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ORIGINAL ARTICLE

The Tonkin weakfish, *Cynoscion similis* (Sciaenidae, Perciformes), an endemic species of the Amazonas-Orinoco Plume

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ABSTRACT

Despite its importance in biogeographical, ecological, and commercial terms, the fish fauna of the northern Brazilian coast is still poorly known, representing the least sampled portion of the Brazilian Exclusive Economic Zone. We collected Tonkin weakfish, *Cynoscion similis* specimens during extensive surveys of the northern Brazilian coast and concluded that *C. similis* is common in this region. While the species had not previously been reported for the northern Brazilian state of Pará, it may have been recorded in studies of industrial fisheries, being identified only as *Cynoscion* sp. or by the common name pescada negra. This reinforces the need for the reliable taxonomical identification of species, to guarantee the collection of accurate data on ecology and fisheries, and ultimately, support the development of effective conservation strategies. Here we provide additional morphological and molecular data to distinguish *Cynoscion similis* from the closely related *Cynoscion jamaicensis*, and other congeners.

KEYWORDS: Brazilian north coast, *Cynoscion jamaicensis*, industrial fisheries, DNA barcoding, reliable taxonomical identification

Pescada negra, *Cynoscion similis* (Sciaenidae Perciformes), uma espécie endêmica da pluma Amazonas – Orinoco

RESUMO

Apesar de sua importância em termos biogeográficos, ecológicos e comerciais, a ictiofauna da costa norte do Brasil ainda é pouco conhecida, representando a porção menos amostrada da Zona Econômica Exclusiva Brasileira. Durante extensivo esforço de inventário na costa norte do Brasil, nós obtivemos uma série de espécimes de *Cynoscion similis* e concluímos que a espécie é comum nesta região. Embora a espécie não tenha sido relatada anteriormente para o estado do Pará, ela pode ter sido registrada em estudos sobre a pesca industrial, sendo identificada apenas como *Cynoscion* sp. ou pelo nome comum pescada negra. Isso reforça a necessidade de identificação taxonômica confiável de espécies, com objetivo de garantir dados precisos de ecologia e pesca, e apoiar o desenvolvimento de estratégias efetivas de conservação. Aqui, nós fornecemos novos dados morfológicos e moleculares importantes para a diferenciação de *Cynoscion similis* e *C. jamaicensis*, a espécie mais próxima morfologicamente, assim como de outros congêneres.

PALAVRAS-CHAVE: costa norte do Brasil, *Cynoscion jamaicensis*, pesca industrial, DNA barcoding, identificação taxonômica

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INTRODUCTION

The Tonkin weakfish or pescada negra, *Cynoscion similis* Randall & Cervigón, 1968, was described from specimens collected on the coast of Venezuela, Suriname, and French Guiana. Since its description, however, the species has only rarely been mentioned in the literature (Chao 1978, 2002, 2003; Uyeno *et al*. 1983; Cervigón 1992, 1993; Aguillera 1998; Casatti and Menezes 2003). *Cynoscion similis* is very similar to the Jamaican weakfish, *Cynoscion jamaicensis* (Vaillant and Bocourt 1883), being distinguished from the latter species by the presence of a sheath of 1–2 scales on the base of the 2nd dorsal fin and the anal fin, which, in *C. jamaicensis*, is covered with small scales over at least half of its total extension (Chao 2003).

In a review of the classification of the sciaenids of the western North Atlantic, Chao (1978) noted that *Cynoscion similis* is found from "Venezuela to Brazil", although its occurrence on the Brazilian coast is known only from records from the state of Amapá (http://www.fishnet2.net). This position was perpetuated in subsequent publications, as in the paper of Uyeno *et al*. (1983) on the fish species trawled off Suriname and French Guyana, and in the list of Brazilian marine fishes (Casatti and Menezes 2003). In the IUCN Red List account for *C. similis*, however, it is stated that "There (are) no known records of this species from Brazil (F. Lucena-Frédou, pers. comm. 2009)" (Chao and Aguillera 2015)

We conducted extensive surveys on the northern Brazilian coast, and, during these surveys, we collected a number of *Cynoscion similis* specimens. In this context, the present study reports the occurrence of *Cynoscion similis* on the northern coast of Brazil, and provides a new morphological diagnosis of the species, together with an analysis of its DNA barcode.

MATERIAL AND METHODS

Material examined

Material examined in the present study is held by the following Brazilian institutions: the zoological collection (Acervo Zoológico) of Universidade Santa Cecília (AZUSC) in Santos, São Paulo State, Brazil; Museu Paraense Emílio Goeldi (MPEG) in Belém, Pará State, Brazil; and the Zoology Museum (Museu de Zoologia) of Universidade de São Paulo (MZUSP) in São Paulo, São Paulo State, Brazil.

Cynoscion similis, 22 specimens 213–309 mm SL: MPEG 35794 (1, 286 mm SL), Amapá, 03°44'N, 50°12'W, 72 m; MPEG 35807 (1, 299 mm SL), Amapá, 03°39'N, 50°10'W, 66 m; MZUSP 68853, (3), Amapá, 2°59'N, 49°22'W; MPEG 35605 (2, 241–269 mm SL), Amapá, 02°19'N, 48°36'W; MPEG 3568 (1, 269 mm SL), Amapá, 2°17'N, 48°33'W; MPEG 35612 (1, 264 mm SL), Amapá, 02°17'N, 48°33'W; MPEG 35696 (2, 241–269 mm SL), Amapá, 02°19'N, 48°36'W; MPEG 35590 (1, 255 mm SL), Amapá, 02°14'N, 48°25'W; MPEG 35679 (1, 300 mm SL), Amapá, 02°09'N, 48°27'W, 47 m; MPEG 35743 (2, 158–184 mm SL), Amapá, 02°07'N, 48°26'W; MPEG 35752 (2, 256–263 mm SL), Amapá, 02°07'N, 48°26'W; MPEG 35691, (1, 303–309 mm SL), Amapá, 02°07'N, 48°26'W, 44 m; MPEG 35636 (1, 224 mm SL), Amapá, 02°04'N, 48°26'W, 42 m; MPEG 35509 (2, 232–240 mm SL), Amapá, 01°25'N, 48°44'W; MPEG 35105 (2, 272–284 mm SL), Amapá, 01°15'N, 48°00'W, 46 m; MPEG 35042 (2, 213–223 mm Sl), Pará, 00°03'S, 47°31'W, 38 m; AZUSC 4650 (1, 240 mm SL), Pará, 00°54'S, 46°37'W.

Cynoscion_jamaicensis, 29 specimens 142–285 mm SL: MPEG 35743 (2, 158–184 mm SL), Amapá, 02°07'N, 48°26'W; MPEG 35588 (1, 152 mm SL), Amapá, 02°14'N, 48°25'W; MPEG 35587 (1, 171 mm SL), Amapá, 02°06'N, 48°33'W; MPEG 35508 (3, 146–184 mm SL), Amapá, 01°25'N, 48°04'W; MPEG 35678 (9, 152–166 mm SL), Amapá, 01°25'N, 48°04'W; MPEG 35683 (1, 160 mm SL), Amapá, 02°09'N, 48°27'W; MPEG 35689 (1, 179 mm SL), Amapá, 02°07'N, 48°26'W; AZUSC 1764 (4, 164–285 mm SL), São Paulo, Santos; AZUSC 2778 (3, 142–157 mm SL), São Paulo, Santos; AZUSC 4719 (4 173–187 mm SL), São Paulo, Santos.

Morphological analysis

Measurements were taken either with a ruler and recorded to the nearest millimeter, or with dial calipers and recorded to the nearest 0.1 mm. The following measurements were obtained through orthogonal projections using a ruler: Caudal - peduncle length (CPl), from the posterior basal margin of the last anal-fin ray to the end of the hypural plate; Distance from snout to anal fin (SAd), from the tip of the snout to the anterior basal portion of the first anal-fin spine; Distance from snout to dorsal fin (SDd), from the tip of the snout to the anterior basal portion of the first dorsal-fin spine; Distance from the tip of the snout to the pectoral fin (SPd), from the tip of the snout to the anterior basal portion of the first pectoral-fin ray; Head length (Hl), from the tip of the snout to the end of the operculum, including its membranous portion; Snout length (Sl), from the tip of the snout to the anterior margin of the orbit; Standard length (SL), from the tip of the snout to the end of the hypural plate. The remaining measurements were taken point-to-point: Anal fin height (Ah), from the insertion to the end of the longest spine; Anal-fin base length (Abl), from the anterior basal margin of the first spine to the posterior basal margin of the last ray; Body depth (Bd), the greatest vertical distance between the anterior basal margin of the first dorsal-fin ray to the anterior basal margin of the first anal-fin ray; Body width (Bw), greatest body width at the pectoral girdle; Caudal peduncle height (CPh), least depth of the caudal peduncle; Dorsal fin height (Dh), from the basal insertion to the tip of the longest spine; Dorsal-fin base length (Dbl), from the anterior basal margin of the first dorsal-fin spine to the posterior basal margin of the last dorsal-fin ray;

Head depth (Hd), the greatest vertical height of the head at the posterior margin of the operculum; Maxillary height (Mh), greatest vertical height of the maxilla at the mouth angle; Maxillary length (Ml), greatest distance between the anterior and posterior margins of the maxilla; Mouth width (Mw), external distance between mouth angles; Orbital diameter (Od), greatest orbital width; Interorbital distance (IOd), the greatest distance between the upper margins of the orbit; Post-orbital length (POl), the distance from the posterior margin of the orbit to the end of the membranous posterior portion of the operculum; Pectoral fin height (Ph), from the basal insertion to the tip of the longest ray. Counts were taken of the elements of the dorsal, anal and pectoral fins, as well as the number of gill rakers on the first gill arches, the number of scales with pores on the lateral line, and the number of scales above and below the lateral line, at the level of the dorsal fin. Whenever possible, the sex of the specimens was determined through the examination of the morphology of the gonads under magnification.

Principal Component Analysis (PCA) was used to analyze the log-transformed measurements in a matrix of co-variance. The values that were constant were excluded from the PCA, so the measurements included were Abl, Bd, CPh, CPl, Dh, Hl, Od, and Ph. *Cynoscion similis* was differentiated from the closely related *C. jamaicensis* based on the analysis of the factor loadings for the first and second principal components. Meristic ranges are presented for *Cynoscion similis* and *C. jamaicensis*. In the text, measurements are given as percentages of the standard length (SL), unless otherwise stated. The diagnosis of the western Atlantic species was based on direct examination of specimens. The diagnostic characters of the western Atlantic species in relation to species from the eastern Pacific was based on the literature (Chao 1978, 1995, 2003; Castro-Aguirre 1999; McEachran and Fechhelm 2005) and the Guide to the shore fishes of the Caribbean and adjacent areas of the Smithsonian Tropical Research Institute (www.stri.org/ sfgc and www.stri.org/sftep).

Molecular data

Partial COI sequences (652 bp) were obtained from five specimens of *Cynoscion similis*. Additionally, sequences were generated for two specimens of *Cynoscion jamaicensis*, and 73 sequences for 11 *Cynoscion* species were obtained from GenBank [*C. acoupa* (4), *C. arenarius* (6), *C. guatuculpa* (20), *C. leiarchus* (4), *C. nebulosus* (3), *C. microlepidotus* (4), *C. nothus* (2), *C. jamaicensis* (9), *C. regalis* (4), *C. similis* (1) and *C. virescevs* (16)] (Table 1). Vouchers and tissues of the specimens sequenced here were deposited in the fish collection of the Laboratory for Fish Biology and Genetics (LBP) of the Department of Morphology of Universidade Estadual Paulista (UNESP) in Botucatu, São Paulo, Brazil and Museu Paraense Emílio Goeldi (MPEG) in Belém, Pará, Brazil.

Table 1. Genbank number of sequences used and added (*) in the present study. Discrepancies of species identification with GenBank are indicated in bold.

Species identification		Locality	GenBank Accession Number
Present study	GenBank		
Cynoscion acoupa	*Cynoscion acoupa*	São Paulo, Brazil	JQ365312
		Buenos Aires, Argentina	KP722713
		Pará, Brazil	KP331710
	Cynoscion nebulosus	**Florida, United States**	JN021296
Cynoscion arenarius	*Cynoscion arenarius*	Florida, United States	JQ841862
		Alabama, United States	KF461162
		Alabama, United States	KF461163
		Alabama, United States	KF461164
		Alabama, United States	KF461165
	Cynoscion	**Florida, United States**	JQ841861
Cynoscion guatucupa	*Cynoscion guatucupa*	São Paulo, Brazil	GU702425
		São Paulo, Brazil	GU702426
		São Paulo, Brazil	GU702427
		São Paulo, Brazil	GU702428
		São Paulo, Brazil	GU702485
		São Paulo, Brazil	GU702486
		São Paulo, Brazil	GU702487
		São Paulo, Brazil	GU702488
		São Paulo, Brazil	GU702490
		São Paulo, Brazil	JQ365313
		São Paulo, Brazil	JQ365314
		São Paulo, Brazil	JQ365315
		São Paulo, Brazil	JQ365316
		Buenos Aires, Argentina	KP722714
		Buenos Aires, Argentina	EU074395
		Buenos Aires, Argentina	EU074396
		Buenos Aires, Argentina	EU074397
		Buenos Aires, Argentina	EU074398
		Buenos Aires, Argentina	EU074399
	Cynoscion steindachneri	**not described**	KP331709
Cynoscion jamaicensis	*Cynoscion jamaicensis*	Rio de Janeiro, Brazil	JX124767
		Rio de Janeiro, Brazil	JX124768
		São Paulo, Brazil	JQ365317
		São Paulo, Brazil	JQ365318
		Pará, Brazil	MH575181*
		Pará, Brazil	MH575182*
		Pará, Brazil	KP331711
		Alagoas, Brazil	KY402377 1
		Alagoas, Brazil	KY402378 1
		Alagoas, Brazil	KY402379
		Alagoas, Brazil	KY402380

Table 1. Continued.

Species identification		Locality	GenBank Accession Number
Present study	GenBank		
Cynoscion leiarchus	*Cynoscion leiarchus*	Bahia, Brazil	BAHIA440 15
		Bahia, Brazil	BAHIA441 15
		São Paulo, Brazil	JQ365319
		Belize, Guatemala	KF929804
Cynoscion microlepidotus	*Cynoscion microlepidotus*	Pará, Brazil	KP331702
		Pará, Brazil	KP331713
		São Paulo, Brazil	JQ365320
	Cynoscion sp.	**Brazil**	HQ689365
Cynoscion nebulosus	*Cynoscion nebulosus*	Alabama, United States	KF461166
		Alabama, United States	KF461167
		Florida, United States	JN021296
Cynoscion nothus	*Cynoscion nothus*	Florida, United States	JQ841863
		Florida, United States	JQ841864
Cynoscion regalis	*Cynoscion regalis*	Virginia, United States	KT075323
		Florida, United States	KP722717
		United States	KT075305
		United States	KF929807
Cynoscion similis	*Cynoscion similis*	Pará, Brazil	MH575183*
		Pará, Brazil	MH575184*
		Pará, Brazil	MH575185*
		Pará, Brazil	MH575186*
		Pará, Brazil	MH575187*
	Cynoscion jamaicensis	**Pará, Brazil**	KP331706
Cynoscion virescens	*Cynoscion virescens*	Pará, Brazil	KP331712 1
		São Paulo, Brazil	JQ365321
		São Paulo, Brazil	JQ36532
		São Paulo, Brazil	HM424137
		Alagoas, Brazil	KY402371
		Alagoas, Brazil	KY402372
		Alagoas, Brazil	KY402373
		Alagoas, Brazil	KY402374
		Brazil	HQ689366
		Brazil	HQ689367
		Brazil	HQ689368
		Brazil	HQ689369
		Brazil	HQ689370
		Brazil	HQ689371
		Brazil	HQ689372
		Brazil	HQ689373

DNA extraction and sequencing

Genomic DNA was isolated from fins or muscle tissues of each specimen with a DNeasy Blood and Tissue Kit (Qiagen, cat. 69506), according to the manufacturer instructions. Amplifications were performed in a total volume of 12.5 µl with 1.25 µl of 10X buffer (10 mM Tris - HCl+15 mM MgCl2), 0.5 µl dNTPs (200 nM of each), 0.5 µl each 5 mM primer (FishF2, FishR2 described in Ward *et al.* 2005), 0.05 µl Platinum® *Taq* Polymerase (Invitrogen - 5 units – µl), 1 µl template DNA (12 ng), and 8.7 µl ddH2O. The PCR reactions consisted of 30 – 40 cycles, 30 s at 95 °C, 15 – 30 s at 48 – 54 °C (according to each species), and 45 s at 72 °C. All PCR products were first visually identified on a 1% agarose gel and then purified using ExoSap - IT® (USB Corporation) following manufacturer instructions. The purified PCR products were sequenced using the "Big DyeTM Terminator v 3.1 Cycle Sequencing Ready Reaction Kit" (Applied Biosystems), purified again by ethanol precipitation and loaded on an automatic sequencer 3130 - Genetic Analyzer (Applied Biosystems).

Sequencing analysis

Consensus sequences from forward and reverse strands were obtained using Geneious Pro 8.1.8 (Kearse *et al*. 2012). Alignments were generated using MUSCLE algorithm (Edgar 2004) under default parameters. After alignment, the matrix was checked by eye for any obvious misalignments, and to detect potential cases of sequencing errors. A quality control step was included in our workflow to detect contamination, paralogous copies or pseudogenes. After that, the presence of stop codons was checked using Geneious. Nucleotide variation, substitution patterns and genetic distances were examined using Mega 6.06 (Tamura *et al*. 2013).

Maximum likelihood (ML) analyses were generated in a partitioned RAxML analysis using the CIPRES web server (Miller *et al*. 2010). Random starting trees were used for ML tree search and all other parameters were set to default values. All ML analyses were performed under GTR+G since RAxML only applies to this model (Stamatakis *et al*. 2008). The robustness of the topology was investigated using 1000 bootstrap pseudoreplicates (Felsenstein 1985).

RESULTS

Cynoscion similis Randall & Cervigón, 1968

Figures 1 and 2, Tables 2 and 3

Cynoscion simlis – Randall and Cervigón 1968: 179 (original description; type locality: Isla de Margarita, Venezuela) – Lasso *et al*. 1999: 11 (type catalog: collection of Fundación La Salle; listed) – Chao 1978: 36 (basis for classifying western Atlantic sciaenids; listed. short description) – Uyeno *et al*. 1983: 371 (fishes trawled off Suriname and French Guiana; listed; photograph and short description) – Cervigón 1992: 401

(FAO sheets of marine fishes in septentrional South America; listed) – Cervigón 1993: 261 (marine fishes of Venezuela; listed and description) – Aguillera 1998: 50 (marine fishes of Venezuela; listed) – Chao 2002: 10 (*Cynoscion*; taxonomy; list and identification key) – Chao 2003: 1614 (living marine resources of the western Central Atlantic; list; short description; illustration) – Casatti and Menezes 2003: 86 (catalog of marine fishes from Brazil; listed) – Chao and Aguillera 2015 (IUCN Redlist; biology and distribution).

Figure 1. Body in lateral view. A. *Cynoscion similis* (MPEG 35679, 304 mm SL). B. *Cynoscion jamaicensis* (MPEG 35508, 184 mm SL). This figure is in color in the electronic version.

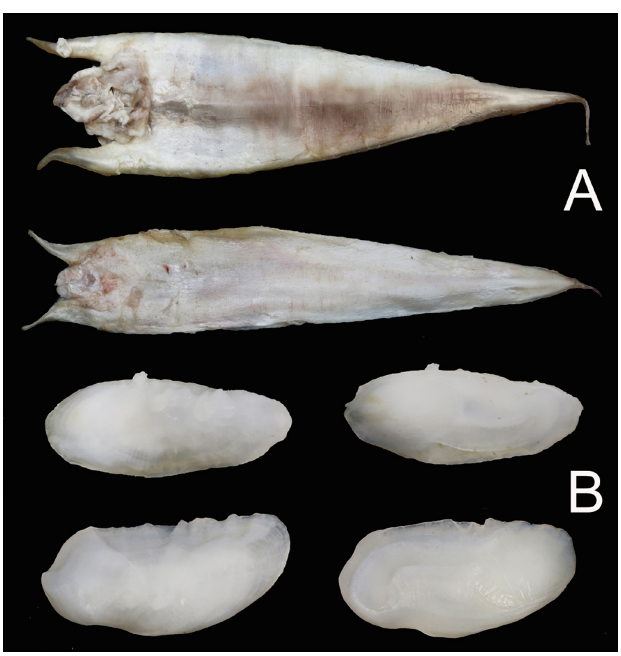

Figure 2. *Cynoscion similis* (above, AZUSC 5709, 388 mm SL) and *C. jamaicensis* (below, AZUSC 2937, 326 mm SL). (A) Swimbladder and (B) Sagitta otoliths (left and right side). This figure is in color in the electronic version.

Table 2. Selected meristic characters of *Cynoscion similis* and *C. jamaicensis*. Underlined values refer to type specimens. Lateral line scales (**A**); dorsal-fin rays (**B**); pectoral-fin rays (**C**); anal-fin rays (**D**); gill rakers on the first gill arch (**E**); gill rakers on the second gill arch (**F**).

A	**51**	**52**	**53**	**54**	**55**	**56**	**57**
C. similis		1	5	7	7	4	2
C. jamaicensis	1	5	5	19	9		
B	**22**	**23**	**24**	**25**	**26**	**27**	**28**
C. similis			1	7	21	7	1
C. jamaicensis	1	13	22	15	5		
C	**15**	**16**	**17**	**18**	**19**		
C. similis			4	23	5		
C. jamaicensis	2	6	41	13			
D	**8**	**9**	**10**				
C. similis	2	25	6				
C. jamaicensis	1	23	5				
E	**11**	**12**	**13**	**14**	**15**	**16**	**17**
C. similis	4	6	3	8			
C. jamaicensis			4	5	13	6	1
F	**7**	**8**	**9**	**10**	**11**	**12**	**13**
C. similis			3	5	4	1	3
C. jamaicensis	4	5	5	5	6	3	1

Table 3. Measurements of *Cynoscion similis* (A. holotype, B. paratypes) and *Cynoscion jamaicensis* expressed as percentages of standard length. Morphometric characters suitable to discriminate the two species are indicated in bold. All measures in mm.

Morphometric	*Cynoscion similis*					*Cynoscion jamaicensis*		
character	A	B	N	Mean	Range	N	Mean	Range
Standard length	284	346 - 482	22		213 - 309	29		142 - 285
Head length	32.4	29.5 - 32.6	21	31.9	30.1 - 34.0	29	31.7	27.2 - 35.5
Head depth			22	24.7	23.0 - 26.2	29	24.4	22.9 - 27.6
Pos-orbital length	19.0	18.2 - 19.8	22	18.7	17.8 - 19.7	29	16.9	15.5 - 18.9
Orbital diameter			22	7.0	6.4 - 7.5	29	8.6	7.7 - 9.3
Interorbital distance	6.4	5.8 - 6.3	22	6.5	5.6 - 7.5	29	7.2	6.6 - 8.2
Snout length	8.3	7.5 - 8.4	21	8.1	7.6 - 8.5	29	8.6	7.8 - 9.1
Mouth width			22	10.7	9.2 - 12.3	28	8.3	7.0 - 9.2
Maxillary length	6.7	4.2 - 4.9	21	4.5	3.7 - 5.0	29	4.8	4.2 - 5.5
Maxillary height	14.4	13.0 - 13.8	22	14.3	13.6 - 14.7	28	14.6	14.0 - 15.5
Body depth	24.1	23.4 - 26.7	22	26.3	24.9 - 27.5	28	24.3	22.9 - 26.0
Body width			22	16.0	13.6 - 17.5	29	14.9	12.0 - 17.4
Distance from snout to dorsal fin	34.8	32.9 - 35.1	22	34.6	33.9 - 35.9	27	36.1	34.8 - 37.8
Dorsal-fin length	15.5	13.0 - 14.9	22	13.3	12.2 - 15.0	29	14.8	11.8 - 17.5
Dorsal-fin base length	53.7	51.2 - 55.3	22	54.0	51.6 - 57.1	27	52.1	48.9 - 54.3
Distance from snout to pectoral fin			21	29.9	29.1 - 31.2	29	30.8	25.9 - 31.7
Pectoral fin length	20.1	18.8 - 20.8	22	17.9	15.8 - 19.6	17	16.5	11.4 - 20.6

Table 3. Continued.

Morphometric character	*Cynoscion similis* A	B	N	Mean	Range	*Cynoscion jamaicensis* N	Mean	Range
Distance from snout to pelvic fin	33.3	32.0 - 34.5	22	30.7	29.2 - 32.2	29	32.1	30.0 - 34.3
Pelvic fin length	16.5	15.3 - 17.6	22	14.4	13.0 - 16.2	29	15.2	11.0 - 19.4
Distance from snout to anal fin	75.8	71.3 - 76.7	16	74.2	71.6 - 76.7	26	76.4	73.7 - 79.6
Anal-fin length	12.5	11.2 - 12.0	21	11.0	9.5 - 12.8	28	11.2	8.9 - 13.8
Anal-fin base length	8.9	7.9 - 10.2	22	8.8	7.7 - 10.2	29	9.0	8.1 - 11.4
Caudal-peduncle height	8.8	7.4 - 8.1	22	8.4	7.8 - 8.9	28	9.8	8.9 - 10.5
Caudal-peduncle length	18.0	17.6 - 19.5	22	18.1	16.5 - 20.5	29	16.6	14.2 - 19.5

Morphological diagnosis

Cynoscion similis is distinguished from its western Atlantic congeners as follows: from *C. acoupa*, by having 24 - 29 soft dorsal rays (*vs*. 17 - 23), pelvic fin much shorter than pectoral fin (*vs*. pelvic fin nearly as long as pectorals), rear tail margin straight to slightly concave (*vs*. rhomboidal), pectoral, anal, and caudal fins black (*vs*. yellowish orange), and dense black coloration of inner margin of operculum (*vs*. dusky); from *C. arenarius*, by having anal and caudal fins black (*vs*. yellowish), and interior of operculum black (*vs*. dusky), anal soft rays 8 - 10 (*vs*. 10 - 12, usually 11); from *C. guatucupa*, by having 24 - 29 soft dorsal rays (*vs*. 18 - 21), and absence of marked dark stripes or spots on flanks (*vs*. flanks with marked dark stripes or spots); gill rakers 11 - 14 (*vs*. 21 - 16); from *C. leiarchus*, by having 24 - 29 soft dorsal rays (*vs*. 20 - 24), less than 100 transversal rows of scales on trunk (*vs*. more than 100 rows), presence of ctenoid scales on trunk (*vs*. cycloid scales), pelvic fin much shorter than pectoral fin (*vs*. pelvic fin larger than pectoral fin), anal fin black (*vs*. yellowish), and dense black coloration in inner operculum margin (*vs*. dusky); from *C. microlepidotus*, by having less than 100 transversal rows of scales on trunk (*vs*. more than 100 rows), presence of ctenoid scales on trunk (*vs*. cycloid scales), pelvic fin much shorter than pectoral fin (*vs*. pelvic fin larger than pectoral fin), rear tail margin truncated (*vs*. rhomboidal), and pectoral, anal and caudal fins black (*vs*. yellowish), scales on lateral line 52 - 57 (*vs*. 65 - 72); from *C. nebulosus*, by pelvic fin much shorter than pectoral fin (*vs*. pelvic fin longer than pectoral fin), and body with no marked round black spots near dorsal fin margin (*vs*. numerous round black spots scattered irregularly on upper half of body); from *C. nothus*, by having pectoral, anal and caudal fins black (*vs*. yellowish); from *C. regalis*, by back with oblique dotted lines along scale rows (*vs*. back with small dark spots forming undulating oblique dotted or reticulated lines), and anal fin black (*vs*. yellowish or pale), gill rakers 11 - 14 (*vs*. 14 - 17), anal soft rays 8 - 10 (*vs*. 10 - 13, usually 12); from *C. virescens*, by presence of ctenoid scales on trunk (*vs*. cycloid scales), less than 100 transversal rows of scales on trunk (*vs*. more than 100 rows), pectoral and anal fins black (*vs*. yellowish to orangish), and rear margin of tail straight to slightly concave (*vs*. pointed in juvenile, with asymmetric blunt point in adult), dorsal soft rays 24 - 29 (*vs*. 27 - 31); *C. steindachneri*, by truncated caudal fin (*vs*. rhomboidal caudal fin), dorsal soft rays 24 - 29 (*vs*. 21 - 24), anal soft rays 8 - 10 (*vs*. 10 - 12).

Cynoscion similis is most similar to *C. jamaicensis*, but both species were clearly distinguished in the Principal Component Analysis (PCA) in relation to the most prominent character traits (Figure 3). The two principal axes of the PCA together explained 85.6% of the variation in the morphometric characters. The first axis was related positively to Od, SDd, CPh, IOd, SPd, SL, Mh, and negatively to Mw and POl (Figure 3). The second axis was related positively to SPd, Pol, Mh, IOd, Sl and negatively to Mw, CPh, SDh, Od (Figure 3). Otherwise *Cynoscion similis* can be differentiated by having black pectoral and anal fins (*vs*. yellowish); soft dorsal fin barely covered with 1 - 2 series of scales (*vs*. dorsal fin covered with scales along more than half its length); pectoral fin usually with 18 rays (*vs*. usually 16 -17 rays in pectoral fin); rear maxillary border slender, rounded, reaching vertical that pass over posterior eye border (*vs*. truncate, not reaching vertical through rear eye border); mouth width 9.2 - 12.3% of SL (*vs*. 7.0 - 9.2% of SL); and caudal peduncle depth 7.8 - 8.9% of SL (*vs*. 8.9 - 10.5% of SL).

Molecular diagnosis

The DNA barcoding showed that *Cynoscion similis* formed a distinct cluster (Figure 4) with genetic distances (K2P) from the remaining western Atlantic species, ranginng from 8.1% (*C. jamaicensis*) to 15.6% (*C. guatucupa*) (Table 4). *Cynoscion similis* haplotypes differed from those of its congeners by 49 (*C. jamaicensis*) to 102 bases (*C. guatucupa*) (Supplementary Material, Appendix S1).

Description

Dorsal fin rays X+I.24 –28; anal fin rays II.8–10; pectoral fin rays 17–19; lateral line scales 52–57; scales above lateral line 7–8, below lateral line 11–13; transverse rows of scales from base of pectoral fin to caudal peduncle 68–79; developed gill rakers 2–3+8 –11, 11–14 in 1st arch, 9–13 in 2nd arch.

Snout pointed, nearly equal to eye length; dorsal profile convex from upper jaw to dorsal fin origin; slightly concave on dorsal margin, immediately anterior to eye. A pair of small, slender pores on the lower jaw separated by symphysis, pores otherwise not visible even under stereomicroscope. Mouth large, terminal, cleft angle when closed 45°; lower jaw prognathous; maxillary reaching vertical at posterior margin of eye. Lower jaw heavy; mental process prominent. Lips slender.

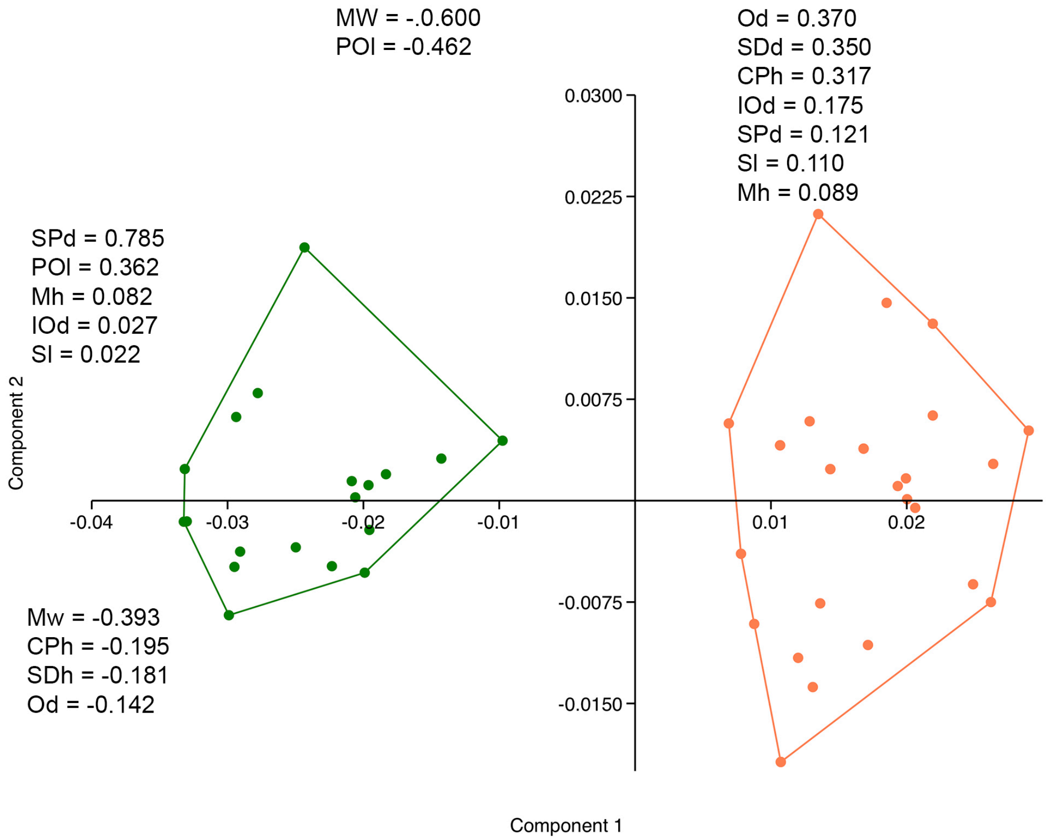

Figure 3. Principal components analysis loadings (PC1 and PC2) for nine morphometric variables of *Cynoscion similis* (green) and *Cynoscion jamaicensis* (orange), with factor loadings for the first and second principal components. Abbreviations: Kph = Caudal - peduncle height; IOd = Interorbital distance; Mh = Maxillary height; Mw = Mouth width; Od = Orbital diameter; POI = Post - orbital length; SDd = Distance from snout to dorsal fin; SPd = Distance from the tip of the snout to the pectoral fin; SI = Snout length. This figure is in color in the electronic version.

Table 4. K2P genetic pairwise distance (mean ± standard error) between *Cynoscion* species. Values in bold on the diagonal are the intraspecific distances.

		1	2	3	4	5	6
1	*C. acoupa*	**0.003±0.002**					
2	*C. arenarius*	0.087±0.011	**0.002±0.001**				
3	*C. guatucupa*	0.147±0.015	0.147±0.013	**0.008±0.002**			
4	*C. jamaicensis*	0.091±0.012	0.095±0.012	0.155±0.015	**0.001±0.000**		
5	*C. leiarchus*	0.147±0.014	0.159±0.015	0.158±0.015	0.128±0.014	**0.003±0.001**	
6	*C. microlepidotus*	0.157±0.015	0.163±0.016	0.169±0.016	0.126±0.014	0.145±0.015	**0.000±0.000**
7	*C. nebulosus*	0.109±0.013	0.103±0.013	0.150±0.015	0.105±0.013	0.147±0.015	0.160±0.017
8	*C. nothus*	0.092±0.012	0.091±0.011	0.155±0.014	0.094±0.012	0.139±0.014	0.152±0.016
9	*C. regalis*	0.098±0.012	0.060±0.010	0.149±0.014	0.107±0.013	0.154±0.015	0.170±0.015
10	*C. similis*	0.104±0.012	0.104±0.012	0.156±0.015	0.081±0.011	0.154±0.015	0.147±0.015
11	*C. virescens*	0.133±0.016	0.139±0.016	0.157±0.017	0.120±0.015	0.146±0.016	0.160±0.018

		7	8	9	10	11
1	*C. acoupa*					
2	*C. arenarius*					
3	*C. guatucupa*					
4	*C. jamaicensis*					
5	*C. leiarchus*					
6	*C. microlepidotus*					
7	*C. nebulosus*	**0.003±0.002**				
8	*C. nothus*	0.097±0.012	**0.003±0.002**			
9	*C. regalis*	0.108±0.013	0.096±0.011	0.000±0.000		
10	*C. similis*	0.112±0.013	0.094±0.012	0.099±0.012	**0.001±0.001**	
11	*C. virescens*	0.148±0.017	0.138±0.016	0.134±0.016	0.111±0.015	**0.005±0.002**

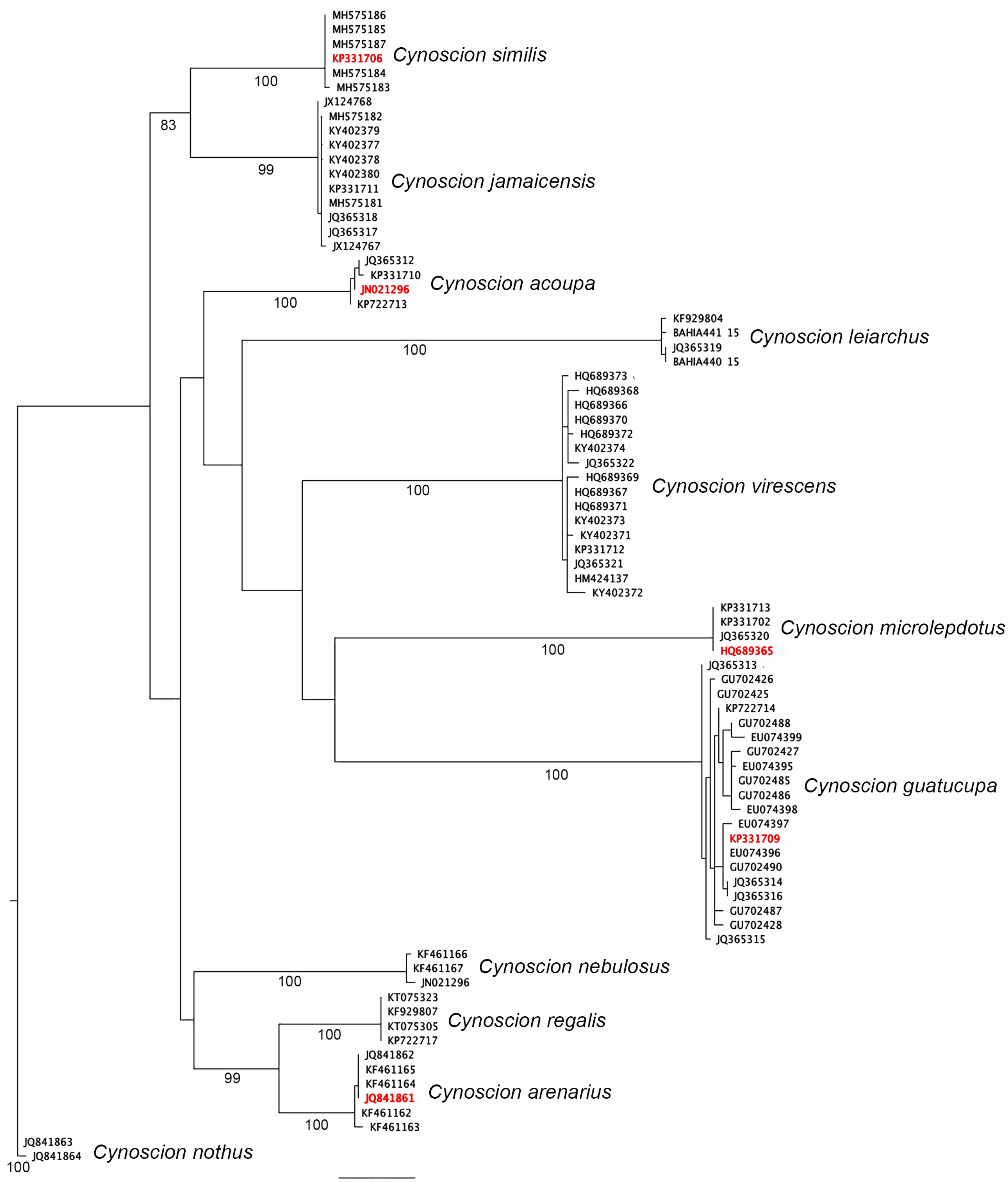

Figure 4. Maximum likelihood tree of the species of *Cynoscion* based on partial sequences of the cytochrome oxidase c subunit I. The numbers at the nodes correspond to the results of the bootstrap analysis. Discrepancies of species identification in GenBank are indicated in red (see Table 1).

Upper jaw with two series of caniniform teeth (on inner row largest); 2 stout fangs nearby tip of upper jaw about half size of pupil; lower jaw with two rows of caniniform teeth, one series posteriorly with 5–8 larger teeth about size of posterior nostril. Eye large, diameter slightly greater than interorbital width. Anterior and posterior nostrils separated, anterior one small, oval, second about 2 times larger, elongate or teardrop-shaped, almost half size of pupil. Distance between nares slightly smaller than first nostril. Gill rakers stout, without spines, longest one about half eye size. Scales on head and body. Head with cycloid scales on interorbital region (posterior to that in smaller specimens to 173 mm SL), nape, chin (about 10 vertical rows), opercle (about 15 vertical rows), posterior part of infraorbital region (naked in smaller specimens), ctenoid on belly, abdomen and flanks. Scales absent on dorsal and anal fins except for basal 2 or 3 rows. Pectoral fins much longer than pelvic fins, reaching pelvic fin tips, but not vent. First anal fin spine, second one shorter than longer anal fin rays. Caudal fin tip concave.

Gas bladder long, carrot-shaped, similar to that of *C. jamaicensis* (Figure 2a), but less slender, with a pair of lateral hornlike stout appendages on the anterior border of bladder. Sagitta more slender than in *C. jamaicensis* (Figure 2b), profile of the upper margin slightly convex, with a small fingerlike projection; lower margin convex with a tiny medial bump, anterior border convex, blunt, or with evident anterodorsal concavity.

Color in life

Fresh specimens are silvery with slender dark brown lines along scale rows on the flanks and upper half (Figure 1a). Snout and lower jaw tip dark, mouth aperture pale with dusky margin near lower jaw. Upper half of pectoral fin with dense black, black spot over pectoral fin, caudal fin rays black, fins otherwise dusky, more so in the first spine of the pelvic fin. Inner operculum margin black, with pale rear border.

Distribution

Cynoscion similis is endemic from the Orinoco-Amazon Plume, with records from Trinidad and Tobago (ROM 61788, CAS 56814), Venezuela (USNM 201382, USNM 233071), French Guiana (UF 204299, USNM 325179), Suriname (UF 212502, USNM 184911), and the Brazilian north coast in the states of Amapá (CAS 48885, USNM 307229, USNM 325182, USNM 325184, and material examined in the present study) and Pará (material examined in the present study) (Figure 5).

Biology

There is a wealth of studies on the biology of the other *Cynoscion* species of the Atlantic Ocean (Santos and Vianna 2017), but no information is available specifically for *C. similis.*

Habits

Randall and Cervigón (1968) described *C. similis* based on specimens collected at depths of 10 to 30 fathoms (18-54 m), but the specimens we examined were collected in deeper waters (40-70 m), over sandy or muddy bottoms.

Remarks

Randall and Cervigón (1968) described 2-3+7-8 rakers (9-11) on the first gill arch of *Cynoscion similis*. Our specimens had a larger number of gill rakers (11-14), but there is compelling

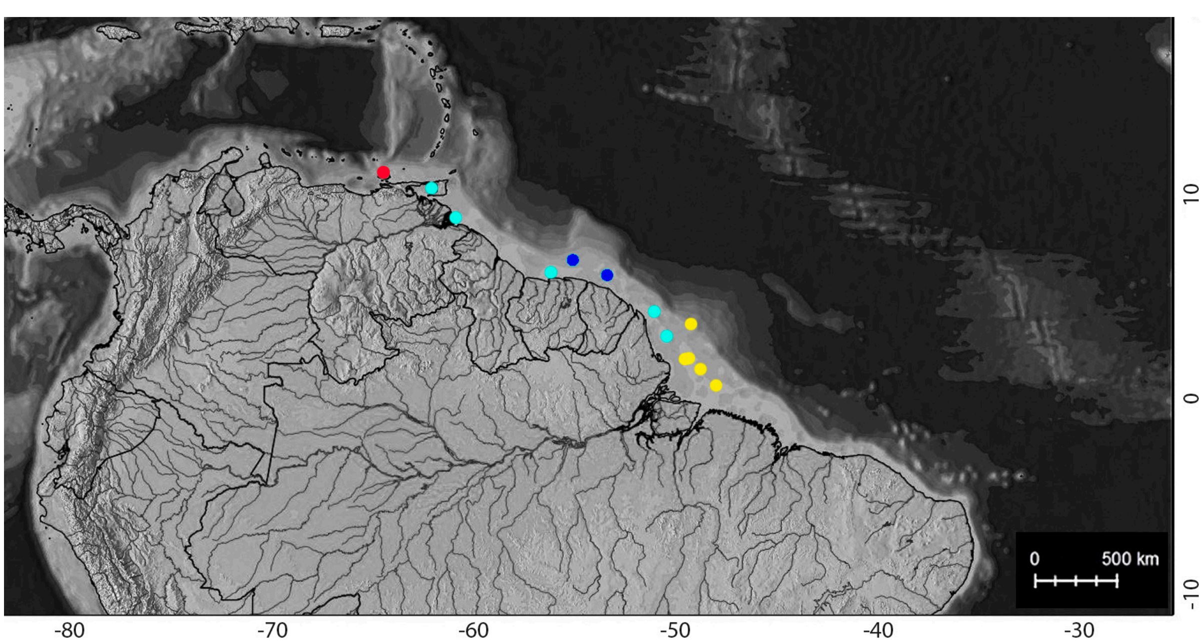

Figure 5. Map of the Atlantic coast of northern South America, showing the geographic distribution of *Cynoscion similis* records. Red: holotype; dark blue: paratypes; light blue: previous records in zoological collections; yellow: new records of the species from the northern Brazilian coast. This figure is in color in the electronic version.

evidence from the other morphological parameters, as well as the DNA barcode, that this difference is derived from individual variation, or different ways to count gill rakers.

DISCUSSION

While *C. similis* had not previously been recorded from the northern Brazilian state of Pará, our examination of material obtained from CEPNOR indicated that the fish identified by Maia *et al*. (2016) as pescada-negra is, in fact, *Cynoscion similis*, given that this species is the only Atlantic sciaenid that presents dark pigmentation. In the same way, quite possibly the species went undetected in other inventory studies of local industrial fisheries, recorded as *Cynoscion* sp. (Pinheiro and Frédou 2004; Paiva *et al*. 2009).

Whereas Randall and Cervigón (1968) reported that *C. similis* and *C. jamaicensis* typically occurred in the same area, this was not so common on the northern Brazilian coast. *Cynoscion similis* showed to be common on the Brazilian continental shelf (at depths of 40-80 m), targeted by industrial trawling fisheries in Pará, while *C. jamaicensis* is more common in the coastal zone, at depths of less than 40 m, where it is typically exploited by artisanal gillnet fisheries. Quite possibly *Cynoscion similis* is harvested in Brazil and marketed as goete or pescada gó, the local name for *C. jamaicensis*. This reinforces the need for reliable taxonomical identification of species, in order to guarantee the collection of accurate data on their ecology and fisheries, and ultimately, support the development of effective conservation strategies.

CONCLUSIONS

Despite its importance in biogeographical, ecological, and commercial terms, the fish fauna of the northern Brazilian coast is still poorly known, and this region is the least well sampled of the Brazilian Exclusive Economic Zone (Marceniuk *et al*. 2013). Our results indicate that *C. similis* is common throughout the northern coast of Brazil. The study also provides new morphological and molecular data to distinguish *C. similis* more reliably from the closely allied *C. jamaicensis*.

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SUPPLEMENTARY MATERIAL

(only available in the electronic version)

CAIRES *et al*. The Tonkin weakfish, *Cynoscion similis* (Sciaenidae, Perciformes), an endemic species of the Amazonas-Orinoco Plume

Appendix S1. Nucleotide differences observed in COI sequences among the samples analyzed. Numbers represent relative position in relation to the COI sequence of *Cynoscion nebulosus* (Genbank number JN021296).

JN021296	9	10	12	15	18	24	30	33	36	45	45	48	54	57	60	63	66	69	70	72
Cynoscion acoupa	A	G	T	T	T	A	A	G	T	T	A	C	A	C	A	G	A	C	A	T
Cynoscion arenarius	.	.	.	C	.	G	.	A	.	.	.	T	.	.	.	A	.	.	.	.
Cynoscion guatucupa	.	A	.	.	.	G	.	.	.	.	.	T	.	.	.	A	G	T	.	.
Cynoscion jamaicensis	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	A	.	.	.	C
Cynoscion leiarchus	.	.	.	.	.	.	.	A	C	C	G	.	G	T	.	A	.	.	.	.
Cynoscion microlepidotus	.	.	.	.	.	.	.	.	.	.	G	T	G	T	.	A	.	.	C	.
Cynoscion nebulosus	.	A	C	.	G	.	.	A	.	.	.	T	G	.	.	A	.	.	.	C
Cynoscion nothus	.	.	.	C	.	.	G	A	.	.	.	T	.	.	.	A	.	.	.	.
Cynoscion regalis	G	A	.	C	.	G	.	A	.	.	.	.	.	.	.	A	.	.	.	.
Cynoscion similis	.	.	.	C	.	G	G	A	.	.	.	T	.	.	T	A	.	.	.	C
Cynoscion virescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JN021296	75	78	81	84	85	87	93	96	99	102	105	106	108	111	114	117	120	126	129	132
Cynoscion acoupa	A	A	T	G	A	T	A	T	C	A	G	C	T	C	T	T	T	A	A	C
Cynoscion arenarius	.	.	C	.	C	.	.	.	.	G	.	.	.	.	A	.	C	G	G	.
Cynoscion guatucupa	G	C	C	.	G	.	.	.	.	G	.	.	.	.	A	.	.	.	C	.
Cynoscion jamaicensis	.	.	C	.	.	.	.	.	.	.	.	.	.	.	A	.	.	.	.	.
Cynoscion leiarchus	.	.	C	.	.	.	.	.	T	G	.	.	.	.	A	C	.	.	.	.
Cynoscion microlepidotus	.	.	C	.	.	C	.	C	.	G	.	T	.	.	A	C	.	.	.	.
Cynoscion nebulosus	.	.	C	.	.	.	.	.	.	.	A	.	.	.	A	.	.	.	.	T
Cynoscion nothus	.	.	C	.	.	.	.	.	.	G	.	.	.	.	A	.	.	.	.	.
Cynoscion regalis	.	.	C	.	C	.	.	.	.	G	.	.	.	.	A	.	.	G	G	.
Cynoscion similis	.	.	C	.	.	.	.	.	.	.	.	.	.	.	A	.	.	.	.	.
Cynoscion virescens	-	-	C	.	.	.	.	.	T	G	.	.	C	T	A	.	.	G	.	.

Appendix S1. Continued.

JN021296	138	144	162	165	171	174	177	180	183	186	196	196	198	201	202	210	213	216	219	225
Cynoscion acoupa	C	A	A	C	A	T	A	G	C	G	A	G	G	A	C	T	A	C	C	A
Cynoscion arenarius	.	.	G	.	G	.	.	.	T	.	T	.	A	.	.	C	G	.	T	.
Cynoscion guatucupa	.	G	G	.	.	.	.	.	.	A	.	A	C	.	.	.	.	.	.	.
Cynoscion jamaicensis	.	.	G	.	.	C	.	.	.	.	T	A	C	C	.	C	G	.	.	G
Cynoscion leiarchus	.	.	G	.	.	.	.	.	T	A	C	A	C	C	.	.	.	.	.	G
Cynoscion microlepidotus	T	.	G	.	G	C	.	.	T	A	T	A	C	G	.	C	.	.	.	G
Cynoscion nebulosus	.	.	.	.	G	.	.	.	.	A	T	A	T	.	.	C	G	.	T	.
Cynoscion nothus	T	.	.	.	.	.	.	.	.	A	T	.	A	.	T	.	.	.	.	.
Cynoscion regalis	.	.	G	.	.	.	G	T	T	A	T	.	.	.	.	.	G	.	T	.
Cynoscion similis	T	.	.	.	G	C	.	.	.	A	T	.	A	.	.	.	.	.	.	G
Cynoscion virescens	.	.	G	T	.	.	.	.	.	.	T	.	A	.	.	.	G	T	.	G
JN021296	231	234	237	240	243	246	249	252	255	258	261	262	264	267	270	273	276	279	280	282
Cynoscion acoupa	C	T	A	G	T	T	G	C	C	A	T	C	A	C	T	T	C	C	C	T
Cynoscion arenarius	.	.	.	A	.	.	.	.	.	.	.	.	C	.	.	.	.	.	.	A
Cynoscion guatucupa	.	C	.	A	C	C	.	.	T	G	C	T	G	.	.	.	.	.	T	G
Cynoscion jamaicensis	.	.	.	.	.	.	.	.	.	.	.	.	C	.	.	.	.	T	.	G
Cynoscion leiarchus	.	.	C	.	C	C	.	T	.	.	.	.	C	A	C	.	.	T	.	G
Cynoscion microlepidotus	.	C	.	A	.	.	.	.	.	.	.	.	.	A	C	C	.	.	.	A
Cynoscion nebulosus	.	C	C	.	C	.	.	.	.	.	C	.	T	.	.	C	.	.	.	A
Cynoscion nothus	T	.	.	.	C	.	A	.	.	.	.	.	T	.	C	C	.	.	.	.
Cynoscion regalis	.	.	.	A	.	.	.	.	.	G	.	.	C	.	.	.	.	.	.	A
Cynoscion similis	.	.	.	A	.	.	.	.	.	.	.	.	C	T	.	.	T	.	.	A
Cynoscion virescens	.	.	.	A	C	.	.	.	.	.	G	.	T	.	C	.	.	.	.	G
JN021296	285	286	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339
Cynoscion acoupa	C	C	A	C	T	A	G	A	A	A	A	C	G	A	A	G	A	C	T	C
Cynoscion arenarius	.	.	.	.	.	.	.	.	G	.	G	.	.	.	.	A	.	.	C	.
Cynoscion guatucupa	T	.	.	.	.	.	.	.	.	G	.	.	A	C	C	A	.	G	.	.
Cynoscion jamaicensis	.	.	.	.	.	.	.	.	.	.	G	.	A	.	C	A	.	.	C	.
Cynoscion leiarchus	T	.	.	.	.	.	.	T	.	G	G	.	A	.	G	A	.	T	C	.
Cynoscion microlepidotus	.	T	.	.	A	.	.	.	.	.	G	.	A	G	C	A	.	T	.	.
Cynoscion nebulosus	.	.	.	.	.	.	A	.	G	.	G	.	.	.	G	A	.	T	C	.
Cynoscion nothus	.	.	.	.	.	.	A	.	G	.	G	.	.	.	C	A	.	.	C	.
Cynoscion regalis	.	.	.	T	.	.	.	.	G	G	.	.	.	G	G	.	.	.	C	.
Cynoscion similis	.	.	G	.	.	.	C	.	G	G	.	.	.	.	C	A	.	T	C	.
Cynoscion virescens	.	.	T	.	.	.	A	.	G	G	.	T	A	.	.	.	.	G	C	.
JN021296	342	345	348	351	354	357	360	363	366	369	372	375	378	381	382	384	387	390	393	397
Cynoscion acoupa	A	C	A	T	C	C	A	C	A	A	C	C	C	T	T	A	C	C	C	C
Cynoscion arenarius	.	.	G	G	.	G	.	.	.	G	.	.	.	.	.	.	.	T	.	T
Cynoscion guatucupa	T	.	T	C	.	.	.	T	G	C	.	T	.	C	C	G	.	.	T	.
Cynoscion jamaicensis	.	.	G	C	.	T	C	.	.	G	.	.	.	C	.	.	.	.	.	.
Cynoscion leiarchus	.	T	.	A	.	T	.	.	.	G	T	.	.	C	C	.	.	.	.	.
Cynoscion microlepidotus	.	T	G	C	T	A	.	T	.	G	T	.	.	C	.	.	.	.	.	.
Cynoscion nebulosus	.	.	.	C	.	T	.	.	.	.	T	T	T	C	C	.	.	.	.	.
Cynoscion nothus	G	T	.	C	.	.	C	.	.	G	.	.	T	C	.	.	T	.	.	.
Cynoscion regalis	.	.	G	G	.	G	.	.	.	G	.	.	.	C	.	G	.	.	.	.
Cynoscion similis	G	.	G	C	.	T	C	.	.	G	.	.	.	C	.	G	.	.	.	.
Cynoscion virescens	G	T	G	.	.	T	.	T	.	G	T	.	.	C	.	G	.	.	T	.
JN021296	399	402	405	408	414	417	420	423	424	426	429	432	435	441	444	447	450	454	456	459
Cynoscion acoupa	C	C	T	A	C	A	A	T	C	A	G	T	T	T	T	A	A	C	T	C
Cynoscion arenarius	A	.	C	.	.	.	.	.	T	.	.	C	.	.	.	.	.	T	.	.
Cynoscion guatucupa	T	.	C	.	.	.	.	.	T	.	.	C	C	.	.	C	C	T	.	.
Cynoscion jamaicensis	.	.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	T	.	T
Cynoscion leiarchus	T	T	.	T	T	.	.	C	.	T	.	.	C	.	.	.	.	T	.	T
Cynoscion microlepidotus	G	T	C	.	G	C	G	.	.	.	.	.	C	C	.	.	C	T	.	T
Cynoscion nebulosus	.	.	C	.	.	.	.	.	T	.	.	.	.	.	.	.	.	T	.	T
Cynoscion nothus	A	.	C	.	.	.	.	.	.	.	.	C	.	.	.	.	.	T	.	T
Cynoscion regalis	A	.	C	.	.	.	G	.	.	G	.	C	.	.	.	.	.	T	.	.
Cynoscion similis	.	.	.	.	.	.	T	.	.	.	.	C	.	.	C	.	.	T	.	T
Cynoscion virescens	.	.	.	.	T	.	.	.	.	.	.	.	.	.	.	.	C	T	.	T

Appendix S1. Continued.

JN021296	462	465	468	471	474	477	480	483	486	489	492	495	496	498	504	507	510	513	514	525
Cynoscion acoupa	G	A	T	T	T	T	C	G	T	G	T	C	T	A	A	A	C	T	C	T
Cynoscion arenarius	.	.	C	.	.	.	T	A	.	A	A	.	.	.	G	.	G	.	.	.
Cynoscion guatucupa	.	.	C	.	C	C	T	.	.	A	G	T	C	G	G	.	.	.	T	C
Cynoscion jamaicensis	.	.	C	.	.	C	.	.	.	.	A	.	.	.	.	G	T	C	.	.
Cynoscion leiarchus	A	.	.	G	.	.	.	.	C	A	A	T	.	.	T	G	.	.	.	C
Cynoscion microlepidotus	.	.	.	C	.	C	.	.	.	.	A	T	C	G	.	G	.	C	.	.
Cynoscion nebulosus	A	.	C	.	.	.	.	A	.	.	A	.	C	C	.	.	.	.	.	C
Cynoscion nothus	.	.	C	.	.	.	.	A	.	A	G	.	.	.	.	G	T	.	.	.
Cynoscion regalis	A	.	C	.	.	.	.	A	.	.	A	.	.	.	G	G	A	.	.	.
Cynoscion similis	.	.	.	C	.	C	.	.	.	.	A	.	C	.	G	G	.	C	T	C
Cynoscion virescens	.	G	C	C	.	C	.	.	.	.	A	T	C	.	G	.	.	C	.	C

JN021296	528	531	532	534	537	540	543	546	549	552	553	555	558	564	567	570	573	576	577	579
Cynoscion acoupa	T	C	C	G	A	C	C	C	T	C	T	A	T	C	C	A	G	T	C	T
Cynoscion arenarius	.	.	.	.	.	.	G	.	.	.	.	.	.	.	T	T	.	.	.	A
Cynoscion guatucupa	C	T	.	A	.	T	A	T	.	.	.	G	C	.	T	.	.	.	.	A
Cynoscion jamaicensis	C	.	.	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cynoscion leiarchus	C	G	.	A	.	T	A	G	.	T	.	.	.	.	T	.	.	.	.	C
Cynoscion microlepidotus	C	.	T	A	G	.	G	.	.	.	.	.	.	T	T	.	A	C	.	.
Cynoscion nebulosus	.	.	.	.	T	.	A	.	C	A	.	.	.	.	T	.	.	.	.	A
Cynoscion nothus	.	.	.	A	.	.	A	.	C	.	.	.	.	.	T	.	.	.	.	G
Cynoscion regalis	.	.	.	.	.	.	A	.	C	.	.	.	.	.	T	.	A	.	.	A
Cynoscion similis	.	.	.	.	.	.	A	T	C	.	.	.	.	.	.	.	.	.	.	A
Cynoscion virescens	.	.	.	A	.	G	G	-	-	-	-	-	-	-	-	-	-	-	-	-

JN021296	582	585	588	591	592	594	597	600	6044	609	615	618	621	622	625	630	633	639	642	645
Cynoscion acoupa	A	C	C	T	C	G	T	A	C	C	A	A	A	A	A	C	T	T	T	A
Cynoscion arenarius	.	.	.	.	T	A	.	.	.	.	G	.	G	.	.	.	.	.	.	.
Cynoscion guatucupa	.	.	.	C	.	A	.	.	.	.	.	.	.	G	T	T	A	.	.	.
Cynoscion jamaicensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cynoscion leiarchus	C	T	G	C	.	A	.	.	.	T	T	.	.	T	G	T	.	.	.	.
Cynoscion microlepidotus	.	.	.	C	.	C	C	.	.	.	C	.	.	G	G	.	A	C	.	.
Cynoscion nebulosus	.	.	.	.	T	A	.	.	T	.	G	.	.	.	G	T	.	.	C	.
Cynoscion nothus	.	.	.	C	.	A	.	.	.	T	.	.	G	.	G	.	C	.	C	.
Cynoscion regalis	.	.	.	.	T	A	.	.	.	.	.	.	G	.	G	T	.	.	C	.
Cynoscion similis	.	.	.	.	.	T	.	.	.	T	G	.	G	.	.	T	.	.	C	.
Cynoscion virescens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-