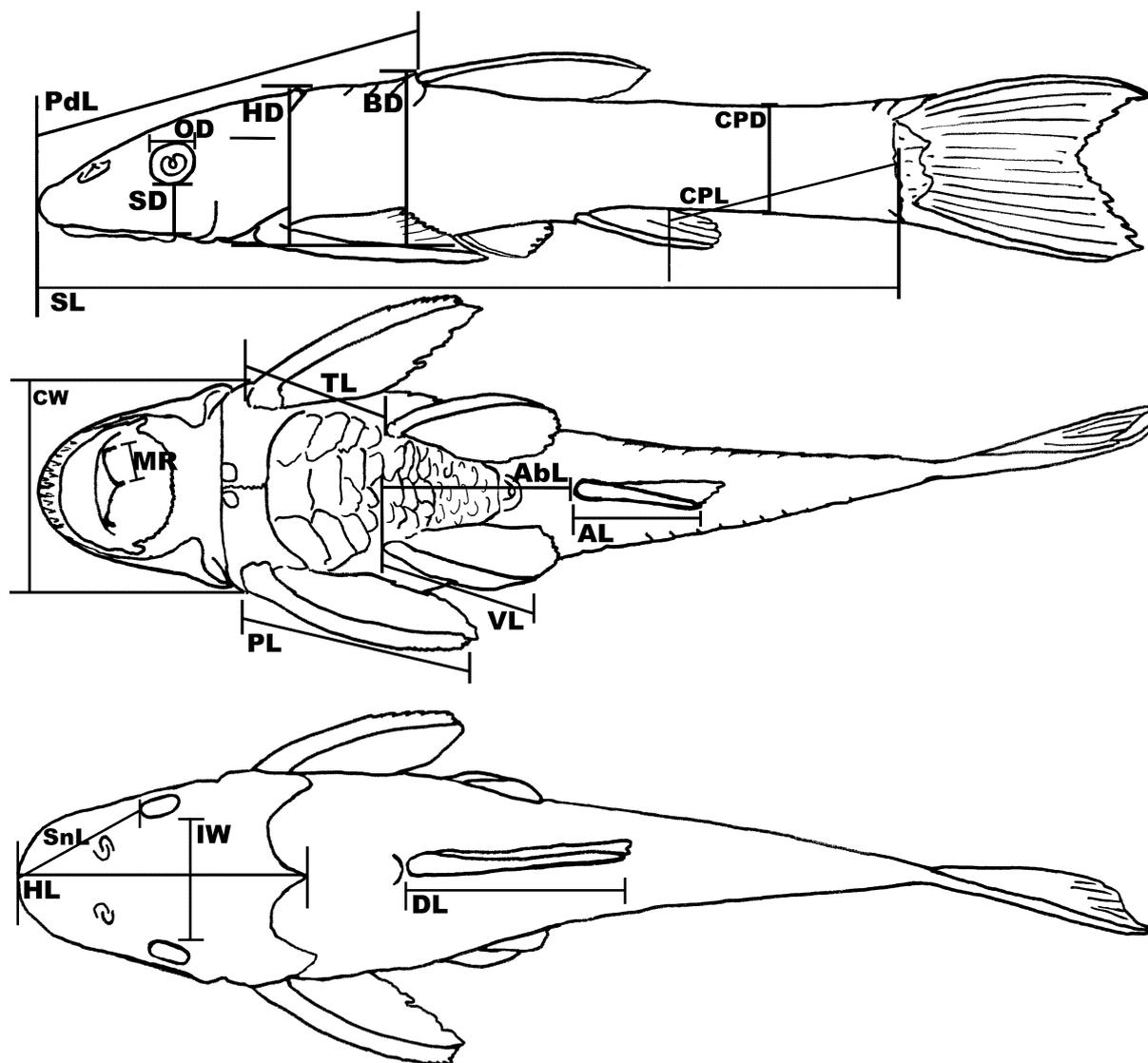


FIGURE 1. Measurements and terminology: **SL**, standard length; **HL**, head length; **PdL**, predorsal length; **DL**, dorsal-fin spine length; **AL**, first anal-fin unbranched ray length; **PL**, pectoral-fin spine length; **VL**, first pelvic-fin unbranched ray length; **CW**, cleithral width; **TL**, thoracic length; **AbL**, abdominal length; **BD**, body depth at dorsal-fin origin; **CPL**, caudal-peduncle length; **CPD**, caudal-peduncle depth; **SnL**, snout length; **OD**, orbital diameter; **IW**, interorbital width; **HD**, head depth; **SD**, suborbital depth; **MR**, mandibular ramus.

Methods

Measurements were made to the nearest 0.1 mm with digital calipers under a stereomicroscope on the left side of specimens. All measurements are shown in Figure 1. The measurements and their abbreviations are as follows: Standard length (SL) from anterior margin of snout to to the posterior end of last plate in middle plate series, excluding horizontally elongate plates covering insertion of caudal-fin rays. Head length (HL) between anterior margin of snout and posterior tip of parieto-supraoccipital process. Predorsal length (PdL) between anterior margin of snout and posterior portion of dorsal-fin spinelet. Dorsal-fin spine length (DL) between insertion and tip of dorsal-fin spine. Length of unbranched anal-fin ray (AL) from insertion to distal tip of unbranched anal-fin ray. Pectoral-fin spine length (PL) from its insertion to distal tip. Unbranched pelvic-fin ray length (VL) measured from its insertion to distal tip. Cleithral width (CW) between lateral portions of

contralateral cleithrae. Thoracic length (TL) between insertion of pectoral-fin spine and insertion of unbranched pelvic-fin ray. Abdominal length (AbL) between pelvic-fin insertions and anal-fin origin along ventral midline. Body depth at dorsal-fin origin (BD) between the dorsal-fin spinelet and ventral body surface. Caudal-peduncle length (CPL) between insertion of last anal-fin ray and posterior end of last plate in middle series, excluding horizontally elongate plates covering insertion of caudal-fin rays. Caudal peduncle depth (CPD) is the least transversal depth of caudal peduncle. Snout length (SnL) from anterior margin of snout to lachrymal margin of orbit. Orbital diameter (OD) is horizontal diameter of bony orbit. Interorbital width (IW) is the least distance between orbits. Head depth (HD) between tip of parieto-supraoccipital bone to ventral body surface. Suborbital depth (SD) between lower margin of bony orbit and ventrolateral surface of head. Mandibular ramus (MR) is width of longest axis of dentary. Morphometric data are expressed as percents of standard length (SL), except for subunits of the cephalic region that are expressed as percents of head length (HL). The numerals used for fin ray counts are: roman numbers for unbranched rays (capitalized when referring to a spine), and arabic numbers for branched rays. Plate counts and nomenclature follow the schemes of serial homology proposed by Schaefer (1997). Vertebral counts included all vertebrae (including the first five vertebrae incorporated into the Weberian apparatus), with the compound caudal centrum (PU1+U1) counted as one element. Accessory patch of teeth is that described by Reis & Schaefer (1992). Cleared and stained specimens (c&s) were prepared according to the method of Taylor & Van Dyke (1985). Whenever available, juvenile specimens were also cleared and stained. Juvenile designation was used for specimens not totally covered by plates; with an anterior paired crest of odontodes on the parieto-supraoccipital; and for males without a fleshy flap on the first thickened pelvic-fin ray, adults presenting the opposite states. Scanning electron microscope pictures were taken from dissected alcohol preserved specimens. Drawings were prepared from c&s specimens using a camera lucida. This work was part of first author's Master in Sciences thesis at the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS; Carvalho, 2008a) and additional information for distributional data and maps of *Hisonotus* species of rio Uruguay basin can be accessed at http://tede.pucrs.br/tde_busca/arquivo.php?codArquivo=1186. Institutional abbreviations are as listed at <http://research.calacademy.org/research/ichthyology/catalog/collections.asp>.

***Hisonotus iota*, new species**

Fig. 2, Table 1

Hisonotus aky non (Azpelicueta, Casciotta, Almirón, Körber, 2004).-Reis & Carvalho (2007: 84) [listed].

Holotype: MCP 42575, 33.4 mm SL, female, Brazil, Santa Catarina, Coronel de Freitas, rio Chapecó at vila São Miguel on road from Coronel de Freitas to Quilombo, rio Uruguai basin, 26°51'26"S 052°44'29"W, 23 Jan 2006, C. A. S. Lucena, V. A. Bertaco, E. H. L. Pereira & J. F. P. Silva.

Paratypes. ANSP 187472, 4, 26.5–27.7 mm SL; MCP 40029, 18 + 3 c&s, 21.6–29.7 mm SL, collected with the holotype.

Diagnosis. *Hisonotus iota* differs from its congeners, except from *Hisonotus hungy*, by the lower lateral plate count 20–22 (mode 21) vs. 22–29 lateral plates (Tab. 2), and by the lower vertebral count 25–26 vs. 27–32 vertebrae. It differs from *Hisonotus hungy* by having an infraorbital canal entering the infraorbital series via the compound pterotic (Fig. 3A) vs. infraorbital canal entering the infraorbital series via the sphenotic (Fig. 3B).

Description. Morphometrics and meristics in Table 1. Adult size small for members of this genus (maximum size 33.4 mm in SL). Body stocky, without conspicuous keels. Caudal peduncle round in cross section. Dorsal body profile almost straight from snout to parieto-supraoccipital tip, convex bump on internareal region. Almost straight from parieto-supraoccipital tip to dorsal-fin origin, except for posterodorsally inclined profile of nuchal region. Dorsal-fin base straight and posteroventrally sloped, straight from posterior end of dorsal-fin base to posterior end of caudal peduncle. Ventral profile straight from snout

tip to anal-fin origin, concave at anal-fin base, and straight from posterior end of anal-fin base to caudal-fin origin. Greatest body depth at dorsal-fin origin. Least body depth at caudal peduncle. Posterior profile of caudal fin concave. Head and snout broad, snout rounded in dorsal view, body progressively narrowing posterior to pectoral-fin insertion. Snout region anterior of nares depressed, interorbital region slightly convex. Upper margin of orbit not elevate. Eye dorsolaterally positioned. Iris operculum present.

Pectoral fin I,6. Pectoral-fin posterior margin gently curved, when depressed tip extending anterior to middle of pelvic fin. Posterior margin of pectoral-fin spine smooth in adults, juveniles with feeble serrae along distal third of pectoral-fin spine. Pectoral-fin axillary slit present, slit posteroventrally sloped below posterior margin of cleithral process. Pelvic fin i,5, tip of depressed fin just reaching anal-fin origin in females, but extending far beyond that point in males. Dorsal fin II,7, its origin located posterior to vertical through pelvic-fin origin. Dorsal-fin spinelet somewhat rounded in shape. Anal fin i,5. First anal-fin pterygiophore exposed anterior to anal fin. Adipose fin absent. Caudal fin i,14,i.

TABLE 1. Morphometrics and meristics of *Hisonotus iota*. SD = Standard deviation, n = number of specimens, H = holotype.

	types		Low	High	Mean	SD
	H	n				
Standard length (mm)	33.4	20	22.6	33.4	26.8	-
Percent of Standard Length						
Head length	37.2	20	36.3	41.1	38.4	1.15
Predorsal Length	50.4	20	47.5	52.6	50.1	1.24
Dorsal-fin spine length	21.9	20	21.9	27.0	24.8	1.20
Anal-fin unbranched ray length	13.1	20	13.1	19.3	16.9	1.29
Pectoral-fin spine length	22.5	20	22.5	29.5	27.4	1.65
Pelvic-fin unbranched ray length	16.6	20	15.9	21.5	18.8	1.67
Cleithral width	28.4	20	27.6	30.5	29.1	0.9
Thoracic length	18.8	20	16.0	19.3	17.8	0.87
Abdominal length	21.4	20	19.2	21.9	20.5	0.78
Body depth at dorsal-fin origin	21.7	20	19.9	23.7	22.3	0.78
Caudal-peduncle length	29.3	20	28.4	32.4	30.6	1.19
Caudal-peduncle depth	13.9	20	12.9	15.8	14.2	0.67
Percent of Head Length						
Snout Length	51.3	20	48.6	53.8	51.3	1.33
Orbital diameter	15.2	20	15.1	17.5	16.1	0.76
Interorbital width	36.8	20	36.4	40.5	37.9	1.01
Head depth	55.7	20	51.1	57.9	54.8	1.97
Suborbital depth	22.0	20	21.4	27.2	22.9	1.29
Mandibular ramus	7.3	20	6.6	9.2	8.2	0.68
Meristics						
Left premaxillary teeth	10	14	9	13	11.1	1.14
Right premaxillary teeth	10	16	9	14	11.3	1.44
Left dentary teeth	11	19	9	13	10.8	1.03
Rigth dentary teeth	-	17	9	12	10.6	1.09
Left lateral scutes	21	20	20	22	20.9	0.59
Rigth lateral scutes	20	20	20	22	20.7	0.59



FIGURE 2. Holotype of *Hisonotus iota*, MCP 42575, female, 33.4 mm SL. Rio Chapecó at vila São Miguel on road from Coronel de Freitas to Quilombo, Coronel de Freitas, Santa Catarina, Brazil.

Body almost entirely covered by plates except for region overlying opening of swim bladder capsule, area between pectoral girdle and lower lip, region around anus, and area around base of paired fins. Rostral plate with posterior notch articulation with mesethmoid. Rostral plate thickened, anterior margin covered by odontodes without anterior odontode-free band (Fig. 4). Region anterior to nares completely covered by plates, prenasal plates present and not reduced in size. Three rows of predorsal plates. Lateral plate series formed by 20–22 plates (Tab. 2). Lateral line incomplete, with gap in line of pores along midlength of body, posterior portion of lateral line sometimes absent. Median-plate series truncated, not reaching posterior end of caudal peduncle (Fig. 5A). Lateral abdominal plates large and forming regular series of three to five plates on each side. Median abdominal series formed by one to three irregularly arranged series. Plates of pre-anal

shield region large (Fig. 6A). Coracoid and cleithrum exposed and covered by odontodes, except for medial region of cleithrum between arrector fossae opening and symphysis.

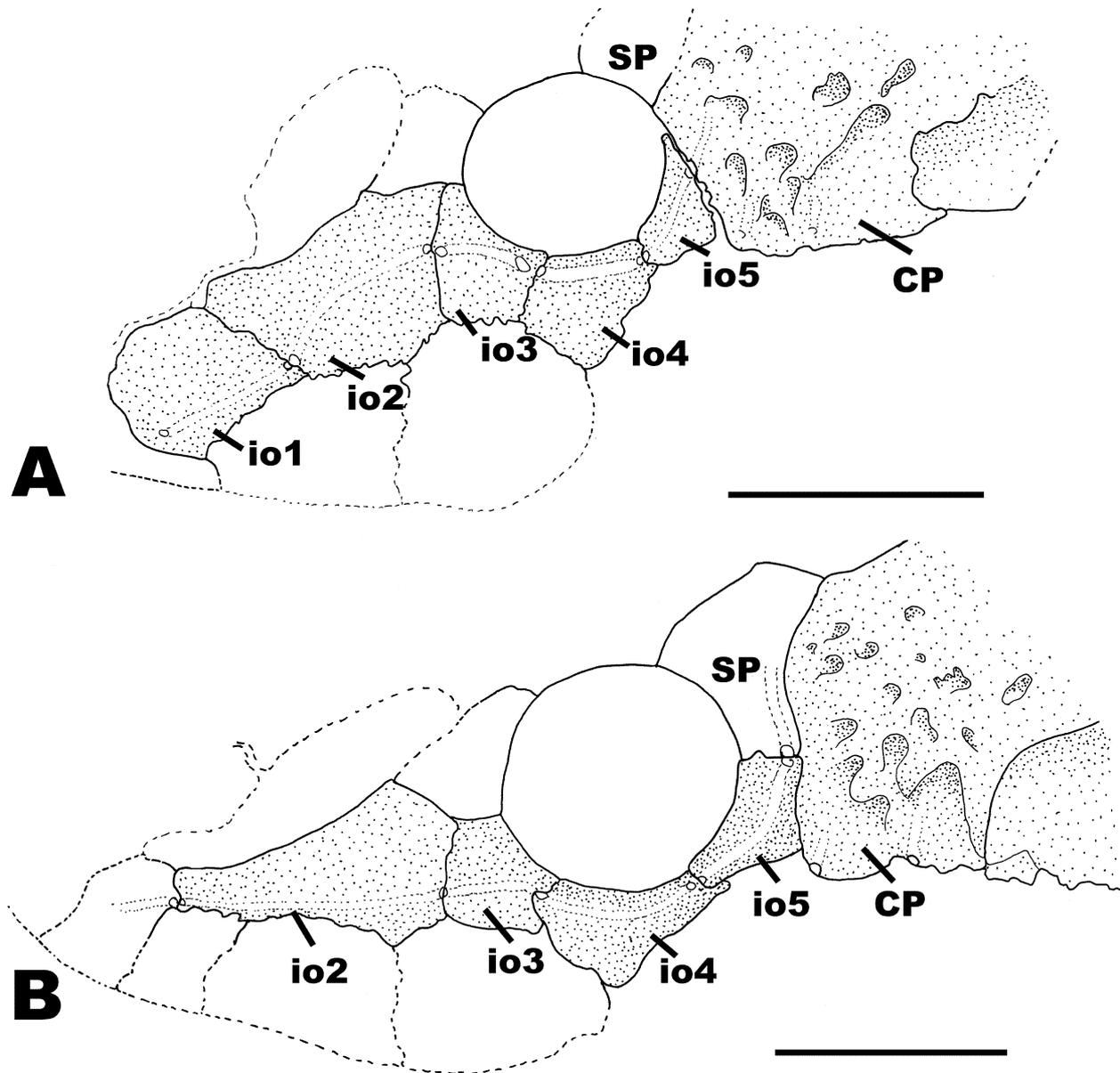


FIGURE 3. Skull of *Hisonotus* in dorsolateral view showing infraorbital canal. A—*Hisonotus iota* species, MCP 40029, 28.0 mm SL. B—*Hisonotus ringueleti*, MCP 11215, 37.2 mm SL. SP— sphenotic; io—Infraorbitals; CP—compound pterotic. Scale bar is 2 mm.

Head without conspicuous crests, except for enlarged odontodes on parieto-supraoccipital tip, forming raised tuft (Fig. 7). Head, fin rays, and body plates covered with odontodes, these larger on anterior surface of all fin spines, and on ventral margin of rostrum. Anteroventral margin of compound pterotic with median-to-large size perforations. Infraorbital canal entering infraorbital series via compound pterotic. Lips roundish and papillose, posterior margin of lower lip gently fimbriate to smooth. Maxillary barbel present.

Premaxillary and dentary teeth bifid, slender proximally and flattened distally; major (medial) cusp large and rounded, minor (lateral) cusp minute and pointed. Accessory patch of teeth absent on dentary and premaxilla.

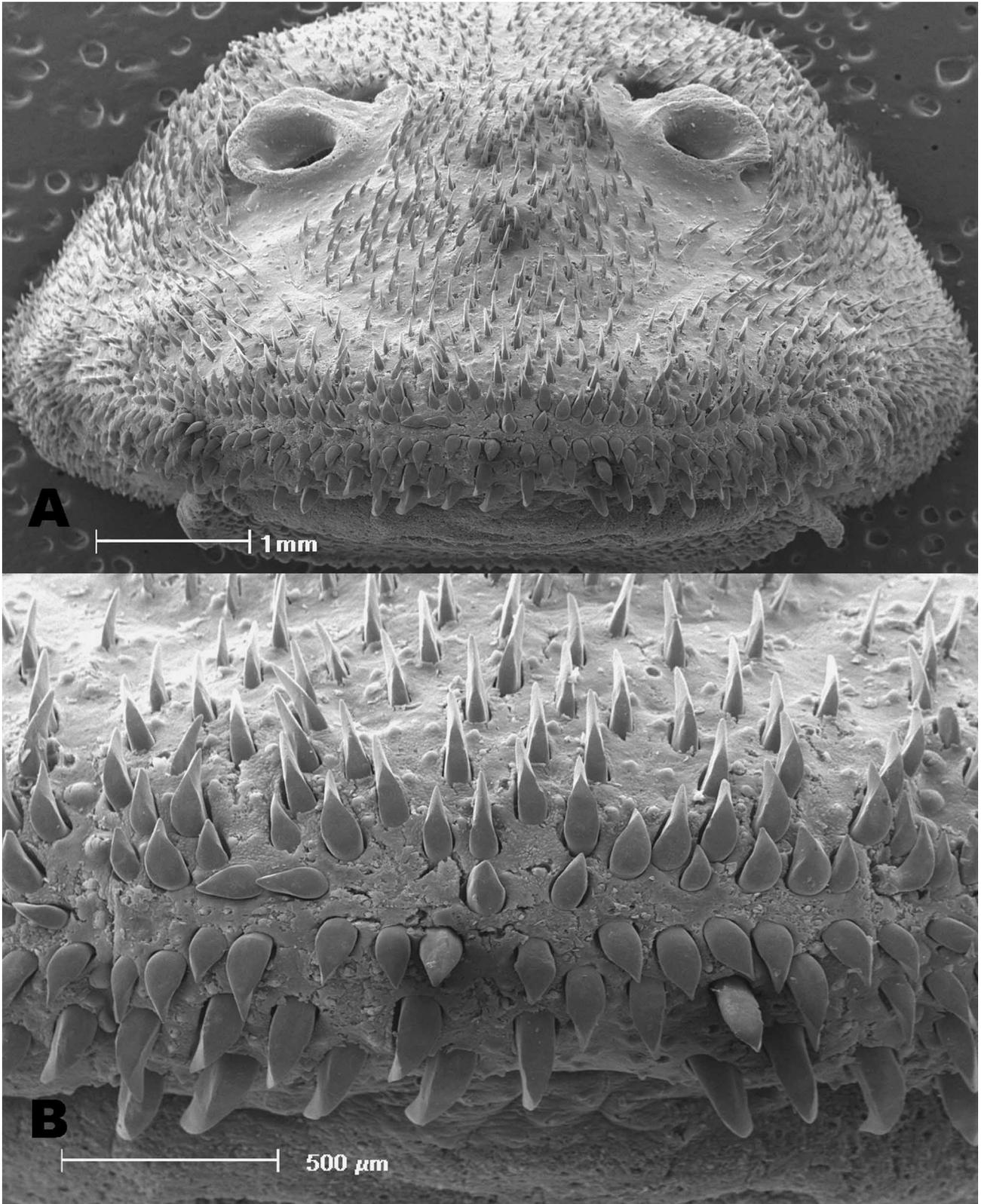


FIGURE 4. Scanning electron micrograph of snout anterior rostral margin of *Hisonotus iota*, MCP 40029, 29.7 mm SL. A—anterior view of rostrum; B—magnification of medial portion.

Hypurals 1–2 and 3–5 completely fused, without median notch on posterior margin of caudal-fin. Total vertebrae 25–26 (2 c&s).

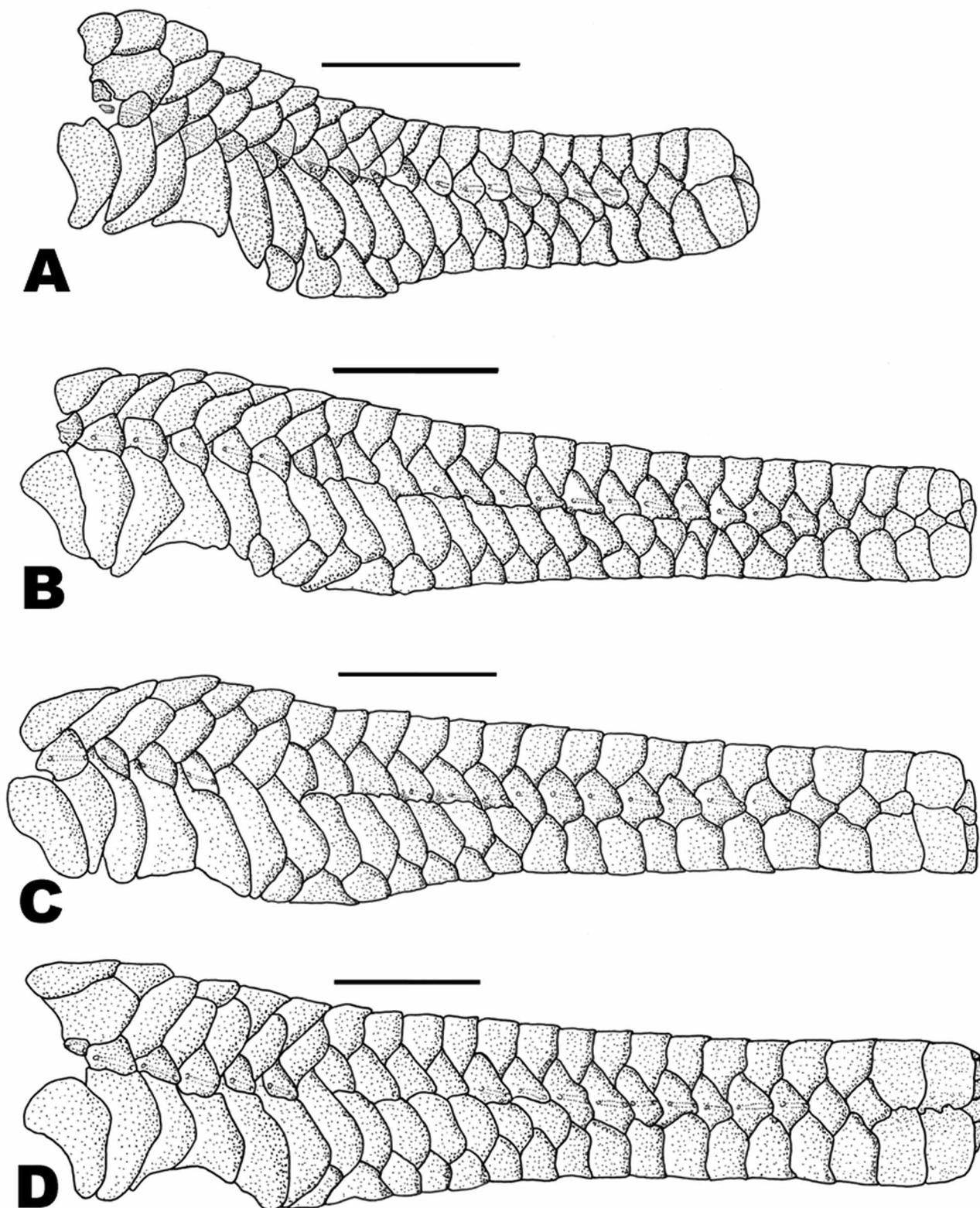


FIGURE 5. Trunk plates of *Hisonotus* species in lateral view of left side. A—*H. iota*, MCP 40029, 23.3 mm SL. B—*H. leucophrys*, MCP 41354, 40.8 mm SL. C—*H. megaloplax*, MCP 31779, 41.3 mm SL. D—*H. montanus*, MCP 41459, 37.9 mm SL. Scale bar is 4 mm.

Color. Ground color of dorsal and lateral surfaces carbon black. Dorsolateral region of head with paired longitudinal stripes, beginning at tip of snout, passing through nares and reaching anterior orbit margin.

Parieto-supraoccipital tip lighter than surrounding areas. Ventrolateral and ventral surfaces yellowish, with scattered chromatophores, most concentrated on cheek, bases of paired fins, and caudal peduncle. Fins mostly unpigmented, except for dark transverse bars, forming striped pattern. Middle portion of caudal fin with wide hyaline band. In life, ground color of dorsum and flanks dark green.

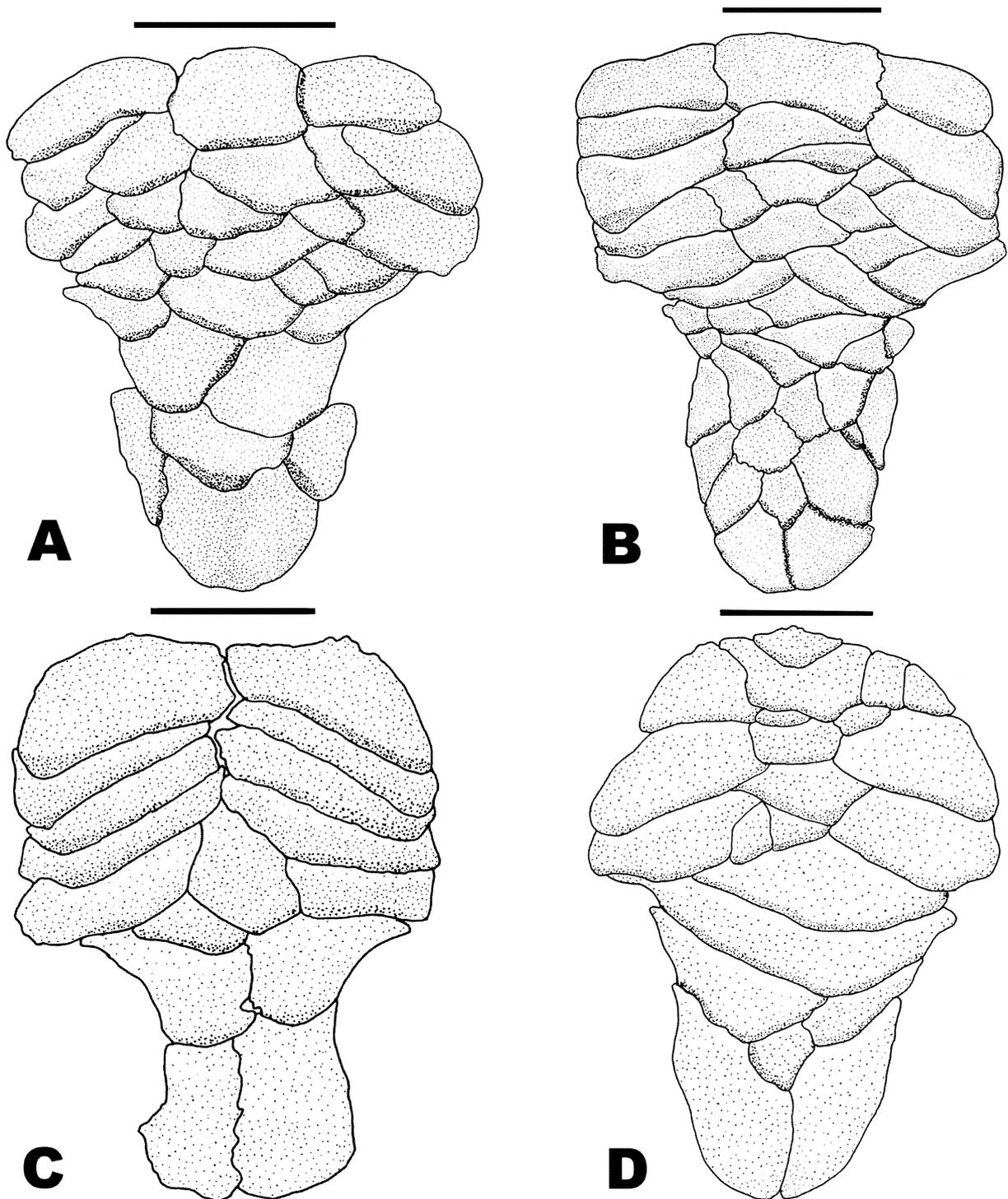


FIGURE 6. Arrangement of abdominal plates of *Hisonotus* species. Anterior portion toward top. A—*H. iota*, MCP 40029, 28.0 mm SL. B—*H. leucophrys*, MCP 41354, 40.8 mm SL. C—*H. megaloplax*, MCP 31779, 37.8 mm SL. D—*H. montanus*, MCP 41459, 37.9 mm SL. Scale bar is 2 mm.

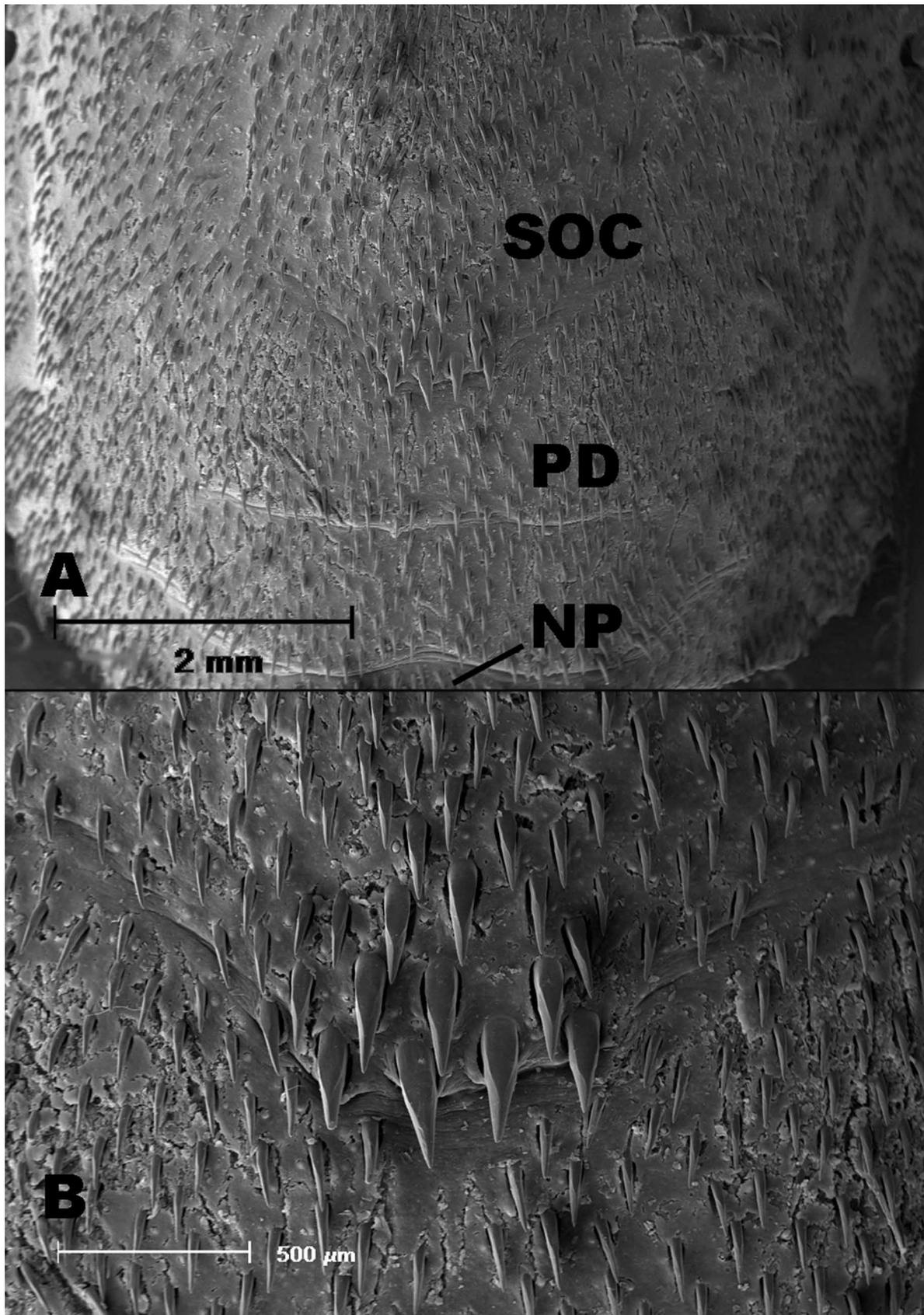


FIGURE 7. Scanning electron micrograph of predorsal region of *Hisonotus iota*, showing raised tuft of odontodes in posterior tip of parieto-supraoccipital. MCP 40029, 29.7 mm SL. Anterior portion toward top. A—dorsal view of predorsal region. B—magnification of raised odontodes. SOC—parieto-supraoccipital; PD—predorsal plates; NP—nuchal plate.

TABLE 2. Frequency distribution for left and right lateral plate counts of species of *Hisonotus* in the rio Uruguay basin. N = number of specimens.

Species	Left Lateral Plates						N	Mean
	20	21	22	23	24	25		
<i>H. nigricauda</i>			7	31	22		60	23.3
<i>H. ringueleti</i>			4	34	29		67	23.4
<i>H. aky</i>			7	19	2		28	22.8
<i>H. charrua</i>				27	36	40	103	24.1
<i>H. megaloplax</i>			5	12	3		20	22.9
<i>H. leucophrys</i>				4	5		9	23.6
<i>H. montanus</i>			8	10			18	22.6
<i>H. iota</i>	5	13	2				20	20.9

continued.

Species	Right Lateral Plates						N	Mean
	20	21	22	23	24	25		
<i>H. nigricauda</i>			6	33	21		60	23.3
<i>H. ringueleti</i>			5	30	32		67	23.4
<i>H. aky</i>			11	14	3		28	22.7
<i>H. charrua</i>				21	42	40	103	24.1
<i>H. megaloplax</i>			3	14	3		20	23.0
<i>H. leucophrys</i>				4	5		9	23.6
<i>H. montanus</i>			8	10			18	22.6
<i>H. iota</i>	8	11	1				20	20.7

Sexual dimorphism. Characterized by the urogenital papilla, positioned just behind the anal opening in males. Adult males also possess a developed fleshy flap along the dorsal margin of the first thickened pelvic-fin ray, that is absent in females. The flap is slightly wider basally and progressively narrows distally. Middle portion of first and second branched rays with a slightly developed fleshy flap. Flap is absent in juvenile males and females. Males have a longer pelvic-fin that extends beyond the anal-fin origin, with pelvic fin just reaching the origin of anal fin in females.

Distribution and habitat. *Hisonotus iota* is known only from the type locality in rio Chapecó, a tributary of the upper rio Uruguay basin (Fig. 8). Rio Chapecó, at the collection site of the new species, is a wide and shallow river with a median to fast waterflow. The stream has clear waters running over a rocky bottom. The species was collected in the aquatic submersed vegetation.

Etymology. The species epithet *iota* is from the Greek meaning anything very small, referring to the small size of the species compared to congeners. A noun in apposition.

Hisonotus leucophrys, new species

Fig. 9, Table 3

Hisonotus sp. 8.-Reis & Carvalho (2007: 84) [listed].

Holotype. MCP 42576, 42.2 mm SL, female, Brazil, Santa Catarina, Xavantina, rio Ariranhas on bridge of highway SC-466, rio Uruguai basin 27°04'17"S 052°20'34"W, 30 Apr 2007, T. P. Carvalho, A. R. Cardoso & C. A. Cramer.

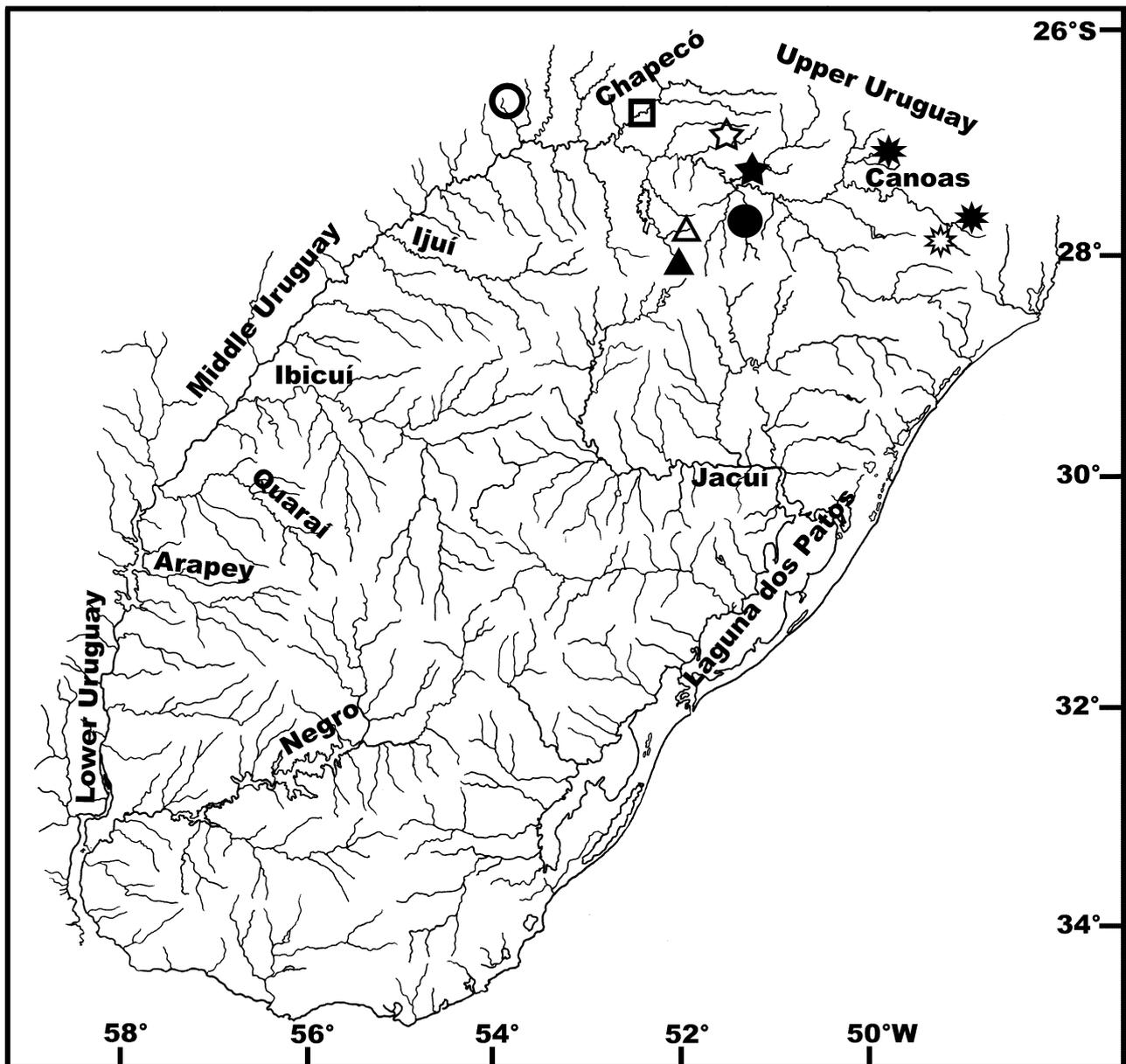


FIGURE 8. Drainage map showing distribution of *Hisonotus* species in the upper rio Uruguai basin. Some symbols represent more than one collecting locality. Open symbols represent type locality. *Hisonotus iota* (square); *Hisonotus leucophrys* (star); *Hisonotus megaloplax* (triangles); *Hisonotus montanus* (asterisk); and *Hisonotus aky* (circles).

Paratypes. All from Brazil, Santa Catarina, rio Uruguai basin: ANSP 187473, 2, 27.6–30.3 mm SL; MCP 41354, 3 + 2 c&s 18.3–40.8 mm SL, collected with the holotype. MCN 12741, 2, 37.4–37.6 mm SL, same type locality, 8 Jul 1996, W. R. Koch, M. Rosenau & K. M. Grosser. MCP 41351, 1, 19.8 mm SL, Xavantina, rio Ariranhas about 800 meters northeast from urban area of Xavantina, 27°03'55"S 052°20'10"W, 30 Apr 2007, T. P. Carvalho, A. R. Cardoso & C. A. Cramer. MCN 12024, 1, 40.2 mm SL, Concórdia, rio Rancho Grande on the highway SC-461, 27°20'22"S 051°57'50"W, 27 Jul 1995, R. C. Vieira, R. R. Estevão & K. M. Grosser. MCN 12553, 1, 37.4 mm SL, Concórdia, rio Rancho Grande on highway SC-461, 27°20'22"S 051°57'50"W, 25 Apr 1996, W. R. Koch, M. Rosenau & K. M. Grosser.

Diagnosis. *Hisonotus leucophrys* differs from its congeners, except *Hisonotus montanus*, by having comparatively broader light stripes on dorsolateral surface of head, from snout tip to posterior end of compound pterotic (wider than pupil diameter) vs. narrow light stripes on dorsal surface of head extended from snout tip to posterior end of compound pterotic, or no longitudinal stripes in that region. *Hisonotus*

leucophrys differs from *Hisonotus montanus* by having the snout covered with odontodes, without an odontode-free band (Fig.10) vs. anterior portion of snout with an odontode-free band; and by having an infraorbital canal entering the infraorbital series via the sphenotic vs. infraorbital canal entering the infraorbital series via the compound pterotic.

TABLE 3. Morphometrics and meristics of *Hisonotus leucophrys*. SD = Standard deviation, n = number of specimens, H = holotype.

	types		Low	High	Mean	SD
	H	n				
Standard length (mm)	42.2	9	28.3	42.2	36.0	-
Percent of Standard Length						
Head length	35.0	9	32.9	37.5	34.8	1.28
Predorsal length	46.8	9	44.5	48.5	46.0	1.18
Dorsal-fin spine length	21.3	9	21.3	25.1	23.8	1.30
Anal-fin unbranched ray length	16.8	8	14.5	18.0	16.7	1.11
Pectoral-fin spine length	22.6	9	20.8	27.0	23.7	1.67
Pelvic-fin unbranched ray length	17.8	9	14.2	20.4	18.0	1.76
Cleithral width	23.3	9	22.2	24.1	23.1	0.54
Thoracic length	16.7	9	15.1	16.8	16.1	0.60
Abdominal length	20.6	9	19.2	21.2	20.4	0.61
Body depth at dorsal-fin origin	18.9	9	17.6	20.2	18.9	0.87
Caudal-peduncle length	32.9	9	31.9	35.9	33.2	1.51
Caudal-peduncle depth	10.1	9	9.8	11.8	10.6	0.59
Percent of Head Length						
Snout Length	48.6	9	46.8	48.8	47.8	0.67
Orbital diameter	15.1	9	15.1	16.5	15.9	0.38
Interorbital width	38.7	9	36.1	42.7	39.5	2.13
Head depth	50.2	9	46.2	52.8	49.5	2.48
Suborbital depth	18.1	9	17.3	20.0	18.9	0.88
Mandibular ramus	7.2	9	7.1	8.4	7.7	0.51
Meristics						
Left premaxillary teeth	12	9	11	15	12.8	1.79
Right premaxillary teeth	13	9	10	16	12.9	2.09
Left dentary teeth	14	9	10	15	12.7	1.80
Rigth dentary teeth	13	9	10	15	12.7	1.50
Left lateral scutes	23	9	23	24	23.6	0.53
Rigth lateral scutes	23	9	23	24	23.6	0.53

Description. Morphometrics and meristics in Table 3. Adult size moderate for members of this genus (large adult reaching 42 mm in SL). Body somewhat robust, moderately elongate, without conspicuous keels. Caudal peduncle round in cross section. Dorsal body profile convex from snout tip to nuchal plate, straight and posterodorsally inclined over nuchal plate to dorsal-fin origin. Straight and posteroventrally sloped at dorsal-fin base, straight from that point to caudal fin. Ventral profile of body almost straight from snout tip to anal-fin origin, except for somewhat concave margin from snout to posterior border of opercle. Straight and posterodorsally inclined at anal-fin base, straight from that point to caudal-fin origin. Greatest body depth at dorsal-fin origin. Least body depth at posterior end of caudal peduncle. Profile of posterior caudal-fin margin pronounced concave. Head and snout somewhat broad, snout rounded to slightly pointed in dorsal view, body

progressively narrowing caudally from pectoral-fin insertions. Snout region anterior to nares depressed, interorbital region convex. Upper margin of orbit somewhat elevate. Eye dorsolaterally positioned. Iris operculum present.



FIGURE 9. Holotype of *Hisonotus leucophrys*, MCP 42576, female, 42.2 mm SL. Rio Ariranhas on bridge of highway SC-466, Xavantina, Santa Catarina, Brazil.

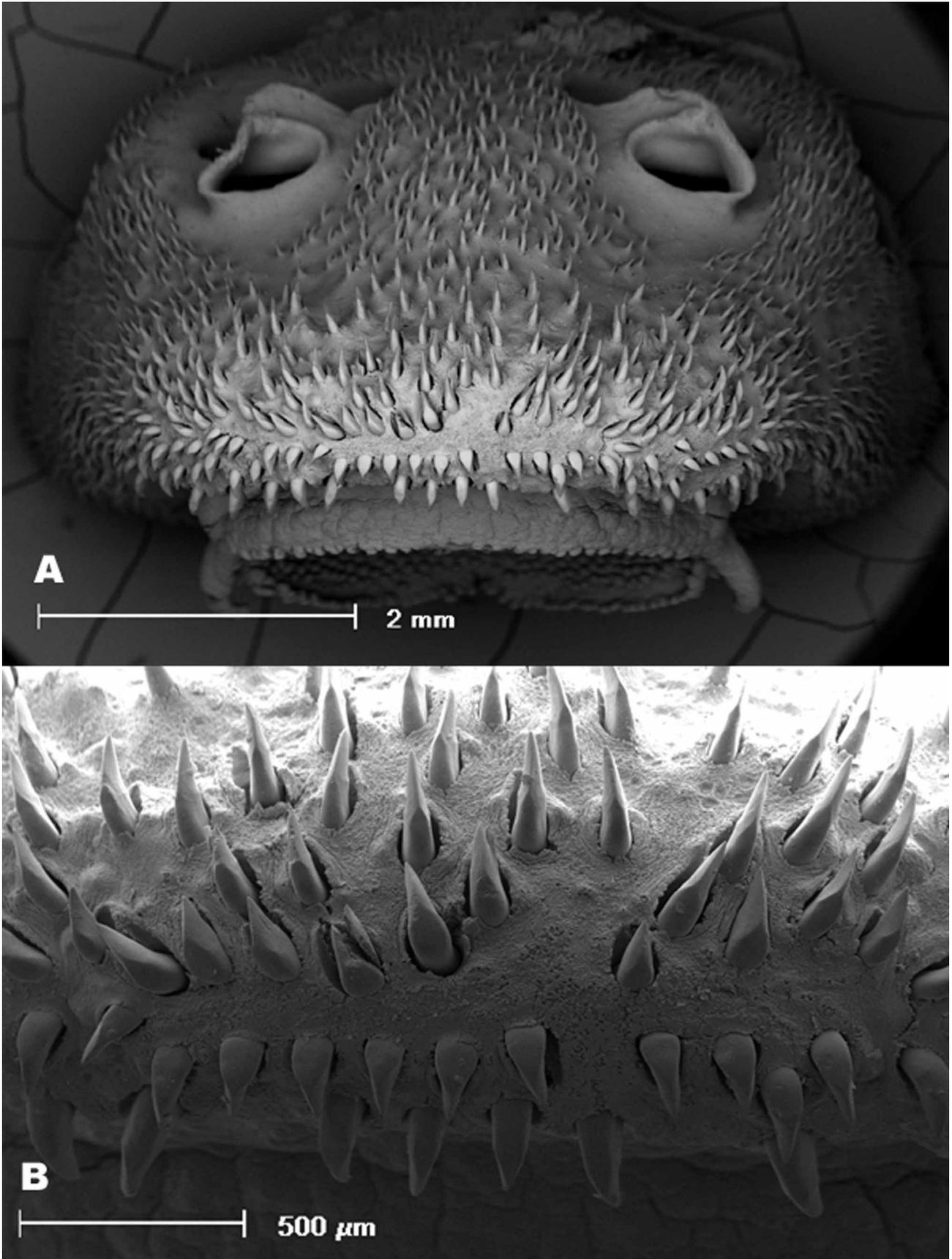


FIGURE 10. Scanning electron micrograph of snout anterior rostral margin of *Hisonotus leucophrys*, MCN 12553, 37.4 mm SL. A—anterior view of rostrum; B—magnification of medial portion.

Pectoral fin I,6. Posterior margin almost straight, when depressed, its tip reaching middle of pelvic fin. Posterior margin of pectoral-fin spine smooth in adults, juveniles with posterior half of spine serrate. Pectoral-fin axillary slit present, located below ventral margin of cleithral process. Pelvic fin i,5. Tip of depressed fin not reaching anal-fin origin in females, but extending beyond that point in males. Dorsal II,7, its origin located posterior to vertical through pelvic-fin origin. Dorsal-fin spinelet somewhat rounded in shape. Anal fin i,5. First anal-fin pterygiophore exposed anterior to anal fin. Adipose fin absent. Caudal fin i,14,i.

Body almost entirely covered by plates except for region overlying opening of swim bladder capsule, area between pectoral girdle and lower lip, region around anus, and base of paired fins. Rostral plate with posterior notch articulation with mesethmoid. Rostral plate thickened, anterior margin covered by odontodes, without odontode-free band, small area devoid of odontodes medially (Fig. 10). Prenasal plates reduced, small unplated area positioned laterally between infraorbitals and prenasal plates. Three rows of predorsal plates. Lateral plate series formed by 23–24 plates (Tab. 2). Lateral line incomplete, with gap on line of pores along midlength of body. Median series not truncated, reaching posterior end of caudal peduncle (Fig. 5B). Abdominal plates composed by three rows, lateral abdominal plates slightly larger, forming regular series of about four to five plates in each side. Median abdominal series formed by one plate series. Pre-anal shield region formed by plates of small size, irregularly arranged (Fig. 6B). Coracoid and cleithrum exposed and covered by odontodes, except for medial region of cleithrum between arrector fossae opening and symphysis.

Head without conspicuous crests. Odontodes on parieto-supraoccipital tip slightly larger than those of surrounding areas, forming slightly pronounced crest. Head, fin rays, and body plates covered with odontodes, these larger on anterior surface of all fin spines, and on ventral and dorsal margin of rostrum. Anteroventral margin of compound pterotic with medium-to-large size perforations. Infraorbital canal entering infraorbital series via sphenotic. Lips roundish and papillose, posterior margin of lower lip fimbriate. Maxillary barbel present.

Premaxillary and dentary teeth bifid, slender proximally and flattened distally; major (medial) cusp round; minor (lateral) cusp minute pointed. Accessory patch of teeth absent on dentary and premaxilla.

Hypurals 1–2 and 3–5 not completely fused, slight median notch on posterior portion of caudal skeleton. Total vertebrae 29 (1 c&s).

Color. Ground color of dorsal and lateral surfaces dark gray to light brown. Dorsal and lateral portions of head darker than body. Light rounded spots over dorsal surface of head between nares and orbits. Pair of longitudinal light stripes starting at snout tip and bifurcating posterior to orbit. One branch reaching posterior tip of parieto-supraoccipital and another branch, not continuous, reaching posterior parieto-supraoccipital tip. Stripes wider than pupil diameter. Ventrolateral region of head mostly yellowish, except for scattered dark marks, variable in shape. Dorsolateral surface of body with three paired light longitudinal stripes. One pair more dorsally, beginning at predorsal plate just after parieto-supraoccipital tip and reaching posterior end of caudal peduncle. Two paired stripes more laterally located. Stripes beginning at posterior end of compound pterotic, joining below dorsal-fin region and from that point, continuous as single stripe, reaching posterior end of caudal peduncle. Sometimes presenting longitudinal stripe at ventrolateral region, from opercle to vertical through end of anal-fin base. Ventral surface of body pale yellow with scattered chromatophores. Gathered chromatophores forming dark blotches on cheeks, on bases of pectoral fin, and on caudal peduncle. Unbranched rays of pectoral, pelvic, dorsal, anal, and caudal fins mostly unpigmented, except for dark transverse bars. Branched rays of pectoral, pelvic, dorsal, and anal fins mostly hyaline except for transverse dark bars. Caudal-fin branched rays mostly dark pigmented, except for hyaline posterior portion of upper rays, and for transversal hyaline bar, composed by rounded light spots crossing middle portion of caudal fin. Ground color in life yellowish.

Sexual dimorphism. Characterized by the presence of an urogenital papilla, positioned just behind the anal opening in males. Adult males also possess a fleshy flap along the dorsal margin of the first thickened pelvic-fin ray. The flap is absent in juvenile males and females. Males have a longer pelvic-fin that surpasses anal-fin origin, falling short of anal-fin origin in females.

Distribution and habitat. *Hisonotus leucophrys* is only known from two tributaries of the right margin of

the upper rio Uruguay, the rio Ariranhas and the rio Rancho Grande (Fig. 8). This species inhabits median to fast flowing watercourses of clear water, with stones and sand on the bottom, and are found in aquatic, partially submersed, vegetation islands composed by grass. Recent collection efforts in rio Rancho Grande failed to capture additional individuals of this species. After the flooding of the reservoir of the Itá dam (a power plant downstream the mouth of rio Rancho Grande into the rio Uruguay) in the year of 2000, a large portion of the rio Rancho Grande was flooded. The changes in the environment from a rapid running river to a lentic habitat apparently are the cause of the disappearance of this species.

Etymology. The species epithet *leucophrys*, from the Greek *leucos*, white and *ophrys*, eyebrow, referring to the white longitudinal stripe above eye orbit in the species. A noun in apposition.

***Hisonotus megaloplax*, new species**

Figure 11, Table 4

Hisonotus sp.-Câmara & Hahn (2002) [listed].

Hisonotus sp. 7.-Reis & Carvalho (2007: 84) [listed].

Holotype. MCP 42577, 42.8 mm SL, female, Brazil, Rio Grande do Sul, Coxilha, arroio Caraguatá on secondary road to highway BR-153 between Passo Fundo and Ipiranga, 28°07'55"S 052°20'56"W, 29 Apr 2007, T. P. Carvalho, A. R. Cardoso & C. A. Cramer.

Paratypes. All from Brazil, Rio Grande do Sul, rio Uruguai basin, rio Passo Fundo drainage, ANSP 187474, 4, 30.9–39.6 mm SL; MCP 41352, 6, 23.7–47.1 mm SL, collected with the holotype. MCP 31765, 2, 18.2–38.6 mm SL, Passo Fundo, rio Passo Fundo on highway BR-285, 28°14'55"S 052°18'39"W, 3 Jan 2003, W. Bruschi Jr. & J. P. Silva. MCP 31779, 9 + 3 c&s, 30.7–43.9 mm SL, Passo Fundo, rio Passo Fundo, downstream of Corsan dam, 28°15'15"S 052°18'52"W, 3 Jan 2003 W. Bruschi Jr. & J. P. Silva.

Diagnosis. *Hisonotus megaloplax* differs from its congeners by the arrangement of abdominal plates, which is composed by greatly enlarged lateral abdominal plates, which contact each other at the belly midline, without a median abdominal series or with a single triangular plate located posteriorly (Fig. 6C). All other species of *Hisonotus*, with the exception of *Hisonotus montanus*, possess a complete median series between the lateral abdominal plates or a naked area between them. This feature is polymorphic in *H. montanus*, some individuals having enlarged lateral abdominal plates contacting at the midline and leading to misidentification. *Hisonotus megaloplax* is further distinguished from *Hisonotus montanus* by the caudal-fin color pattern which is almost completely dark vs. color pattern composed by vertical dark stripes, and by the infraorbital canal entering infraorbital series via sphenotic vs. infraorbital canal entering infraorbital series via compound pterotic.

Description. Morphometrics and meristics in Table 4. Adult size moderate to large for members of this genus (larger individual surpassing 47 mm SL). Body robust, somewhat elongate, without conspicuous keels. Caudal peduncle round in cross section. Dorsal body profile slightly concave from tip of snout to nares, convex from that point to parieto-supraoccipital tip. Straight and posterodorsally inclined from posterior end of parieto-supraoccipital to dorsal fin origin. Dorsal-fin base straight and posteroventrally sloped, almost straight from posterior end of dorsal-fin base to caudal-fin origin. Ventral profile almost straight from snout tip to anal-fin origin. Concave at anal-fin base, straight from that point to origin of caudal fin. Greatest body depth at dorsal-fin origin. Least body depth just posterior to middle of caudal peduncle. Posterior profile of caudal-fin margin concave. Head and snout broad, snout rounded in dorsal view, body progressively narrowing posterior of pectoral-fin insertion. Snout region anterior of nares slightly depressed; interorbital region straight to slightly convex. Upper margin of orbit not elevated. Eye dorsolaterally positioned. Iris operculum present.

TABLE 4. Morphometrics and meristics of *Hisonotus megaloplax*. SD = Standard deviation, n = number of specimens, H = holotype.

	types					
	H	n	Low	High	Mean	SD
Standard length (mm)	42.8	20	30.7	47.1	38.6	
Percent of Standard Length						
Head length	32.1	20	29.6	35.5	32.3	1.30
Predorsal Length	45.7	20	41.2	46.7	44.2	1.44
Dorsal-fin spine length	21.6	20	19.4	24.4	21.5	1.31
Anal-fin unbranched ray length	15.7	19	13.4	19.1	16.2	1.33
Pectoral-fin spine length	22.6	19	20.4	26.0	22.7	1.47
Pelvic-fin unbranched ray length	12.2	20	12.2	19.9	15.7	2.44
Cleithral width	22.3	20	20.5	23.3	22.0	0.76
Thoracic length	15.4	20	14.6	17.1	16.1	0.83
Abdominal length	18.1	20	17.9	20.6	19.1	0.64
Body depth at dorsal-fin origin	20.0	20	17.8	21.1	19.3	1.01
Caudal-peduncle length	38.8	20	33.3	39.1	36.8	1.50
Caudal-peduncle length	11.2	20	10.3	12.6	11.4	0.67
Percent of Head Length						
Snout Length	53.0	20	46.4	53.0	49.9	1.48
Orbital diameter	15.6	20	13.9	16.8	15.3	0.84
Interorbital width	41.6	20	39.4	44.9	42.1	1.51
Head depth	55.5	20	49.8	56.2	53.0	2.19
Suborbital depth	22.0	20	19.3	23.6	21.8	1.16
Mandibular ramus	7.9	20	6.2	8.5	7.6	0.76
Meristics						
Left premaxillary teeth	20	20	13	21	17.4	2.52
Right premaxillary teeth	20	19	14	22	17.4	2.52
Left dentary teeth	18	20	12	19	16.1	1.86
Rigth dentary teeth	16	20	12	19	15.6	1.70
Left lateral scutes	23	20	22	24	22.9	0.64
Rigth lateral scutes	23	20	22	24	23.0	0.56

Pectoral fin I,6. Posterior margin almost straight, when depressed tip extending beyond middle of pelvic fin. Posterior margin of pectoral-fin spine smooth. Pectoral-fin axillary slit present in juveniles, but absent in larger specimens. Pelvic fin i,5. Tip of depressed fin not reaching anal-fin origin in females, but extending just to that point in males. Dorsal II,7, its origin located slightly posterior of vertical through pelvic-fin origin. Dorsal-fin spinelet laterally extended. Anal fin i,5. First anal-fin pterygiophore exposed anterior to anal fin. Adipose fin absent. Caudal fin i,14,i.

Body almost entirely covered by plates except for region overlying opening of swim bladder capsule, area between pectoral girdle and lower lip, region around anus, and base of paired fins. Rostral plate with posterior notch articulation with mesethmoid. Rostral plate thickened, with odontode-free band between dorsal and ventral series of odontodes. Area devoid of odontodes narrow at medial portion and wider at lateral portions (Fig. 12). Prenasal plates present and not reduced. Three rows of predorsal plates. Lateral plate series formed by 22–24 plates (Tab. 2). Lateral line incomplete, with gap on line of pores along midlength of body. Median

plate series truncated, not reaching posterior end of caudal peduncle (Fig. 5C). Abdominal plates composed by enlarged lateral plate series, contacting each other at midline of belly. Lateral abdominal plates forming regular series of three to five plates, two to four of them contacting at midline. Pre-anal shield region formed by large size plates (Fig. 6C). Coracoid and cleithrum exposed and covered by odontodes, except for medial region of cleithrum between arrector fossae opening and symphysis.



FIGURE 11. Holotype of *Hisonotus megaloplax*, MCP 42577, female, 42.8 mm SL. Arroio Caraguatá on secondary road to highway BR-153 between Passo Fundo and Ipiranga, Coxilha, Rio Grande do Sul, Brazil.

Head without conspicuous crests. Odontodes on parieto-supraoccipital tip slightly larger than those of surrounding areas, mostly in smaller specimens. Head, fin rays, and body plates covered with odontodes, these larger on anterior surface of all fin spines, and on ventral margin of rostrum, slightly enlarged in dorsal margin of rostrum. Anteroventral margin of compound pterotic with median-to-large size perforations. Infraorbital canal entering infraorbital series via sphenotic. Lips roundish and papillose, posterior margin of lower lip fimbriate. Maxillary barbel present.

Premaxillary and dentary teeth bifid, slender proximally and flattened distally; major (medial) cusp round; minor (lateral) cusp minute pointed. Accessory patch of teeth absent on dentary and premaxilla.

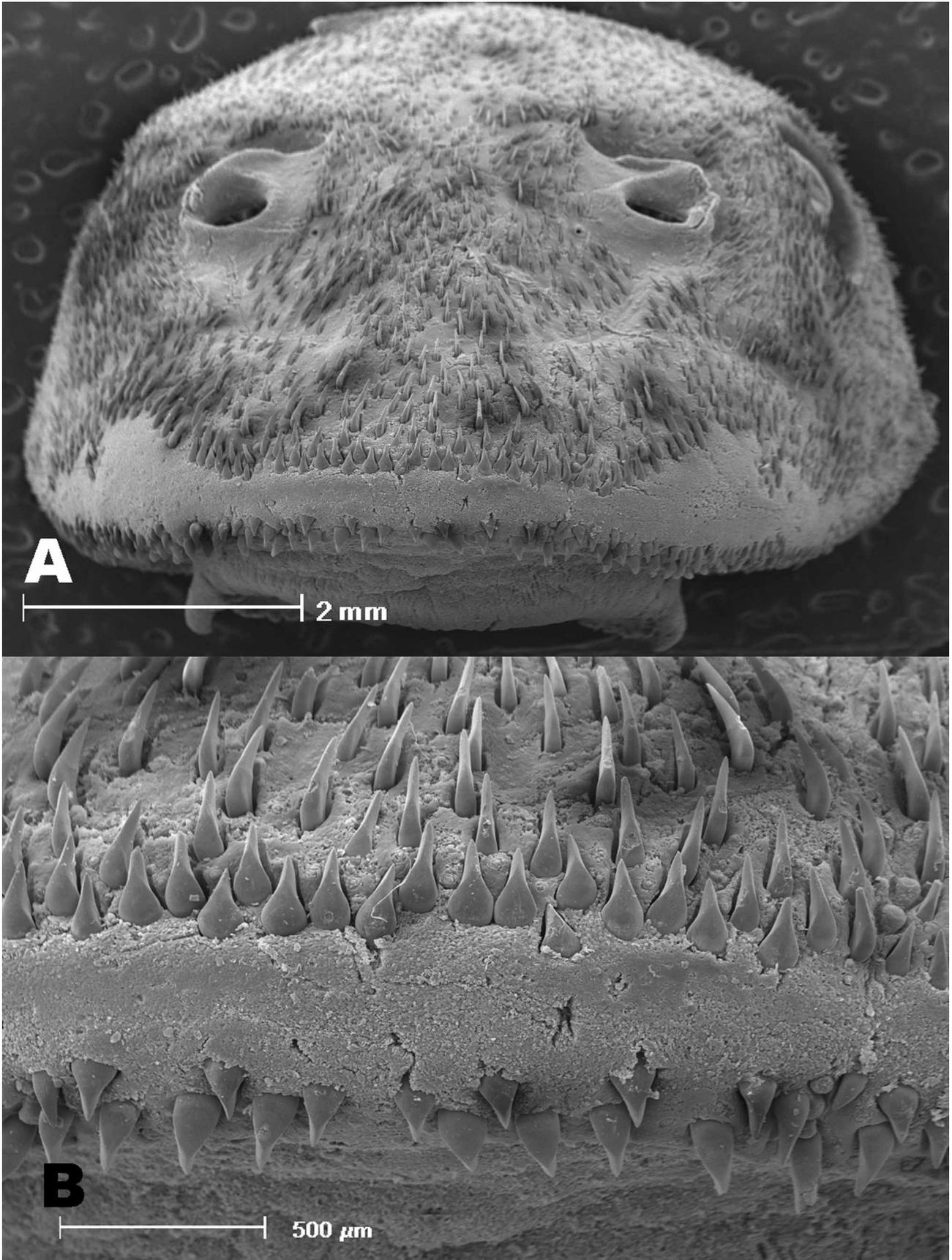


FIGURE 12. Scanning electron micrograph of snout anterior rostral margin of *Hisonotus megaloplax*, MCP 41352, 40.9 mm SL. A—anterior view of rostrum; B—magnification of medial portion.

Hypurals 1–2 and 3–5 almost completely fused, with median notch on anterior portion caudal-fin skeleton. Total vertebrae 28 (2 c&s).

Color. Ground color of dorsal and lateral surfaces dark gray to almost black. Dorsal and lateral portions of head darker than body, except for yellowish area in ventrolateral region of head contrasting with dark rounded blotches, and lighter spots on parieto-supraoccipital. Region anterior to nares lighter than surrounding areas, forming narrow paired longitudinal light stripes from snout tip to posterior end of parieto-supraoccipital, bifurcating and becoming inconspicuous from that point, and completely disappearing at vertical bellow dorsal-fin origin. Ventral surface of body pale yellow, with scattered chromatophores grouped on base of pectoral fin, forming dark blotches. Unbranched rays of pectoral, pelvic, dorsal, and anal fins mostly unpigmented, except for dark transverse bars, forming striped pattern. Branched rays of these fins mostly hyaline except for unconvincing dark transverse bars. Caudal fin mostly dark gray pigmented, except for hyaline transverse bands on posterior portion of upper rays. Unbranched rays of caudal fin with transverse dark bands. In life, ground color of dorsum and flanks dark green.

Sexual dimorphism. Characterized by the urogenital papilla, positioned just behind the anal opening in males. Adult males also possess a developed fleshy flap along the dorsal margin of the first thickened pelvic-fin ray, that is absent in females. The flap is slightly wider basally and progressively narrows distally. A fleshy flap also present on medial portion of first and second branched rays of pelvic fin. In juvenile males, flaps smaller or absent. Males have a longer pelvic fin that extends up to the anal-fin origin, with pelvic fin falling short of anal-fin origin in females.

Distribution and habitat. *Hisonotus megaloplax* is known only from the headwaters of the rio Passo Fundo drainage, tributary to the upper rio Uruguay basin (Fig. 8). The arroio Caraguatá at the type-locality is a small watercourse with slow to median flow of clear to brown waters running over stones, vegetal litter, and sandy bottom. The species inhabits marginal submerged vegetation composed mainly by grass. See Câmara & Hahn (2002) for detailed description of arroio Caraguatá and its fish fauna. Recent collection efforts failed to capture this species in the headwaters of rio Passo Fundo, near the city of Passo Fundo. The construction of a dam (Barragem da Fazenda da Brigada) and the pollution caused by sewer rejects from the urban area of Passo Fundo seems to be the cause of the disappearance of this species in that region.

Etymology. The species epithet *megaloplax*, from the Greek *megalos*, big and *plax*, plate, referring to the large lateral abdominal plate series present in the new species. A noun in apposition.

***Hisonotus montanus*, new species**

Figure 13, Table 5

Holotype. MCP 42578, 43.0 mm SL, female, Brazil, Santa Catarina, Rio Rufino, rio Rufino on highway SC-427 by the city of Rio Rufino, 27°51'36"S 049°46'55"W, 1 May 2007, T. P. Carvalho, A. R. Cardoso & C. A. Cramer.

Paratypes. All from Brazil, Santa Catarina, rio Uruguai basin, rio Canoas drainage, ANSP 187475, 4, 26.8–40.7 mm SL; MCP 41459, 16 + 3 c&s, 16.0–45.1 mm SL, collected with the holotype. MCP 22369, 1, 33.5 mm SL, Bom Retiro, creek tributary to rio João Paulo on road of Fazenda Jair Philippe, 27°45'36"S 049°36'19"W, 21 Dec 1998, R. E. Reis, A. R. Cardoso, P. A. Buckup & F. Melo. UFRGS 9597, 3, 31.8–37.3 mm SL, Curitiba, rio Marombas, 27°11'50"S 50°38'02"W, F. R. Carvalho & A. Hirschmann.

Diagnosis. *Hisonotus montanus* can be distinguished from other congeners, except *Hisonotus aky* and *Hisonotus iota* by having an infraorbital canal entering the infraorbital series via the compound pterotic vs. infraorbital canal entering the infraorbital series via the sphenotic. It is distinguished from *Hisonotus aky* and *Hisonotus iota* by having wider light stripes on the dorsal surface of head extending from snout tip to posterior end of compound pterotic, and by the presence of white marks on dorsal surface of head vs. narrow light stripes on dorsal surface of head extending from snout tip to posterior end of compound pterotic, and absence of white marks on dorsal surface of head.



FIGURE 13. Holotype of *Hisonotus montanus*, MCP 42578, female, 43.0 mm SL. Rio Rufino on highway SC-427 at city of Rio Rufino, Santa Catarina, Brazil.

Description. Morphometrics and meristics in Table 5. Adult size moderate to large for members of this genus (larger specimen surpassing 45 mm in SL). Body robust anteriorly, somewhat slender posteriorly, without conspicuous keels. Caudal peduncle round in cross section. Dorsal body profile almost straight from tip of snout to parieto-supraoccipital, except for convex bump above nares in nasal and frontal contact, straight to slightly convex from that point to dorsal-fin origin. Dorsal-fin base straight and posteroventrally sloped, slightly convex from posterior end of dorsal-fin base to caudal-fin origin. Ventral profile almost straight from snout tip to anal-fin origin. Concave at anal-fin base and straight from that point to caudal-fin origin. Greatest body depth at dorsal-fin origin. Least body depth just posterior to middle of caudal peduncle. Posterior profile of caudal-fin margin concave. Head and snout broad, snout rounded, somewhat square in dorsal view. Body progressively narrowing posterior of pectoral-fin insertion. Snout region anterior of nares slightly depressed; interorbital region straight to slightly convex. Upper margin of orbit not elevated. Eye dorsolaterally positioned. Iris operculum present.

Pectoral fin I,6. Posterior margin somewhat convex, when depressed tip extending beyond middle of pelvic fin. Posterior margin of pectoral-fin spine smooth in adults, juveniles with half of spine length serrate. Pectoral-fin axillary slit present, located below ventral margin of cleithral process. Pelvic fin i,5. Tip of depressed fin not reaching anal-fin origin in females, but extending beyond that point in males. Dorsal fin II,7, its origin located posterior to vertical through pelvic-fin origin. Dorsal-fin spinelet not laterally extended,

somewhat rounded. Anal fin i,5. First anal-fin pterygiophore exposed anterior to anal fin. Adipose fin absent. Caudal fin i,14,i.

TABLE 5. Morphometrics and meristics of *Hisonotus montanus*. SD = Standard deviation, n = number of specimens, H = holotype.

	types		Low	High	Mean	SD
	H	n				
Standard length (mm)	43.0	18	27.1	45.1	36.3	
Percent of Standard Length						
Head length	33.3	18	31.8	37.6	33.7	1.67
Predorsal Length	44.9	18	41.9	46.8	44.3	1.32
Dorsal-fin spine length	22.3	18	21.7	25.3	23.6	1.12
Anal-fin unbranched ray length	16.8	18	15.8	19.8	17.8	1.14
Pectoral-fin spine length	23.8	18	21.0	25.1	23.6	1.03
Pelvic-fin unbranched ray length	14.3	18	13.1	20.1	17.1	2.05
Cleithral width	23.7	18	22.9	25.2	23.8	0.70
Thoracic length	16.0	18	14.3	16.3	15.6	0.57
Abdominal length	20.9	18	18.2	21.6	20.2	0.91
Body depth at dorsal-fin origin	20.1	18	19.7	21.9	20.7	0.64
Caudal-peduncle length	35.1	18	33.5	38.7	35.8	1.41
Caudal-peduncle depth	11.0	18	10.4	12.8	11.6	0.56
Percent of Head Length						
Snout Length	48.0	18	46.1	49.5	48.1	1.00
Orbital diameter	15.2	18	14.9	18.0	16.7	0.86
Interorbital width	41.3	18	35.9	44.9	41.2	3.08
Head depth	56.2	18	51.0	59.5	55.7	2.70
Suborbital depth	22.5	18	18.0	24.3	22.3	1.52
Mandibular ramus	8.25	18	7.1	9.2	8.4	0.72
Meristics						
Left premaxillary teeth	14	18	11	14	12.2	1.10
Right premaxillary teeth	14	18	10	14	11.9	1.13
Left dentary teeth	13	18	8	14	10.7	1.87
Rigth dentary teeth	13	18	9	13	11.2	1.44
Left lateral scutes	23	18	22	23	22.6	0.51
Rigth lateral scutes	22	18	22	23	22.6	0.51

Body almost entirely covered by plates except for region overlying opening of swim bladder capsule, area between pectoral girdle and lower lip, region around anus, and bases of paired fins. Rostral plate with posterior notch articulation with mesethmoid. Rostral plate thickened, with narrow odontode-free band between dorsal and ventral series of odontodes. Area devoid of odontodes narrower at medial portion, wider laterally (Fig. 14). Prenasal plates present and not reduced, without unplated area anterior to nares. Three rows of predorsal plates. Median series formed by 22–23 plates (Tab. 2). Lateral line incomplete, with gap on line pores along midlength of body. Median plate series truncated, not reaching posterior end of caudal peduncle (Fig. 5D). Arrangement of abdominal plates variable. Lateral abdominal plates slightly larger and forming regular series of about two or three plates. Median abdominal plates formed by single series (Fig. 6D), or

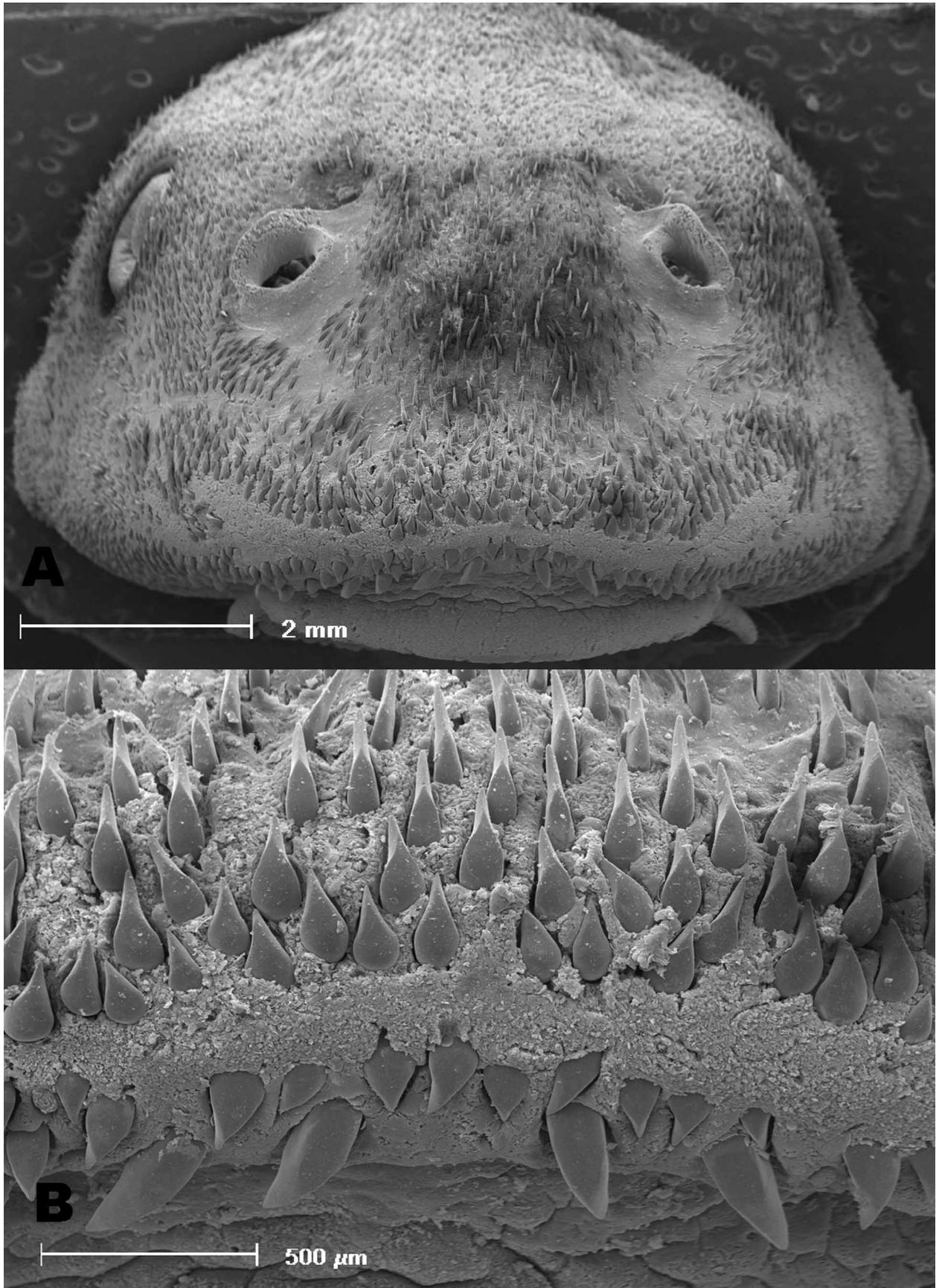


FIGURE 14. Scanning electron micrograph of snout anterior rostral margin of *Hisonotus montanus*, MCP 41459, 41.4 mm SL. A—anterior view of rostrum; B—magnification of medial portion.

abdominal region plated only by enlarged lateral abdominal plates which contact each others at belly midline. Sometimes, lateral abdominal plates relative larger, forming regular series of two to three plates contacting each other at midline and median abdominal series composed by one plate, triangular in shape, located posteriorly. Pre-anal shield region formed by large size plates. Coracoid and cleithrum exposed, covered by odontodes, except for medial region of cleithrum between arrector fossae opening and symphysis.

Head without conspicuous crests. Odontodes on parieto-supraoccipital tip slightly larger than those of surrounding areas, mostly in smaller specimens. Head, fin rays, and body plates covered with odontodes, these larger on anterior surface of all fin spines, and on ventral margin of rostrum. Anterior and ventral margins of compound pterotic with median-to-large size perforations. Infraorbital canal enters infraorbital series via compound pterotic. Lips roundish and papillose, posterior margin of lower lip fimbriate. Maxillary barbel present.

Premaxillary and dentary teeth bifid, slender proximally and flattened distally; major (medial) cusp round; minor (lateral) cusp minute pointed. Accessory patch of teeth absent on dentary and premaxilla.

Hypurals 1–2 and 3–5 completely fused. Total vertebrae 28 (2 c&s).

Color. Ground color of dorsal and lateral surfaces light to dark gray. Dorsal and lateral portions of head darker than body. Light rounded spots over dorsal surface of head between nares and orbits. Pair of longitudinal light stripes starting at snout tip, passing through nares, and bifurcating posterior to orbit. One branch reaching posterior end of parieto-supraoccipital and another branch, not continuous, reaching V-shaped mark at parieto-supraoccipital tip. Stripes width about pupil diameter. Ventrolateral region of head yellowish, covered with scattered dark spots. Dorsolateral surface of body with two light longitudinal stripes, from posterior end of compound pterotic to vertical through dorsal-fin base. Dorsum, between posterior end of dorsal fin and caudal fin, with three to four light saddles. Ventral surface of body pale yellow, with scattered chromatophores, these gathered on base of pectoral fin, forming dark blotch. Unbranched rays of pectoral, pelvic, dorsal, anal, and caudal fins mostly unpigmented, except for dark transverse bands, forming barred pattern. Branched rays of these fins mostly hyaline except for dark transverse bars. Caudal fin mostly unpigmented, except for transverse dark bars, some individuals with square-lined pattern or presenting triangular hyaline areas in middle of ventral lobe of caudal fin. In life, ground color of dorsum and flanks shiny light green.

Sexual dimorphism. Characterized by the urogenital papilla, positioned just behind the anal opening in males. Adult males also possess a developed fleshy flap along the dorsal margin of first thickened pelvic-fin ray, which is absent in females. The flap is slightly wider basally and progressively narrows distally. A fleshy flap is present on the medial portion of first and second branched rays of pelvic fin. In juvenile males, flaps are smaller or absent. Males have a longer pelvic fin that surpasses anal-fin origin, with pelvic fin falling short of anal-fin origin in females.

Distribution and habitat. *Hisonotus montanus* is known only from the rio Canoas drainage, a tributary to the upper rio Uruguay basin (Fig. 8). This species inhabits median flow watercourses, with clear waters of sandy and rocky bottom and is found associated with marginal vegetation composed mainly of grass. *Hisonotus montanus* is found at high altitudes, about 850 m above the sea level, and represents the species of *Hisonotus* occurring in the most elevated portions of the rio Uruguay basin.

Etymology. The species epithet *montanus* is from the Latin, meaning of mountains, referring to the high altitudes where this species is found. An adjective.

***Hisonotus aky*, new combination**

(Azpelicueta, Casciotta, Almirón & Körber, 2004).

(Figures 15, Table 6)

Epactionotus aky Azpelicueta, Casciotta, Almirón & Körber, 2004: 81–90, [original description, type locality: Arroyo Garibaldi, rio Uruguay basin at Misiones, Argentina].-Liotta, 2005:354 [listed].

Hisonotus sp. “Argentinien”.-Evers & Seidel, 2002 [listed and illustrated].

Material examined. All from rio Uruguay basin: AI 124, holotype of *Epactionotus aky*, 29.2 mm SL, Argentina, Misiones, Arroyo Garibaldi, tributary of Arroyo Yabotí-Guazú, 26°38'46"S 053°59'55"W. AI 125, paratypes of *E. aky*, 7, 25.0–34.5 mm SL, same collecting data as holotype. MCP 41474, 36 + 3 c&s 18.2–39.7 mm SL, Brazil, Rio Grande do Sul, Paim Filho, rio Forquilha at Espraiado bathing spot on secondary road from Maximiliano de Almeida to Paim Filho, 27°40'37"S 51°44'11"W.

TABLE 6. Morphometrics and meristics of *Hisonotus aky*. SD = Standard deviation, n = number of specimens, H = holotype.

	Types						non-types				
	H	n	Low	High	Mean	SD	n	Low	High	Mean	SD
Standard length (mm)	29.2	8	25.0	34.5	28.6		20	28.8	39.7	32.06	
Percent of Standard Length											
Head length	35.6	8	34.9	38.7	36.7	1.43	20	33.3	36.3	34.8	0.81
Predorsal length	46.4	8	45.6	48.3	47.1	1.36	20	42.8	47.7	46.2	1.06
Dorsal-fin spine length	24.5	7	24.3	26.5	25.5	1.00	20	20.7	26.4	23.6	1.48
Anal-fin unbranched ray length	17.5	8	17.0	20.8	18.1	1.22	19	15.1	18.4	16.4	0.91
Pectoral-fin spine length	24.0	8	23.7	27.9	25.5	1.44	20	21.4	26.7	24.3	1.30
Pelvic-fin unbranched ray length	16.7	8	15.6	21.2	17.9	2.02	20	14.9	21.6	17.5	2.10
Cleithral width	23.5	8	23.5	26.0	24.8	0.90	20	23.6	25.6	24.4	0.62
Thoracic length	17.3	8	16.2	18.0	17.2	0.57	20	13.1	18.2	16.1	1.11
Abdominal length	19.7	8	17.5	21.8	19.3	1.24	20	18.8	22.6	20.7	0.86
Body depth at dorsal-fin origin	20.2	8	19.7	23.8	20.8	1.29	20	18.5	22.0	20.6	0.70
Caudal-peduncle length	33.6	8	32.3	34.5	33.5	0.68	20	31.3	36.0	33.5	1.25
Caudal-peduncle depth	12.3	8	12.3	14.3	13.0	0.65	20	11.3	13.2	11.9	0.48
Percent of Head Length											
Snout Length	48.6	8	48.4	51.2	49.3	0.96	20	48.5	53.8	51.2	1.55
Orbital diameter	17.4	8	16.3	18.4	17.4	0.71	20	15.4	17.9	16.7	0.75
Interorbital width	37.7	8	37.6	43.2	39.6	2.13	20	38.5	43.0	40.5	1.34
Head depth	55.5	8	48.4	58.3	52.4	3.65	20	51.2	56.9	53.4	1.40
Suborbital depth	20.3	8	16.7	22.9	19.9	2.16	20	21.1	24.3	22.4	0.80
Mandibular ramus	7.8	8	6.5	10.1	8.3	1.48	20	7.9	10.7	9.2	0.74
Meristics											
Left premaxillary teeth	17	8	11	17	14.1	1.89	20	10	14	12.4	5.33
Right premaxillary teeth	16	8	12	16	14.3	1.75	20	11	14	12.6	3.85
Left dentary teeth	13	8	11	16	12.9	1.96	20	10	15	11.9	5.04
Right dentary teeth	12	8	11	15	12.6	1.51	20	11	15	12.4	4.95
Left lateral scutes	23	8	22	23	22.9	0.35	20	22	24	22.8	0.62
Right lateral scutes	23	8	22	24	23.1	0.64	20	22	24	22.6	0.60

Diagnosis. *Hisonotus aky* differs from its congeners, except from *H. iota*, and *H. montanus* by having an infraorbital canal entering the infraorbital series via the compound pterotic vs. infraorbital canal entering the infraorbital series via the sphenotic. *Hisonotus aky* differs from *H. iota* by the presence of a narrow odontode-free band in the anterior portion of snout (Fig. 16); and by having 27–29 vertebrae vs. presence of a snout

completely covered with odontodes, and 25–26 vertebrae. *Hisonotus aky* differs from *H. montanus* by having narrow longitudinal light stripes on head; and by the absence of white marks on the dorsal surface of head vs. wider longitudinal light stripes markings on the head; and presence of white marks on dorsal surface of head.

Distribution and habitat. *Hisonotus aky* is known only from two tributaries to the rio Uruguay widely separated from each other, the Arroyo Yabotí-Guazú a tributary to middle Río Uruguay basin in Argentina (type-locality), and the rio Forquilha a tributary to upper rio Uruguay basin in Brazil (Fig. 8). There is a large distributional hiatus between these populations located in different tributaries. However, these populations are similar in morphometric data (Tab. 6) and no additional morphological difference was found, except for a more densely pigmented caudal fin in the specimens from rio Forquilha. Hence, these populations are considered conspecific. The population in rio Forquilha inhabits a rapid flowing watercourse, with clear to brown waters and rocky bottom. The individuals were found between aquatic vegetation mainly composed of *Echinodorus* sp., which form green islands attached to a rocky substrate.



FIGURE 15. *Hisonotus aky*, MCP 41474, female, 33.7 mm SL. Rio Forquilha at Espraiado bathing spot on secondary road from Maximiliano de Almeida to Paim Filho, Paim Filho, Rio Grande do Sul, Brazil.

Remarks. *Hisonotus aky* (Azpelicueta, Casciotta, Almirón & Körber, 2004) was originally described in *Epactionotus* Reis & Schaefer, 1998 because of its supposed possession of three synapomorphies of that genus: absence of an expanded fleshy flap on the dorsal surface of the first pelvic-fin ray in males, neural spine of seventh vertebra not contacting the nuchal plate dorsally (contacting unpaired predorsal plates), and first dorsal proximal radial contacting the eighth vertebral centrum. However, the examination of type specimens of *Epactionotus aky* indicated the absence of most diagnostic features of *Epactionotus*. The first pelvic-fin ray without a dorsal skin flap in males is a derived feature that independently evolved three times in the Hypoptopomatinae (*Schizolecis*, *Epactionotus*, and the clade formed by *Acestridium*, *Oxyropsis*, *Hypoptopoma*, and *Nannoptopoma*), according to the topology proposed by Schaefer (1998:382) and Gauger & Buckup (2005:511). The presence of a fleshy flap on the dorsal surface of the first pelvic-fin ray of mature males is plesiomorphic and shared by all species of *Hisonotus*, most hypoptopomatines, and *Epactionotus aky* (Fig 17). The character-states: neural spine of seventh vertebra not contacting the nuchal plate dorsally, and

the first proximal radial of dorsal fin contacting the eighth vertebra (Fig. 18A), are not present in *H. aky*. *Hisonotus aky* shares with remaining *Hisonotus* species and other hypoptopomatines (except *Microlepidogaster*) the neural spine of the seventh vertebra contacting the nuchal plate, at least posteriorly, and the first proximal radial of dorsal fin contacting the seventh vertebra (Fig. 18B). Another character, discussed by Azpelicueta *et al.* (2004), suggesting the inclusion of *H. aky* in *Epactionotus* is the presence of light longitudinal stripes on head and trunk. Because the presence of light stripes is more widespread among hypoptopomatines and appears in several species of *Hisonotus*, that feature does not diagnose *H. aky* as belonging to the genus *Epactionotus*. Moreover, *Epactionotus aky* shares with two species of *Hisonotus* (*H. iota* and *H. montanus*) the presence of an infraorbital canal entering the infraorbital series via the compound pterotic, which is a derived feature and suggests a close relationship between these three species. For these reasons, *Epactionotus aky* is here transferred to the genus *Hisonotus*.

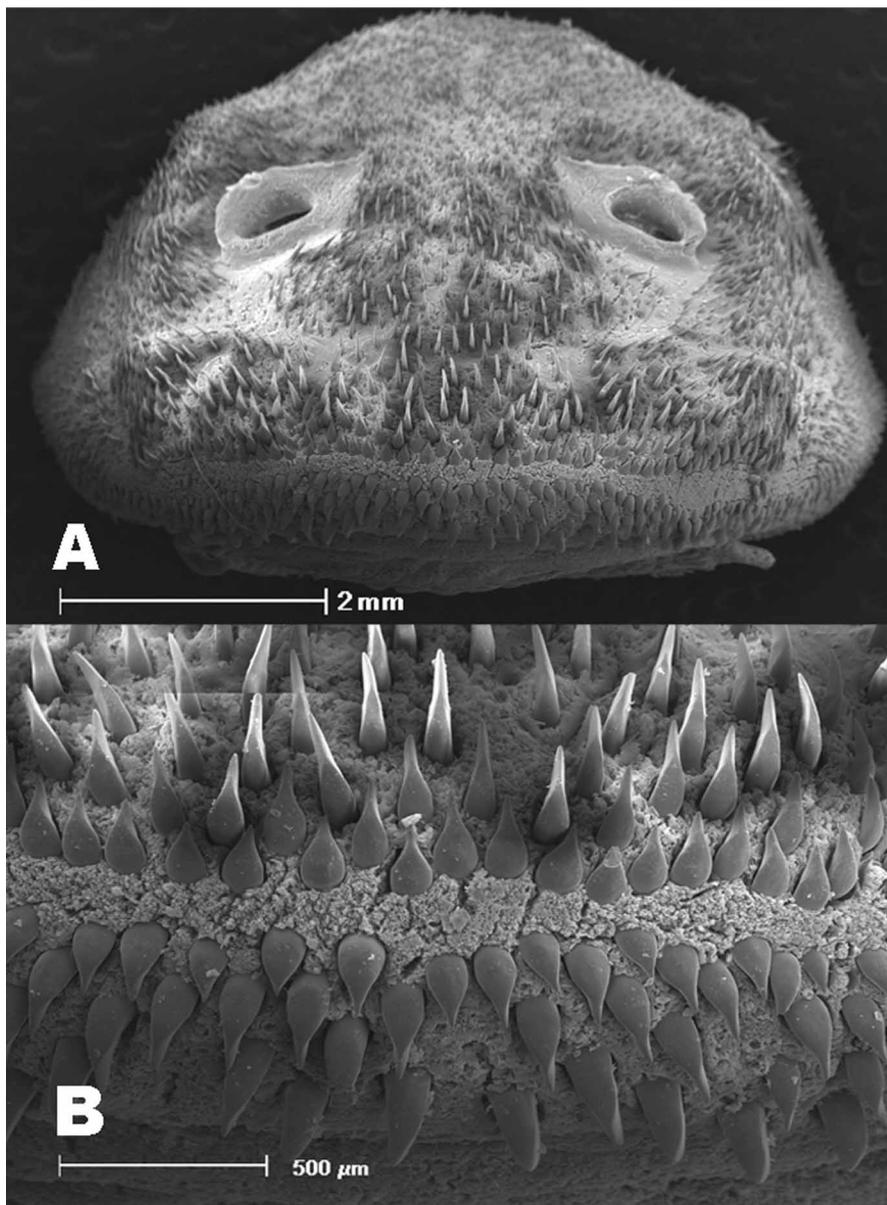


FIGURE 16. Scanning electron micrograph of snout anterior rostral margin of *Hisonotus aky*, MCP 41474, 34.7 mm SL. A—anterior view of rostrum; B—magnification of medial portion.



FIGURE 17. Paratype of *Hisonotus aky*, AI 125, male, 34.5 mm SL. Anterior portion of body in ventrolateral view. Arrow indicates the developed fleshy flap on pelvic-fin unbranched ray of adult male.

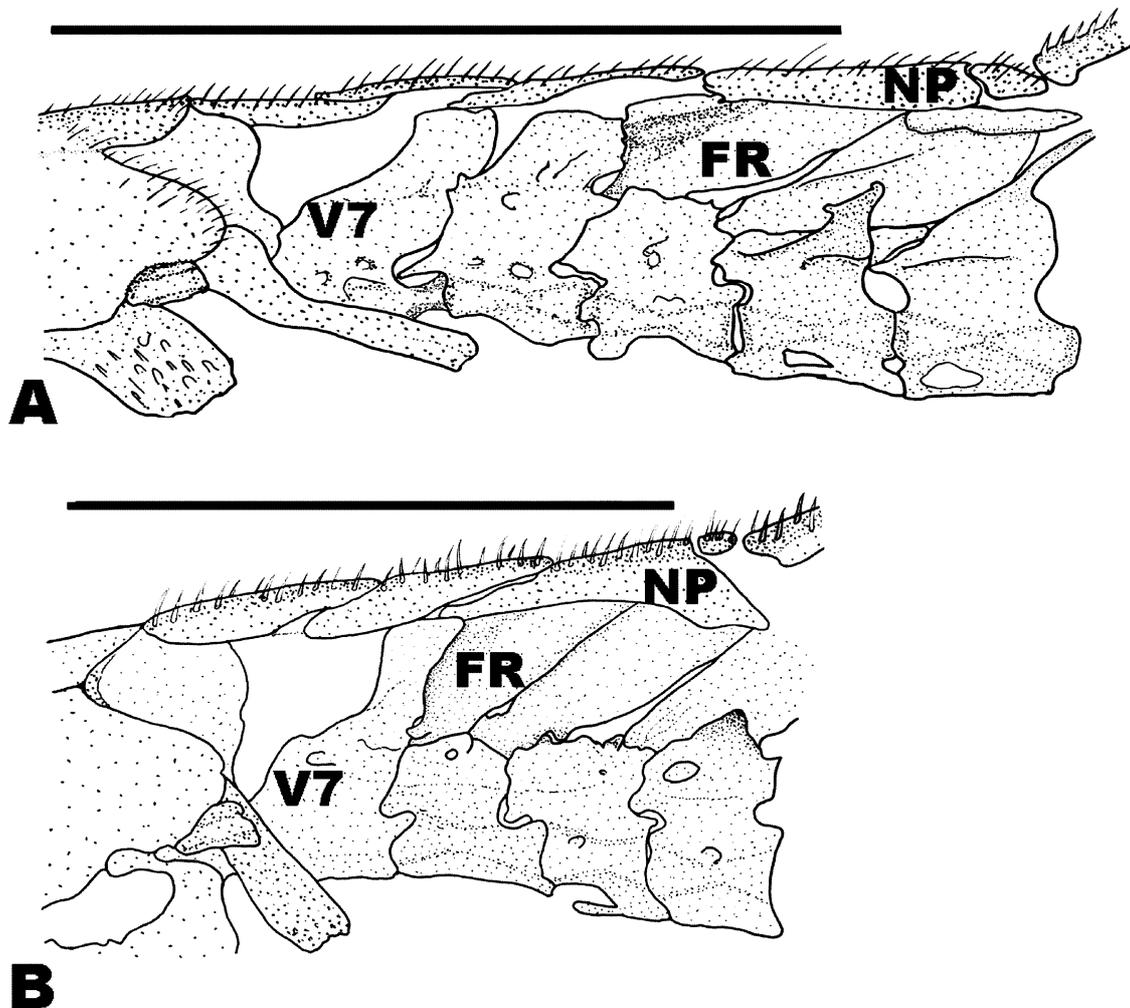


FIGURE 18. Anterior portion of axial skeleton in lateral view. A— *Epactionotus bilineatus*, MCP 29293, 36.5 mm SL, neural spine of seventh vertebra not contacting nuchal plate dorsally, and first proximal radial of dorsal fin contacting eighth vertebra. B— *Hisonotus aky*, MCP 41474, 37.2 mm SL, neural spine of seventh vertebra contacting nuchal plate, and first proximal radial of dorsal fin contacting the seventh vertebra. FR = first proximal radial; NP = nuchal plate; V = vertebra. Scale bar is 5 mm.



FIGURE 19. *Hisonotus ringueleti*, MCP 11215, female, 37.0 mm SL. Arroio Quaraí-Mirim on road between Quaraí and Alegrete, Quaraí, Rio Grande do Sul, Brazil.

***Hisonotus ringueleti* Aquino, Schaefer & Miquelarena, 2001**
(Figures 19–20, Table 7)

Hisonotus ringueleti Aquino, Schaefer & Miquelarena, 2001:1–12, (type locality: Uruguay, Rivera, creek at km 18 of route joining Santana do Livramento, Brazil, and Rivera, Uruguay).

Hisonotus candombe Casciotta, Azpelicueta, Almirón & Litz, 2006:147–152, (type locality: Uruguay, Departamento Salto, río Uruguay basin, arroyo Palomas – New synonym).

Material examined. All from rio Uruguai basin: **Rio Quaraí drainage:** ILPLA 886, holotype, 35.4 mm SL, Uruguay, Rivera, creek at km 18 of route joining Santana do Livramento, Brazil, and Riveira, Uruguay, close

to border, tributary to rio Quaraí drainage (ca. 31°00' S 55°30'W). ILPLA 883, paratypes, 95, 24.2–35.4 mm SL; ANSP 177878, paratypes, 3 + 1 c&s, 22.8–31.3 mm SL; MCP 26154, paratypes, 3 + 1 c&s, 22.6–32.1 mm SL; and MLP 9536, 4, 27.2–34.1 mm SL; collected with the holotype. AI 187, paratypes of *H. candombe*, 3, 23.6–29.2 mm SL, Uruguay, Artigas, arroyo Catalán Grande, 30°50'35" S 56°14'30" W. MCP 11215, 128 + 4 c&s 13.5–38.4 mm SL, Brazil, Quaraí, arroio Quaraí-Mirim on road between Quaraí and Alegrete, 30°18' S 56°19' W. MCP 35239, 1, 39.4 mm SL, Brazil, Quaraí, arroio Quaraí-Mirim on road from Quaraí to Baltazar Brum train station about 20 km northeast from Quaraí, 30°14'38" S 56°18'23" W. UFRGS 4208, 1, 31.9 mm SL, Brazil, Uruguaiana, sanga Mergulhão tributary of arroio Garupá on highway BR-290. UFRGS 7763, 3, 19.7–38.3 mm SL, Uruguay, Artigas, arroyo Cuaró Grande on ruta 4, 30°46'57" S 56°46'47" W. **Río Ibicuí drainage:** MCN 11383, 2, 35.5–37.7 mm SL, Brazil, Alegrete, sanga do Lagoão about 20 km south of Alegrete, tributary of arroio Pai-Passo, tributary of rio Ibirapuitã, MCP 11373, 3, 13.6–18.8 mm SL, Brazil, Quaraí, arroio Pai-Passo on highway RS-185 between Alegrete and Santana do Livramento, 30°13' S 56°02' W. MCP 27659, 1, 36.8 mm SL, Brazil, Tupaciretã, rio Santana near to locality of Jari, tributary to rio Jaguari, 29°14'33" S 54°16'47" W. **Río Arapey Grande drainage:** ZVC-P 5595, holotype of *Hisonotus candombe*, 28.7 mm SL, Uruguay, Salto, Arroyo Palomas, 31°04'43" S 57°37'26" W. ZSM 32062, paratype of *H. candombe*, 1, 25.9 mm SL; AI 164, paratype of *H. candombe*, 25.5 mm SL; and MHNG 2662.86, paratype of *H. candombe*, 1, 26.3 mm SL, collected with the holotype. UFRGS 8029, 1, 26.3 mm SL, Uruguay, Salto, creek tributary to Río Arapey Grande on ruta 4. **Other drainages of Río Uruguay:** UFRGS 7976, 3, 32.3–40.8 mm SL, Uruguay, Artigas, arroyo Guaviyú on ruta 3, 30°38' S 57°41' W. UFRGS 8064, 3, 29.9–43.4 mm SL, Uruguay, Artigas, arroyo Mandiyú on ruta 3, 30°51' S 57°39' W. UFRGS 8573, 3, 33.5–40.6 mm SL, Uruguay, Salto, arroyo del Tala on ruta 31 between Artigas and Salto, 31°23' S 57°33' W.



FIGURE 20. Juvenile specimens of *Hisonotus ringueleti*. A—ILPLA 883, paratype of *H. ringueleti*, 23.9 mm SL. Creek at km 18 of route joining Santana do Livramento and Rivera, rio Quaraí drainage, Rivera, Uruguay. B—MHNG 2662:86, paratype of *H. candombe*, 26.3 mm SL. Arroyo Palomas, Río Arapey Grande drainage, Salto, Uruguay.

Remarks on synonymy. Examination of the type-series of *Hisonotus candombe* did not reveal any consistent differences between the later and *Hisonotus ringueleti* (Fig.19–20). According to Casciotta et al. (2006, p.150) *H. candombe* differs from *H. ringueleti* in having larger pectoral spine serrae distributed all along the posterior margin of the pectoral spine vs. serrae smaller and placed on distal two thirds of the spine. Besides that, *H. candombe* could be distinguished from *H. ringueleti* by having five branched anal-fin rays

and males with a smaller flap on first pelvic-fin unbranched ray, whereas *H. ringueleti* supposedly presents four anal-fin rays and a well developed flap. A disappearance of the pectoral-fin spine serrae in the ontogeny of specimens of *H. ringueleti* was observed. Smaller individuals of that species present strong serrations on the posterior portion of pectoral spine, decreasing in size with the development, being totally absent at about 35 mm SL (Fig. 21). A similar disappearance of serrae in adults occurs in several other congeners. Since specimens used in the description of *H. candombe* are relatively small (range size 22.8–30.0 mm in SL) compared to the range of the species (up to 43 mm in SL), that difference seems to be due to the degree of ontogenetic development. In the same manner, a smaller pelvic flap in males of *H. candombe* is related with the maturity of the individuals, and not useful to diagnose the species. Lastly, the anal-fin ray count is identical in both nominal species. The description of Aquino et al. (2001, tab.1) of four branched anal-fin rays for *H. ringueleti* seems to be an error, since from 30 paratypes examined only one specimen presented four branched anal-fin rays, all remaining having five. Fin-ray counts do not vary considerably within or among species of *Hisonotus*, and are not useful to distinguish species. Therefore *H. candombe* is considered a junior synonym of *H. ringueleti*.

TABLE 7. Morphometrics and meristics of *Hisonotus ringueleti*. SD = Standard deviation, n = number of specimens, H = holotype.

	<i>H. ringueleti</i> types						<i>H. candombe</i> types					
	H	n	Low	High	Mean	SD	H	n	Low	High	Mean	SD
Standard length (mm)	35.4	30	27.0	35.5	30.4		28.7	7	23.6	29.2	26.4	
Percent of Standard Length												
Head length	34.6	30	34.2	38.9	36.2	1.17	35.6	7	35.6	38.9	37.7	1.23
Predorsal length	46.3	30	43.9	50.7	47.1	1.53	45.2	7	45.2	48.2	47.2	1.12
Dorsal-fin spine length	26.1	30	24.6	30.6	26.6	1.33	25.6	7	24.0	28.5	26.1	1.42
Anal-fin unbranched ray length	18.8	30	17.2	22.0	19.3	1.04	16.4	7	16.4	20.1	18.0	1.30
Pectoral-fin spine length	25.9	30	24.8	28.9	26.7	0.97	24.4	7	24.4	27.0	25.7	1.13
Pelvic-fin unbranched ray length	13.7	30	13.7	20.8	16.9	1.99	15.7	7	14.5	17.8	16.3	1.33
Cleithral width	23.2	30	21.8	24.6	23.2	0.74	22.8	7	22.8	24.3	23.5	0.57
Thoracic length	15.3	30	14.5	17.9	16.0	0.88	16.8	7	16.3	17.1	16.8	0.24
Abdominal length	19.2	30	17.1	20.7	19.1	0.92	18.6	7	18.3	20.9	19.5	0.84
Body depth at dorsal-fin origin	18.9	30	17.2	21.6	19.8	0.92	20.1	7	18.8	21.0	19.9	0.78
Caudal-peduncle length	31.8	30	28.7	35.4	32.0	1.62	34.4	7	28.4	34.4	31.2	2.15
Caudal-peduncle depth	14.0	30	12.5	14.9	13.5	0.68	13.6	7	13.4	14.9	14.1	0.53
Percent of Head Length												
Snout Length	47.5	30	44.9	49.2	46.9	1.10	48.1	7	46.9	49.8	48.1	1.01
Orbital diameter	18.6	30	17.7	20.7	19.4	0.78	17.0	7	17.0	19.4	18.5	0.91
Interorbital width	40.4	30	35.3	43.7	40.4	1.83	39.4	7	37.3	41.5	38.5	1.47
Head depth	52.5	30	47.0	55.9	51.3	2.12	50.8	7	46.8	50.8	49.7	1.38
Suborbital depth	16.7	30	14.4	18.4	16.6	1.02	18.6	7	15.1	18.6	17.0	1.13
Mandibular ramus	8.7	30	6.1	9.3	8.1	0.70	9.0	7	7.1	9.5	8.6	0.87
Meristics												
Left premaxillary teeth	14	30	11	15	13.4	1.28	13	6	12	14	13.0	0.89
Right premaxillary teeth	14	30	11	17	13.8	1.47	15	6	11	15	13.5	1.64
Left dentary teeth	14	30	10	15	12.6	1.30	12	6	10	12	11.2	0.98
Right dentary teeth	12	27	10	15	12.4	1.39	-	6	10	13	11.2	1.47
Left lateral scutes	24	30	22	24	23.2	0.63	24	7	23	24	23.6	0.53
Right lateral scutes	23	30	22	24	23.3	0.66	24	7	23	24	23.4	0.53

continued.

	<i>H. ringueleti</i> non-types				
	n	Low	High	Mean	SD
Standard length (mm)	30	28.4	43.5	34.5	
Percent of Standard Length					
Head length	30	32.7	37.2	35.3	1.31
Predorsal length	30	43.5	48.0	45.8	1.13
Dorsal-fin spine length	28	23.2	29.0	26.2	1.46
Anal-fin unbranched ray length	30	15.9	20.7	18.3	1.12
Pectoral-fin spine length	30	23.8	28.7	26.1	1.14
Pelvic-fin unbranched ray length	29	12.9	20.1	16.0	2.10
Cleithral width	30	22.0	24.5	23.1	0.56
Thoracic length	30	16.1	19.0	17.5	0.78
Abdominal length	30	17.9	21.3	19.5	0.99
Body depth at dorsal-fin origin	30	18.1	22.2	20.0	0.88
Caudal-peduncle length	30	29.5	35.0	32.2	1.42
Caudal-peduncle depth	30	12.1	15.2	13.6	0.85
Percent of Head Length					
Snout Length	30	45.7	50.5	47.9	1.29
Orbital diameter	30	17.3	20.8	18.9	0.88
Interorbital width	30	36.5	45.6	40.8	1.91
Head depth	30	48.0	56.8	52.5	2.33
Suborbital depth	30	15.7	19.4	17.5	0.89
Mandibular ramus	30	7.3	9.7	8.4	0.70
Meristics					
Left premaxillary teeth	28	10	18	14.3	1.78
Right premaxillary teeth	28	12	20	14.5	1.75
Left dentary teeth	29	10	16	12.7	1.37
Right dentary teeth	29	10	15	12.7	1.32
Left lateral scutes	30	22	24	23.5	0.57
Right lateral scutes	30	22	24	23.5	0.63

Remarks on type-locality. *Hisonotus ringueleti* was described from a single locality on the rio Uruguay basin (Aquino et al., 2001). The type-locality is a creek tributary to the rio Quaraí at km 18 of route joining Santana do Livramento, Brazil and Rivera, Uruguay (ca. 31°00'S 55°30'W). However, the cities of Rivera and Santana do Livramento are contiguous and only divided by an avenue, without a route of 18 km between them. These cities are surrounded by the headwaters of three large drainages, rio Negro, rio Quaraí, and rio Ibicuí, all tributaries to the rio Uruguay basin. The approximate coordinates (ca. 31°00' S 55°30'W) as well as all localities at about 18 km from Rivera in Uruguay are situated in the río Negro drainage. However, *Hisonotus ringueleti* was not found in that drainage. The headwaters of rio Quaraí drainage, nearby Santana do Livramento/Rivera were located in the Brazilian territory, or in the Departamento of Artigas in Uruguay which seems the most probable type-locality of *Hisonotus ringueleti*.

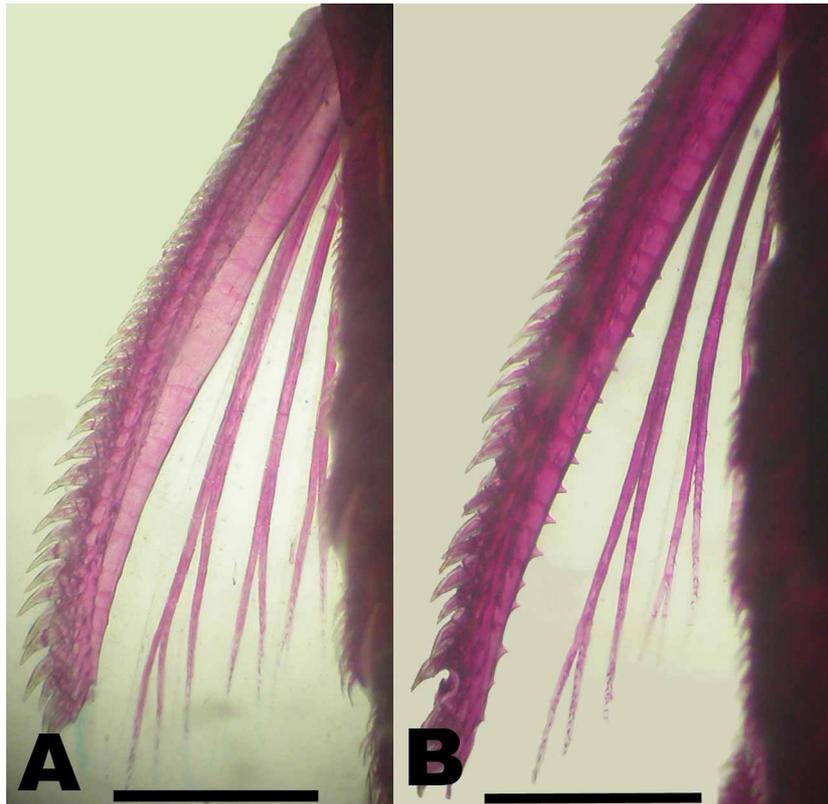


FIGURE 21. Left pectoral-fin spine of *Hisonotus ringueleti* in dorsal view. A—MCP 11215, 38.1 mm SL. B—MCP 11215, 31.2 mm SL. Scale bar is 2mm.

Key to the species of *Hisonotus* of the rio Uruguay basin.

- 1 Body relatively stocky, cleithral width (27.6–30.5% in SL); 20–22 (usually 21) plates in lateral series; and 25–26 vertebrae.....*Hisonotus iota* (rio Chapecó drainage)
- Body relatively elongated, cleithral width (20.5–27.7% in SL); 22–25 plates in lateral series; and 27–29 vertebrae ..
..... 2
- 2 Median portion of caudal fin with a vertical light bar composed by round dots 3
- Caudal-fin completely dark, without light bar on median portion, or presenting light areas of different patterns 4
- 3 Odontode-free band on tip of snout absent, anterior margin of snout covered by odontodes; comparatively broader light longitudinal stripes on head *Hisonotus leucophrys* (Ariranhas and Rancho Grande drainages)
- A narrow odontode-free band present between dorsal and ventral series of odontodes along the anterior margin of the snout; comparatively narrow light longitudinal stripes on head
..... *Hisonotus charrua* (lower and middle rio Uruguay basin, and Río de La Plata tributaries in Uruguay)
- 4 Posterior portion of pectoral-fin spine serrate in specimens smaller than 35 mm SL; median series of lateral plates not truncated posteriorly, reaching the posterior end of caudal peduncle
..... *Hisonotus ringueleti* (middle rio Uruguay basin)
- Posterior portion of pectoral-fin spine not serrate in specimens larger than 25 mm SL; median series of lateral plates truncated posteriorly, not reaching the posterior end of caudal peduncle..... 5
- 5 Odontodes on dorsal margin of rostrum enlarged, more than 3 times the size of remainder of dorsal surface of head; posterior portion of lateral line absent; a darkish color pattern in life.....
..... *Hisonotus nigricauda* (lower and middle rio Uruguay basin and laguna dos Patos system)
- Odontodes on dorsal margin of rostrum slightly enlarged compared to those of remainder of dorsal surface of head; posterior portion of lateral line usually present; a greenish color pattern in life 6
- 6 Median series of abdominal plates absent or composed by one triangular plate, located posteriorly, the lateral abdominal series contacting each other at belly midline; infraorbital canal entering infraorbital series via sphenotic
..... *Hisonotus megaloplax*, **n. sp.** (rio Passo Fundo drainage)
- Median series of abdominal plates usually present, separating the lateral abdominal plates at midline; infraorbital

	canal entering infraorbital series via compound pterotic	7
7	Dorsal surface of head with rounded light marks, head with two wide light longitudinal stripe	
 <i>Hisonotus montanus</i> , n. sp. (rio Canoas drainage)	
-	Dorsal surface of head without light marks; head with two narrow light longitudinal stripe	
 <i>Hisonotus aky</i> (Yabotí-Guazú and Forquilha drainages)	

Discussion

The diversity of *Hisonotus* in the rio Uruguay basin is immense. As a comparison, the upper rio Paraná drainage has five species (Britski & Garavello, 2003), and just two species, apparently are found in southeastern coastal drainages of Brazil. Eight species are herein reported for the rio Uruguay, but many portions of the upper rio Uruguay basin are poorly sampled, and the number of *Hisonotus* species can be underestimated. Comparatively as diverse as the rio Uruguay basin is the laguna dos Patos system having about 10 species of *Hisonotus* (Carvalho et al., 2008).

Lucena & Kullander (1992) described five general distributional patterns for the fish fauna in the rio Uruguay and neighboring drainages. The distribution of species of *Hisonotus* can be included in three of these patterns: *Hisonotus leucophrys*, *H. iota*, *H. megaloplax*, and *H. montanus* fit in the pattern (1) with species endemic to the upper rio Uruguay. *Hisonotus aky* is likely to be part of the pattern (2) of species endemic within the Uruguay basin. *Hisonotus nigricauda* and *H. charrua* share the pattern (5), of species restricted to the coast of Uruguay and Rio Grande do Sul plus the Uruguay drainage. The exception is *Hisonotus ringueleti* that do not fit in any pattern proposed by Lucena and Kullander (1992). That species is widespread in the middle rio Uruguay, suggesting it is an endemic component for that portion of basin.

The diversity of *Hisonotus* in the rio Uruguay presents two distributional trends: (1) species restricted to the upper rio Uruguay basin, found in one or two tributaries to rio Uruguay, allopatric in distribution, and occurring in separated headwaters; (2) widespread species occurring in the middle and lower Uruguay courses, inhabiting several sub-drainages, mostly sympatric to one another. A single species, *Hisonotus aky*, is shared between upper and middle rio Uruguay tributaries. The distribution of that species is somewhat awkward; being only found in the rio Forquilha drainage (upper rio Uruguai/Brazil) and Río Yabotí-Guazu drainage (middle Río Uruguay/Argentina) and nowhere in between these localities or downstream the latter. The rio Forquilha apparently has a peculiar fish fauna as previously observed by Lucena & Kullander (1992), which reported a different fauna of the cichlid genus *Crenicichla*. According to them, local conditions of that drainage do not offer any clue to the presence of an endemic *Crenicichla* fauna, no falls or other apparent barriers are present in the rio Forquilha. Rican & Kullander (2008) studying the diversity of *Australoheros* cichlids, found a species inhabiting the rio Forquilha and a conspecific inhabiting tributaries of the middle Uruguay basin in Misiones, Argentina. No conspicuous differences were found suggesting the split between *Hisonotus aky* from Yabotí-Guazú and the specimens from rio Forquilha into different taxa. Moreover, the ichthyofauna of some portions of the upper rio Uruguay basin are still unknown, and perhaps that distributional gap can be due to the existence of poorly sampled areas.

Several authors suggested the upper rio Uruguay as an endemism area (Wimberger et al., 1998; Aquino et al., 2001; Miquelarena & Lopez, 2004; Rican & Kullander, 2008). The presence of a putative clade of *Hisonotus* (see Remarks of *Hisonotus aky*) inhabiting the upper portions of that basin reinforces that hypothesis of endemism. These species share the derived presence of an infraorbital canal entering infraorbital series via compound pterotic. That feature was discussed by Carvalho (2008b) and seems to be a convergence between some species of *Corumbataia* and this putative clade of *Hisonotus*, since these genera are not closely related (Gauger & Buckup, 2005).

The great diversity in the upper rio Uruguay, compared to its lower portions, can be explained by its accidented relief. The upper portions of the rio Uruguay basin differ from the neighbouring Paraná/Paraguay system mainly by its geomorphic immaturity, indicated by the sloped river profile and the prevalence of rocky substrata and strong currents (Di Persia & Neiff, 1986). Rapids and waterfalls are dispersal barriers for most

Hisonotus species, and is likely the cause for allopatric speciation during the process of drainage evolution. A similar aspect is found in the headwaters of the rio Jacuí basin, which possesses several endemic and restrictedly distributed species (Carvalho, 2008a).

The endemism of the lower portions (middle and lower courses) is less apparent. The species *Hisonotus nigricauda* and *H. charrua* are widely distributed in these lower portions, but are also present in other hydrographic systems. *Hisonotus ringueleti* is endemic to the middle course of rio Uruguay. However, Aquino et al. (2001) considered that species pertaining to the upper rio Uruguay basin, which differs from the definition of the rio Uruguay portions used here. Miquelarena & Lopez (2004) erroneously cited *H. ringueleti* from the upper rio Uruguay and their delimitations of rio Uruguay courses follows the same used here, which subdivides the upper course (sensu Aquino et al., 2001) into middle and upper rio Uruguay. *Hisonotus ringueleti* and *H. nigricauda* distributions are remarkably complementary. These species are never collected together but are sympatric with *H. charrua* throughout. A phylogenetic review of *Hisonotus*, and more sampling efforts in the upper rio Uruguay basin should provide refined evidences to discuss the history of this group in these areas.

Comparative material. *Epactionotus bilineatus*: MCP 29293, 29 + 3 c&s, Brazil, Rio Grande do Sul, Itati, arroio das Bananeiras. *Eurycheilichthys pantherinus*: MCP 35042, 17 + 3 c&s, Brazil, Rio Grande do Sul, Bom Jesus, rio dos Touros on road from Rondinha to Silveira. *Hisonotus armatus*: MCP 41323, holotype, Brazil, Rio Grande do Sul, Pedro Osório, arroio Arambaré, about 5 km south of Vila Basílio, on road to Pedro Osório. MCP 37682, paratypes, 13 + 4 c&s, collected with the holotype. *Hisonotus charrua*: ZVC-P 5639, holotype, Uruguay, Tacuarembó, Cañada de Los Peña. AI 165, paratypes, 5, collected with the holotype. MCP 40256, 4 + 1 c&s, same collecting site of holotype. UFRGS 7184, 9 + 2 c&s, Uruguay, Rivera, lateral pools and arroyo Corrales on ruta 27, tributary to Río Tacuarembó. UFRGS 7185, 12, Uruguay, Rivera, arroyo Batovi at Km 24 of ruta 27, tributary to Río Tacuarembó. UFRGS 8096, 17, Uruguay, Artigas, arroyo Sarandi affluent of arroyo Yacuy 3km from ruta 3. MACN 7593, 1, Argentina, Entre Rios, Parque Nacional El Palmar. MAPA 1969, 15, Uruguay, Maldonado, San Carlos, arroyo Maldonado. MAPA 2282, 57, Uruguay, Canellones, arroyo Tropa Vieja (bridge of Tambó) Pinamar. AI 186, paratype, 1, Uruguay, Artigas, arroyo Catalán Grande. MCP 9630, 2, Brazil, Rio Grande do Sul, Dom Pedrito, rio Santa Maria at km 246 of highway BR-293, between Dom Pedrito and Santana do Livramento. MCP 19573, 41, Brazil, Rio Grande do Sul, Quaraí, rio Quaraí-Mirim on road between Uruguaina and Quaraí. MCP 40904, 23 + 4 c&s, Brazil, Rio Grande do Sul, Quaraí, arroio Quaraí-Mirim on road between Uruguaiana and Quaraí. MCP 37232, 2 + 2 c&s, Brazil, Rio Grande do Sul, São Pedro do Butiá, arroio Albino. *Hisonotus chromodontus*: MZUSP 45355, holotype, Brazil, Mato Grosso, Diamantino, creek tributary of rio Preto on road to São Francisco. MCP 35873, 194 + 5 c&s, Brazil, Mato Grosso, rio Sauê-Uina on highway BR-364. *Hisonotus depressicauda*: MZUSP 1004, lectotype of *Otocinclus depressicauda*, Brazil, São Paulo, Sorocaba. MZUSP 5381-5384, 4, paralectotypes of *Otocinclus depressicauda*, Brazil, São Paulo, Sorocaba. *Hisonotus francirochai*: MZUSP 3258, lectotype of *Otocinclus francirochai*, Brazil, São Paulo, Pirangi, headwaters of rio Turvo. MZUSP 5387-5397, 11, paralectotypes of *Otocinclus francirochai*, Brazil, São Paulo, Pirangi, headwaters of rio Turvo. MCP 41341, 3 + 1 c&s, Brazil, São Paulo, Araras, stream tributary of rio Mogi-Guaçu. *Hisonotus insperatus*: MZUSP 78957, holotype, Brazil, Botucatu, São Paulo, rio Capivara. MZUSP 78958, 5, collected with the holotype. MZUSP 78966, 7, paratypes, Brazil, São Paulo, Botucatu, rio Capivara. *Hisonotus laevior*: ANSP 21563, holotype, Brazil, Rio Grande do Sul, Rio Jacuí. MAPA 1755, 24 + 3 cs, Brazil, Rio Grande do Sul, São Sebastião do Caí, small creek in Rio Branco. *Hisonotus leptochilus*: ANSP 21564, holotype, Brazil, Rio Grande do Sul, Rio Jacuí. *Hisonotus leucofrenatus*: MCP 11540, 60 + 3 c&s, Brazil, Santa Catarina, Joinville, rio Cubatão (north). MZUSP 36565, 20, Brazil, São Paulo, Eldorado, small creek on road from Eldorado to Sete Barras. MZUSP 60220, 11, Brazil, São Paulo, Barra do Turvo, córrego Fria. *Hisonotus luteofrenatus*: MZUSP 62593, holotype, Brazil, Mato Grosso, Sinop, riacho Loanda tributary of rio Teles Pires. MCP 32670, 9 + 1 c&s, Brazil, Mato Grosso, Porto dos Gaúchos, igarapé Ribeirão Preto on highway MT-338. MCP 32666, 2, Brazil, Mato Grosso, Santa Carmem, rio Azul on highway MT-140. *Hisonotus maculipinnis*: BMNH 1909.4.2.19-22, syntypes of *Otocinclus maculipinnis*, La Plata. BMNH 1934. 8. 20. 321-5, San Lorenzo,

Paraguay. BMNH 1934.8.20:220-240, + 500, Paraguay, near Asunción. ANSP 187011, 507, Argentina, Corrientes, side channels and backwaters of Rio Paraná and lower Río Guayquiraró, about 25 km south from Esquina. ILPLA 235, 6 + 1, Argentina, Corrientes, Arroyo Batel. MACN 3240, +50, Argentina, Buenos Aires. MACN 7594, +50, Argentina, Santa Fé, Arroyo Ciquenã. *Hisonotus nigricauda*: BMNH 91.3.16.53-62, 9, syntypes of *Otocinclus nigricauda*, Brazil, Rio Grande do Sul. MCP 19584, 33 + 3 c&s, Brazil, Rio Grande do Sul, São Gabriel, creek on road between São Gabriel and Tiaraju. MCP 28986, 11, Brazil, Rio Grande do Sul, Eldorado do Sul, arroio Passo dos Carros. MCP 17416, 20 + 3 c&s, Brazil, Rio Grande Sul, Camaquã, marsh at rio Camaquã in Pacheca. MCP 26865, 88 + 3 c&s, Brazil, Rio Grande do Sul, Rosário do Sul, arroio do Salso on the highway BR-158, affluent of rio Ibicuí da Armada. MCP 10000, 34, Uruguay, Cerro Largo, lagoon 10 m from Río Negro at Arrieria. MAPA 2493, 15, Brazil, Rio Grande do Sul, Barra do Quaraí, arroio Quaraí-Chico. *Hisonotus notatus*: BMNH 1904.1.28.13-16; MNRJ 28882, 3; NWM 45380-4, NMW 45380-7, NMW 45381-6, NMW 45381-4; ANSP 166924, 6; all syntypes, Brazil, Rio de Janeiro, rio Grande (arroio Fundo) on fazenda Santa Cruz. MCP 18098, 204 + 4 cs, Brazil, Espírito Santo, São José dos Torres, rio São José dos Torres on road BR-101. *Hisonotus paulinus*: BMNH 1907.7.6.9, holotype of *Otocinclus paulinus*, Brazil, São Paulo, rio Piracicaba. *Hisonotus taimensis*: MZUSP 3258, 14133, holotype of *Microlepidogaster taimensis*, Rio Grande do Sul, Rio Grande, new channel of arroio Taim, Estação Ecológica do Taim. MCN 4835-4844, 10, paratypes of *Microlepidogaster taimensis*, Brazil, Rio Grande do Sul, Rio Grande, new channel of Arroio Taim, Estação Ecológica do Taim. MCP 17417, 27 + 3 c&s, Brazil, Rio Grande do Sul, Rio Grande, new channel of arroio Taim. *Hisonotus yasi*: AI 159, 4, paratypes of *Epactionotus yasi*, Argentina, Misiones, Arroyo Lobo. NUP 790, 13 + 2 c&s, Brazil, Paraná, Leônidas Marques, Caxias reservoir. UFRGS 4187, 2, Brazil, Paraná, Ampére, small creek tributary to rio dos Macacos. *Lampiella gibosa*: MCP 31588, 1 + 1 c&s, Brazil, São Paulo, Barra do Turvo, rio Bonito tributary to rio Pardo. *Microlepidogaster perforatus*: MCP 17717, 4 + 1 c&s, Brazil, Minas Gerais, Carandaí, rio Carandaí. *Otothyropsis marapoama*: MCP 38303, paratypes, 9 + 1 c&s, Brazil, São Paulo, Catanduva, córrego Cubatão. *Otocinclus flexilis*: MCP 17414, 11 + 2 c&s, Brazil, Rio Grande do Sul, Capão do Leão, arroio Itaeté at Passo das Pedras. *Parotocinclus maculicauda*: MCP 31591, 50 + 4 c&s, Brazil, São Paulo, Barra do Turvo, rio Bonito tributary to Rio Pardo. MCP 20087, 17, Brazil, Paraná, Cerro Azul, arroio Ribeirão Bonito.

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