

A new species of *Unilatus* (Platyhelminthes: Monogenoidea) from the gills of *Leporacanthicus galaxias* Isbrücker et Nijssen (Siluriformes: Loricariidae) from Brazil

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Abstract

Unilatus irae sp. nov. (Dactylogyridae) is described from the gills of the armored catfish, *Leporacanthicus galaxias* Isbrücker et Nijssen (Loricariidae: Ancistrinae), from Guamá river, Pará State, Brazil. The new species can be differentiated from its congeners by the combination of the following features: anterior anchor with well-developed superficial root, inconspicuous deep root, shaft bent at midpoint, forming angle of approximately 60°, evenly short curved point; posterior anchor with inconspicuous roots, sclerotized cap of base with small protuberance for articulation to posterior bar; evenly curved shaft and short point; anterior bar broadly V-shaped, with small posteromedial projection; and posterior bar anteriorly expanded on its midportion, with expanded ends slightly curved in posterior direction.

Keywords

Monogenoidea, Dactylogyridae, *Unilatus irae* sp. nov., Siluriformes, *Leporacanthicus galaxias*

Introduction

Loricariids are endemic to rivers from the Neotropical region and represent the largest family of siluriform fish with approximately 800 known species (¼ of the diversity of the Siluriformes) (Nelson 2006, Armbruster 2011). However, despite of this diversity, only 4% of the loricariids species have been investigated for monogenoidean parasites. Thirty species of monogenoids are known parasitizing suckermouth armored catfishes: Seventeen species reported from the body surface (7 of *Aglaigyrodactylus*, 1 of *Hyperopletes*, 3 of *Nothogyrodactylus*, 2 of *Onychogydactylus*, 1 of *Ooggyrodactylus*, 1 of *Phanerothecioides*, and 2 of *Phanerothecium*), and the remaining species described from the gills (2 of *Demidospermus*, 1 of *Heteropriapulus*, 1 of *Paranaella*, 4 of *Trinigyrrus* and 5 of *Unilatus*) (Table I).

Unilatus was proposed by Mizelle and Kritsky (1967) to accommodate their new species, *Unilatus unilatus* Mizelle et Kritsky, 1967, from the gills of *Plecostomus* sp. (= *Hypostomus* sp.) obtained from the Steinhart Aquarium, California, U.S.A. and, according the authors, the host specimens were collected from

the Amazon river Basin. The genus was characterized by having both pairs of anchors in the dorsal position compared with other dactylogyrids (i.e., one pair dorsal, one pair ventral). Price (1968) proposed *Diaccessorius* Price, 1968 to accommodate *D. anoculus* Price, 1968 described from the gills of *Hypostomus bolivianus* Pearson from the Bolivian Amazonia. The most important diagnostic features for *Diaccessorius* included: the presence of two accessory pieces, and the absence of eyespots. Mizelle *et al.* (1968) redescribed *U. unilatus* and described *U. brittani* Mizelle, Kritsky et Crane, 1968 from the gills of *Plecostomus* sp. from Amazon river Basin, Brazil. Molnar *et al.* (1974) registered the occurrence of *U. unilatus* from the gills of *Hypostomus robinii* Valenciennes in Talparo River near Talparo, Trinidad and Tobago. Suriano (1985) redescribed *U. brittani*, and described four new species: *U. brevispinus* Suriano, 1985 and *U. longispinus* Suriano, 1985 from the gills of *Pterigoplichthys multiradiatus* Hancock, *U. dissimilis* Suriano, 1985 from the gills of *Hemiancistrus* sp., and *U. scaphirhynchae* Suriano, 1985 from the gills of *Hemiancistrus scaphirhynchae* (= *Dekeyseria scaphirhyncha* [Kner]) collected from Negro river, Manaus, Brazil, and considered *Diaccessorius* a junior synonym of *Unilatus* based on

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Table I. List of host species, parasite species, site and references. *Agla.* = *Aglaigyrodactylus*, *Demi.* = *Demidospermus*, *Hete.* = *Heteropriapulius*, *Hype.* = *Hyperopletes*, *Noth.* = *Nothogyrodactylus*, *Onyc.* = *Onychogyrodactylus*, *Oogy.* = *Oogyrodactylus*, *Para.* = *Paranaella*, *Phan.* = *Phanerothecium*, *Phane.* = *Phanerothecioides*, *Trin.* = *Trinigyryus*, *Unil.* = *Unilatus*. G = gills, BS = body surface

Host	Parasite	Site	Reference
<i>Acanthicus hystrix</i>	<i>Trin. acuminatus</i>	G	Kritsky <i>et al.</i> 1986
<i>Ancistrus multispinis</i>	<i>Onyc. hydaticus</i>	BS	Kritsky <i>et al.</i> 2007
	<i>Onyc. sudis</i>	BS	Kritsky <i>et al.</i> 2007
<i>Ancistrus</i> sp.	<i>Noth. amazonicus</i>	BS	Kritsky and Boeger 1991
	<i>Noth. clavatus</i>	BS	Kritsky and Boeger 1991
	<i>Noth. plaesiophallus</i>	BS	Kritsky and Boeger 1991
<i>Dekeyseria scaphirhyncha</i>	<i>Unil. scaphirhyncha</i>	G	Suriano 1985
<i>Farlowella amazonum</i>	<i>Oogy. farlowellae</i>	BS	Harris 1983
<i>Hemiancistrus</i> sp.	<i>Unil. dissimilis</i>	G	Suriano 1985
<i>Hypoptopoma thoracatum</i>	<i>Trin. tentaculoides</i>	G	Kritsky <i>et al.</i> 1986
<i>Hypostomus bolivianus</i>	<i>Unil. anoculus</i>	G	Price 1968
<i>H. iheringii</i>	<i>Unil. unilatus</i>	G	Zica <i>et al.</i> 2012
<i>H. punctatus</i>	<i>Phan. spinatus</i>	BS	Boeger <i>et al.</i> 1994
<i>H. regani</i>	<i>Para. luquei</i>	G	Kohn <i>et al.</i> 2000
	<i>Unil. unilatus</i>	G	Zica <i>et al.</i> 2012
<i>H. robinii</i>	<i>Trin. hypostomatis</i>	G	Hanek <i>et al.</i> 1974
	<i>Unil. unilatus</i>	G	Molnar <i>et al.</i> 1974
<i>H. strigaticeps</i>	<i>Unil. unilatus</i>	G	Zica <i>et al.</i> 2012
<i>Hypostomus</i> sp.	<i>Hete. heterotylus</i>	G	Jogunoori <i>et al.</i> 2004, Kritsky 2007
	<i>Para. luquei</i>	G	Kohn <i>et al.</i> 2000
	<i>Phane. agostinhoi</i>	BS	Kritsky <i>et al.</i> 2007
	<i>Unil. brittani</i>	G	Suriano 1985
<i>Kronichthys lacerta</i>	<i>Agla. forficulatus</i>	BS	Kritsky <i>et al.</i> 2007
<i>Loricaria anus</i>	<i>Demi. anus</i>	G	Suriano 1983
<i>Loricariichthys platymetopon</i>	<i>Demi. paranaensis</i>	G	Ferrari-Hoeninghaus <i>et al.</i> 2010
<i>Pareiorhaphis parvula</i>	<i>Agla. coneii</i>	BS	Kritsky <i>et al.</i> 2007
	<i>Agla. ctenistus</i>	BS	Kritsky <i>et al.</i> 2007
	<i>Agla. salebrosus</i>	BS	Kritsky <i>et al.</i> 2007
<i>Plecostomus plecostomus</i>	<i>Phan. harrisi</i>	BS	Kritsky and Boeger 1991
<i>Plecostomus</i> sp.	<i>Unil. brittani</i>	G	Mizelle <i>et al.</i> 1968
	<i>Unil. unilatus</i>	G	Mizelle and Kritsky 1967
<i>Pseudotothyris obtusa</i>	<i>Agla. guttus</i>	BS	Kritsky <i>et al.</i> 2007
<i>Pterygoplichthys anisitsi</i>	<i>Unil. unilatus</i>	G	Mendoza-Palmero <i>et al.</i> 2012
	<i>Unil. brittani</i>	G	Mendoza-Palmero <i>et al.</i> 2012
<i>Pterygoplichthys pardalis</i>	<i>Heteropriapulius</i> sp.	G	Mendoza Franco <i>et al.</i> 2012
<i>Pterigoplichthys multiradiatus</i>	<i>Unil. unilatus</i>	G	Suriano 1985
	<i>Unil. brittani</i>	G	Suriano 1985
<i>Rhinelepis aspera</i>	<i>Para. luquei</i>	G	Kohn <i>et al.</i> 2000
<i>Rhineloricaria</i> sp.	<i>Hype. malmbergi</i>	BS	Boeger <i>et al.</i> 1994
<i>Schizolecis guntheri</i>	<i>Agla. calamus</i>	BS	Kritsky <i>et al.</i> 2007
	<i>Agla. forficuloides</i>	BS	Kritsky <i>et al.</i> 2007
<i>Squaliforma emarginata</i>	<i>Trin. mourei</i>	G	Boeger and Jégu 1994

morphological similarities among species of both genera. Zica *et al.* (2012) reported *U. unilatus* from the gills of *Hypostomus iheringii* Regan, *H. regani* Ihering and *H. strigaticeps* Regan

from the Chavantes reservoir, São Paulo, Brazil. Mendoza-Palmero *et al.* (2012) reported *U. unilatus* and *U. brittani* from the gills of *Pterygoplichthys anisitsi* Eigenmann et Kennedy

from the Peruvian Amazonia. These authors considered *U. longispinus* and *U. brevispinus* junior synonymy of *U. brittani* and *U. unilatus*, respectively, based on the morphology and morphometry of the haptor structures and the copulatory complex.

In the present paper, a new species of *Unilatus* is described from the gills of *Leporacanthicus galaxias* from the Guamá River, Pará, Brazil.

Materials and Methods

Eight host specimens were collected by apnea diving in Guamá River, municipality of Capitão-Poço, Pará State, Brazil (01°34.465'S, 047°02.063'W) in August 2012. Gill arches were removed and placed in vials containing heated water (~65°C). Each vial was vigorously shaken and formalin was added to obtain a 5% solution. In the laboratory, the contents of each vial were examined under a dissecting microscope LEICA S6D and helminths were removed from the gills or sediment using small probes. Some specimens were stained with Gomori's trichrome (Humason 1979) and mounted in Canada balsam to determine internal soft structures and others were mounted in Gray and Wess medium (Humason 1979) for study of sclerotized structures. The measurements, all in micrometers, were made according to the procedures of Mizelle and Klucka (1953). Dimensions of organs and other structures represent the greatest measurement in dorsoventral view; lengths of curved or bent structures (anchors, bars, accessory piece, male copulatory organ) represent the straight line distances between extreme ends. The average measurement is followed by the ranges and the number (n) of specimens measured in parentheses. Illustrations were prepared with the aid of a drawing tube on a Leica DM 2500 microscope with differential interference contrast and phase contrast optics. Definitions of prevalence and mean intensity follow the definition of Bush *et al.* (1997). Type specimens and vouchers were deposited in the following collections: Invertebrate Collection of the Museu Paraense Emílio Goeldi (MPEG), Belém, PA Brazil; Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, RJ, Brazil; Invertebrate Collection of the Instituto de Pesquisas da Amazônia (INPA), Manaus, AM, Brazil; and the United States National Parasite Collection (USNPC), Beltsville, MD, USA. Host scientific names were validated according to FishBase (Froese and Pauly 2013). Basins and sub-basins nomenclature follow the Agência Nacional de Águas, Ministério do Meio Ambiente, Brazil (<http://hidroweb.ana.gov.br/>).

Results

Class Monogenoidea Bychowsky, 1937
Subclass Polyonchoinea Bychowsky, 1937
Order Dactylogyridea Bychowsky, 1937
Dactylogyridae Bychowsky, 1933

Unilatus irae sp. nov. (Figs 1–9)

Type-host: *Leporacanthicus galaxias* Isbrücker et Nijssen (Siluriformes: Loricariidae).

Site: Gills.

Type-locality: Guamá River (North/Northeast Atlantic Basin; Meruu, Acará, Guamá sub-basin), municipality of Capitão-Poço, Pará State, Brazil (01°34.465'S, 047°02.063'W) in August, 27, 2012.

Prevalence: 62,5% of 8 hosts examined.

Mean intensity: 42,6 parasites per infected host.

Specimens studied: Holotype, CHIOC 37861a; 22 paratypes, CHIOC 37861b-k, MPEG 0033–0037, INPA 626a-f, USNPC 106993; 6 vouchers, CHIOC 37862, USNPC 106994–106995.

Etymology: The specific name is in honor of Dra. Maria Iracilda da Cunha Sampaio (Irá), Universidade Federal do Pará, Brazil, in recognition of her valuable work on the Amazonian Biodiversity and for sincere gratitude for helping the senior author with laboratory support when he came to work at the Universidade Federal do Pará.

Description (based on 37 specimens; 11 mounted in Gomori's trichrome, 26 mounted in Gray and Wess): Body fusiform, total length (excluding haptor) 353 (340–575; n = 4), 116 (110–125; n = 3) wide at level of germarium. Tegument smooth. Cephalic lobes poorly developed or absent; 3–4 pairs of head organs and cephalic glands posterolateral to pharynx. Eyes, pigment granules (eye-spots), absent. Mouth subterminal. Pharynx muscular, glandular, spherical to sub-spherical, 26 (23–29; n = 8) long, 23 (22–25; n = 8) wide; oesophagus short, intestinal caeca two, confluent posterior to germarium, lacking diverticula. Accessory structures (1 pair) associated with the peduncle (Fig. 1). Haptor hexagonal, 77 (70–80; n = 4) long, 87 (80–95; n = 7) wide. Anchors dissimilar, members of anterior pair with well-developed superficial root, inconspicuous deep root, shaft bent at midpoint, forming angle of approximately 60°, short point (Fig. 6), outer 32 (30–35; n = 16) long, inner 40 (37–44; n = 16), base 15 (14–17; n = 22). Posterior anchor with inconspicuous roots, sclerotized cap of base with small protuberance for articulation to posterior bar; evenly curved shaft and short point; anchor filament one or two (Figs 8–9), outer 41 (39–44; n = 17) long, inner 43 (41–47; n = 17), base 14 (12–17; n = 20) – excluding sclerotized cap. Anterior bar broadly V-shaped with small posteromedial projection (Fig. 7), 8 (8–10; n = 15) long, 34 (30–38; n = 13) wide. Posterior bar anteriorly expanded on it midportion, tapered ends, with or without projection, curved in posterior direction (Fig. 4), 11 (10–15; n = 24) long, 85 (82–95; n = 12) wide. Hooks similar in shape (Fig. 5), 12 (10–14; n = 21) long, shank without inflation, erect thumb, lightly curved long shaft, delicate point, filamentous hook loop (FH loop) not observed. Male copulatory organ sclerotized, spiral, counter clockwise, with approximately 13 rings, base with sclerotized cap, distal medial portion with small bulb, distal portion thin (Fig. 2), 66 (65–67; n = 4) long, non-articulated with accessory piece. Accessory piece 52 (40–68; n = 19),

with variable sheath, parallel to the male copulatory organ, distal portion, serving as guide to male copulatory organ. Gonads overlapping; testis dorsal to germarium, subspherical, 32 (27–40; $n = 3$) long, 30 (25–38; $n = 3$) wide; seminal vesicle, an expansion of vas deferens, sigmoid; prostatic reservoir oval with medial constriction. Germarium elongated, 109 (103–112; $n = 3$) long, 41 (36–47; $n = 4$) wide; Mehlis' gland, ootype not observed. Vagina muscular, vaginal canal with internal sclerotized wall. Vaginal pore medial, ventral, at level of the beginning of the seminal vesicle expansion. Vitelline follicles coextensive with gut, absent in regions of reproductive organs. Egg ovate elongated (Fig. 3), length – excluding filament – 69 (66–71; $n = 2$) long, 46 (41–52; $n = 2$) wide, with one short proximal filament, about $\frac{1}{2}$ egg size.

Discussion

Several genera have been proposed for monogenoids from the gills of loriciid fishes (see Table I). Except the monotypic *Paranaella* Kohn, Baptista-Farias et Cohen, 2000 (Microcotylidae) from the gills of *Hypostomus* spp. and *Rhinelepis aspera* Spix et Agassiz, the other genera belong to the Dactylogyridae: *Demidospermus*, *Heteropriapulius*, *Trinigyrus* and *Unilatus*.

Unilatus is distinguished from other dactylogyrid genera occurring in loriciids by a combination of characters, including the morphology of the male copulatory organ

(i.e., spiral, cork-screw like, with small bulb in the distal medial portion); absence of eyes; and the haptoral armaments (i.e., anchors, bars) with dorsal distribution.

Unilatus irae sp. nov. differs from *U. anoculus*, *U. dissimilis*, *U. scaphirhynchoe*, and *U. unilatus* by having the anterior anchor with well-developed superficial root, inconspicuous deep root, shaft bent at midpoint, forming angle of approximately 60° , evenly short curved point. The new species resembles *U. brittani* in the general morphology of the anterior anchor. However, *Unilatus irae* sp. nov. differs from *U. brittani* in the comparative morphology of the anterior bar and posterior anchor/bar complex. The anterior bar is broadly V-shaped with small posteromedial projection in *U. irae* sp. nov. (Fig. 7), whereas the anterior bar has a short anteromedial projection in *U. brittani* (Mizelle et al. 1968: Figs 12–13, Mendoza-Palmero et al. 2012: Fig. 45). Suriano (1985) re-described *U. brittani* as having Y-shaped anterior bar (Suriano 1985: Fig. 5). However, no specimen was available to confirm the feature reported by this author. The posterior bar is anteriorly expanded on its midportion, with expanded ends slightly curved in posterior direction in *U. irae* sp. nov. (Fig. 4), but it is tapered (Mizelle et al. 1968: Fig. 14) or flattened W-shaped with expanded ends (Suriano 1985: Fig. 4, Mendoza-Palmero et al. 2012: Fig. 44) in *U. brittani*. The posterior anchor has a shaft evenly curved in *U. irae* sp. nov. (Figs 8, 9), whereas it is strongly recurved near midlength in *U. brittani* (Mizelle et al. 1968: Fig. 11). Also, *Unilatus irae* sp. nov. differs morphometrically from *U. brittani*. The new species is

Table II. Comparative measurements (μm) of *Unilatus irae* sp. nov. and *U. brittani* Mizelle, Kritsky et Crane, 1968

	<i>Unilatus irae</i> sp. nov.	<i>Unilatus brittani</i> ¹	<i>Unilatus brittani</i> ²	<i>Unilatus brittani</i> ³
Body length	353 (340–575)	937 (870–1005)	650 (625–800)	–
Body width	116 (110–125)	102 (100–104)	175 (100–130)	–
Pharynx	26 (23–29) $\times$ 23 (22–25)	25 $\times$ 26	25 (24–27)	
Peduncle/haptor				
Length	77 (70–80)	87	–	–
width	87 (80–95)	87	–	–
Anterior anchor				
Length	40 (37–44)*	32 (31–34)	26 (25–30)	29 (27–32)
Base width	15 (14–17)	13 (12–14)	18 (16,5–19)	12 (11–13)
Posterior anchor				
Length	43 (41–47)*	30 (27–32)	31,5 (28–35)	30 (27–32)
Base width	14 (12–17)	10	6 (5–7)	8 (8–10)
Anterior bar	34 (30–38)	23 (22–24)	25 (24–26)	24 (20–28)
Posterior bar	85 (82–95)	61 (59–64)	62 (60–63)	64 (57–72)
Hook	12 (10–14)	13 (12–14)	14 (13–15)	12 (11–14)**
MCO	66 (65–67)	54 (52–55)	34 (33–35)	33 (30–37)
Accessory piece	52 (40–68)	40 (38–42)	44 (43–45)	24 (20–30)

¹Mizelle et al. 1968; ²Suriano 1985; ³Mendoza-Palmero et al. 2012; *For *U. irae* sp. nov. the length of anchors is the outer measurement which represents the greatest distance extreme points; **Mendoza-Palmero et al. 2012 separated hook measure in five categories (i.e., hook pairs 1, 6; hook pair 2; hook pairs 3, 4; hook pair 5; hook pair 7). Hooks pair 7 is the only category which is different, 15 (14–19) (See Mendoza-Palmero et al. 2012)

smaller than *U. brittani*, however anchors, bars and copulatory complex of *U. irae* sp. nov. are slightly larger when compared with specimens of *U. brittani* (Table II).

Unilatus irae sp. nov. is characterized by having all hook pairs similar in shape (Fig. 5). Mendoza-Palmero *et al.* (2012) reported the presence of expanded shank and highly reduced thumb of hooks of pair 7 for specimens of *U. brittani* from *Pterygoplichthys anisits* (Mendoza-Palmero *et al.* 2012: Fig. 46). However, the original drawings of all hook pairs of *U. brittani* from *Plecostomus* sp. (Mizelle *et al.* 1968: Fig. 15) and *Hypostomus* sp. (Suriano 1985: Fig. 6) seem to be similar in shape, suggesting the existence of intraspecific variation among specimens of *U. brittani* and limiting the usefulness of this feature to distinguish *U. irae* sp. nov. from *U. brittani*.

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