

Two new species of *Sciadicleithrum* (Monogenea, Dactylogyridae) parasites of Neotropical cichlid fishes from the Paraná River, Brazil

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Abstract

Two new species of *Sciadicleithrum* are described from the gills of Neotropical cichlid fishes collected from Paraná River, Brazil. *Sciadicleithrum satanopercae* sp. nov. is described from the gills of *Satanoperca pappaterra* and differs from congeners by having a dorsal anchor with the distal portion complex and the inner margin with a “denticulum” between shaft and point. *Sciadicleithrum joanae* sp. nov. is described from the gills of *Crenicichla niederleinii* and *C. britskii* collected from Paraná River. *Sciadicleithrum joanae* sp. nov. differs from congeners by having a male copulatory organ comprising about half a clockwise loop and a vaginal pore “bulb-shaped”.

Keywords

Monogenea, *Sciadicleithrum*, cichlid fishes, Brazil

Introduction

Sciadicleithrum Kritsky, Thatcher et Boeger, 1989 includes species of gill parasites of Neotropical cichlid fishes and is characterized mainly by a ventral bar with two umbelliform membranes or cavities on the anterior margin. To date, 19 species of *Sciadicleithrum* have been described (Mendoza-Franco and Vidal-Martínez 2005, Mendoza-Franco *et al.* 2007, Bellay *et al.* 2008, Carvalho *et al.* 2008), with eleven species of *Sciadicleithrum* parasitizing seven species of cichlids from South America, and eight species of this genus parasitizing twenty-two hosts from Central America and Southeast Mexico (Mendoza-Franco and Vidal-Martínez 2005, Mendoza-Franco *et al.* 2007).

During surveys of helminth parasites of freshwater fishes from the Paraná River, two undescribed dactylogyrid species of *Sciadicleithrum* were recovered, one from the gills of *Satanoperca pappaterra* (Heckel, 1840) and another one from *Crenicichla niederleinii* (Holmberg, 1891) and *Crenicichla britskii* Kullander, 1982.

Materials and methods

Twenty four specimens of *Satanoperca pappaterra* and one *Crenicichla britskii* were captured from the Upper Paraná River floodplain, Brazil (22°50'–22°70'S, 53°15'–53°40'W) and forty one specimens of *C. niederleinii* were captured from the Itaipu Reservoir (24°05'–25°33'S, 54°00'–54°37'W). Gills were removed and placed in vials containing 1:4000 formalin solution. Collected parasites were fixed and stored in 5% formalin. Some specimens were mounted unstained in Hoyer's medium in order to study the sclerotized structures. Other specimens, stained with Gomori's trichrome, were used to observe internal organs (Eiras *et al.* 2006). Measurements, all presented in micrometers, are expressed as the mean followed by the range and number (n) of specimens measured in parentheses. Illustrations were prepared with the aid of a drawing tube and a Nikon YS 2 microscope. Ecological terminology was based on Bush *et al.* (1997). Numbering (distribution) of haptor hook pairs follow that of Mendoza-Franco *et al.* (1999), and the description of the coiled tube of the male copulatory organ

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(MCO) follows that of Kritsky *et al.* (1985). Terminology specific to *Sciadicleithrum* follows Kritsky *et al.* (1989). Type specimens are deposited in the Instituto Oswaldo Cruz Collection (CHIOC), Rio de Janeiro, Brazil.

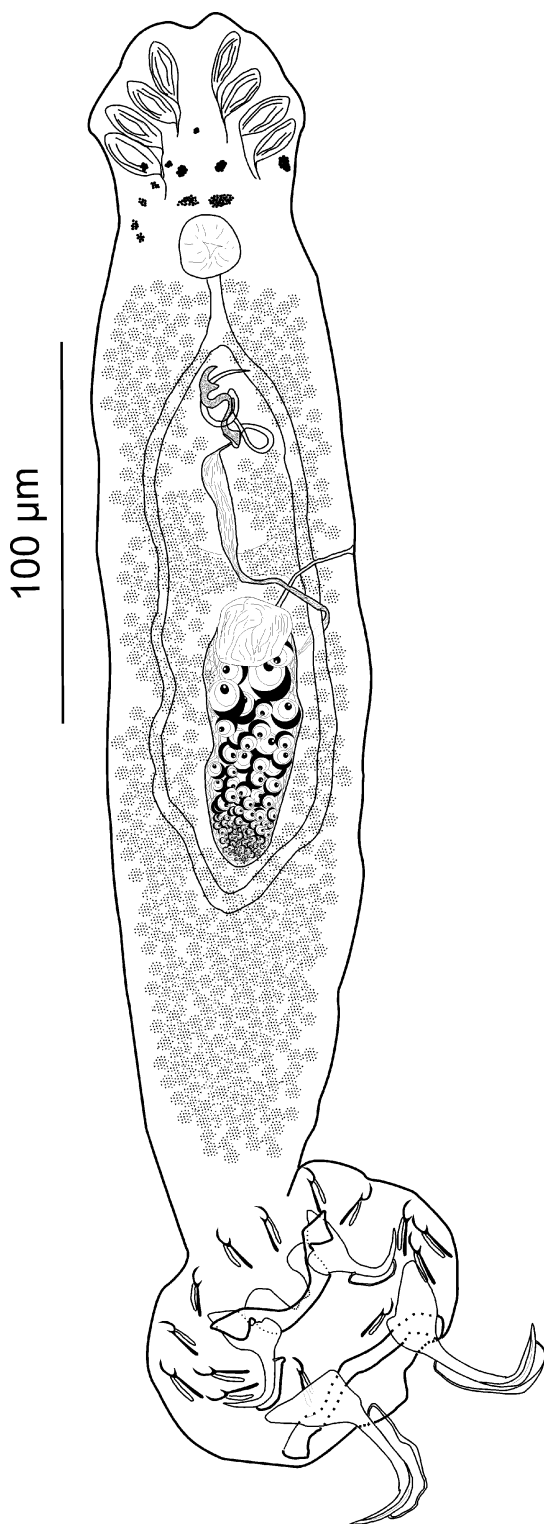


Fig. 1. *Sciadicleithrum satanopercae* sp. nov. from *Satanoperca pappaterra*: Composite drawing of whole-mount (ventral view)

Results

Dactylogyridae Bychowsky, 1933

Sciadicleithrum satanopercae sp. nov. (Figs 1–11)

Description (based on 20 adult specimens): Body elongate, fusiform, 384 (350–430; $n = 15$) long; greatest width 72 (60–110; $n = 17$) near midlength or in anterior half of body. Four cephalic lobes well developed. Eyes 4, equidistant; posterior pair larger than anterior pair; eye granules small, generally elongate ovate; accessory granules sparse in cephalic and anterior trunk regions. Pharynx spherical, 19 (18–22, $n = 18$) in diameter; oesophagus elongate. Peduncle broad; haptor subhexagonal, 78 (70–88, $n = 19$) wide, 53 (48–70, $n = 19$) long. Ventral anchor 22 (19–26, $n = 16$) long, with short deep root, rapidly tapering point, base width 17 (15–21; $n = 16$). Dorsal anchor 39 (34–42, $n = 11$) long, with poorly differentiated roots, distal portion complex and the inner margin with a “denticulum” between shaft and point, base width 20 (15–24; $n = 10$). Ventral bar 39 (31–45; $n = 14$) long, yoke-shaped, with slightly enlarged ends and with delicate umbelliform membranes; dorsal bar 52 (45–56; $n = 13$) long, slender, rod-shaped, with enlarged ends. Hooks similar, each with delicate point, upright thumb, uniform shank, filament hook loop 2/3 shank length; hook pairs 1, 2, 3, 5: 13 (12–15, $n = 19$) long, hook pairs 4, 6, 7: 17 (15–18, $n = 17$) long. Coiled tube of MCO comprising about 2.5 clockwise rings; MCO 36 (30–43, $n = 2$) long, base with proximal elongation. Accessory piece 23 (21–25, $n = 3$) long, articulated to base of MCO, with hook-like distal portion. Vagina sclerotized sinistral, with delicate tube leading to midventral seminal receptacle. Gonads overlapping. Seminal vesicle elongate. Oviduct, ootype, uterus not observed. Vitelline follicles dense, dispersed throughout trunk but absent in region of reproductive organs and MCO. Egg oval, with appendage.

Type-host: *Satanoperca pappaterra* (Heckel) (Perciformes, Cichlidae).

Site of infection: Gill filaments.

Type-locality: Upper Paraná River floodplain, Paraná State, Brazil (22°50′–22°70′S, 53°15′–53°40′W).

Specimens deposited: Holotype, CHIOC no. 37165a; four paratypes, CHIOC nos. 37165b, 37166a–b, and 37167.

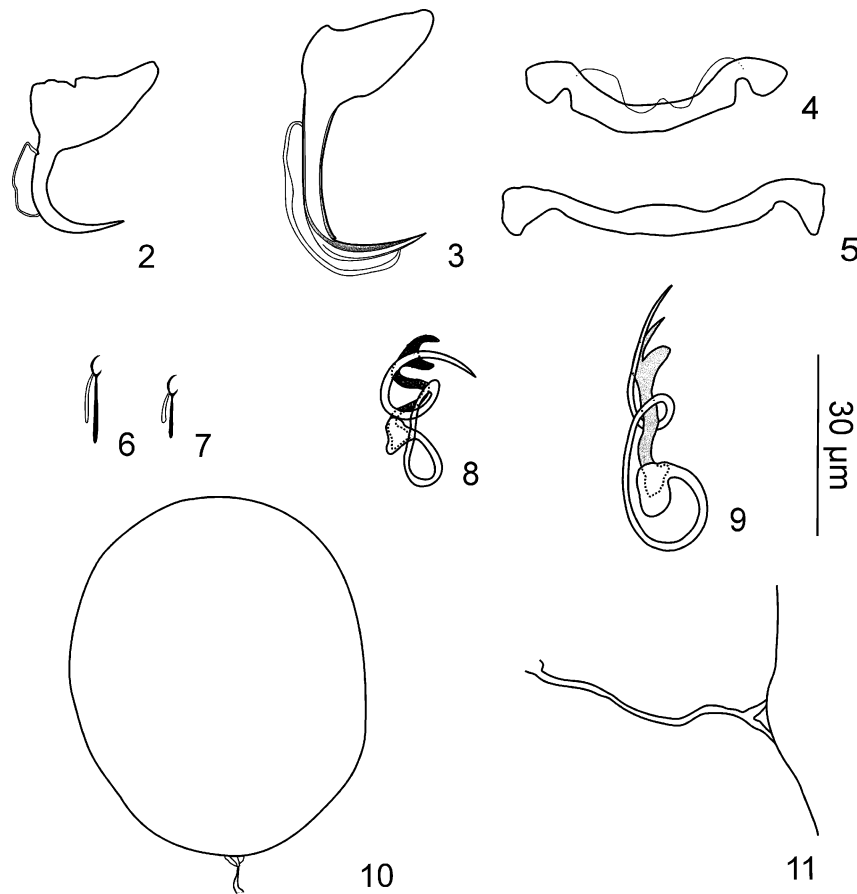
Prevalence: 75% (18 of 24 fishes examined).

Mean intensity: 23 parasites per parasitized host.

Specimens studied: 16 specimens in Hoyer’s medium and 4 stained with Gomori’s trichrome.

Etymology: The specific name derives from the genus of the type host.

Remarks: *Sciadicleithrum satanopercae* sp. nov. closely resembles the others members of *Sciadicleithrum* by having a ventral bar with umbelliform membranes on the anterior margins, a MCO with clockwise rings, and hooks with slender shanks and upright thumbs (Kritsky *et al.* 1989). The new species closely resembles *Sciadicleithrum meekii* Mendoza-



Figs 2–11. *Sciadicleithrum satanopercae* sp. nov. from *Satanoperca pappaterra*. **2.** Ventral anchor. **3.** Dorsal anchor. **4.** Ventral bar. **5.** Dorsal bar. **6.** Hook pairs 4, 6 and 7. **7.** Hook pairs 1, 2, 3 and 5. **8–9.** Copulatory complex. **10.** Egg. **11.** Vagina

Franco, Scholz et Vidal-Martínez, 1997; *Sciadicleithrum splendidae* Kritsky, Vidal-Martínez et Rodríguez-Canul, 1994 and *Sciadicleithrum tortrix* Kritsky, Thatcher et Boeger, 1989, by possessing more than 2 loops in the MCO, and resembles *Sciadicleithrum ergensi* Kritsky, Thatcher et Boeger, 1989, and *Sciadicleithrum uncinatum* Kritsky, Thatcher et Boeger, 1989, by having an accessory piece with a hook-like distal portion. The other distinctive feature is hooks of dissimilar size (hook pairs 1, 2, 3, 5 smaller than hook pairs 4, 6, 7); this feature is also found in *Sciadicleithrum frequens* Bellay, Takemoto, Yamada et Pavanelli, 2008, in only which hook pair 5 is reduced in size.

Sciadicleithrum satanopercae sp. nov. can be distinguished from most of its congeners by having a dorsal anchor with the distal portion complex and the inner margin with a “denticulum” between shaft and point.

***Sciadicleithrum joanae* sp. nov.** (Figs 12–20)

Description (based on 19 adult specimens): Body elongate, fusiform, 281 (192–432; $n = 14$) long; greatest width 84 (55–108; $n = 14$) near middle or in anterior half of body. Four cephalic lobes well developed. Eyes 4; subequal; eye granules small, generally elongate ovate; accessory granules sparse in

cephalic, anterior trunk regions. Pharynx spherical, 20 (15–25; $n = 13$) in diameter; oesophagus elongate. Peduncle broad; haptor subhexagonal, 42 (27–55; $n = 13$) wide, 66 (50–87; $n = 13$) long. Ventral anchor 20 (19–22; $n = 14$) long, short deep root, rapidly tapering point, base width 15 (13–16; $n = 14$). Dorsal anchor 33 (30–36; $n = 7$) long, with short deep root, having elongate superficial root, bent shaft, base width 19 (17–21; $n = 6$). Ventral bar 30 (23–33; $n = 13$) long, with bilateral delicate umbelliform membranes, yoke-shaped, with slightly enlarged ends; dorsal bar 24 (21–28; $n = 14$) long, straight, with umbelliform membranes, and enlarged ends. Hooks similar; each 12 (10–14; $n = 19$) long, with upright thumb, delicate point, shank varying in diameter along length; filament hook loop $3/4$ shank length. Coiled tube of MCO comprising about half a clockwise loop and winding distal portion; base of MCO 36 (30–43; $n = 2$) long, with proximal elongation. Accessory piece comprising delicate sheath enclosing subterminal portion of MCO. Vagina opening on dextral margin, sclerotized, with “bulb-shaped” near its aperture and a long delicate tube with an enlargement before the seminal receptacle. Gonads slightly overlapping. Seminal vesicle elongate. Oviduct, ootype, uterus not observed. Vitelline follicles dense, dispersed throughout trunk but absent in region of reproductive organs and copulatory complex. Egg oval, with appendage.

Type-host: *Crenicichla niederleinii* (Holmberg) (Perciformes, Cichlidae).

Other host: *Crenicichla britskii* Kullander (Perciformes, Cichlidae).

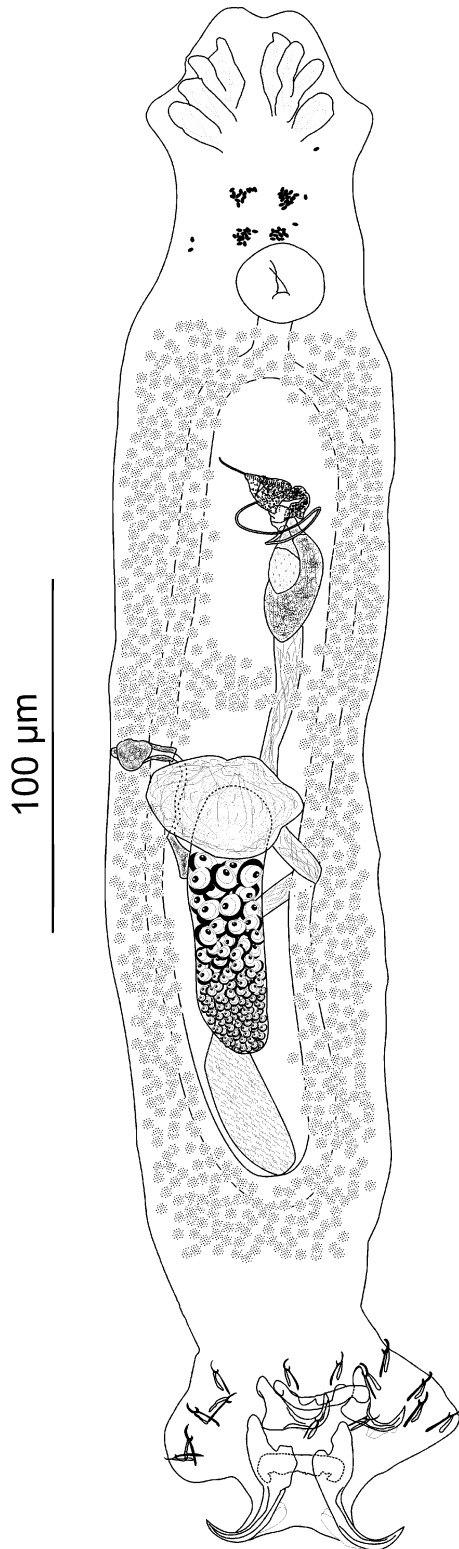


Fig. 12. *Sciadicleithrum joanae* sp. nov. from *Crenicichla niederleinii*. Composite drawing of whole-mount (ventral view)

Site of infection: Gill filaments.

Type-locality: Paraná River, Paraná State, Brazil (22°50'–22°70'S, 53°15'–53°40'W).

Specimens deposited: Holotype, CHIOC no. 37161; four paratypes, CHIOC nos. 37162, 37163a-b, and 37164.

Prevalence: 41% (17 of 41 fishes examined) in *C. niederleinii* and 100% (1 of 1 fishes examined) in *C. britskii*.

Mean intensity: 11 parasites per parasitized host.

Specimens studied: 14 specimens in Hoyer's medium and 5 stained with Gomori's trichrome.

Etymology: The specific name derives from the common name "joaninha" of the type host.

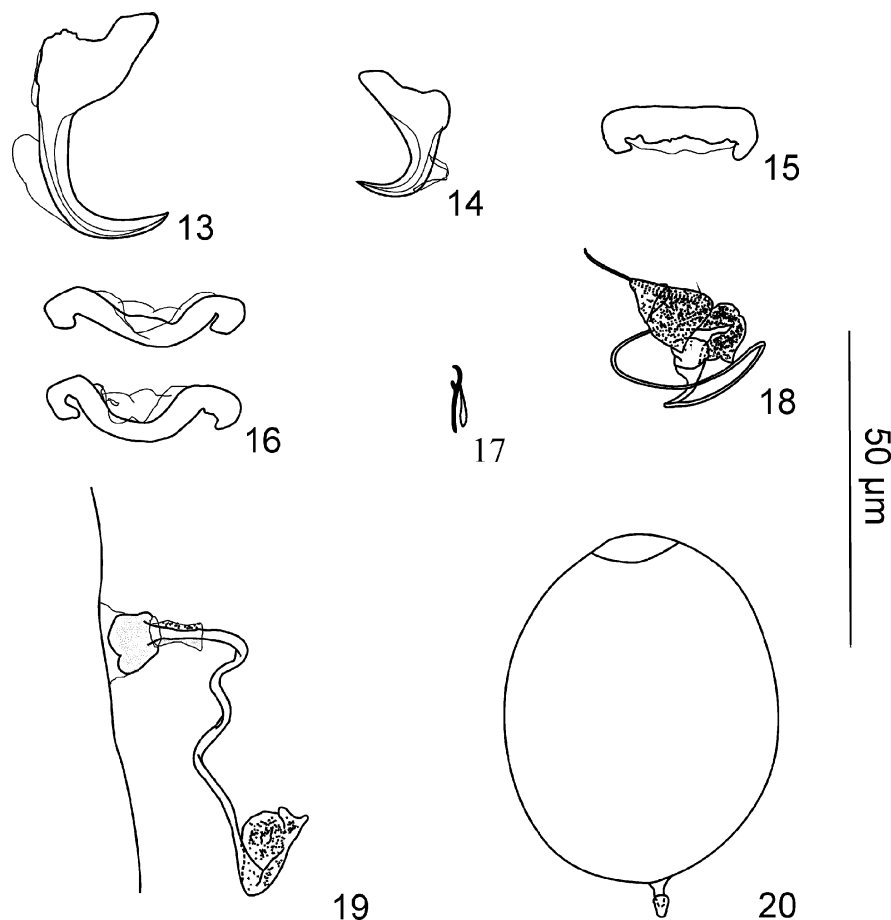
Remarks: *Sciadicleithrum joanae* sp. nov. has a yoke-shaped ventral bar, with bilateral delicate umbelliform membranes and with slightly enlarged ends, similar to *S. aequidens* (Price et Schlueter, 1967); *S. bravohollisae* Kritsky, Vidal-Martínez et Rodríguez-Canul, 1994; *S. cavanaughi* (Price, 1966); *S. iphthimum* Kritsky, Thatcher et Boeger, 1989; *S. tortrix* and *S. variabilum* (Mizelli et Kritsky, 1969).

The new species differs from its congeners by having a vagina with a "bulb-shaped" near its aperture and a long delicate sclerotized tube with an enlargement before the seminal receptacle.

Sciadicleithrum joanae sp. nov. parasitizes *Crenicichla niederleinii* and *C. britskii*. It is the first record of a *Sciadicleithrum* species from South America parasitizing more than one host species.

Discussion

In South America 11 species of *Sciadicleithrum* [*S. aequidens* (Price et Schlueter, 1967); *S. cavanaughi* (Price, 1966); *S. ergensi* Kritsky, Thatcher et Boeger, 1989; *S. frequens* Bellay, Takemoto, Yamada et Pavanelli, 2008; *S. geophagi* Kritsky, Thatcher et Boeger, 1989; *S. guanduensis* Carvalho, Tavares et Luque, 2008; *S. iphthimum* Kritsky, Thatcher et Boeger, 1989; *S. tortrix* Kritsky, Thatcher et Boeger, 1989; *S. umbilicum* Kritsky, Thatcher et Boeger, 1989; *S. uncinatum* Kritsky, Thatcher et Boeger, 1989 and *S. variabilum* (Mizelli et Kritsky, 1969)] have been identified from 7 cichlid species (Kritsky *et al.* 1989, Bellay *et al.* 2008). In Central America and in Southeast Mexico, only 8 species of *Sciadicleithrum* (*S. bicuense* Vidal-Martínez, Scholz et Aguirre-Macedo, 2001; *S. bravohollisae* Kritsky, Vidal-Martínez et Rodríguez-Canul, 1994; *S. maculicaudae* Vidal-Martínez, Scholz et Aguirre-Macedo, 2001; *S. meekii* Mendoza-Franco, Scholz et Vidal-Martínez, 1997; *S. mexicanum* Kritsky, Vidal-Martínez et Rodríguez-Canul, 1994; *S. nicaraguense* Vidal-Martínez, Scholz et Aguirre-Macedo, 2001; *S. panamensis* Mendoza-Franco, Aguirre-Macedo et Vidal-Martínez, 2007 and *S. splendidae* Kritsky, Vidal-Martínez et Rodríguez-Canul, 1994) have been identified from 22 cichlid species, demonstrating a low specificity (Kritsky *et al.* 1994, Mendoza-Franco *et al.* 1997, Vidal-Martínez *et al.* 2001, Mendoza-Franco and Vidal-Martínez 2005, Mendoza-Franco *et al.* 2007).



Figs 13–20. *Sciadicicleithrum joanae* sp. nov. from *Crenicichla niederleinii*. 13. Dorsal anchor. 14. Ventral anchor. 15. Dorsal bar. 16. Ventral bar. 17. Hook. 18. Copulatory complex. 19. Vagina. 20. Egg

According to Vidal-Martínez *et al.* (2001), this low specificity may be explained by a host speciation in Central America and Mexico that has outpaced the evolution of their parasites. As a result, host switching increased as these parasites were able to survive in different host species from the same family.

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References

- Bellay S., Takemoto R.M., Yamada F.H., Pavanelli G.C. 2008. A new species of *Sciadicicleithrum* (Monogenea: Ancyrocephalinae), gill parasite of *Geophagus brasiliensis* (Quoy et Gaimard) (Teleostei: Cichlidae) from reservoirs in the State of Paraná, Brazil. *Zootaxa*, 1700, 63–68.
- Bush A.O., Lafferty K.D., Lotz J.M., Shostak A.W. 1997. Parasitology meets ecology on its own terms: Margolis *et al.* revisited. *Journal of Parasitology*, 83, 575–593. DOI: 10.2307/3284227.
- Carvalho de A.R., Tavares L.E.R., Luque J.L. 2008. A new species of *Sciadicicleithrum* (Monogenea, Dactylogyridae) parasitic on *Geophagus brasiliensis* (Perciformes, Cichlidae) from Guandu River, Southeastern Brazil. *Acta Parasitologica*, 53, 237–239. DOI: 10.2478/s11686-008-0035-6.
- Eiras J.C., Takemoto R.M., Pavanelli G.C. 2006. Métodos de estudo e técnicas laboratoriais em parasitologia de peixes. Eduem, Maringá, 199 pp.
- Kritsky D.C., Boeger W.A., Thatcher V.E. 1985. Neotropical Monogenea. 7. Parasites of the pirarucu, *Arapaima gigas* (Cuvier), with descriptions of two new species and redescription of *Dawestrema cyloancistrum* Price and Nowlin, 1967 (Dactylogyridae, Ancyrocephalinae). *Proceedings of the Biological Society of Washington*, 98, 321–331.
- Kritsky D.C., Thatcher V.E., Boeger W.A. 1989. Neotropical Monogenea. 15. Dactylogyrids from the gills of Brazilian Cichlidae with proposal of *Sciadicicleithrum* gen. n. (Dactylogyridae). *Proceedings of the Helminthological Society of Washington*, 56, 128–140.
- Kritsky D.C., Vidal-Martínez V.M., Rodríguez-Canul R.P. 1994. Neotropical Monogenoidea 19. Dactylogyridae of cichlids

- (Peciformes) from the Yucatan Peninsula, with descriptions of three new species of *Sciadicleithrum*. *Journal of Helminthological Society of Washington*, 61, 26–33.
- Mendoza-Franco E.F., Aguirre-Macedo M.L., Vidal-Martínez V.M. 2007. New and previously described species of Dactylogyridae (Monogenea) from the gills of Panamanian freshwater fishes (Teleostei). *Journal of Parasitology*, 93, 761–771. DOI: 10.1645/GE-1068R.1.
- Mendoza-Franco E.F., Scholz T., Vidal-Martínez V.M. 1997. *Sciadicleithrum meeki* sp. n. (Monogenea: Ancyrocephalinae) from the gills of *Cichlasoma meeki* (Pisces: Cichlidae) from cenotes (= sinkholes) in the Yucatan Peninsula, Mexico. *Folia Parasitologica*, 44, 205–208.
- Mendoza-Franco E.F., Scholz T., Vivas-Rodríguez C., Vargas-Vázquez J. 1999. Monogeneans of freshwater fishes from cenotes (sinkholes) of the Yucatan Peninsula, Mexico. *Folia Parasitologica*, 46, 267–273.
- Mendoza-Franco E.F., Vidal-Martínez V.M. 2005. Phylogeny of species of *Sciadicleithrum* (Monogenea: Ancyrocephalinae), and their historical biogeography in the Neotropics. *Journal of Parasitology*, 91, 253–259. DOI: 10.1645/GE-3389.
- Vidal-Martínez V.M., Scholz T., Aguirre-Macedo M.L. 2001. Dactylogyridae of cichlid fishes from Nicaragua, Central America, with descriptions of *Gussevia herotilapia* sp. n. and three new species of *Sciadicleithrum* (Monogenea: Ancyrocephalinae). *Comparative Parasitology*, 68, 76–86.

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