



A new species of the rare genus *Myroconger* Günther, 1870 (Anguilliformes: Myrocongridae) from Brazilian waters, tropical western Atlantic

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Abstract

The family Myrocongridae comprises some of the rarest and least known benthopelagic eel species. It is composed of a single genus, *Myroconger* Günther, 1870, and five valid species: *M. compressus* Günther, 1870, from the Atlantic Ocean; *M. gracilis* Castle, 1991, *M. prolixus* Castle & Béarez, 1995, and *M. nigrodentatus* Castle & Béarez, 1995, from the Pacific Ocean; and *M. seychellensis* Karmovskaya, 2006, from the Indian Ocean. Herein, we report on an additional species from the Atlantic Ocean, *Myroconger pietschi* n. sp., based on a specimen obtained on the Aracati Bank, North Brazilian ridge, off Ceará State, western South Atlantic. *Myroconger pietschi* can be diagnosed by having 190 anal-fin rays, a short pectoral fin (16.6% HL), the posterior portion of the ethmovomerine teeth arranged in a single row, teeth on lower and upper pharyngeal tooth plate 24 and 27, and 10 branchiostegal rays.

Key words: CT-Scan, Deep Sea, Elopomorpha, North Brazilian ridge, Northeastern Brazil

Resumo

A família Myrocongridae compreende algumas das espécies mais raras e pouco conhecidas de enguias bentopelágicas. A família é composta por um único gênero, *Myroconger* Günther, 1870 e cinco espécies válidas: *M. compressus* Günther, 1870, do oceano Atlântico; *M. gracilis* Castle, 1991, *M. prolixus* Castle & Béarez, 1995, e *M. nigrodentatus* Castle & Béarez, 1995, do oceano Pacífico; e *M. seychellensis* Karmovskaya, 2006, do oceano Índico. Aqui, nós descrevemos uma espécie adicional para o oceano Atlântico, *Myroconger pietschi* n. sp., baseada em um exemplar obtido no Banco de Aracati, na Cadeia Norte do Brasil ao largo do Estado do Ceará, Atlântico Sul ocidental. *Myroconger pietschi* pode ser diagnosticada por possuir 190 raios na nadadeira anal, a nadadeira peitoral curta (16.6% HL), e os dentes da porção posterior da placa de dentes ethmovomerianos dispostos em uma única fileira, 24 a 27 dentes na placa dentária faríngea inferior e superior, e 10 raios branquiostégios.

Palavras chave: CT-Scan, Oceano Profundo, Elopomorpha, Cadeia Norte do Brasil, Nordeste Brasileiro

Introduction

The family Myrocongridae includes five valid species of deep-sea eels typically distributed on seamounts and oceanic islands, at depths from 50 to 640 meters, which makes them extremely difficult to collect and rare in scientific

collections (Smith 1984a, 1989; Castle 1991; Castle & Béarez 1995; Karmovskaya 2006). The family is composed of a single genus, *Myroconger* Günther, 1870, and the following five valid species: *M. compressus* Günther, 1870, *M. gracilis* Castle, 1991, *M. nigrodentatus* Castle & Béarez, 1995, *M. prolixus* Castle & Béarez, 1995, and *M. seychellensis* Karmovskaya, 2006 (Fricke *et al.* 2021).

The first reference to *Myroconger* was made by Günther (1869) as “I may mention that the genus *Myroconger* is of great interest being a *Muraena* Linnaeus, 1758 with pectoral fins” (Günther 1869:238–239). However, such mention lacked a formal description or definition, which only appeared later in Günther (1870), along with the formal description of *M. compressus*. Günther (1870) assigned *Myroconger* to the subfamily Muraenidae Engyschistae due to the narrow slit-like branchial openings in the pharynx and the group Muraenina, which also included *Muraena*, *Gymnomuraena* (Shaw, 1797), and *Enchelycore* Forster, 1788. Günther (1870) described *Myroconger compressus* based on a unique specimen donated by John Charles Mellis from Saint Helena Island, in the eastern South Atlantic. According to the collector, it was a common fish and used as food (Mellis 1875).

A few years later, Gill (1890) proposed a new, monotypic family Myrocongridae, to include *M. compressus*. The validity of the family Myrocongridae and a proposal of relationships was first discussed by Regan (1912), who placed it in the Anguilloid group based on the frontal bones separated by a suture. Later, the family Myrocongridae was placed within the suborder Muraenoidei by Nelson (1966, 1967), suggesting a closer relationship to Chlopsidae (=Xenocongridae) and Muraenidae, based on the absence of the basibranchial and the separated frontals (Smith 1984b). More recently, phylogenies based on molecular data (Tang & Fielitz 2013; Santini *et al.* 2013) also recovered *M. compressus* as sister taxon to the Muraenidae.

Smith (1984a) redescribed *M. compressus* using the holotype and an additional specimen obtained at a fish market in Dakar, Senegal, providing osteological information and a hypothesis of relationship. The latter author cast doubt on the accuracy of the reported type locality because no other specimen had ever been collected off Saint Helena Island, despite several efforts and consultation with local fishermen. However, Edwards and Glass (1987) disagreed with that conclusion and argued that the holotype originated at Saint Helena. Additional records of *M. compressus* include two specimens from the Senghor Seamount (Vieira *et al.* 2016), nearly 100 specimens from the Cape Verde Islands (Brito *et al.* 1999; Menezes *et al.* 2004, González-Herrera *et al.* 2012), both in the tropical eastern Atlantic, a specimen from Saint Peter and Saint Paul Archipelago in central equatorial Atlantic (Hazin *et al.* 2018), and two specimens from the Vavilov Underwater Ridge in the eastern South Atlantic (Parin *et al.* 2010). Adding to that, we report an additional specimen from off northern Angola (see below). Unconfirmed literature records include a specimen from São Tomé Island in the Gulf of Guinea (Osório 1893; Afonso *et al.* 1999).

Throughout the 1990s, three species were discovered in the Pacific Ocean, as follows. *Myroconger gracilis* was described based on a single specimen collected by the Japanese R/V SIN-EI MARU No. 53 on the Kyushu-Palau Ridge, at a depth of 640–320 m, Northwestern Pacific. *Myroconger nigrodentatus* Castle & Béarez, 1995 was described based on a specimen found in a fish market at Puerto López, Manabi, Ecuador, eastern Pacific. Castle & Béarez (1995) reported the specimen as an uncommon catch made by local fishermen using a longline on hard bottom, at 70–80 meters. Curiously, the species was never collected again in its type locality, and all subsequent confirmed records are based on specimens from the Galapagos Archipelago and Cocos Island in the eastern Pacific (McCosker & Rosenblatt 2010; Robertson & Allen 2015). *Myroconger prolixus* Castle & Béarez, 1995 was described based on a specimen collected on the Kaiyo Maru seamount just south of New Caledonia, western South Pacific, at depths of 260–280 meters and is also only known from its type locality. More recently, *M. seychellensis* Karmovskaya, 2006 was described from the Mascarene Ridge, off the Seychelles archipelago, western Indian Ocean, at 200 meters. It remains known only from the type locality.

In a species checklist, Paiva *et al.* (2011) reported on a specimen of *Myroconger* without precise identification collected on the Aracati bank, off Ceará State, Northeastern Brazil. We examined the specimen in detail, confirming it to be an undescribed taxon, which is herein described as *Myroconger pietschi*, n sp.

Materials and Methods

Morphometric and meristic data were obtained using the protocol described by Böhlke (1989); all measurements were made from the left side of the specimen with the aid of a digital caliper to the nearest 0.1 mm; counts of lateral-line pores were made on both sides and are discriminated in text whenever values differ bilaterally. Dentition

terminology also follows Böhlke (1989), with the replacement of premaxillary-ethmoid teeth with ethmovomerine teeth following Johnson *et al.* (2011). The holotype was CT-scanned at the Museu de Zoologia da Universidade de São Paulo using a Phoenix Vtomex M 3D – General Electric Co: VoxelSizeX=0.02506636 microns, number of images 1700, voltage 70Kv, and current 220mA. Three-dimensional reconstruction of the skull was performed at the DEEP Lab, using FIJI (Schindelin *et al.* 2012, <https://imagej.net/Fiji/>), and the images viewing, editing, processing, surface and volume rendering was made using 3D Slicer (Fedorov *et al.* 2012; Kikinis *et al.* 2014, <https://download.slicer.org>), following the protocol described by Buser *et al.* (2020). Institutional abbreviations follow Sabaj (2020), with the addition of Coleção Ictiológica Dias da Rocha, Instituto de Ciências do Mar, Universidade Federal do Ceará (CIDRO). REVIZEE refers to the “Programa de Avaliação do Potential Sustentável dos Recursos Vivos da Zona Econômica Exclusiva” a national scientific program to evaluate the living resources in the Brazilian Economic Exclusive Zone active from 1995 to 2004, and B/Pq, to “Barco de Pesquisa.”

***Myroconger pietschi* sp. nov.**
(Figures 1–5, Table 1)

LSIDurn:lsid:zoobank.org:pub:86118D7F-7CFD-4FC2-B915-6FDAA6259BD1
Myroconger sp. – Paiva *et al.* 2011.

Holotype: MZUSP 125266 (Ex CIDRO 81), 431.0 mm TL, Brazil, Ceará State, Aracati Bank, 3°28'38" S, 37°20'48" W, 253 m depth, 10 January 2001, Program REVIZEE, col. B/Pq 'Professor Martins Filho'.

Diagnosis. *Myroconger pietschi* can be diagnosed by having 190 total anal-fin rays (*vs.* 195 in *M. compressus*, 229 in *M. gracilis*, 206–213 in *M. nigrodentatus*, 239 in *M. prolixus*, and 163 in *M. seychellensis*) and a short pectoral fin (16.6 % HL *vs.* 18.4–30.9% HL in *M. compressus*, 20.1 % HL in *M. gracilis*, 22.1–24.6 % HL in *M. nigrodentatus*, 17.8 % in *M. prolixus*, and 18.7 % HL in *M. seychellensis*). It can be further distinguished from its congeners by 291 total dorsal-fin rays (*vs.* 349 in *M. gracilis*, 298–313 in *M. nigrodentatus*, 398 in *M. prolixus*, 300 in *M. seychellensis*); and 125 total vertebrae (*vs.* 139 in *M. gracilis*, 130 in *M. seychellensis*, and 147 in *M. prolixus*). It possesses a single row of teeth arranged along the ethmovomerine tooth patch (*vs.* two irregular rows on the anterior portion and reduced to one in *M. compressus*, three rows on the anterior portion reduced to one in *M. gracilis*, and three rows on the anterior portion and contracted to two in *M. seychellensis*). It further differs from *M. gracilis* and *M. prolixus* in having five lateral-line pores (*vs.* seven and 11, respectively), and from *M. nigrodentatus* by the ethmovomerine tooth patch extending to nearly half-length of upper jaw (*vs.* ethmovomerine tooth patch extending to posterior portion of maxilla in all other species), preanal vertebrae 48 (*vs.* 43), preoperculomandibular pores six (*vs.* five). *Myroconger pietschi* further differs from *M. nigrodentatus* and *M. compressus* in having 24 teeth on the lower pharyngeal (*vs.* 37 and 60, respectively), and 27 upper pharyngeals (*vs.* 33 and 60 or more, respectively), and 10 branchiostegal rays (*vs.* 13 and 11, respectively).

Description. Morphometric and meristic data are in Table 1. Body anguilliform, not remarkably compressed anteriorly, tapering along caudal region. Entire body and head scaleless. Greatest body depth at anterior fourth of TL. Pectoral fin short, round, lateral on body, inserted slightly posterior to gill opening. Dorsal-fin origin anterior to vertical through gill slit; anal-fin origin immediately posterior to anus. Dorsal-fin rays longer than anal-fin rays. Dorsal and anal fins well developed, confluent with caudal fin.

Head posterior limit almost indistinguishable from trunk, snout triangular in lateral view, dorsal portion of cranium with mild dorsal depression. Mouth terminal, gape of mouth extending well posterior to eye. Lower jaw projecting anterior to upper jaw. Upper and lower jaw lacking labial folds.

Anterior nostril tubular, at tip of snout and directed anterodorsally. Posterior nostril dorsal on snout, at vertical through dorsal margin of eye, with short dermal flap, closer to eye than to anterior nostril. Eye oval, anteroventrally elongated, positioned at middle of upper jaw. Gill opening lateral on body, oblique, with dorsal margin anterior to ventral margin; dorsal margin at level of dorsal most pectoral-fin ray.

Maxillary teeth conical, with smooth margins, arranged in three rows anteriorly and two rows posteriorly; teeth decreasing in size from anterior to posterior; medial teeth about twice size of lateral teeth, lateral row with 48 teeth, medial row with 31 or 33 teeth. Ethmovomerine teeth conical, with smooth margins, anteriorly arranged in subcircular patch, extending in single row to level of posterior third of upper jaw (Fig. 2, 3B). Dentary teeth conical, with smooth margins, arranged in three rows anteriorly and two rows posteriorly; teeth decreasing in size from anterior

to posterior; medial teeth about twice as large as lateral ones; teeth in internal row 29; teeth in lateral row 33 (Fig. 2, 3C). Upper pharyngeal tooth plate rhomboid, restricted to upper pharyngeals 3 and 4, with 24 teeth; lower pharyngeal tooth plate antero-ventrally elongated, restricted to lower pharyngeal, with 27 teeth (Fig. 4).



FIGURE 1. *Myroconger pietschi* sp. nov., holotype, MZUSP 125266, 431.0 mm TL, Brazil, Ceará, Aracati Bank, 03°28'38" S, 37°20'48" W, 253 m depth.

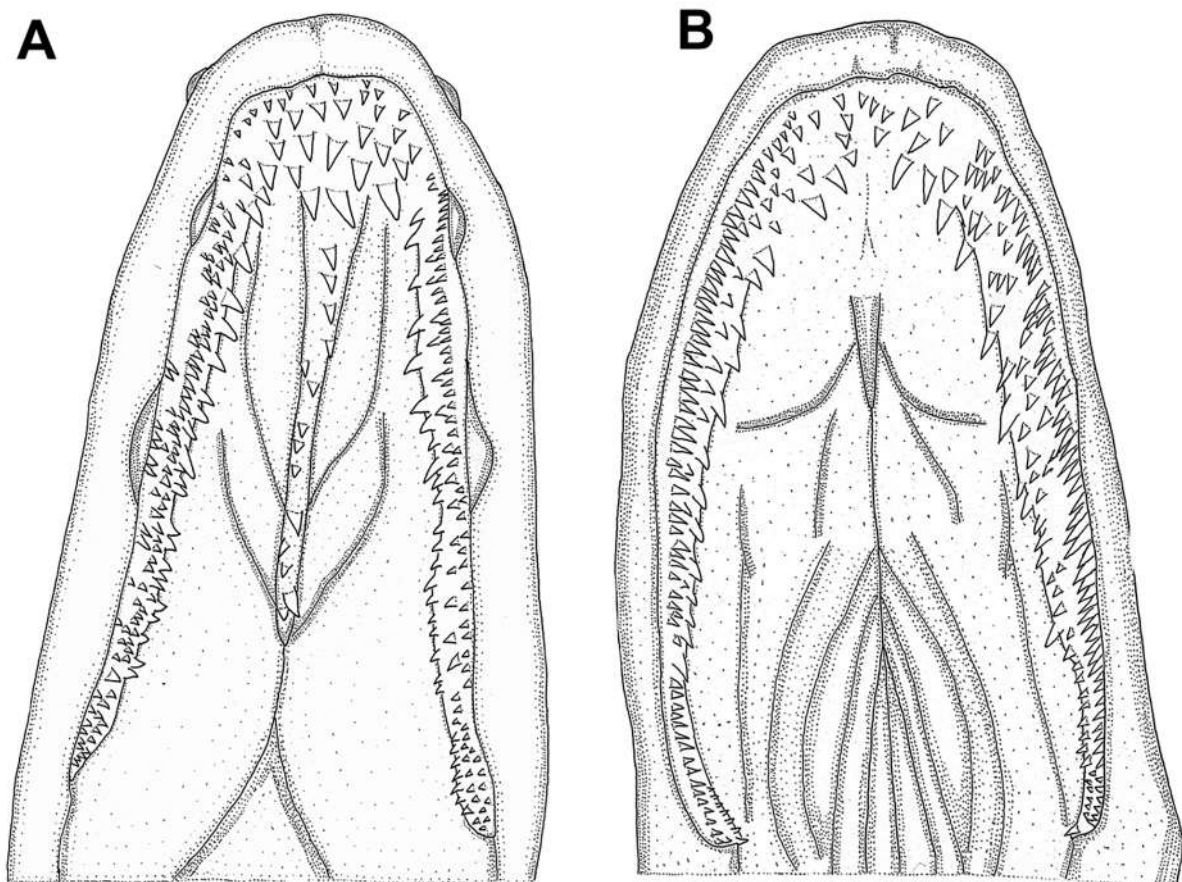


FIGURE 2. Schematic of dentition in *Myroconger pietschi* sp. nov., holotype, MZUSP 125266, 431.0 mm TL; in (A) upper jaw and (B) lower jaw.

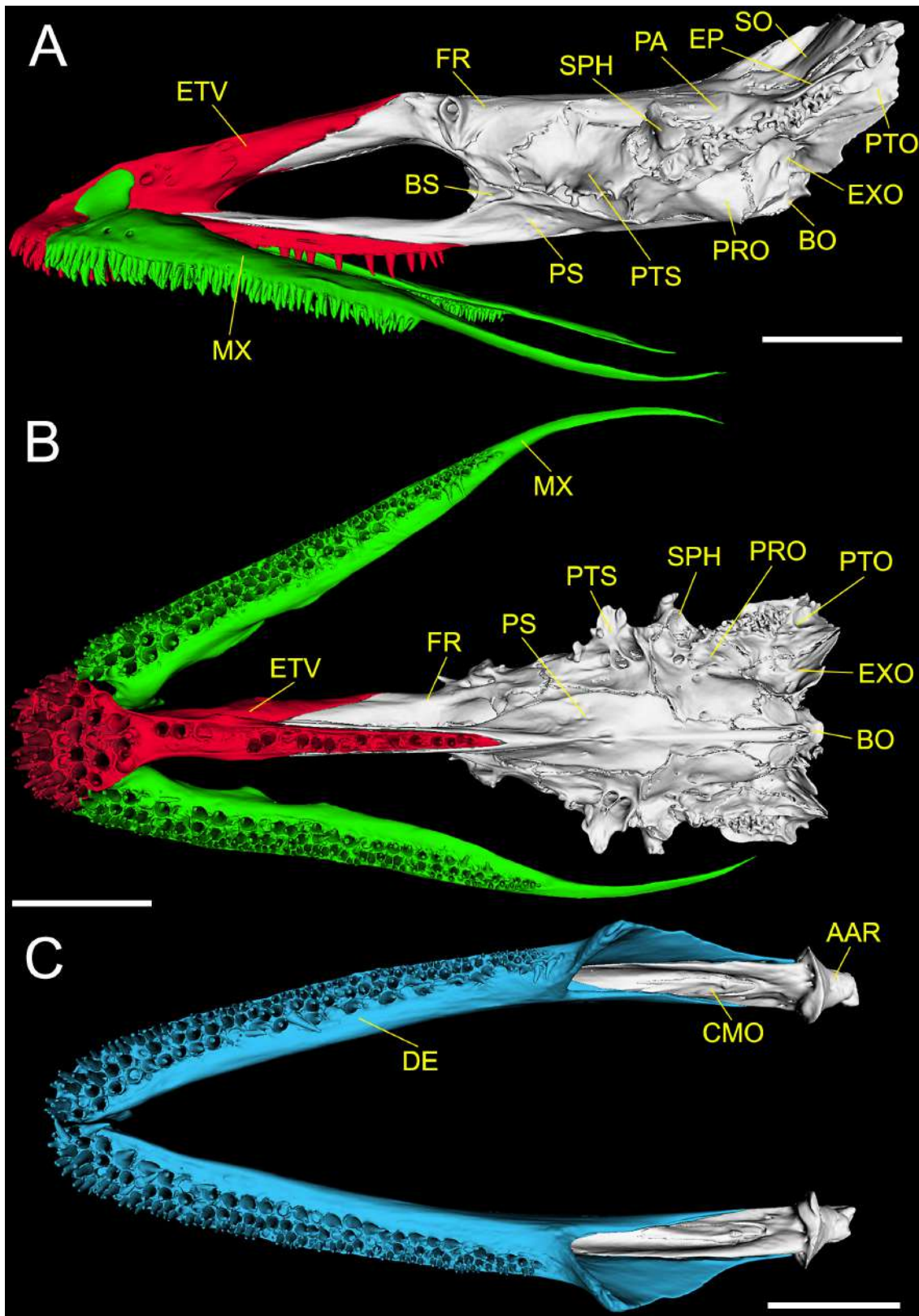


FIGURE 3. 3D reconstruction of the CT Scanned head bones of *Myroconger pietschi* n. sp., holotype, MZUSP 125266, 431.0 mm TL, with the dentigerous bones highlighted in differential colors: in (A), skull and upper jaw in lateral view; in (B), skull and upper jaw in ventral view; and in (C), lower jaw in dorsal view. Abbreviations: AAR, angulo-articulo-retroarticular; BS, basisphenoid; CMO, coronomeckelian ossification; DE, dentary; EP, epiotic; ETV, ethmovomer; EXO, exoccipital; BO, basioccipital; FR, frontal; MX, maxilla; PA, parietal; PRO, prootic; PS, parasphenoid; PTO, pterotic; PTS, ptersphenoid; RA, retroarticular; SO, supraoccipital; SPH, sphenotic. Scales bars equal 10 mm.

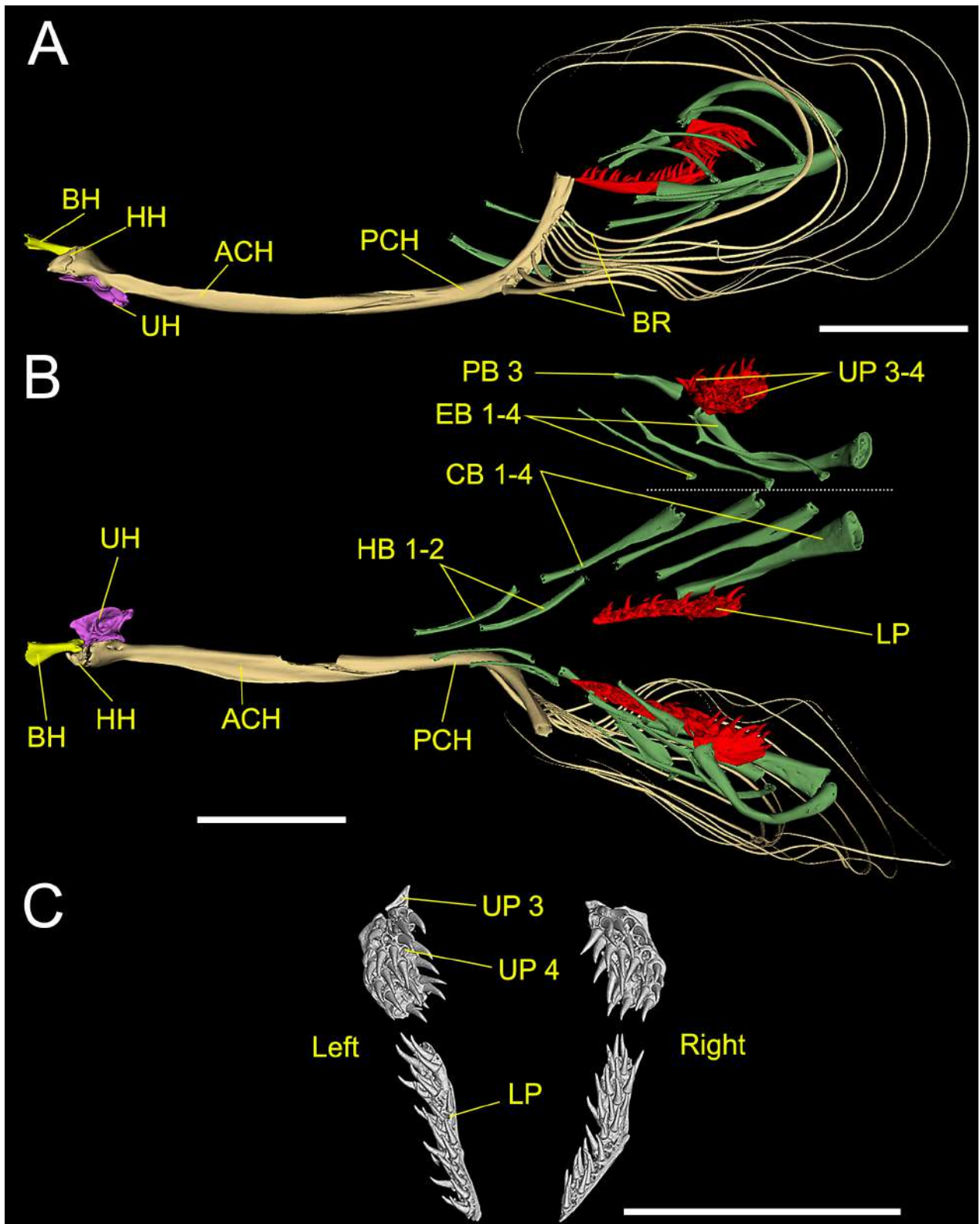


FIGURE 4. 3D reconstruction of the CT-scanned hyoid arch and branchial arches of *Myroconger pietschi* n. sp., holotype, MZUSP 125266, 431.0 mm TL – only bones illustrated, cartilaginous structures not recovered; (A), left and middle elements in lateral view; (B), arches in dorsal view, except upper elements of right branchial arch flipped to allow ventral view (indicated by dashed line) and right hyoid arch removed; and (C), upper pharyngeals and lower pharyngeals in anterior view. Abbreviations of the hyoid arch: BH, basihyal; HH, hypohyal; UH, urophyal; ACH, anterior ceratohyal; PCH, posterior ceratohyal; BR, branchiostegal rays. Abbreviations of the branchial arches: HB, hyobranchial; CB, ceratobranchial; EB, epibranchial; PB, pharyngobranchial; UP, Upper pharyngobranchial; LP; lower pharyngobranchial. Scale bars equal 10 mm.

TABLE 1. Morphometric and meristic data for the species of *Myroconger*. Data obtained during this study or compiled from literature, as indicated.

Source	<i>M. pietschi</i>		<i>M. compressus</i>		<i>M. gracilis</i>		<i>M. nigrodentatus</i>		<i>M. prolixus</i>		<i>M. seychellensis</i>	
	This study	Smith, 1989	This study	González-Herrera <i>et al.</i> 2012	Castle 1991	Castle & Béarez 1995	This study	Castle & Béarez 1995	Castle & Béarez 1995	Castle & Béarez 1995	This study	Karmovskaya 2006
Number of specimens	Holotype	Holotype + 1	1	60	Holotype	Holotype	1	Holotype	Holotype	1	Holotype	Holotype
Morphometric Characters												
Total length	431	538.0–253+	371.0	308.0–611.0	484.0	366.0	382.0	383.0	383.0	382.0	383.0	450.0
Percentage of Total Length												
Prenal length	47.3	45.0 (1)	45.6	41.6–48.0	44.5	45.6	44.7	45.4	45.4	44.7	45.4	50.7
Predorsal length	13.9	12.0 (1)	13.6	10.8–14.8	9.9	13.6	12.7	10.3	10.3	12.7	10.3	12.2
Head length	14.9	14.0 (1)	16.6	13.0–17.5	10.9	17.4	18.5	11.8	11.8	18.5	11.8	14.2
Depth of the body at the level of anus	6.4	8.0 (1)	–	5.8–10.5	5.1	7.5	6.7	4.6	4.6	6.7	4.6	6.4
Percentage of Head Length												
Snout length	24.9	24.0 (2)	24.6	17.7–32.8	23.0	21.0	22.0	27.1	27.1	22.0	27.1	25.8
Eye diameter	12.7	12.0–14.0 (2)	11.4	12.6–17.4	15.0	15.1	14.9	13.9	13.9	14.9	13.9	11.7
Interorbital width	–	–	–	16.7–25.4	18.2	18.9	–	20.9	20.9	–	20.9	20.3
Distance snout to rictus	49.8	48.0 (1)	41.9	38.4–56.8	45.4	41.9	42.6	49.5	49.5	42.6	49.5	47.6
Gill opening	10.0	10.0–12.0 (2)	14.8	10.9–17.3	11.2	18.1	14.0	8.4	8.4	14.0	8.4	10.9
Pectoral-fin length	16.6	19.0–22.0 (2)	21.7	18.4–30.9	20.1	22.1	24.6	17.8	17.8	24.6	17.8	18.7
Meristic Characters												
Pectoral-fin rays	16	16 (2)	16	15–20	16	16, 17	16	15, 16	15, 16	16	15, 16	–
Total dorsal-fin rays	291	–	290	–	349	298	313	398	398	313	398	300
Total anal-fin rays	190	–	195	–	229	213	206	239	239	206	239	163
Dorsal-fin rays anterior to anal origin	–	–	–	–	134	100	–	156	156	–	156	–
Predorsal vertebrae	4	4–5 (2)	3	–	7	6	3	5	5	3	5	7
Prenal vertebrae	48	47 (1)	47	–	53	43	43	57	57	43	57	56
Precaudal vertebrae	–	52 (1)	–	–	65	50	–	71	71	–	71	68
Total vertebrae	125	131 (1)	121	–	139	123	125	147	147	125	147	130
Branchiostegal rays	10	11	–	–	–	–	13	–	–	–	–	–

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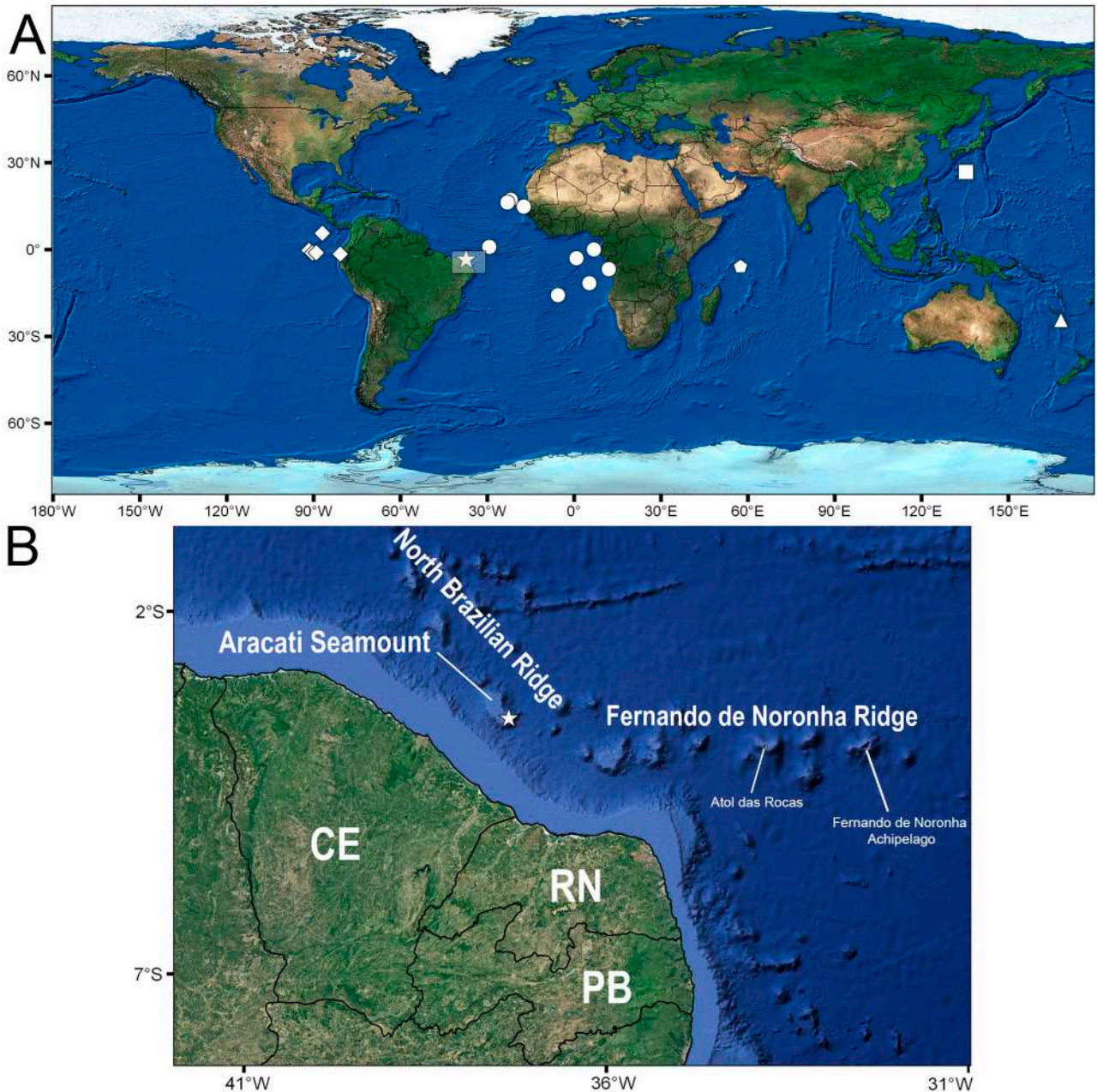


FIGURE 5. Known distribution of the species of *Myroconger*, with a detailed map of the northern portion of Northeastern Brazil indicating the seamounts and the type of *Myroconger pietschi* sp. nov. on the Aracati Bank. Symbols: star represents *M. pietschi*; circles, *M. compressus*; diamonds, *M. nigrodentatus*; triangles, *M. proluxus*; squares, *M. gracilis*; and pentagons, *M. seychellensis*.

Infraorbital pores four; first and second pores located between verticals through anterior and posterior nostrils, third infraorbital pore at vertical through anterior margin of eye; fourth infraorbital pore at vertical through middle of eye. Preoperculomandibular pores six, all in lower jaw, extending from tip of chin to immediately anterior to rictus; first and second pores anterior to vertical through anterior nostril, third pore at vertical through first infraorbital pore, fourth pore at vertical through second infraorbital pore, fifth pore at vertical through anterior margin of eye; sixth pore slightly posterior to posterior margin of eye. Supratemporal pores absent. Supraorbital pores two or three; first pore anteroventral to anterior nostril; second pore anterodorsal to anterior nostril, third pore present only on left side, posterodorsal to anterior nostril. Lateral line short, last pore well behind the pectoral fin, with five pores.

Color in alcohol. General ground color of body and head orange. Ventral surface of head light yellow on lower jaw and ventral part of cheek. Body whitish on belly and ventral third of caudal portion of body. Single broad

dichromatic stripe, pale yellow on dorsal and ventral margins, brown in center; extending medially on flank from posteriormost lateral-line pore to posterior third of body. Pectoral fin mostly orange, lighter on distal third. Anterior half of dorsal fin orange, posterior half yellowish. Anterior third of anal fin whitish; posterior two-thirds yellow. Color of live specimen not available.

Remarks. The only known specimen has some damage caused by collection. The head is slightly mashed, and there is a strong compression of the body slightly posterior to the pectoral fin.

Distribution. *Myroconger pietschi* is known only from its type locality on the Aracati Bank, Northern Brazilian Ridge, tropical western South Atlantic, Ceará State, Brazil (Fig. 5).

Etymology. The species name honors Theodore Wells Pietsch III, in recognition of his outstanding contributions to the knowledge of deep-sea fishes.

Discussion

Morphological comparisons. Myrocongrids are characterized by the reduction of the lateral-line sensory system on head and body, with a short lateral line consisting of three to 11 pores, two or three supraorbital pores, four infraorbital pores, and four to six preoperculomandibular pores; by the presence of a suture separating the frontal bones; the posterior nostril positioned anterodorsally to the eye and the presence of pectoral fins. (Nelson 1966, 1967; Robins & Robins 1976; Smith 1984a, 1989). All such characters have been confirmed in *M. pietschi*, leaving no reasonable doubt as to its familial allocation.

The reduced pectoral fin of *Myroconger pietschi* is very distinctive, and the shortest among all congeners (16.6 % HL). *Myroconger prolixus* and *M. seychellensis* also have short pectoral fin (17.8 and 18.7 % HL, respectively), and in *M. nigrodentatus* there is strong variation (18.4–30.9% HL). The number of anal-fin rays is another unique character in *M. pietschi*, bringing it closer to *M. compressus* and *M. nigrodentatus* (195 and 206–213, respectively). Notably, except for *M. compressus* known from over 60 specimens, all species are known from one or two specimens, making it impossible to estimate the interspecific variation and make proper interpretations about such differences.

Myroconger pietschi resembles *M. nigrodentatus* and *M. compressus* because of the orange pigmentation in preserved specimens, which is bright and uniformly red in live specimens of *M. compressus*, and bright orange with a yellow longitudinal stripe in *M. nigrodentatus* (Castle & Béarez 1995; Menezes *et al.* 2004). Unlike those species, the color pattern is brownish orange with a broad, dark longitudinal stripe and light ventrally in *M. seychellensis*, and light tan or brown dorsally and light ventrally, but lacking a longitudinal stripe in *M. prolixus* and *M. gracilis* (Castle 1991; Castle & Béarez 1995; Karmovskaya 2006).

The number of total vertebrae (125), and the posterior arrangement of the ethmovomerine tooth patch in a single row of *M. pietschi* resembles *M. nigrodentatus* (123–125 vertebrae). Nevertheless, *M. pietschi* has more preanal vertebrae (48 vs. 43), the ethmovomerine tooth patch is shorter than the maxillary tooth patch (vs. ethmovomerine tooth patch as long as the maxillary tooth patch), and has one extra preoperculomandibular pore (6 vs. 5).

Comparative material examined: *Myroconger nigrodentatus* USNM 347340, 1, 127.0 mm TL, North of Islas Plazas, off Isla Santa Cruz, Galapagos Archipelago, Ecuador, 0°31'23.9"S, 90°09'00.0"W. USNM 347341, 1, 210.0 mm TL, West of Punta Suarez, Isla Española, Galapagos Archipelago, Ecuador, 1°22'12.0"S, 89°49'09.8"W. CAS 86753, 1, 380.0 mm TL, Seamount southeast of San Cristobal Island, Galapagos Archipelago, Ecuador; *Myroconger compressus* CAS 225356, 1, 371.0 mm TL, Southeastern Atlantic, 6°46'57.0"S, 11°55'12.0"E.

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