

→ *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*

LILIAN CASATTI¹

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 by the number of dorsal fin soft rays. Also a redescription of *Petilipinnis grunniens* is presented.

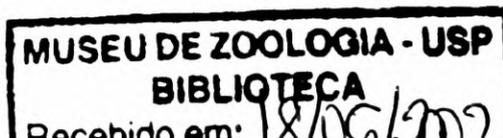
KEYWORDS: *Petilipinnis*, freshwater Sciaenidae, *Petilipinnis grunniens*.

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

1. Laboratório de Ictiologia, Departamento de Biologia, FFCLRP-USP, Av. Bandeirantes, 3900, 14040-901, Ribeirão Preto, SP, Brazil. E-mail: licasatti@netsitemail.com.br

Trabalho recebido para publicação em 16.XI.1999 e aceito em 08.II.2001.



genera *Aplodinotus* Rafinesque, *Pachypops* Gill, *Pachyurus* Agassiz, *Plagioscion* Gill, and *Boesemania* Trewavas are restricted to freshwater. *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. Petrere 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 adspersus*, 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

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

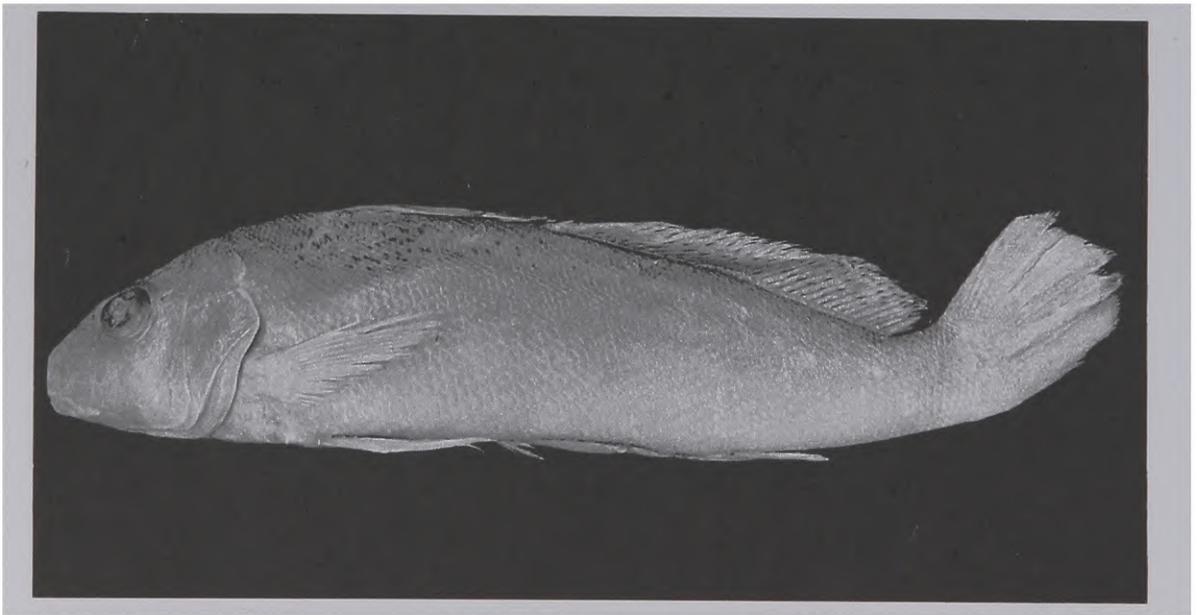


Figure 1. *Petilipinnis grunniens*, MZUSP 35995, 276.0 mm from Rio Fresco, state of Pará, Brazil.

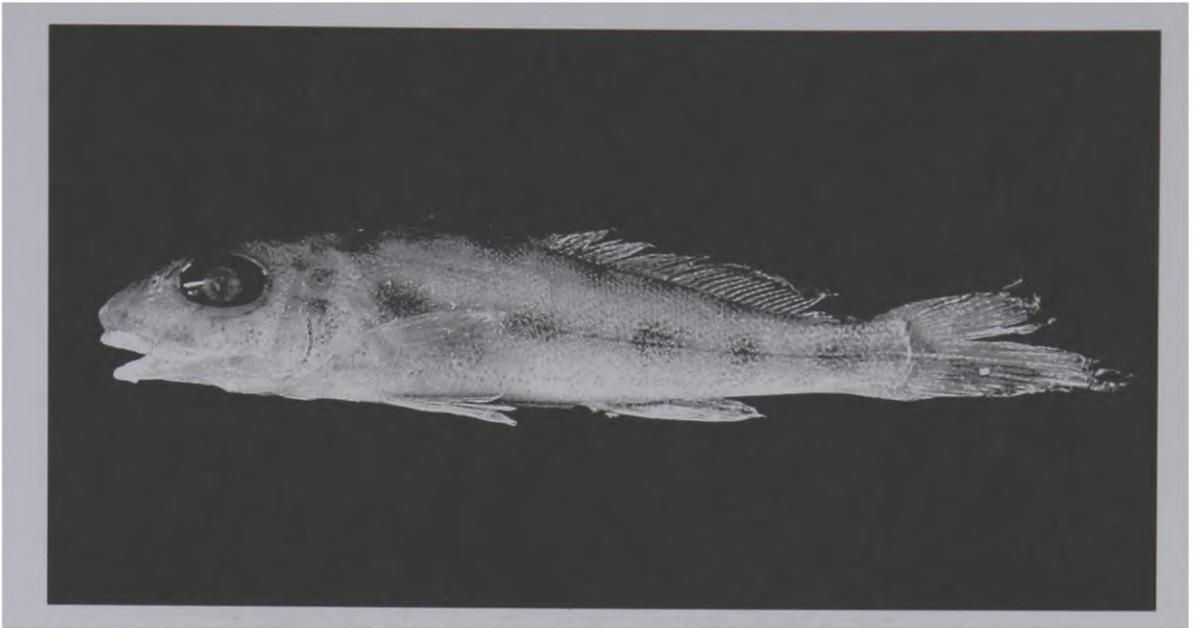


Figure 2. *Petilipinnis grunniens*, juvenile, ANSP 176038, 33.9 mm from Essequibo River, Guyana.

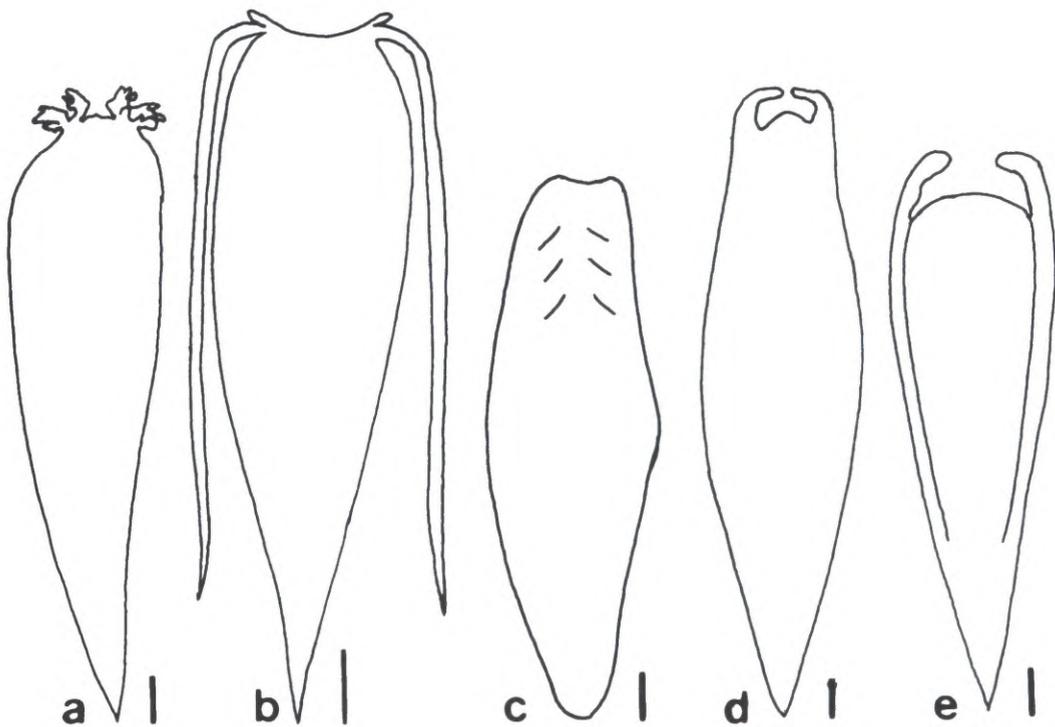


Figure 3. External ventral view of the swimbladder: a) *Petilipinnis grunniens*, INPA 10420; b) *Pachypops fourcroyi*, MZUSP 34096; c) *Pachyurus francisci*, MZUSP 39757; d) *Pachyurus schomburgkii*, INPA 11993; e) *Plagioscion squamosissimus*, MZUSP 7028. Scale bar: 5 mm.

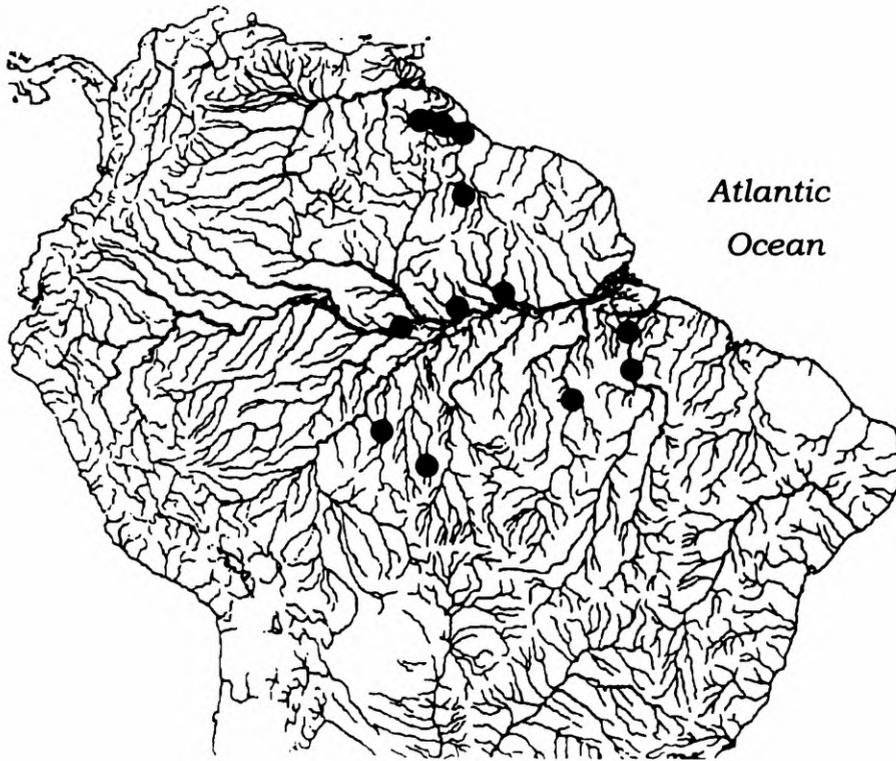


Figure 4. Geographic distribution of *Petilipinnis grunniens*. Some symbols represent more than one examined lot.

Efrem Ferreira (INPA). I am also thankful to Dr. Labbish Ning Chao for providing literature, to Vanessa Andrade for finishing swimbladder illustrations, and to the 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).

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 Sciaenidae. 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. Periplus Ed., Hong Kong, 221 pp.
- Sasaki, 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, Edinburgh, 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. Cytium, 9: 107-119.
- Trewavas, E. 1966. Comments on the type species of *Sciaena* Linnacus, 1758. Z. N. (S.). Bull. Zool. Nom., 23: 4-5.



EDITORIAL COMMITTEE

Editor-in-Chief. Hussam Zaher, Serviço de Vertebrados, Museu de Zoologia, Universidade de São Paulo, Caixa Postal 42594, 04299-970, São Paulo, SP, Brazil. E-mail: hzaher@ib.usp.br

Associated Editors. Mario C. C. de Pinna (Universidade de São Paulo, Brazil), Antonio C. Marques (Universidade de São Paulo, Brazil), Sergio A. Vanin (Universidade de São Paulo, Brazil).

Editorial Board. Adriano Kury (Museu Nacional do Rio de Janeiro, Brasil), Aziz N. Ab-Saber (Universidade de São Paulo, Brazil), Carlos Roberto F. Brandão, (Universidade de São Paulo, Brazil), Christian de Muizon (Museum National d'Histoire Naturelle, France), Darrel Frost (American Museum of Natural History, U.S.A.), Gerardo Lamas (Museu Javier Prado de Lima, Peru), H. R. Heyer (National Museum of Natural History, U.S.A.), James Carpenter (American Museum of Natural History, U.S.A.), James Patton (University of Berkeley, U.S.A.), John Maisey (American Museum of Natural History, U.S.A.), Marcos Raposo (Museu Nacional do Rio de Janeiro, Brazil), Marcos Tavares (Universidade Santa Ursula, Brazil), Mario de Vivo (Universidade de São Paulo, Brazil), Miguel T. U. Rodrigues (Universidade de São Paulo, Brazil), Naércio Menezes (Universidade de São Paulo, Brazil), Nelson Papavero (Museu Paraense Emilio Goeldi, Brazil), Olivier Rieppel (Field Museum of Natural History, U.S.A.), Paulo E. Vanzolini (Universidade de São Paulo, Brazil), Paulo Young (Museu Nacional do Rio de Janeiro, Brazil), Ralf Holzentahl (University of Minnesota, U.S.A.), Randahl Schuh (American Museum of Natural History, U.S.A.), Ricardo Macedo Correa e Castro (Universidade de São Paulo, Brazil), Richard Prum (University of Kansas, U.S.A.), Richard Vari (National Museum of Natural History, U.S.A.), Rudiger Bieler (Field Museum of Natural History, U.S.A.), Ubirajara Martins (Universidade de São Paulo, Brazil), Walter A. P. Boeger (Universidade Federal do Paraná, Brazil).

INSTRUCTIONS FOR AUTHORS

General information. *Papéis Avulsos de Zoologia* covers primarily the fields of Zoology, publishing original contributions in systematics, paleontology, evolutionary biology, ecology, taxonomy, anatomy, behavior, functional morphology, molecular biology, ontogeny, faunistic studies, and biogeography. *PAZ* also encourages submission of theoretical and empirical studies that explore principles and methods of systematics.

All contributions must follow the International Code of Zoological Nomenclature and relevant specimens should be properly curated and deposited in a recognized public or private, non-profit institution. Tissue samples should be referred to their voucher specimens and all nucleotide sequence data (aligned as well as unaligned) should be submitted to Genbank (<http://www.ncbi.nlm.nih.gov/Genbank/>) or EMBL (<http://www.ebi.ac.uk/>).

Peer Review. All submissions to *Papéis Avulsos de Zoologia* are subject to review by at least two referees and the Editor-in-Chief. Three legible copies (including photocopies of original illustrations) and original illustrations must be submitted; all authors will be notified of submission date. Authors may suggest potential reviewers. Communications regarding acceptance or rejection of manuscripts are made through correspondence with the first or corresponding author only. Once a manuscript is accepted providing changes suggested by the reviewers, the author is requested to return a revised version incorporating those changes (or a detailed explanation of why reviewer's suggestions were not followed) in four weeks upon receiving the communication by the editor. Revised manuscripts must be submitted as both hard copy and disk file (3.5" disk with text in Microsoft Word format).

Proofs. Page-proofs with the revised version will be sent to the first or corresponding author. Page-proofs *must be returned to the editor in two weeks, preferably within 48 hours*. Failure to return the proof promptly may be interpreted as approval with no changes and/or may delay publication. Only necessary corrections in proof will be permitted. Once page proof is sent to the author, further alterations and/or significant additions of text are permitted only at the author's expense or in the form of a brief appendix ("note added in proof").

Submission of manuscripts. Manuscripts should be sent to the Editor-in-Chief (H. Zaher, Museu de Zoologia da USP, Caixa Postal 42694, CEP 04299-970, São Paulo, SP, Brasil). Manuscripts are considered on the understanding that they have not been published or will not appear elsewhere in substantially the same or abbreviated form. The criteria for acceptance of articles are quality and relevance of research, clarity of text, and compliance with the guidelines for manuscript preparation.

Manuscripts should be written preferentially in English, but texts in Portuguese or Spanish will also be considered. Studies with a broad coverage are encouraged to be submitted in English. All manuscripts should include an abstract in English regardless of the original language.

Authors are requested to pay attention to the instructions concerning the preparation of the manuscripts. Close adherence to the guidelines will expedite processing of the manuscript, whereas manuscripts deviating from the required form will be returned for revision prior to review.

Manuscript form. Manuscripts should not exceed 100 pages of double-spaced typescript on 21 by 29.7 cm (A4 format) or 21.5 by 28 cm (Letter format) paper, with wide margins. The pages of the manuscript should be numbered consecutively.

The text of articles should be arranged in the following order: title page, abstract, body of text, literature cited, tables, appendices, and figure captions. Each of these sections should begin on a new page. All typescript pages must be double-spaced.

- (1) *Title page.* This should include the title, author(s) name(s), institutions, and Key words in English as well as in the language of the manuscript, and a short running title in English. The title should be concise and, where appropriate, should include mention of families and/or higher taxa. Names of new taxa should not be included in titles.
- (2) *Abstract:* All papers should have an abstract in English, regardless of the original language. The abstract is of great importance as it may be reproduced elsewhere. It should be in a form intelligible if published alone in conjunction with the title and should summarize the main facts, ideas, and conclusions of the article. Indicative abstracts are strongly discouraged. Include all new taxonomic names for referencing purposes. Abbreviations should be avoided. It should not include references. Abstracts should not exceed 350 words.
- (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.
- (4) *Literature cited.* Citations in the text should be given as: Silva (1998)..., Silva (1998: 14-20)..., Silva (1998: figs. 1, 2)..., Silva (1998a, b)..., Silva and Oliveira (1998)..., (Silva, 1998)..., (Rangel, 1890; Silva and Oliveira, 1998a, b; Adams, 2000)..., (Silva, pers. comm.)..., (Silva *et al.*, 1998), the latter when the paper has three or more authors. The reference need not be cited when author and date are given only as authority for a taxonomic name. The literature section should be arranged strictly alphabetically and given in the following format:
Journal Article – Silva, H. R., H. Oliveira & S. Rangel. Year. Article title. Journal name, 00:000-000. Names of journals must be spelled out in full.
Books – Silva, H. R. Year. Book title. Publisher, Place, 000 pp.
Articles in Books – Silva, H. R. Year. Article title; pp. 000-000. In: H. Oliveira & S. Rangel (Eds.), Book Title. Publisher, Place.
Articles in Larger Works – Silva, H. R. Year. Article title; pp. 000-000. In: H. Oliveira & S. Rangel (Eds.), Title of Larger Work. Serial Publication 00. Publisher, Place.
Dissertations and Theses – Silva, H. R. Year. Dissertation title. Ph.D. dissertation, University, Place, 000 pp.

Tables. All tables must be numbered in the same sequence in which they appear in the text. Authors are encouraged to indicate where the tables should be placed in the text. They should be comprehensible without reference to the text. Tables should be formatted with horizontal, not vertical, rules. In the text, tables should be referred as Table 1, Tables 2 and 3, Tables 2-6. Use "TABLE" in the table heading.

Illustrations. Figures should be numbered consecutively, in the same sequence they appear in the text. Separate illustrations of a composite figure should be identified by capital letters and referred in the text as so (fig. 1A). Where possible, letters should be placed in the lower right corner of each illustration of a composite figure. Hand-written lettering on illustrations are unacceptable. Illustrations should be mounted on stout, white cardboard. Figures should be mounted in order to minimize blank areas between separate illustrations. High quality color or black and white photographs, and computer generated figures are preferable. Authors are encouraged to indicate where the figures should be placed in the text. Use "(Fig(s).)" and "Figure(s)" for referring to figures in the text, but "FIGURE(S)" in the figure captions and "(fig(s).)" when referring to figures in another paper.

For other details of manuscript preparation of format, consult the CBE Style Manual, available from the Council of Science Editors (<http://www.councilscienceeditors.org/pubs>).

