

Papéis Avulsos de Zoologia

MUSEU DE ZOOLOGIA DA UNIVERSIDADE DE SÃO PAULO

ISSN 0031-1049

PAPÉIS AVULSOS DE ZOOL., S. PAULO 42(7):169-181

14.VI.2002

PETILIPINNIS, A NEW GENUS FOR *CORVINA GRUNNIENS*
SCHOMBURGK, 1843 (PERCIFORMES, SCIAENIDAE) FROM THE
AMAZON AND ESSEQUIBO RIVER BASINS AND REDESCRIPTION
OF *PETILIPINNIS GRUNNIENS*

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ABSTRACT

Petilipinnis, new genus, is proposed for *Corvina grunniens* Schomburgk, from the Amazon and Essequibo river basins. It is distinguishable from other Sciaenidae genera with the exception of *Menticirrhus*, by the presence of only one spine in the anal fin. From *Menticirrhus*, *Petilipinnis* differs by the morphology of the swimbladder and the number of dorsal fin soft rays. Also a redescription of *Petilipinnis grunniens* is presented.

KEYWORDS: *Petilipinnis*, freshwater Sciaenidae, *Petilipinnis grunniens*.

INTRODUCTION

The Sciaenidae (croakers, drums, pescadinhos, pescadas, and corvinas) is one of the largest perciform families in number of species and distribution, including approximately 78 genera and 287 species worldwide, in coastal and brackish waters of temperate and tropical areas of the world (Chao, 1986). The genera *Aplodinotus* Rafinesque, *Pachypops* Gill, *Pachyurus* Agassiz, *Plagioscion* Gill, and *Boesemania* Trewavas are restricted to freshwater.

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Aplodinotus occurs in North America; *Pachypops*, *Pachyurus*, and *Plagioscion* in South America, from northern Venezuela to the lowlands of Argentina (Chao, 1978); and *Boesemania* in Thailand, Vietnam, Cambodia, and Sumatra (Kottelat *et al.*, 1993). Furthermore, *Dendrophysa* Trewavas, *Johnius* Bloch and *Nibeia* Jordan & Thompson, from the Indo-Pacific, can occasionally enter freshwater (Kunio Sasaki, personal communication).

The genus *Corvina* was proposed by Cuvier (1829) and the type species, *C. nigra*, was subsequently designed by Gill (1861). According to Trewavas (1966), *Corvina* is a pre-occupied name in Aves, and moreover is a synonym of *Sciaena* Linnaeus, 1758. Since *Corvina* is an invalid name in the zoological literature, *Corvina grunniens* Schomburgk cannot presently be placed in any valid genus. Notwithstanding this, the diagnosable external character (the presence of one anal spine) and the locality (Essequibo and Amazon River basins), among other characters pointed out in the discussion, show that this species cannot be assigned to any other genus in the Sciaenidae.

A new genus, *Petilipinnis*, is here proposed for *Corvina grunniens* with a redescription of *Petilipinnis grunniens* (Schomburgk).

METHODS

Counts and measurements were taken with calipers with 0,1 mm of resolution and follow Hubbs & Lagler (1958); lateral-line scales counts include the perforated scales to the hypural joint. Subunits of body are expressed as proportions of standard length (SL), except the anal fin spine length; the anal fin spine length and subunits of the cephalic region are expressed as proportions of head length (HD). One specimen was cleared and stained according the method proposed by Taylor & Van Dyke (1985), and compared with cleared and stained specimens of *Pachypops* and *Pachyurus*. The list of the material examined comprises the locality, including the country, state or department, river and complement, institutional number, number of specimens, in parentheses the standard length in mm, collection date and collector.

The examined specimens are deposited in the following institutions: AMNH, American Museum of Natural History; ANSP, Academy of Natural Sciences of Philadelphia; FMNH, Field Museum of Natural History; MZUSP, Museu de Zoologia da Universidade de São Paulo; and INPA, Instituto Nacional de Pesquisas da Amazônia.

***Petilipinnis*, new genus**

Type species: *Corvina grunniens* Schomburgk, 1843: 136 (type not found).

DIAGNOSIS OF THE GENUS

Petilipinnis is distinguishable from all other Sciaenidae genera, with the exception of *Menticirrhus*, by having only one spine in the anal fin. From *Menticirrhus* it differs by having 29 to 32 soft dorsal-fin rays and a carrot-shaped swimbladder with an anterior pair of short branched appendages (fig. 3 a); in *Menticirrhus* the dorsal fin has 18 to 27 soft rays and the swimbladder, when present, is reduced to a simple vesicle. A single species is included in the genus: *Petilipinnis grunniens* (Schomburgk, 1843).

Etymology: From the Latin *petilus* (adjective), slender, and *pinna* (substantive), fin, in allusion to the slender morphology of the anal fin. Gender feminine.

***Petilipinnis grunniens* (Schomburgk, 1843)**

(Figs. 1-2)

Corvina grunniens Schomburgk, 1843: 136, pl. 2 (original description; type locality: British Guiana [Guyana], Essequibo River).

Pachypops grunniens Jordan & Eigenmann, 1889: 414 (name only); Eigenmann, 1912: 476 (freshwater fishes of British Guiana [Guyana]).

Pachyurus grunniens Chao, 1978: 43 (Western Atlantic Sciaenidae).

MATERIAL EXAMINED

63 specimens. Guyana: Essequibo: Essequibo River, upstream Kurupukari, ANSP 176038, 10(33.9-102.5), 27.I.1997, W.G. Saul col.; Essequibo River, upstream Maipure, ANSP 176039, 5(22.6-51.7), 02.II.1997, W.G. Saul col.; Essequibo River, ANSP 176040, 1(50.7), 31.I.1997, W.G. Saul col.; ANSP 176041, 1(77.5), 26.I.1997, D.Torres col.; ANSP 176042, 2(90.3-107.7), 25.I.1997, W.G. Saul col.; ANSP 176043, 1(252.0), 27.I.1997, W.G. Saul col.; AMNH 215024, 5(49.2-69.6), 1935, A.S. Pinkus col.; AMNH 220463, 1(140.9), 09.XII.1937, T. Holden col.; Essequibo River, Kartabo, AMNH 220423, 1(34.0), 12.IV.1924, Beebe col.; AMNH 220438, 4(62.7-95.6), 05.VI.1924, Beebe col.; Potaro River, Tumatumari, FMNH 53957, 1(132.7), 1908, C.H. Eigenmann col.; Unorowo River, branch of Essequibo River, AMNH 220483, 2(176.0-202.4), 28.XII.1937, T. Holden col.; Mazzaruni-Potaro: Cuyuni River, AMNH 73005, 1(155.6), 18.VIII.1983, Schmidt col.; AMNH 72961, 2(123.6-127.4), 12.VIII.1983, Schmidt col.; AMNH 72063, 1(97.7), 06.VIII.1982, Schmidt col.; Venezuela: Bolivar: Cuyuni River, ANSP 167919, 1(38.6), 23.I.1991,

S. Schaefer col.; Brazil: Amazonas: Rio Uatumã, INPA 10433, 1(192.0), 17.IV.1983, Equipe de Ictiologia INPA col.; INPA 2724, 1(266.0), IX.1985, M. Jegu col.; INPA 2725, 2(225.0-245.0), VII.1985, M. Jegu col.; INPA 12918, 2(187.1-215.2), 31.I.1985, Equipe de Ictiologia INPA col.; Rio Pitinga, Cachoeira Quarenta Ilhas, INPA 3302, 1(278.0), 12.X.1989, F. Martinho col.; Pará: Rio Trombetas, INPA 3293, 1(198.0), 17.IV.1985, E. Ferreira col.; INPA 10425, 1(166.0), V.1988, Equipe de Ictiologia INPA col.; INPA 10420, 3(98.1-117.5), 1 Cleared and Stained, 10.XI.1981, Equipe de Ictiologia INPA col.; Rio Trombetas, Cachoeira Porteira, INPA 10418, 1(132.1), V.1988, Equipe de Ictiologia INPA col.; INPA 10425, 1(166.0), V.1988, Equipe de Ictiologia do INPA col.; Rio Trombetas, Cachoeira Vira-Mundo, INPA 3263, 1(139.3), 09.X.1985, Equipe de Ictiologia INPA col.; Rio Fresco, São Félix do Xingu, MZUSP 35995, 1(275.5), VIII.1983, M. Petreire col.; Rio Tocantins, INPA 10415, 2(97.0-110.6), 10.XI.1981, Equipe de Ictiologia INPA col.; INPA 10429, 1(217.0), 08.XI.1981, Equipe de Ictiologia INPA col.; INPA 10414, (102.2-114.6), I.1981, Equipe de Ictiologia INPA col.; INPA 10436, 1(200.6), XI.1980, Equipe de Ictiologia INPA col.; MZUSP 14673, 1(83.7), 17.IX.1970, Expedição Permanente à Amazônia col. Rondônia: Rio Machado, INPA 12916, 1(222.7), 04.VI.1984, G. Mendes col.

DESCRIPTION

Morphometric and meristic data are presented in Table I. Body relatively elongate, sub-cylindrical; greatest body depth at origin of dorsal fin. Dorsal profile of body convex. Ventral profile flattened from prepelvic region to anal fin. Ventral profile of caudal peduncle slightly convex.

Head pointed in profile. Mouth inferior and small (4.2-6.9 in HD). Lower jaw not extending beyond vertical through anterior edge of eye. Teeth small, villiform, and in single bands in both jaws. Snout pointed, typically longer than horizontal diameter of eye; nostrils of each side close together, anterior circular and posterior crescent-shaped.

Eye elliptical, horizontal diameter longer than vertical, 3.0-3.6 in head length. Laterosensory canal segments clearly visible externally, passing through lachrymals, suborbitals, preopercle, and lower jaw. Preopercle margin slightly serrate. Gill rakers short and slender.

Scales ctenoid, except on snout and preopercle, where they are cycloid. Lateral line curved until the anterior third of second dorsal fin, extending to the hind margin of the caudal fin. Small ctenoid scales on proximal 2/3 of dorsal fin, proximal 3/4 of pelvic fin, proximal 3/4 of caudal fin, and proximal 1/2 of pectoral and anal fins.

First dorsal fin with 10 spines, first very small; a notch present between first and second dorsal fins; second dorsal with an spine. Posterior tip of pectoral-fin not reaching the posterior tip of pelvic-fin when depressed. Anal-fin spine slender, most commonly 3.3-3.6 times in head length. Caudal fin rhombic in lateral view.

Swimbladder carrot-shaped with an anterior pair of short branched appendages, its posterior end slightly surpassing anus (fig. 3 a).

Color in alcohol: Head and dorsal 3/4 of body light tan, with small brown irregular spots, concentrated anteriorly. Lower 1/4 of body silvery. First dorsal fin light tan with dark edges and second dorsal fin with numerous small brown spots forming irregular stripes. Pectoral, pelvic, anal, and caudal fins light yellow, slightly silvery. Juveniles are light tan with brown spots smaller than eye on body.

Distribution: Known from rivers of the Amazon River basin in Brazil, and Cuyuni and Essequibo River basins in Guyana (fig. 4).

REMARKS

In the description of *Corvina grunniens*, a South American freshwater sciaenid from the Essequibo River, Guyana, Schomburgk (1843: 136) cited the presence of black dorsal and anal fins spots, elongate eye, terminal mouth, 32 dorsal-fin soft rays, 14 pectoral-fin rays, and anal-fin with one spine and 7 soft rays. Eigenmann (1912: 476-78), in his study of the freshwater fishes of Guyana, based on four specimens, also reported the presence of a single anal spine in a sciaenid species, identified by him as *Pachypops grunniens*.

The comparison of swimbladder and external morphology of *Petilipinnis* to the South American freshwater genera, *Pachypops*, *Pachyurus*, and *Plagioscion*, is presented in Table 2.

The single published phylogenetic hypothesis about sciaenid genera relationships was proposed by Sazaki (1989). In his work, *Pachyurus* and *Pachypops*, both included in the subfamily Pachyurinae, comprise a monophyletic clade supported by three synapomorphies: an anteriorly straight vomer, a pointed ventral tip of the nasal bone, and the dorsal surface of the third infraorbital lying almost parallel to the horizontal axis of eye. A fourth synapomorphy pointed out by Sazaki (1989: 40), a suspensorium strongly depressed, is here discarded as a character since the depression level is not comparable among other genera within the family. The sinapomorfies of the Pachyurinae shared by *Petilipinnis* reinforces its position in this subfamily. *Petilipinnis* also shares with *Pachyurus* the derived second pharyngobranchial plate enlarged, more than twice as large as that

on the third epibranchial; in *Pachypops* the plate on the second pharyngobranchial is smaller than that on the third epibranchial (Sazaki, 1989: 56; Casatti, 2000: 29). Another derived *Pachyurus* character is a derived metapterygoid lateral margin overlapping the medial side of the lower arm of hyomandibular which, in contrast, is not found in *Petilipinnis* and *Pachypops* that present a straight metapterygoid lateral margin (Sazaki, 1989: 40; Casatti, 2000: 31).

COMPARATIVE MATERIAL

Cleared and stained specimens: *Pachypops fourcroi*, MZUSP 34096, 1 specimen, Rio Trombetas, Cuminá, PA, 96,4 mm; MZUSP 34113, 1 specimen, Rio Tapajós, Alter do Chão, PA, 86,7 mm; *Pachypops* sp., MZUSP 34108, 1 specimen, Rio Machado, Jamarizinho, RO, 42,7 mm; *Pachypops trifilis*, MZUSP 6754, 1 specimen, Rio Negro, Manaus, AM, 101,1 mm; *Pachyurus adpersus*, uncatalogued, 2 specimens, Rio Mucuri, BA, 118,7-118,7 mm; *Pachyurus bonariensis*, MCP 13206, 2 specimens, Rio Ijuí, RS, 119,9-127,1 mm; *Pachyurus francisci*, MZUSP 39757, 1 specimen, Rio São Francisco, Projeto UHE/Formoso, MG, 164,1 mm; *Pachyurus paucirastrus*, MNRJ 13240, 1 specimen, Rio Tocantins, Cavalcante, GO, 118,4 mm; *Pachyurus schomburgkii*, INPA 11993, 1 specimen, Rio Uatumã, AM, 186,6 mm; *Pachyurus* sp., INPA 15050, 1 specimen, Rio Xingu, Senador José Porfírio, PA, 150,3 mm; *Pachyurus* sp., MZUSP 49721, 1 specimen, Rio Purus, AM, 84,4 mm; *Pachyurus squamipinnis*, uncatalogued, 2 specimens, Rio São Francisco, Projeto UHE/Formoso, MG, 130,0-160,0 mm.

ACKNOWLEDGMENTS

I thank Dr. Ricardo M. C. Castro, Dr. José L. de Figueiredo, Dr. Richard P. Vari, Dr. Mario de Vivo, and Ricardo C. Benine for comments and suggestions on improving the manuscript. For assistance at their institutions, I thank Drs. Osvaldo T. Oyakawa, José L. Figueiredo, Naércio A. Menezes, and Heraldo A. Britski (MZUSP), William G. Saul (ANSP), Barbara C. Brown (AMNH) and Efrem Ferreira (INPA). I am also thankful to Dr. Labbish Ning Chao for providing literature, to Vanessa Andrade for finishing swimbladder illustrations, and to Departamento de Zoologia (IB-UNESP Botucatu campus) for assistance during my doctoral degree. The author is a postdoctoral researcher at Departamento de Biologia (FFCLRP-USP) and is supported by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP).

Table 1. Biometric data of *Petilipinnis grunniens* (n = 55). For morphometric data were calculated mean and standard deviation (sd); for counts, the mode.

	range	mean/mode	sd
Standard length (mm)	27.0-278.0	127.12	72.41
proportion of standard length			
Greatest body depth	3.6-4.8	4.08	0.34
Snout to dorsal fin origin	2.7-3.1	2.84	0.07
Dorsal fin base length	1.6-1.8	1.69	0.05
End of dorsal fin base to caudal-fin origin	7.5-9.7	8.47	0.60
Prepelvic length	2.9-3.2	2.98	0.12
Preanal length	1.6-1.7	1.66	0.04
Preanal fin length	1.5-1.6	1.53	0.04
Anal fin base length	8.3-13.6	11.05	1.08
End of anal fin base to caudal fin origin	3.4-4.1	3.69	0.17
Dorsal fin length	4.9-6.8	5.46	0.56
Pectoral fin length	4.7-6.0	5.04	0.29
Pelvic fin length	4.7-5.7	5.26	0.21
Caudal peduncle depth	9.4-12.9	11.13	0.86
Head length	2.9-3.6	3.36	0.17
proportion of head length			
Snout length	2.3-3.2	2.67	0.22
Horizontal diameter of the eye	2.9-3.8	3.22	0.30
Postorbital length	2.4-3.0	2.66	0.15
Maximum interorbital width	4.2-5.5	4.92	0.49
Gape width	4.5-6.4	5.86	0.61
Anal fin length	2.8-4.8	3.47	0.48
counts			
Pored lateral line scales	50-55	53	
Upper series lateral scales	10	10	
Lower series lateral scales	11	11	
Dorsal fin	XI+32	XI+31	
Anal fin	I+7	I+7	
Pectoral fin	I+16-17	I+16-17	
Pelvic fin	I+5	I+5	
Mandibular pores	6	6	
Gill rakers	16-17	16	

Table 2. Comparison of external and swimbladder morphological characters the four among South American freshwater Sciaenidae genera.

	<i>Petilipinnis</i>	<i>Pachypops</i>	<i>Pachyurus</i>	<i>Plagioscion</i>
Anal spines	one	two	two	two
Swimbladder appendages	short and branched (fig. 3a)	a pair of posterior branches from the base of the anterolaterally ones (fig. 3b)	absent or short, not branched (fig. 3c-d)	horn-like (fig. 3e)
Mental barbels	one or three	three	absent or present (three)	absent
Mouth	inferior	inferior	inferior	oblique



Figure 1. *Petilipinnis grunniens*, MZUSP 35995, 276.0 mm from Rio Fresco, state of Pará, Brazil.

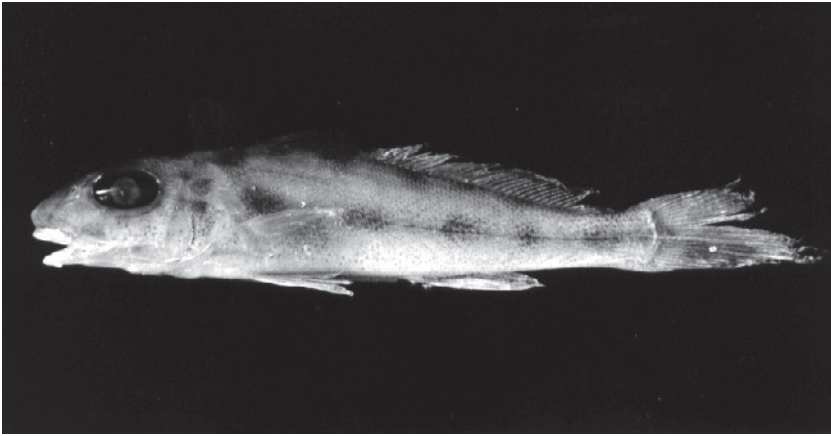


Figure 2. *Petilipinnis grunniens*, juvenile, ANSP 176038, 33.9 mm from Essequibo River, Guyana.

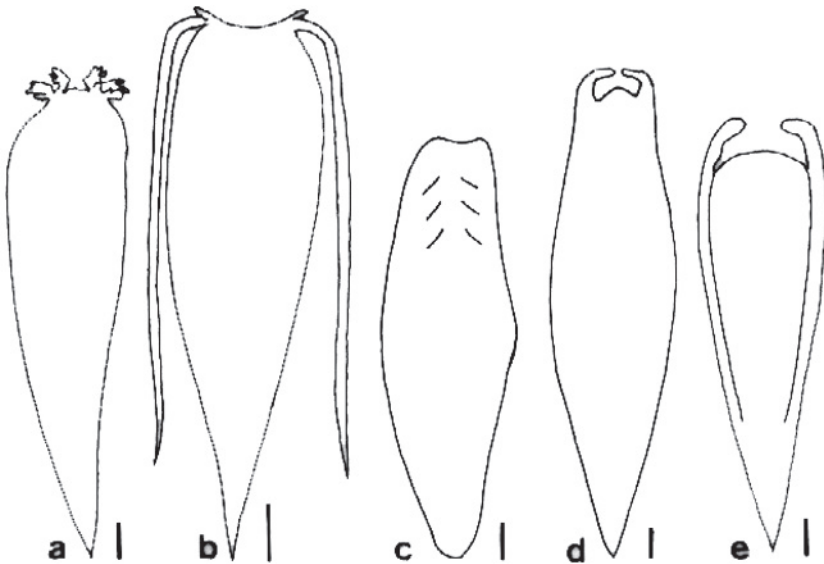


Figure 3. External ventral view of the swimbladder: a) *Petilipinnis grunniens*, INPA 10420; b) *Pachypops fourcroi*, MZUSP 34096; c) *Pachyurus francisci*, MZUSP 39757; d) *Pachyurus schomburgkii*, INPA 11993; e) *Plagioscion squamosissimus*, MZUSP 7028. Scale bar: 5mm.

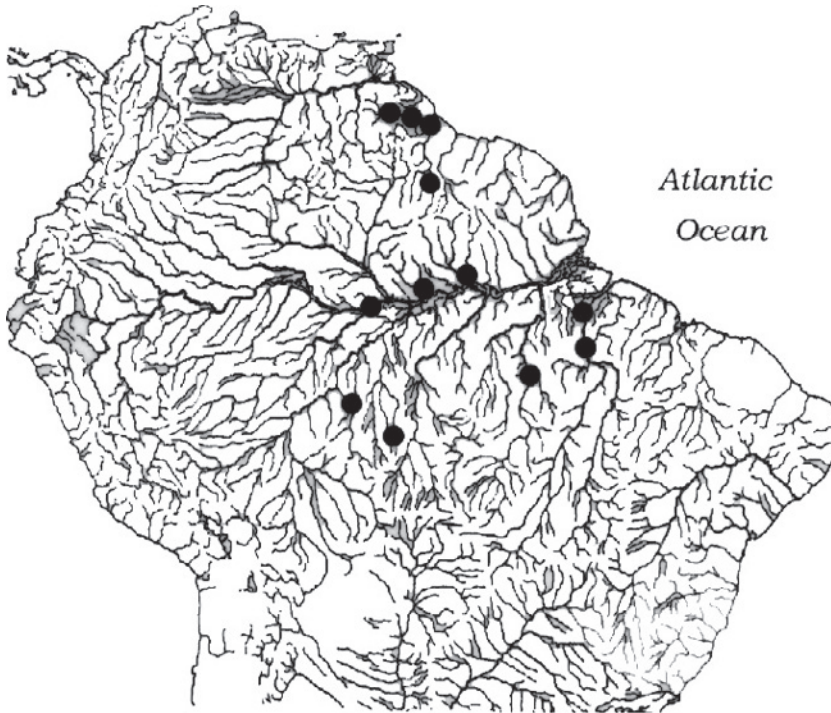


Figure 4. Geographic distribution of *Petilipinnis grunniens*. Some symbols represent more than one examined lot.

REFERENCES

- Casatti, L. 2000. Taxonomia e relações filogenéticas das corvinas de água doce sul-americanas (Sciaenidae, Perciformes). Unpublished Doctoral Thesis, Instituto de Biociências, UNESP, Botucatu, 189 pp.
- Chao, L. N. 1978. A basis for classifying western Atlantic Sciaenidae (Teleostei: Perciformes). NOAA Technical Report NMFS Circular 415: 1-65.
- Chao, L. N. 1986. A synopsis on zoogeography of the Sciaenidae. Pp. 570-589 in: T. Uyeno, R. Arai, T. Taniuchi, K. Matsuura (eds.), Indo-Pacific fish biology: Proceedings of the Second International Conference of Indo-Pacific Fishes. Ichthyological Society of Japan, Tokyo.
- Cuvier, G. 1829. Le règne animal distribué d'après son organisation, pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. Nouvelle édition, Paris, 532 pp.
- Eigenmann, C. H. 1912. The fresh-water fishes of British Guiana, including a study of the ecological grouping of species and the relation of the fauna of the plateau to that of the lowlands. Mem. Carn. Mus., 5: 1-554.

- Jordan, D. S. & C. H. Eigenmann. 1889. A review of the Sciaenidae of America and Europe. Rep. U. S. Fish Comm. for 1886, 14: 343-451.
- Gill, T. 1861. Revision of the genera of North American Sciaeninae. Proc. Acad. Nat. Sci. Philadelphia, 13: 79-89.
- Hubbs, C. L. & Lagler, K. F. 1958. Fishes of the Great Lakes region. Univ. Michigan Press, Michigan, 213 pp.
- Kottelat, M., Whitten, A. J., Kartikasari, S. N. & Wirjoatmodjo, S. 1993. Freshwater fishes of Indonesia and Sulawesi. Periphus Ed., Hong Kong, 221 pp.
- Sazaki, K. 1989. Phylogeny of the family Sciaenidae, with notes on its zoogeography (Teleostei, Perciformes). Mem. Fac. Fish. Hokkaido Univ., 36: 1-137.
- Schomburgk, R. H. 1843. The natural history of fishes of Guiana. Part 2 *In*: W. Jardine (ed.), The Naturalists' Library, W.H. Lizars, Edinburg, 212 pp. (also an 1852 edition, entitled Fishes of British Guiana, as v. 40).
- Taylor, W. R. & Van Dyke, G. C. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage. *Cybium*, 9: 107-119.
- Trewavas, E. 1966. Comments on the type species of *Sciaena* Linnaeus, 1758. Z. N. (S.). Bull. Zool. Nom., 23: 4-5.

Casatti, 2002. Papéis Avulsos de Zoologia 42(7).

CORRIGENDA: The original author for *Corvina grunniens* is Jardine (in Schomburgk, 1843).

The correct citation for the authorship of the new combination herein proposed is:

Pettilipinnis grunniens (Jardine, 1843).



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- (3) *Body of text:* The main body of the text should include the following sections: Introduction, Materials and Methods, Results, Discussion, and Acknowledgments at end. Primary headings in the text should be in capital letters and centered; the following text should begin on the next line, indented. Secondary headings should be in capital and lowercase letters and flush left; the following text should begin on the next line, indented. Tertiary headings should be in capital and lower case letters, in italics and indented; the following text should be on the same line and separated from the heading by a hyphen.
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