

Distocyclus guchereauae a new species of Neotropical electric fish, (Gymnotiformes: Sternopygidae), from French Guiana

by

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Abstract. – Several specimens of a new knife-fish, *Distocyclus guchereauae*, belonging to Sternopygidae (Gymnotiformes), were caught in two tributaries (Litany and Tampoc) of Maroni river (French Guiana). This species differs from the other *Distocyclus* by having 13-14 *versus* 11-15 precaudal vertebrae, a small number of anal fin rays (184-187 *versus* 160-260), a triangular head with a short snout and a terminal mouth, and the anus located straight below the eyes.

Résumé. – *Distocyclus guchereauae* une nouvelle espèce d'anguille électrique de Guyane française (Gymnotiformes : Sternopygidae).

Plusieurs spécimens d'une nouvelle espèce de Sternopygidae, *Distocyclus guchereauae* (Gymnotiformes), ont été capturés dans deux affluents du Haut-Maroni, le Litany et le Tampoc (Guyane française). Cette espèce diffère des autres espèces du genre *Distocyclus*, par 13-14 vertèbres précaudales *versus* 11-15, 184-187 rayons à la nageoire anale *versus* 160-260, par une tête triangulaire avec un court museau, une bouche terminale et l'anus situé à l'aplomb des yeux.

Key words

Gymnotiformes
Sternopygidae
Distocyclus guchereauae
French Guiana
New species

Since the publication of the “Check list of the Freshwater Fishes of South and Central America” ten years ago (Reis *et al.*, 2003), the number of species belonging to

the five Gymnotiform families has grown regularly. Intensive inventories in the Amazonian Basin *sensu lato*, allied to revision studies owed to accurate morphological, meristic and/or genetical studies, and produced specialised reviews, specially geographical up to date checklists like those of the Guiana shield (Planquette *et al.*, 1996; Vari *et al.*, 2009; Le Bail *et al.*, 2012; Mol *et al.*, 2012). Other studies dealt with specific genera or families (Albert 2003b; Albert and Crampton, 2003; Campos-Da-Paz, 2003; Ferraris, 2003; Maxime, 2013).

The Sternopygidae family comprises six genera, *Sternopygus* (Muller & Troschell, 1849), *Eigenmannia* (Jordan & Evermann, 1896), *Rhabdolichops* (Eigenmann & Allen, 1942), *Archolaemus* (Korringa, 1970), *Distocyclus* (Mago-Leccia, 1978), and a newly described genus, *Japigny* (Meunier *et al.*, 2011). This family includes 31 species (Albert, 2003a; Albert and Crampton, 2005; Crampton *et al.*, 2005; Hulén *et al.*, 2005; Correa *et al.*, 2006). The Sternopygidae species are distributed in Neotropical river basins between the Tuira River in Panama south, to the River Plata in Argentina (Mago Leccia, 1978, 1994; Lundberg and Mago Leccia, 1986; Albert and Fink, 1996; Albert 2001, 2003a; Hulén *et*

al., 2005). Species are present in the continental waters of all South American countries except in Chile. The Amazon River basin contains the greatest diversity of Sternopygidae (Albert, 2003a) and five species of Sternopygidae are known in French Guiana: *Sternopygus macrurus* (Bloch & Schneider, 1801), *Eigenmannia virescens* (Valenciennes, 1836), *Archolaemus blax* Korringa 1970, *Rhabdolichops jegui* Keith & Meunier, 2000, *Japigny kirschbaum* Meunier, Jégu & Keith, 2011 (Planquette *et al.*, 1996; Le Bail *et al.*, 2012).

In 2000-2002, field trip expeditions held by MNHN in the upper Maroni Basin permitted to collect six specimens of a new *Distocyclus* species. The aim of this paper is to describe this new species.

MATERIAL AND METHODS

Measurements and counts follow Mago-Leccia (1978) and Meunier *et al.* (2011). Measurements were taken with a dial caliper to the nearest tenth of a millimetre. Measurements are presented as percentage of head length (HL) or length to anal fin (LAF) except for parts of total length (TL). Abbreviations are reported in tables I and II. Counts of fins rays were made with a dissecting microscope with light transmitted through the fins and were confirmed with radiographs. Vertebrae counts were made on radiographs. Bone terminology follows Mago-Leccia (1978) and Albert and

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Fink (1996). Abbreviations for institutions and collections follow Leviton *et al.* (1985).

Distocyclus guchereauae, new species

(Figs 1, 2, 3; Tabs I, II)

Comparative material

Archolaemus blax, French Guiana: MNHN 2013-1199, 1 spm, 198 mm TL, Approuague, Le Bail coll., 3 Apr. 1983.

Distocyclus conirostris, Venezuela: Eight specimens (data from Mago-Leccia, 1978, tables IV, V). USNM 121597, holotype, photograph and X-ray.

Distocyclus goajira. USNM 121596, holotype and USNM 121597, paratype (data from Mago-Leccia F., 1978, tables VI, VII). USNM 121596, holotype, X-ray.

Eigenmannia virescens, French Guiana: MNHN 2006-1785, 8 spms, 93-183 mm TL, Litany river (Maroni), Antecume Pata; Fermon *et al.* coll. 4 Jun. 2001. MNHN 1999-1362, 4 spms, 113-154 mm TL, Saul, Duranton coll., 1983.

Japigny kirschbaum, French Guiana: Holotype, MNHN 2008-1201, 156 mm TL, Mana River, Saut Fracas, Oct. 1994, Keith *et al.* coll. Paratypes: MNHN 1999-1301, 5 spms, 103-176 mm TL, Approuague drainage, Crique Japigny, 17 Nov. 1988, Boujard *et al.* coll.; MNHN 2000-5914, 1 spm, 206 mm TL; Maroni drainage, Litany, Oct. 2000, Jégu *et al.* coll.; MNHN 2000-5911, 2 spms, 159 and 220 mm TL, Maroni drainage, Tampoc at Saut Pierkuru, Oct. 2000, Keith *et al.* coll.; MNHN 2000-5915, 3 spms, 136-174 mm TL, Maroni drainage, Litany, Oct. 2000, Jégu *et al.* coll.; MNHN 2006-1793, 4 spms, 105-136 mm TL, Maroni drainage, Litany, Oct. 2000, Jégu *et al.* coll.; MNHN 1999-1334, 7 spms, 72-160 mm TL, French Guiana, Mana drainage, Saut Fracas, Oct. 1994, Keith *et al.* coll.; MNHN 2000-5954, 2 spms, 99 and 111 mm, Alizarin rot stained specimens, Maroni drainage, Litany, Oct. 2000, Jégu *et al.* coll.

Rhabdolichops jegui, French Guiana: Holotype, MNHN 1999-1024, 215 mm LT, Litany River (Maroni), Antecume Pata, Oct. 1998, Jégu coll. Paratypes: MNHN 1998-1576, 113 mm LT, Litany River (Maroni), Antecume Pata, Oct. 1998, Jégu coll.; MNHN 1999-1025, 198,5 mm LT, Litany River (Maroni), Antecume Pata, Oct. 1998, Jégu coll.; MNHN 1999-1026, 202 mm LT, Litany River (Maroni), Antecume Pata, Oct. 1998, Jégu coll.; MNHN 1998-2010, 277 mm LT, Mana River, Saut Fracas, Sep. 1994, Keith *et al.*, coll.

Material examined

Six specimens from French Guiana.

Holotype. - MNHN: 2000-5927, 271 mm TL, French Guiana, Maroni drainage, Tampoc River, Saut Pierkuru (2°49'N; -53°32'W), Oct. 2000, Jégu *et al.* coll.

Paratypes. - MNHN 2001-2284, 1 spm, 271 mm TL, French Guiana, Maroni drainage, Litany River Saut Aliminen (3°17'N; -54°4'W), 5 Apr. 2001, Fermon *et al.* coll.; MNHN 2003-0014, 1 spm, 232 mm TL, French Guiana, Maroni drainage, Litany, Antecume Pata, 30 Oct. 2002, Fermon *et al.* coll.; MNHN 2003-0018, 2 spms, 322-331 mm TL, French Guiana, Maroni drainage, Litany; 23 Oct. 2000, Fermon *et al.* coll.; MNHN 2003-0013, 1 spm, 222 mm TL; Alizarin rot staining (Taylor and Van Dyke, 1985); French Guiana, Maroni drainage, Litany, Antecume Pata, 24 Oct. 2002, Fermon *et al.* coll.

Diagnosis

In preserved specimens, the new species is characterized by a grey colour with several longitudinal lightly dark lines, the lowest being regularly striped (Fig. 1); 13-14 precaudal vertebrae; 184-187 anal fin rays in the undamaged specimens (see below "regeneration of the caudal skeleton"); a triangular head with a snout short (less than one third of the head length), a terminal mouth and the anus located straight below the eyes.

Description

Morphometrics are presented in tables I and II. The tail of two specimens, MNHN 2001-2284 and MNHN 2003-0013, was cut, so several morphometric and meristic data are lacking.

Anal rays 184 (184-187); pectoral rays ii16 (ii16-19); 13 (13-14) precaudal vertebrae and a total number of 79 (56-84) vertebrae; three or four rib-like bones [*sensu* Lundberg and Mago-Leccia (1986); = loose hemal spines *sensu* De La Hoz and Chardon (1984)] (Fig. 2). In paratypes, the variability of total number of anal fin rays and vertebrae results from regenerative peculiarities of the caudal part after accidental or predatory wound (see below). On undamaged specimens, the caudal appendage is flattened. The body is totally covered with cycloid scales.

Mouth terminal and snout short at the tip of a triangular head. Body and tail compressed; head length 6,6-7,2% (H/T) of length to anal fin; greatest body depth 5% (H/G) of length to anal fin and about 7-8,5% (B/G) of total length; head depth at nape 1,3-1,6% (C/S) and at eyes 1,7-2,1% (C/R) of its length; snout length 2,3-3% (C/K), interocular distance 4,5-6% (C/M) and postorbital distance 1,5-1,7% (C/N) of head length; distance from eye to posterior nare 4,8-7,3% (C/P), internarial distance 8-12,1% (C/O) and distance from tip of snout to posterior nare 4,4-5,6% (C/Q) of head length; eye diameter 6,1-8,7% (C/L) of head length; mouth small, its gape 3,3-6,6% (C/U) of head length; snout short 2,4-3% (C/K) of head length and mouth terminal; anus located straight below the eyes; gill opening 2,4-3,3% (C/V) of head length; origin of anal fin behind pectoral fin base.



Figure 1. - *Distocyclus guchereauae*. Holotype MNHN 2000-5927, 271 mm TL, Maroni, French Guiana; **A**: Photograph (C. Ferrara); **B**: X-ray.

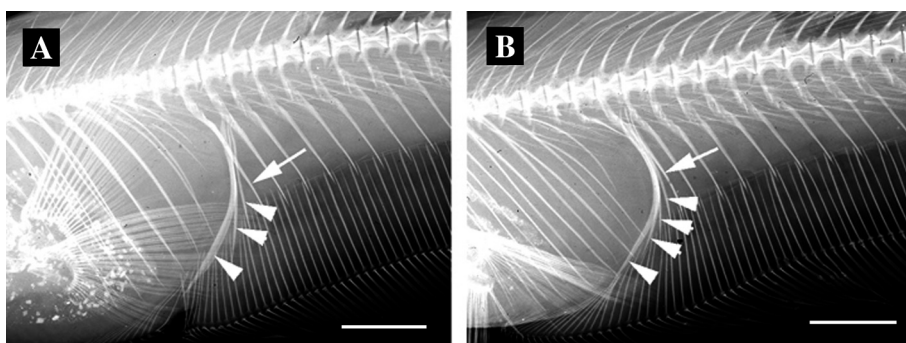


Figure 2. - *Distocyclus guchereauae*. Paratypes X-ray. **A**: MNHN 2003-0014; **B**: MNHN 2003-0013. Detail of the posterior abdominal region showing respectively three and four rib-like bones (arrowheads). The arrow points to the first hemal spine. Scale bars = 10 mm.

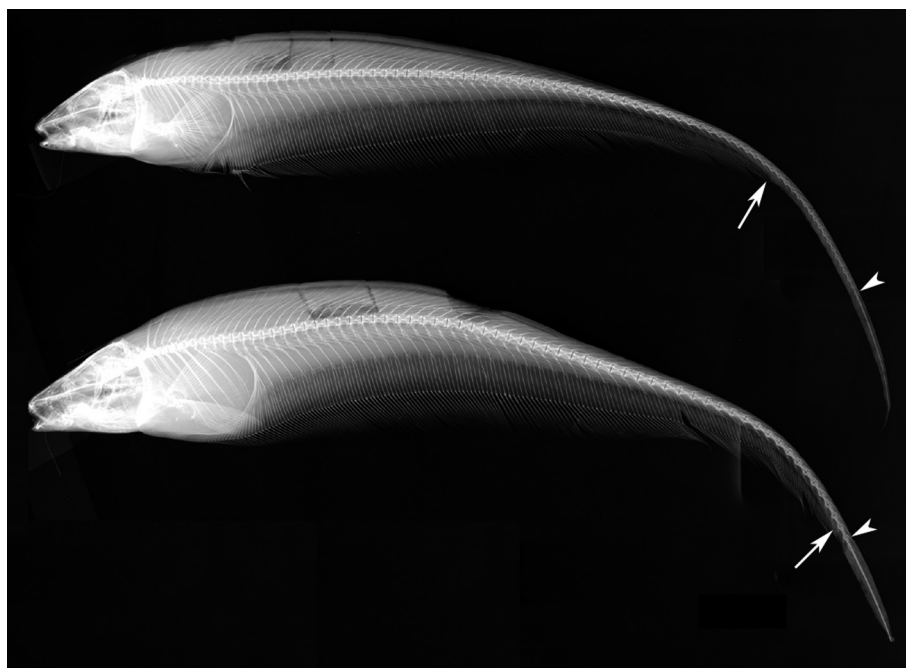


Figure 3. - *Distocyclus guchereauae*. Paratypes X-ray (MNHN 2003-0018). Upper specimen normal (331 mm TL); lower specimen regenerated (322 mm TL). In the regenerated tail, an ossified rod developed from the 65th vertebra and replaced caudal vertebrae; the regenerated anal rays stopped at the anterior part of the rod. Arrows point to the end of the anal fin; arrowheads point to the articulation of the bony rod with the last true vertebrae.

Table I. - Measurements (in mm) with their abbreviations and meristic data for type series of *Distocyclus guchereauae*: holotype and five paratypes. Two specimens show regenerative process of the caudal part (*) and two others have damaged caudal part of the body (**).

Metric data		Holotype	Paratypes				
		2000-5927	2003-0018	2003-0018	2001-2284	2003-0013	2003-0014
A	Length to anal fin (LAF)	194.0	287.0	241.0			
B	Total length (TL)	271.0	322.0	331.0			
C	Head length to gill opening (HL)	31.0	42.5	38.8	43.8	39.24	41.3
D	Distance from snout to anus	24.5	32.9	30.1	35.5	21.42	30.9
E	Preanal fin distance	36.7	47.4	42.0	52.4	49.73	45.2
F	Prepectoral fin distance	35.1	48.9	42.5	51.4	44.08	40.6
G	Greatest body depth	32.1	46.2	38.8	47.9	39.82	41.3
H	Anal fin base length	160.0	233.0	195.0			
I	Pectoral fin length	24.1	30.3	26.6	33.4	27.63	27.7
J	Tail length	72.0	40.0	94.0			
K	Snout length	12.4	16.3	17.2	15.2	16.66	13.9
L	Orbital diameter	5.0	5.4	5.7	5.1	4.54	4.8
M	Interorbital distance	6.8	8.1	8.2	8.5	6.57	7.1
N	Postorbital distance	20.2	28.8	23.4	26.5	26.90	24.4
O	Internarinal distance	3.7	5.3	3.7	4.3	3.23	4.7
P	Dist. posterior naris to eye	5.3	8.9	7.9	6.0	7.89	6.6
Q	Dist. snout to posterior naris	6.1	8.9	8.9	8.5	8.30	7.4
R	Head depth at eye	18.1	21.2	20.9	24.9	19.45	20.1
S	Head depth at nape	21.7	30.6	26.9	32.5	24.60	27.7
T	Head length to nape	24.3	35.2	27.2	30.4	26.03	28.6
U	Mouth length	7.7	11.4	11.6	9.2	7.80	6.3
V	Gill opening	12.9	14.5	12.1	16.3	14.78	12.6
W	Pectoral fin base	6.0	7.5	6.8	9.6	7.78	8.1
Meristic data							
Anal rays count		184	187	178	> 158	> 147	> 160
Pectoral rays count		ii16/ii16	ii18-ii18	ii17-ii18	ii16/ii16	ii17/ ii18	ii17-ii19
Precaudal vertebrae		13	14	14	13	13	14
Total number vertebrae		79	84	68*	> 59**	> 59**	56*

Coloration in life

Unknown.

Coloration in alcohol

Body lightly brownish to dusky with a lightly darker head and several longitudinal dark lines, the lowest one being exactly above the insertion of the anal fin and regularly striped; pectoral fins and anal fin translucent; eyes black.

Etymology

Distocyclus guchereauae is dedicated to Miss Corinne Guchereau who facilitates, since 15 years, our work on all technical aspects.

Comparison of the *Distocyclus* species (Tabs III, IV)

The new species belong to the Sternopygidae family characterized by multiple rows of small villiform teeth in both jaws; large eyes; anterior nares outside gape; anal-fin

origin at isthmus, no urogenital papilla and no caudal fin (see Mago-Leccia, 1994; Albert, 2003a).

Sternopygidae are constituted of two subfamilies (Albert and Fink, 1996): the Sternopyginae with one genus (*Sternopygus*) and the Eigenmanniinae with five genera (*Archolaemus*, *Distocyclus*, *Eigenmannia*, *Japigny*, *Rhabdolichops*). The new species belongs to the Eigenmanniinae subfamily as it possesses a foramen in the scapula, which is not the case in the Sternopyginae. The precaudal vertebrae are 14-15 for *Archolaemus* and *Japigny*, 11-14 for *Eigenmannia* and *Rhabdolichops* (Meunier *et al.*, 2011), 13-14 for *Distocyclus* and 19-29 for *Sternopygus* (Mago-Leccia, 1994; Crampton *et al.*, 2004, 2005). The new species differs from *Rhabdolichops* species, which have two rib-like bones (De La Hoz and Chardon, 1984; Lundberg and Mago-Leccia, 1986) versus 3-4 for *D. guchereauae* and shows "transparent" ventro-caudal electrocytes (Mago-Leccia, 1994; Albert, 2003a). It also differs from *Eigenmannia* species,

Table II. - Morphometric relative data for type series of *Distocyclus guchereauae*: holotype and five paratypes and the mean, M (right column). Two specimens show regenerative process (*) and two others have damaged caudal part of the body (**). (See table I for abbreviations).

	Holotype	Paratypes					M
	2000-5927	2003-0018	2003-0018*	2001-2284**	2003-0013**	2003-0014*	
A/C	6.3	6.7	6.2				6.4
A/D	7.9	8.7	8.0				8.2
A/E	5.3	6.1	5.7				5.7
A/G	6.0	6.2	6.2				6.2
A/H	1.2	1.2	1.2				1.2
A/I	8.0	9.5	9.0				8.9
A/T	8.0	8.2	8.9				8.3
B/C	8.8	7.6	8.5				8.3
B/G	8.4	7.0	8.5				8.0
B/H	1.7	1.4	1.7				1.6
C/D	1.3	1.3	1.3	1.2	1.8	1.3	1.4
C/E	0.8	0.9	0.9	0.8	0.8	0.9	0.9
C/G	1.0	0.9	1.0	0.9	1.0	1.0	1.0
C/I	1.3	1.4	1.5	1.3	1.4	1.5	1.4
C/K	2.5	2.6	2.3	2.9	2.4	3.0	2.6
C/L	6.1	7.9	6.8	8.5	8.6	8.7	7.8
C/M	4.5	5.3	4.7	5.2	6.0	5.9	5.3
C/N	1.5	1.5	1.7	1.6	1.5	1.7	1.6
C/O	8.5	8.0	10.4	10.3	12.1	8.8	9.7
C/P	5.9	4.8	4.9	7.3	5.0	6.3	5.7
C/Q	5.1	4.8	4.4	5.1	4.7	5.6	4.9
C/R	1.7	2.0	1.9	1.8	2.0	2.1	1.9
C/S	1.4	1.4	1.4	1.3	1.6	1.5	1.4
C/T	1.3	1.2	1.4	1.4	1.5	1.4	1.4
C/U	4.0	3.7	3.3	4.7	5.0	6.6	4.6
C/V	2.4	2.9	3.2	2.7	2.7	3.3	2.9
C/W	5.1	5.7	5.7	4.6	5.0	5.1	5.2
H/C	5.2	5.5	5.0				5.2
H/D	6.5	7.1	6.5				6.7
H/E	4.4	4.9	4.6				4.6
H/G	5.0	5.0	5.0				5.0
H/N	7.9	8.1	8.3				8.1
H/T	6.6	6.6	7.2				6.8
K/L	2.5	3.0	3.0	3.0	3.7	2.9	3.0
M/L	1.4	1.5	1.4	1.7	1.4	1.5	1.5
M/Q	1.1	0.9	0.9	1.0	0.8	1.0	0.9
Q/P	1.2	1.0	1.1	1.4	1.1	1.1	1.1

which have a short snout with a terminal mouth and posterior nares near the eyes *versus* nares remote from the eyes on an elongate conical snout. The third and fourth infraorbitals of *D. guchereauae* are horizontally elongated and not connected by a dorsal bony bridge contrary to *Eigenmannia* species (Mago-Leccia, 1978). It differs from *Archolaemus* (Korringa, 1970), having no teeth outside the mouth, and from *Japigny* species, having a higher number of anal fin

rays (184-187) *versus* 132-164 (see Meunier *et al.*, 2011). The new species belongs to the *Distocyclus* genus because it has “a conical snout with the upper and lower jaws of the same length resulting in a terminal mouth”, an autapomorphy of the genus (Dutra *et al.*, 2014).

Distocyclus comprised two species: *D. conirostris* (Eigenmann & Allen, 1942) and *D. goajira* (Schultz, 1949). The comparison of morphometrical, anatomical and meristi-

Table III. - Morphometric comparative data from the three species of *Distocyclus*. (1) MNHN 2000-5927; (2) mean, see table II; (3) data from Mago-Leccia, 1978. The asterisks indicate the most discriminating characters.

		<i>D. guchereauae</i>	<i>D. guchereauae</i>	<i>D. conirostris</i>	<i>D. goajira</i>
		Holotype (1)	M (2)	M (3)	M (3)
A/C	Length to anal fin / Head length to gill opening	6.2	6.4 (6.2-6.7)	8.0 (7.6-8.3)	7.7 (7.1-8.2)
A/D*	Length to anal fin / Distance from snout to anus	7.9	8.2 (7.9-8.7)	10.9 (9.3-17.0)	13.9 (12.2-14.5)
A/E	Length to anal fin / preanal fin distance	5.3	5.7 (5.3-6.1)	7.6 (7.2-7.8)	6.7 (5.7-7.2)
A/G	Length to anal fin / greatest body depth	6.0	6.2 (6.0-6.2)	7.0 (6.5-7.6)	7.6 (7.3-7.8)
A/H	Length to anal fin / Anal fin base length	1.2	1.2 (1.2-1.2)	1.1 (1.1-1.1)	1.1 (1.1-1.2)
A/I*	Length to anal fin / Orbital diameter	8.0	8.9 (8.0-9.5)	10.9 (9.7-11.8)	12.0 (11.5-12.5)
A/T	Length to anal fin / Head length to nape	8.0	8.3 (8.0-8.9)	9.6 (8.7-10.5)	10.3 (9.4-10.8)
B/C*	Total length / Anal fin base length	8.8	8.3 (7.6-8.8)	11.7 (9.8-11.5)	9.8 (8.7-10.7)
B/G*	Total length / Greatest body depth	8.4	8.0 (7.0-8.5)	10.3 (8.7-11.4)	9.5 (8.9-10.1)
B/H	Total length / Anal fin base length	1.7	1.6 (1.4-1.7)	1.7 (1.5-1.8)	1.4 (1.3-1.5)
C/D	Head length to gill opening / Distance from snout to anus	1.3	1.4 (1.2-1.8)	1.4 (1.2-2.0)	1.8 (1.5-2.0)
C/E	Head length to gill opening / Preanal fin distance	0.8	0.9 (0.8-0.9)	1.0 (0.9-1.0)	0.9 (0.7-1.0)
C/G	Head length to gill opening / Greatest body depth	1.0	1.0 (0.9-1.0)	0.9 (0.8-1.0)	1.0 (0.9-1.0)
C/I	Head length to gill opening / Pectoral fin length	1.3	1.4 (1.3-1.5)	1.4 (1.2-1.6)	1.6 (1.5-1.6)
C/K	Head length to gill opening / Snout length	2.5	2.6 (2.3-3.0)	3.4 (3.1-3.6)	2.7 (2.7-2.9)
C/L	Head length to gill opening / Orbital diameter	6.1	7.8 (6.1-8.7)	6.9 (6.0-7.7)	6.5 (5.1-8.4)
C/M	Head length to gill opening / Interorbital distance	4.5	5.3 (4.7-6.0)	4.1 (3.8-4.5)	4.5 (4.2-5.0)
C/N	Head length to gill opening / Postorbital distance	1.5	1.6 (1.5-1.7)	1.7 (1.6-1.8)	1.9 (1.8-2.2)
C/O*	Head length to gill opening / Internarinal distance	8.5	9.7 (8.0-12.1)	23.4 (18.9-30.8)	10.6 (9.7-12.0)
C/P*	Head length to gill opening / Dist. posterior naris to eye	5.9	5.7 (4.8-7.3)	8.3 (7.3-10.0)	7.0 (6.5-8.0)
C/Q	Head length to gill opening / Dist. snout to posterior naris	5.1	4.9 (4.4-5.6)	5.9 (5.1-6.4)	5.0 (4.3-6.1)
C/R	Head length to gill opening / Head depth at eye	1.7	1.9 (1.7-2.1)	2.3 (2.0-2.4)	2.3 (2.0-2.4)
C/S	Head length to gill opening / Head depth at nape	1.4	1.4 (1.3-1.6)	1.3 (1.1-1.5)	1.5 (1.3-1.7)
C/T	Head length to gill opening / Head length to nape	1.3	1.4 (1.2-1.5)	1.2 (1.1-1.3)	1.3 (1.3-1.4)
C/U	Head length to gill opening / Mouth length	4.0	4.6 (3.3-6.6)	5.2 (4.7-5.8)	6.2 (5.4-8.0)
C/V*	Head length to gill opening / Gill opening	2.4	2.9 (2.4-3.3)	3.7 (3.2-4.4)	3.8 (3.2-5.2)
C/W	Head length to gill opening / Pectoral fin base	5.1	5.2 (4.6-5.7)	5.5 (5.0-6.2)	5.2 (4.7-5.8)
H/C*	Anal fin base length / Head length to gill opening	5.2	5.2 (5.0-5.5)	7.2 (6.7-7.5)	6.7 (6.0-7.3)
H/D*	Anal fin base length / Distance from snout to anus	6.5	6.7 (6.5-7.1)	9.8 (8.5-15.3)	12.1 (11.0-12.9)
H/E*	Anal fin base length / Preanal fin distance	4.5	4.6 (4.4-4.9)	6.8 (6.4-7.1)	5.9 (5.1-6.5)
H/G	Anal fin base length / Greatest body depth	5.0	5.0 (5.0-5.0)	6.3 (5.8-6.9)	6.6 (6.2-6.9)
H/N*	Anal fin base length / Postorbital distance	7.9	8.1 (7.9-8.3)	12.0 (11.0-13.3)	13.1 (11.3-15.8)
H/T	Anal fin base length / Head length to nape	6.6	6.8 (6.6-7.2)	8.6 (7.8-9.6)	9.0 (7.9-9.4)
K/L	Snout length / Orbital diameter	2.5	3.0 (2.5-3.7)	2.1 (1.8-2.4)	2.4 (1.9-3.1)
M/L	Interorbital distance / Orbital diameter	1.4	1.5 (1.4-1.7)	1.7 (1.5-2.0)	1.4 (1.2-1.9)
M/Q	Interorbital distance / Dist. snout to posterior naris	1.1	0.9 (0.8-1.0)	1.4 (1.3-1.6)	1.1 (1.0-1.3)
Q/P	Dist. snout to posterior naris / Dist. posterior naris to eye	1.2	1.1 (1.0-1.4)	1.4 (1.2-1.9)	1.4 (1.1-1.9)

cal data allows the separation of *D. guchereauae* from the two other species, increasing to three the *Distocyclus* species (Tabs III, IV). Relatively to *D. conirostris* and *D. goajira*, the head, the gill opening and the pectoral fin of *D. guchereauae* are longer and its body is deeper. The internarinal dis-

tance is the highest in *D. guchereauae* and the smallest in *D. conirostris*. The eye-posterior naris distance is lower in *D. conirostris* than in *D. guchereauae* and *D. goajira*. The distance between the eye and the gill opening is higher in *D. guchereauae*. The anus position is straight below the eyes

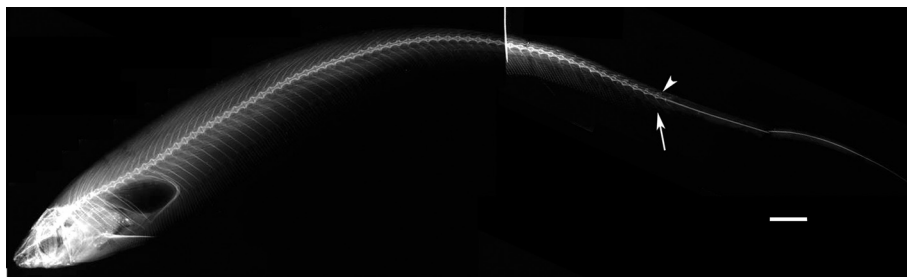


Figure 4. - *Distocyclus goajira*. Holotype USNM 121596. X-ray. The anal fin ends (arrow) at the level of the “last caudal vertebra/caudal bony rod” (arrowhead) indication of the a regenerated tail. Scale bar = 50 mm.

Table IV. - Synthesis of the significative differences between the three species of *Distocyclus*: *D. guchereauae*, *D. conirostris* and *D. goajira*. See table III for detailed ratio values.

A/D : *D. guchereauae* < *D. conirostris* < *D. goajira*

A/I : *D. guchereauae* < *D. conirostris* < *D. goajira*

B/C : *D. guchereauae* < *D. conirostris* = *D. goajira*

B/G : *D. guchereauae* < *D. conirostris* = *D. goajira*

C/O : *D. guchereauae* < *D. goajira* << *D. conirostris*

C/P : *D. guchereauae* < *D. goajira* < *D. conirostris*

C/V : *D. guchereauae* < *D. conirostris* < *D. goajira*

H/C : *D. guchereauae* < *D. goajira* < *D. conirostris*

H/D : *D. guchereauae* < *D. conirostris* < *D. goajira*

H/E : *D. guchereauae* < *D. goajira* < *D. conirostris*

H/N : *D. guchereauae* < *D. conirostris* = *D. goajira*

in *D. guchereauae*, whereas it is behind the eyes in *D. goajira* and before the gill opening in *D. conirostris* (see Mago-Leccia, 1978: fig. 35). Finally, *D. guchereauae* possesses 184–187 anal rays vs more than 200 in *D. conirostris* and more than 240 in *D. goajira*.

Distribution and habitat

Distocyclus guchereauae is known from French Guiana in Tampoc and Litany rivers, two tributaries of Maroni stream.

Regeneration of the caudal skeleton

Like numerous Gymnotiformes, especially sternopygids, two specimens of *D. guchereauae* show clear morphological features of caudal appendage regeneration (Fig. 3). When the posterior part of the body is wounded, following predator attacks for example, the missed anal fin regenerates, and the lost vertebrae are replaced by a more or less ossified cylindrical rod (Meunier and Kirschbaum, 1978; Kirschbaum and Meunier, 1981; Gayet *et al.*, 1994). The total number of vertebrae is reduced depending on the importance of the removal: 56 and 68 vertebrae are lacking in the two specimens (Tabs I, III). The high regenerative potentiality avoids

estimation of meristic data, specially for the anal rays count and the total number of vertebrae (see Tabs I, III). For example, the holotype of *D. goajira* (USNM 121596) is a regenerated specimen as revealed by X-ray analysis (Fig. 4).

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REFERENCES

- ALBERT J.S., 2001. - Species diversity and phylogenetic systematics of American knifefishes (Gymnotiformes, Teleostei). *Misc. Publ. Mus. Zool., Univ. Michigan*, 190: 1-127.
- ALBERT J.S., 2003a. - Family Sternopygidae (Glass knifefishes, Rattail knifefishes). *In: Check List of the Freshwater Fishes of South and Central America* (Reis R.E., Kullander S.O. & Ferraris C.J., eds), pp: 487-491. Porto Alegre: Edipucrs.
- ALBERT J.S., 2003b. - Gymnotiformes: Apterodontidae – ghost knifefishes. *In: Check List of the Freshwater Fishes of South and Central America* (Reis R.E., Kullander S.O. & Ferraris C.J., eds), pp: 497-502. Porto Alegre: Edipucrs.
- ALBERT J.S. & CRAMPTON W.G.R., 2003. - Family Hypopomidae (Bluntnose knifefishes). *In: Check List of the Freshwater Fishes of South and Central America* (Reis R.E., Kullander S.O. & Ferraris C.J., eds), pp: 494-496. Porto Alegre: Edipucrs.
- ALBERT J.S. & CRAMPTON W.G.R., 2005. - Diversity and phylogeny of neotropical electric fishes. *In: Electrorception* (Bullock T.H., Hopkins C.D., Propper N.A. & Fay R.R., eds), pp: 360-409. Springer.
- ALBERT J.S. & FINK W.L., 1996. - *Sternopygus xingu*, a new species of electric fish from South America (Teleostei: Gymnotoidei), with comments on the phylogenetic position of *Sternopygus*. *Copeia*, 1(1996): 85-102.
- CAMPOS-DA-PAZ R., 2003. - Family Gymnotidae (Naked-back knifefishes). *In: Check List of the Freshwater Fishes of South and Central America* (Reis R.E., Kullander S.O. & Ferraris C.J., eds), pp: 483-486. Porto Alegre: Edipucrs.
- CORREA S.B., CRAMPTON W.G.R. & ALBERT J.S., 2006. - Three new species of the neotropical electric fish *Rhabdolichops* (Gymnotiformes: Sternopygidae) from the Central Amazon, with a New Diagnosis of the Genus. *Copeia*, 1(2006): 27-42.
- CRAMPTON W.G.R., HULEN K.G. & ALBERT J.S., 2004. - Redescription of *Sternopygus obtusirostris* (Gymnotiformes: Sternopygidae) from the Amazon basin, with description of osteology, ecology and electric organ discharges. *Ichthyol. Explor. Freshw.*, 15(2): 121-134.

- CRAMPTON W.G.R., HULEN K.G. & ALBERT J.S., 2005. - *Sternopygus branco*: a new species of neotropical electric fish (Gymnotiformes: Sternopygidae) from the lowland Amazon Basin, with descriptions of osteology, ecology, and electric organ discharges. *Copeia*, 2(2005): 245-259.
- DE LA HOZ E. & CHARDON M., 1984. - Skeleton, muscles, ligaments and swimbladder of a gymnotid fish, *Sternopygus macrurus* Bloch & Schneider (Ostariophysi, Gymnotoidei). *Bull. Soc. R. Sci. Liège*, 53(1): 9-53.
- DUTRA G.M., DE SANTANA C.D., VARI R.P. & WOSIACKI W.B., 2014. - The South American electric glass knifefish genus *Distocyclus* (Gymnotiformes: Sternopygidae): redefinition and revision. *Copeia*, 2(2014): 345-354.
- FERRARIS C.J. Jr., 2003. - Family Rhamphichthyidae (Sand knifefishes). In: Check List of the Freshwater Fishes of South and Central America (Reis R.E., Kullander S.O. & Ferraris C.J., eds), pp. 492-493. Porto Alegre: Edipucrs.
- GAYET M., MEUNIER F.J. & KIRSCHBAUM F., 1994. - *Ellisella kirschbaumi* Gayet & Meunier, 1991, gymnotiforme fossile de Bolivie et ses relations phylogénétiques au sein des formes actuelles. *Cybium*, 18: 273-306.
- HULEN K.G., CRAMPTON W.G. & ALBERT J.A., 2005. - Phylogenetic systematics and historical biogeography of the Neotropical electric fish *Sternopygus* (Teleostei: Gymnotiformes). *Syst. Biodiversity*, 3 (4): 407-432.
- KIRSCHBAUM F. & MEUNIER F.J., 1981. - Experimental regeneration of the caudal skeleton of the glass knifefish, *Eigenmannia virescens* (Rhamphichthyidae, Gymnotoidei). *J. Morphol.*, 168: 121-135.
- KORRINGA M., 1970. - A new gymnotoid fish from the Rio Tocantins, Brazil. *Proc. Calif. Acad. Sci.*, 38(13): 265-272.
- LE BAIL P.Y., COVAIN R., JÉGU M., FISCH-MULLER S., VIGOUROUX R. & KEITH P., 2012. - Updated checklist of the freshwater and estuarine fishes of French Guyana. *Cybium*, 36(1): 293-319.
- LEVITON A.E., GIBBS R.H. Jr., HEAL E. & DAWSON C.E., 1985. - Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia*, 3(1985): 802-832.
- LUNDBERG J.G. & MAGO-LECCIA F., 1986. - A review of *Rhabdolichops* (Gymnotiformes, Sternopygidae), a genus of South American freshwater fishes, with descriptions of four new species. *Proc. Acad. Nat. Sci. Philad.*, 138: 53-85.
- MAGO-LECCIA F., 1978. - Los peces de la familia Sternopygidae de Venezuela. *Acta Cient. Venezol.*, 29, (supl. 1): 1-85.
- MAGO-LECCIA F., 1994. - Electric Fishes of Continental Waters of America. 206 p. Fundación para el Desarrollo de las Ciencias Físicas, Matemáticas y Naturales.
- MAXIME E., 2013. - Phylogenetic and revisionary studies of the banded knifefishes *Gymnotus* (Teleostei, Ostariophysi, Gymnotiformes) with description of fourteen new species. 488 p. PhD thesis, Univ. Louisiana, Lafayette, USA.
- MEUNIER F.J. & KIRSCHBAUM F., 1978. - Étude anatomique et histologique du squelette axial de *Eigenmannia virescens* (Rhamphichthyidae, Gymnotoidei). *Acta Zool.*, 59: 215-228.
- MEUNIER F.J., KEITH P. & JÉGU M., 2011. - A new genus and species of Neotropical electric fish, *Japigny kirschbaum* (Gymnotiformes: Sternopygidae), from French Guiana. *Cybium*, 35(1): 47-53.
- MOL J.H., VARI R.P., COVAIN R., WILLINK P.W. & FISCH-MULLER S., 2012. - Annotated checklist of the freshwater fishes of Suriname. *Cybium*, 36(1): 263-292.
- PLANQUETTE P., KEITH P. & LE BAIL P.Y., 1996. - Atlas des Poissons d'eau douce de Guyane. 429 p. Patrimoines naturels, 22.
- TAYLOR W.R. & VAN DYKE G.C., 1985. - Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium*, 9(2): 107-119.
- VARI R.P., FERRARIS C.J., RADOSAVALJEVIC A. & FUNK V.A., 2009. - Checklist of the freshwater fishes of the Guiana Shield. *Bull. Biol. Soc. Washington*, 17: 1-93.