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Three new species of *Jainus* (Monogenoidea: Dactylogyridae) from the gills of *Triportheus angulatus* (Characiformes: Triportheidae) collected in the Peruvian Amazonia

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Abstract Three new species of *Jainus* Mizelle, Kritzky & Crane, 1968, are described parasitizing the gill filaments of *Triportheus angulatus* (Spix & Agassiz) (Characiformes: Triportheidae), an omnivorous fish endemic to the Amazon River basin. *Jainus iquitensis* **n. sp.** is characterized by the morphology of the vagina, which is bell-shaped, with a canal as a sclerotized tube and the morphology of hook pair VII, which in the new species presents an inflated base, a characteristic not observed in other congeners. *Jainus loretoensis* **n. sp.** is unique among *Jainus* species due to the morphology of its Y-shaped ventral anchors, with an arrow-shaped superficial root and a finger-shaped deep root. *Jainus sardinae* **n. sp.** is characterized by presenting a slender, small J-shaped tube with a sigmoid accessory piece and a ventral anchor that is Y-shaped, with inconspicuous finger-shaped deep root and superficial root with rounded ending with a chin-shaped projection. These findings add three new species to the previously reported two *Jainus* species from Peru.

Keywords Ectoparasite · Iquitos · *Jainus* · Monogenoids

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Introduction

Triportheus angulatus (Spix & Agassiz) (Characiformes: Triportheidae), commonly referred to as the "dusky narrow hatchetfish" and locally known in Peru as "sardina," is an omnivorous fish species that feeds on fruits, seeds, terrestrial and aquatic insects, as well as small fish (Froese & Pauly, 2023). This species is widely distributed in South America (Peru, Brazil, Ecuador, Bolivia, Venezuela, Colombia and Guyana). In the Peruvian Amazon it has been recorded in regions Loreto, Ucayali and Madre de Dios. It

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inhabits the main channels of rivers, minor tributaries, marginal flood zones, and nearby lagoons. *Triportheus angulatus* undertakes reproductive migrations that coincide with the rising water levels before reaching their peak. It typically swims in mixed schools along with *Triportheus albus* (Cope) and *Triportheus elongatus* (Günther) (García-Dávila et al., 2018).

Despite the scientific study concerning the metazoan parasites of *T. angulatus* in the Peruvian Amazon (Rengifo-Chota et al., 2022; Santillán et al., 2024), some parasites still need to be formally described. Currently, only the research of (Rengifo-Chota et al., 2022) has been conducted. The authors reported the presence of the following monogenoid diversity: *Anacanthorus acuminatus* Kritsky, Boeger & Van Every, 1992; *Anacanthorus chaunophallus* Kritsky, Boeger & Van Every, 1992; *Anacanthorus chelophorus* Kritsky, Boeger & Van Every, 1992; *Anacanthorus euryphallus* Kritsky, Boeger & Van Every, 1992; *Anacanthorus lygophallus* Kritsky, Boeger & Van Every, 1992; *Anacanthorus pithophallus* Kritsky, Boeger & Van Every, 1992; *Ancistrohaptor falciferum* Agarwal & Kritsky, 1998; *Ancistrohaptor falcunculum* Agarwal & Kritsky, 1998, and three unidentified species belonging to the genus *Jainus* Mizelle, Kritzky & Crane, 1968 (Rengifo-Chota et al., 2022).

The genus *Jainus* parasitizes characiform hosts from the Anostomidae, Characidae, Thriportheidae and Bryconidae families (Santillán et al., 2024). *Jainus* species are distinguished from other Dactylogyridae members by their ventral anchor, which features an elongate rod-like deep root and a flattened superficial root (Mizelle et al., 1968; Abdallah et al., 2012). Currently, 11 species of *Jainus* are known from Brazil, Costa Rica, and Peru (Kritsky et al., 1980; Karling et al., 2011; Abdallah et al., 2012; Cohen et al., 2012; Yamada et al., 2023; Cruces et al., 2024) (Table 1). In Peru, two species of *Jainus* have been recorded in *Brycon amazonicus* (Spix & Agassiz): *J. amazonensis* Kritsky, Thatcher & Kayton, 1980, and *J. peruensis* Cruces, Santillán, Silvera, Morey, Rubin & Chero, 2024 (Kritsky et al., 1980, Cruces et al., 2024).

During a study on the diversity of dactylogyrids infecting the gill filaments of a commercially significant

Table 1 List of valid species of *Jainus* Mizelle, Kritsky & Crane, 1968, type hosts, host family, country and reference

Species	Type host	Host family	Country	References
Jainus amazonensis Kritsky, Thatcher & Kayton, 1980	*Brycon melanopterus*	Bryconidae	Brazil	Kritsky et al. (1980)
Jainus beccus Yamada, Müller, Zago, Yamada, Ebert, Franceschini & da Silva, 2023	*Leporinus friderici*	Anostomidae	Brazil	Yamada et al. (2023)
Jainus hexops Kritsky & Leiby, 1972	*Psalidodon fasciatus*	Characidae	Costa Rica	Kritsky and Leiby (1972)
Jainus iocensis Cohen, Kohn & Boeger, 2012	*Salminus brasiliensis*	Characidae	Brazil	Cohen et al. (2012)
Jainus iquitensis **n. sp.**	*Triportheus angulatus*	Triportheidae	Peru	Present study
Jainus jainus Mizelle, Kritsky & Crane, 1968	*Chalceus macrolepidotus*	Chalceidae	Brazil	Mizelle et al. (1968)
Jainus leporini Abdallah, Azevedo & Luque, 2012	*Hypomasticus copelandii*	Anostomidae	Brazil	Abdallah et al. (2012)
Jainus loretoensis **n. sp.**	*Triportheus angulatus*	Triportheidae	Peru	Present study
Jainus ornatus Yamada, Müller, Zago, Yamada, Ebert, Franceschini & da Silva, 2023	*Leporinus friderici*	Anostomidae	Brazil	Yamada et al. (2023)
Jainus peruensis Cruces, Santillán, Silvera, Morey, Rubin & Chero, 2024	*Brycon amazonicus*	Bryconidae	Peru	Cruces et al. (2024)
Jainus piava Karling, Bellay, Takemoto & Pavanelli, 2011	*Schizodon borellii*	Anostomidae	Brazil	Karling et al. (2011)
Jainus radixelongatus Yamada, Müller, Zago, Yamada, Ebert, Franceschini & da Silva, 2023	*Leporinus striatus*	Anostomidae	Brazil	Yamada et al. (2023)
Jainus robustus Mizelle, Kritsky & Crane, 1968	*Bryconops affinis*	Iguanodectidae	Brazil	Mizelle et al. (1968)
Jainus sardinae **n. sp.**	*Triportheus angulatus*	Triportheidae	Peru	Present study

Amazonian fish species, *T. angulatus*, three new species of *Jainus* were found and are described herein.

Materials and methods

Thirty specimens of *T. angulatus* were obtained during three visits to the "Belen" market in the city of Iquitos, Peru. According to fishermen, specimens were captured in the Amazonas River. Samples were collected between September (10 specimens), October (10 specimens), and November 2019 (10 specimens) under the license for collection of biological material: Resolution No132-2014-GRL-DIREPRO; Resolution No21-2016 GRL-DIREPRO; and PTH-068-16-PECSANIPES. The collected fish were transported alive to the Laboratory of Parasitology of the "Instituto de Investigaciones de la Amazonía Peruana" (IIAP), in Iquitos, Loreto-Peru. After the necropsy of the fish, gill archers were immediately removed and placed in vials containing heated water (approximately 68 °C). Each vial was vigorously shaken, and 96% ethanol was added. In the laboratory, the content of each vial was examined using a dissecting microscope and parasites were removed from the gills or sediment using dissection needles. Some monogenean specimens were stained with Gomori's trichrome (Boeger and Vianna, 2006) and mounted in Canada Balsam to determine internal soft structures, while others were cleared in Hoyer's medium for the study of sclerotized structures (Boeger and Vianna, 2006).

Sclerotized structures of all parasites were photographed with a digital camera (LEICA ICC50W) connected to a phase contrast microscope (LEICA DM750), and the images were used to obtain the measurements of the male copulatory organ (MCO) and haptoral sclerites (Humason, 1979). Measurements are expressed as the range followed by the mean and number (n) of structures measured in parentheses. Measurements, all in micrometers were made using the software LAS EZ from LEICA and following the procedures of Mizelle & Klucka (1953) (Table 2). Lengths of curved or bent structures (anchors, bars, and accessory piece) represent the straight-line distances between extreme ends (Fig. 1). Illustrations were prepared with the aid of a drawing tube and microprojector.

The type specimens were deposited in the Helminthological Collection of the Museum of Natural History at the San Marcos University (MUSM) Peru, and in the collection of the Laboratorio de Parasitología y Sanidad Acuícola of the Instituto de Investigaciones de la Amazonía Peruana (LAPYSA). To comply with the regulations set out in article 8.5 of the amended 2012 version of the International Code of Zoological Nomenclature (ICZN, 2012), details of the new taxon have been submitted to ZooBank (i.e., generic name, specific name). The Life Science Identifier (LSID) is reported in the taxonomic summary.

Table 2 Comparative measurements (in µm) of the new species of *Jainus* Mizelle, Kritsky & Crane, 1968 described in the present study

Measurements	*Jainus iquitensis* **n. sp.**	*Jainus loretoensis* **n. sp.**	*Jainus sardinae* **n. sp.**
Body length	262 (242–320)	265 (239–310)	325 (286–354)
Body width	99 (90–115)	88 (80–94)	180 (146–199)
Pharynx	10 (8–12)	10 (8–12)	8 (6–10)
MCO	34 (29–36)	33 (24–37)	31 (22–33)
Accessory piece	21 (18–27)	24 (15–28)	20 (14–23)
Haptor length	40 (35–52)	32 (29–48)	16 (12–28)
Haptor width	73 (62–85)	60 (53–74)	43 (31–64)
Ventral bar length	6 (6–8)	4 (4–6)	6 (4–8)
Dorsal bar length	20 (14–24)	37 (24–44)	36 (25–46)
Ventral anchor length	8 (6–10)	21 (17–24)	9 (7–14)
Ventral anchor width	4 (4–6)	8 (4–10)	8 (4–9)
Dorsal anchor length	26 (20–35)	25 (20–30)	23 (22–29)
Dorsal anchor width	15 (10–20)	14 (10–16)	16 (12–19)
Hooks	9 (6–12)	12 (8–14)	10 (8–13)
Hook pair VII	24 (20–26)	–	–

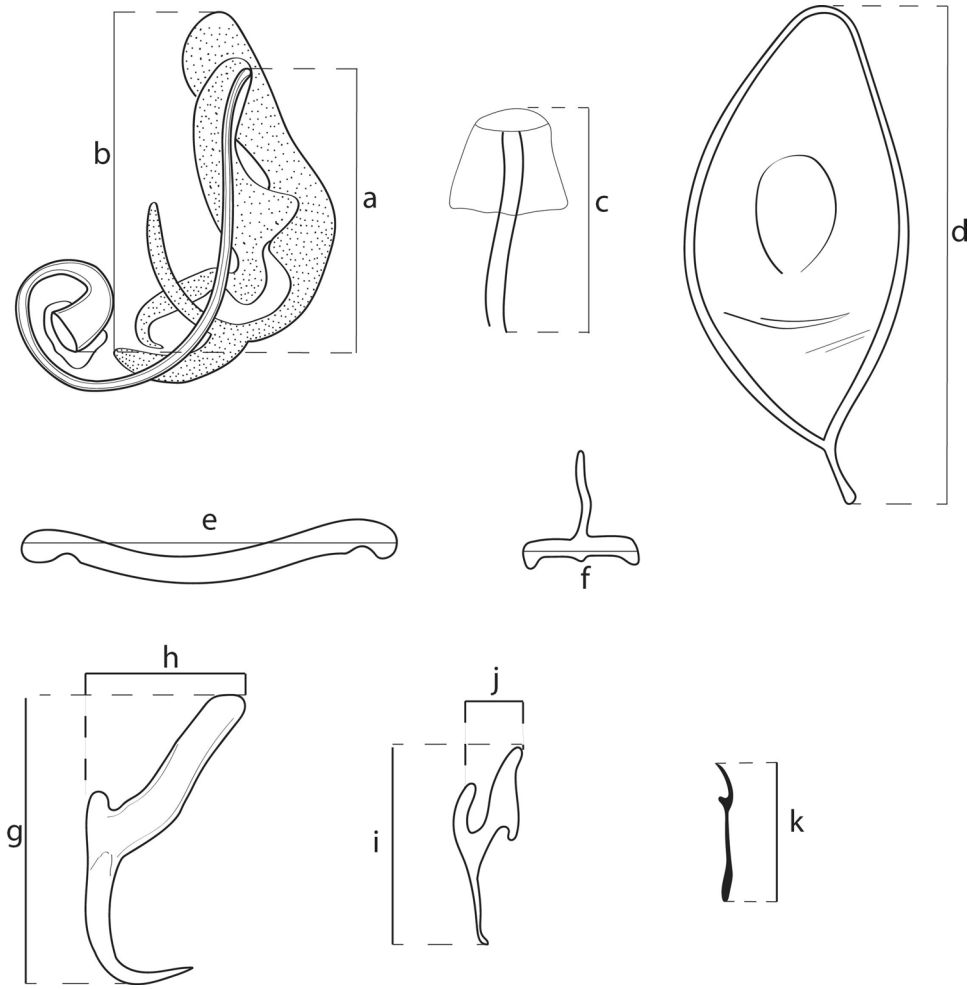

Fig. 1 Scheme of measurements of the sclerotized structures of the copulatory complex and the haptor of *Jainus* spp. (a) total length of MCO, (b) total length of accessory piece, (c) total length of vagina, (d) total length of egg, (e) total length of dorsal bar, (f) total length of ventral bar, (g) total length of dorsal anchor, (h) total width of dorsal anchor, (i) total length of ventral anchor, (j) total width of ventral anchor, (k) total length of hook.

Parasitological indices were calculated according to Bush et al. (1997)

Ethic aspects: statement on ethical approval from an ethics committee and license for working with fish species were followed according to the resolutions: Resolution No132-2014-GRL-DIREPRO; Resolution No21-2016 GRL-DIREPRO; and PTH-068-16-PECSANIPES.

Results

Order Dactylogyridea Bychowsky, 1937

Family *Dactylogyridae* Bychowsky, 1937

Jainus Mizelle, Kritsky & Crane, 1968

Jainus iquitensis n. sp.
Syn: *Jainus* sp1. of Rengifo-Chota et al. (2022)
Jainus sp1. of Moreira et al. (2017)
Type-host: *Triportheus angulatus* (Spix & Agassiz) (Characiformes: Triportheidae).
Type-locality: Belen Market, in Loreto, Peru (3°46′01″ S 73°14′48″ W).
Type-material: Holotype (MUSM 5390), three paratypes (MUSM 5391a-c) and two vouchers (LAPYSA M-18 a-b).
Site in host: Gill filaments.

Parasitological indices: prevalence 66.6% (20/30), mean intensity of infestation 2.5, mean abundance of infestation 1.6

ZooBank registration: The Life Science Identifier (LSID) for *Jainus iquitensis* **n. sp.** is urn:lsid:zoobank.org:act:2F5B1DAC-4D9D-4048-82C8-80F9B1C9F62C

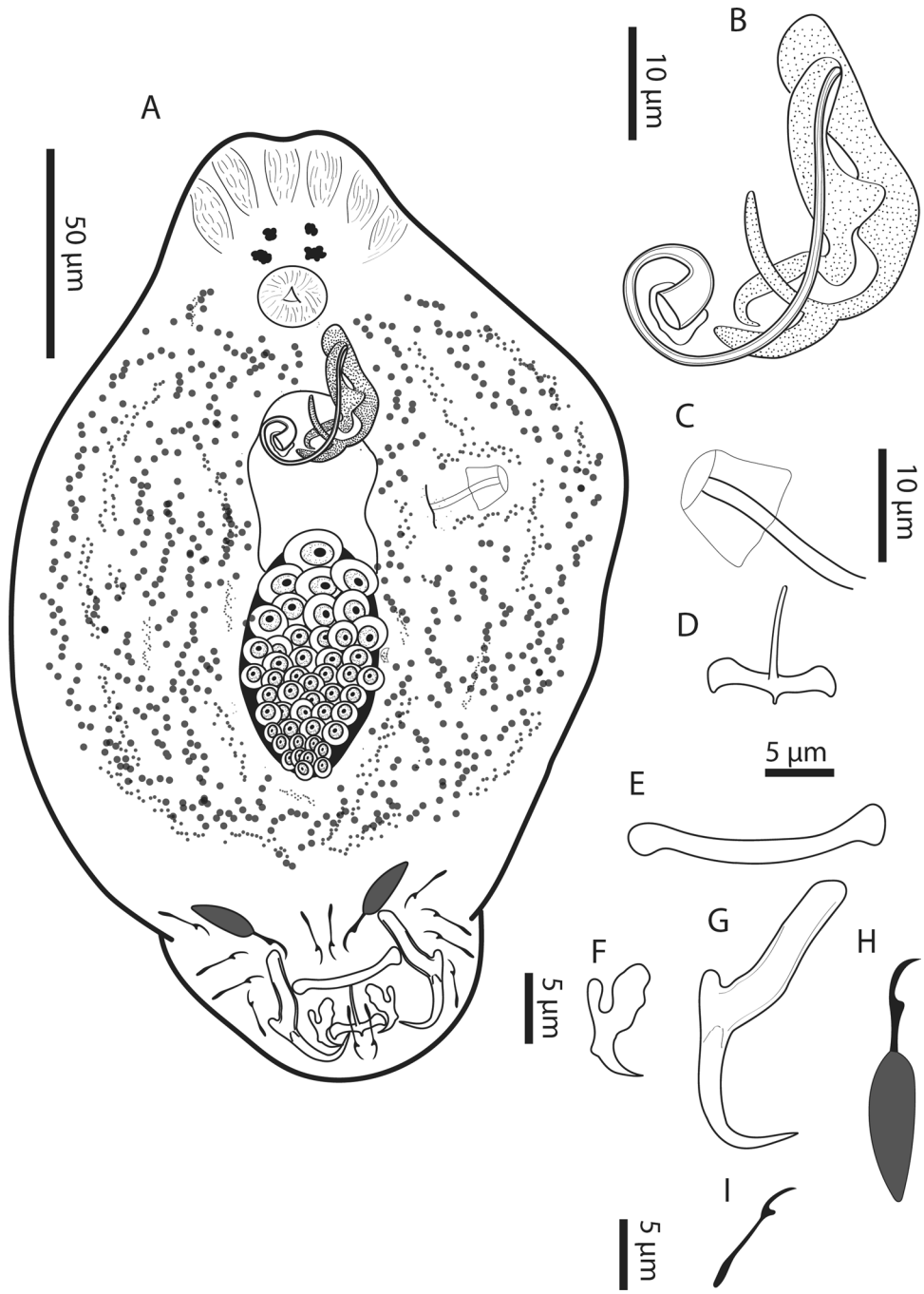

Fig. 2 *Jainus iquitensis* **n. sp.** ex *Triportheus angulatus*. A, whole mount, ventral view; B, copulatory complex; C, vagina; D, ventral bar; E, dorsal bar; F, ventral anchor; G, dorsal anchor 7; H, hook pair VII; I, hook pair II.

Etymology: The specific name refers to the city (Iquitos) where the species was found.

Description (Fig. 2A–I)

[Based on 08 adult specimens; four stained in Gomori's Trichrome and four clarified in Hoyer's medium] Body robust (Fig. 2A), 242–320 (262; n = 6) long; greatest width (at the level of the germarium) 90–115 (99; n = 6). Two bilateral cephalic lobes poorly developed. Three bilateral pairs of conspicuous head organs. Eyes present, being the posterior par bigger than anterior one. Pharynx spherical 10–14 (12; n = 6) long, 8–12 (10; n = 6) wide. MCO 29–36 (34; n = 6) long, slender J-shaped tube, with a delicate loop at the base. Accessory piece 18–27 (21; n = 6) long, unarticulated to MCO base, with a robust termination, with bifurcations in its distal part resembling branches (Fig. 2B). Testis subspherical, dorsal to germarium 42–52 (48; n = 4) long, 25–30 (25; n = 4) wide. Prostatic reservoir and prostatic glands not observed. Germarium elongate 45–55 (50; n = 4) long, 22–34 (26; n = 4) wide; oviduct, oötype, uterus, and seminal receptacle not observed. Presence of a mid-sinistral vagina, bell-shaped, vaginal canal a sclerotized tube 12–14 (10; n = 6) (Fig. 2C). Eggs not observed. Haptor subovate, 35 –52 (40; n = 6) long; 62–85 (73; n = 6) wide. Ventral bar 6–8 (6; n = 6) long, with long medial anterior projection and small posterior projection (Fig. 2D). Dorsal bar elongated, with expanded ends 14–24 (20; n = 6) long (Fig. 2E). Anchors dissimilar in shape and size. Ventral anchor 6–10 (8; n = 6) long, 4–6 (4; n = 6) wide; inconspicuous deep root, smaller than superficial root, robust superficial root with lateral bulges; curved shaft with a small hump; short point (Fig. 2F). Dorsal anchor 20–35 (26 n = 6) long, 10–20 (15; n = 6) wide, with superficial root approximately 6 times longer than deep root; superficial root elongated, resembling a hump between the end of the deep root and the shaft; straight shaft and recurved point (Fig. 2G). Hooks similar in shape and size 6–12 (9; n = 6) long, except hook pair VII 20–26 (24; n = 6) (Fig. 2H) is differentiated from the others by presenting an inflated base longer than the shank and poorly developed thumb. Hooks with upright thumb, slender shank with slightly inflated termination, short and recurved point; filamentous hook (FH) not observed (Fig. 2I).

Remarks *Jainus iquitensis* **n. sp.** most closely resembles *J. ornatus* Yamada, Müller, Zago, Yamada, Ebert, Franceschini & Silva, 2023 based on the morphology of the MCO and the accessory piece. However, the new species is differentiated from *J. ornatus* by the presence of an accessory piece not articulated to the base of the MCO (Fig. 3A). The morphology of the vagina is bell-shaped, with a canal as a sclerotized tube (Fig. 3B) in the new species, while in *J. ornatus* the vagina is not observed. The new species also differs from *J. ornatus* by the morphology of the anchors (Fig. 2F–G, 3C) and the morphology of hook pair VII, which in the new species presents an inflated base (Fig. 2H, 3D), while in *J. ornatus* all seven hook pairs are similar.

***Jainus loretoensis* n. sp.**

Type-host: *Triportheus angulatus* (Spix & Agassiz) (Characiformes: Triportheidae).

Type-locality: Belen Market, in Loreto, Peru (3°46′01″S 73°14′48″W).

Type-material: Holotype (MUSM 5392), three paratypes (MUSM 5393a-c), and two vouchers (LAPYSA M-19 a-b).

Site in host: Gill filaments.

Parasitological indices: prevalence 53.3% (16/30), mean intensity of infestation 1.75, mean abundance of infestation 0.93

ZooBank registration: The Life Science Identifier (LSID) for *Jainus loretoensis* **n. sp.** is urn:lsid:zoobank.org:act:2F5B1DAC-4D9D-4048-82C8-80F9B1C9F62C

Etymology: The specific name refers to the Region (Loreto) where the species was found.

Description (Fig. 4A–G)

[Based on 08 adult specimens; four stained in Gomori's Trichrome and four clarified in Hoyer's medium] Body robust, fusiform, 239–310 (265; n = 6) long; greatest width (at the level of the germarium) 80–94 (88; n = 6) (Fig. 4A). One terminal, two bilateral cephalic lobes poorly developed. Three bilateral pairs of conspicuous head organs. Eyes present, being the posterior par bigger than the anterior one. Pharynx spherical 12–14 (12; n=6) long, 8–12 (10; n =6) wide. MCO 24–37 (33; n = 6) long, slender J-shaped tube, to forming a clockwise ring. Accessory piece 15–28 (24; n = 6) long, articulated to MCO base, with bifurcations in its distal part resembling

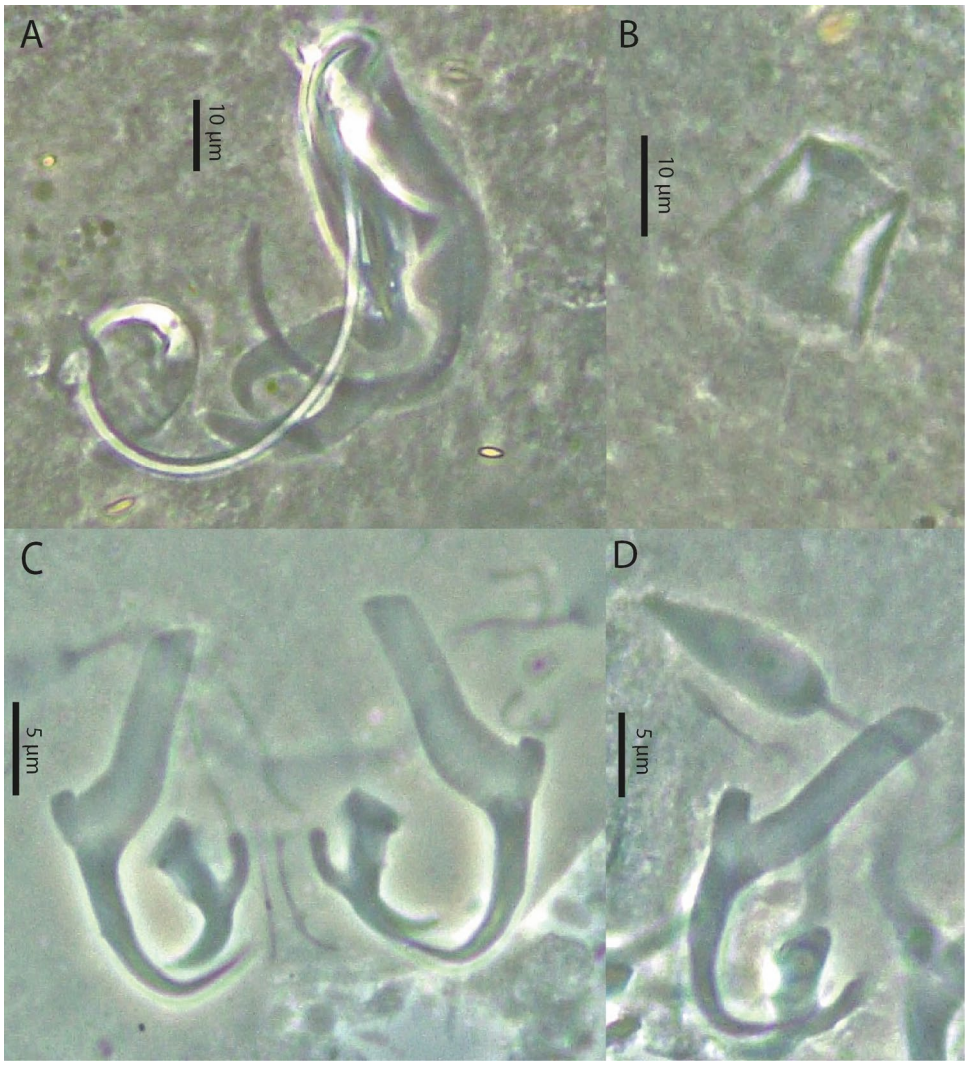

Fig. 3 Photomicrography of sclerotized structures in *Jainus iquitensis* **n. sp.** A. Copulatory complex, B. Vagina, C. Structures of the haptor, D. Hook pair VII.

tweezers and one branch in its middle part (Fig. 4B). Testis subspherical, dorsal to germarium 18–26 (22; n = 4), long, 10–14 (12; n = 4) wide. Prostatic reservoir and prostatic glands not observed. Germarium elongate 20–30 (26; n = 4) long, 14–20 (16; n = 4) wide; oviduct, oötype, uterus, vagina, and seminal receptacle not observed. Haptor subovate, 29–48 (32; n = 6) long; 53–74 (60; n = 6) wide. Ventral bar 4–6 (4; n = 6) long, with long medial anterior projection, with lateral extremities directed posteriorly (Fig. 4C). Dorsal bar elongated, 24–44 (37; n = 6) long (Fig. 4D). Anchors dissimilar in shape and size. Ventral anchor Y-shaped, 17–24 (21; n = 6) long, 4–10 (8; n = 6) wide; conspicuous, and elongated deep root finger-shaped; arrow-shaped superficial root, with a small opening in its middle part; curved shaft and quadrangular point (Fig. 4E). Dorsal anchor 20–30 (25; n = 6) long, 10–16 (14; n = 6) wide; with straight shaft and point (Fig. 4F). Hooks similar in shape and size 8–14 (12; n = 6) long; each hook with upright thumb, slender shank, and short and recurved point; filamentous hook (FH) not observed (Fig. 4G).

Remarks *Jainus loretoensis* **n. sp.** resembles *J. ornatus* and *Jainus radixelongatus* Yamada, Müller, Zago, Yamada, Ebert, Franceschini & Silva, 2023

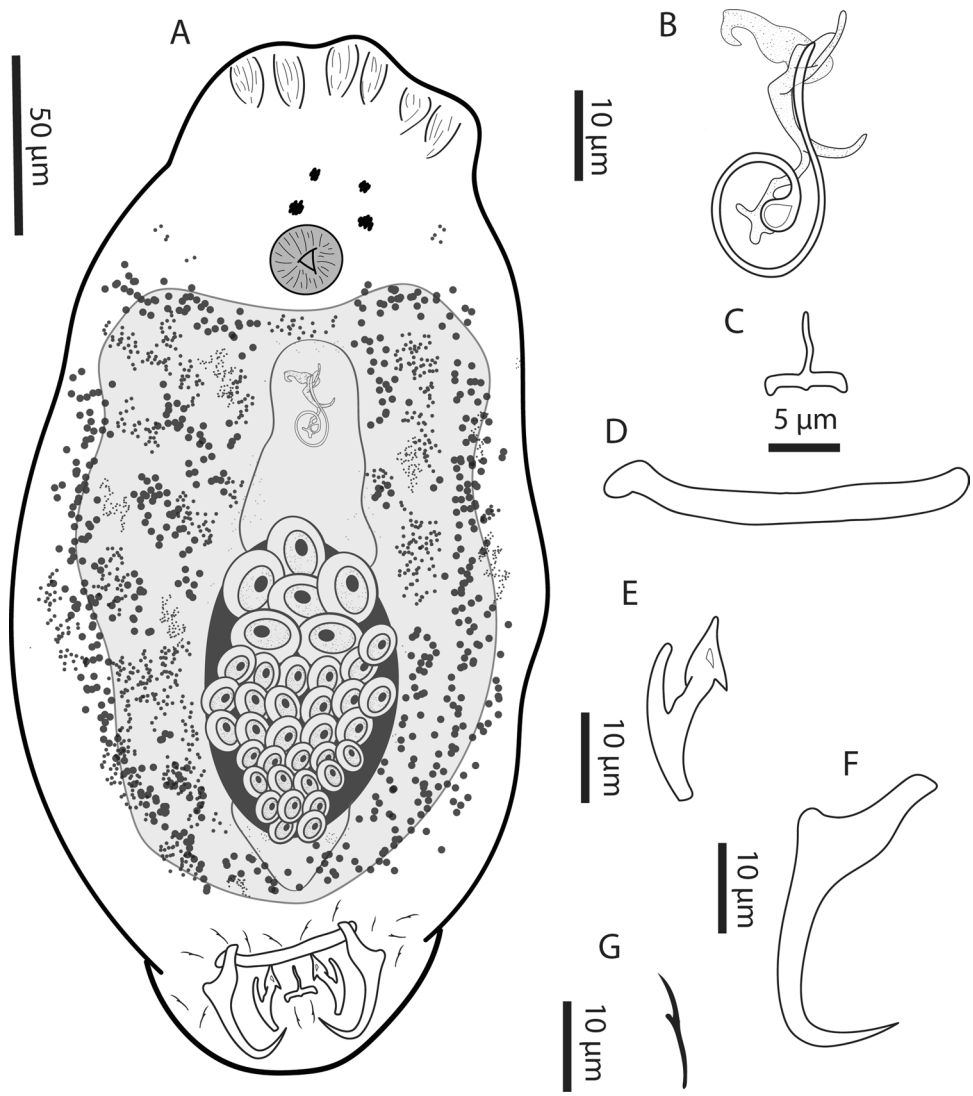

Fig. 4 *Jainus loretoensis* **n. sp.** ex *Triportheus angulatus*. A, Whole mount, ventral view; B, copulatory complex; C, ventral bar; D, dorsal bar; E, ventral anchor; F, dorsal anchor; G, hook pair I.

regarding the shape of the MCO (Fig. 5A). However, the new species differs from *J. ornatus* and *J. radix-elongatus* by the morphology of the ventral anchor, which is Y-shaped, with elongated finger-shaped deep root; arrow-shaped superficial root, with a small opening in its middle part, and curved shaft with quadrangular point (Fig. 5B).

***Jainus sardinae* n. sp.**

Type-host: *Triportheus angulatus* (Spix & Agassiz) (Characiformes: Triportheidae).

Type-locality: Belen Market, in Loreto, Peru (3°46′01″ S 73°14′48″ W).

Type-material: Holotype (MUSM 5394), five paratypes (MUSM 5395a-e), and two vouchers (LPYSA M-20 a-b).

Site in host: Gill filaments.

Parasitological indices: prevalence 33.3% (10/30), mean intensity of infestation 1.9, mean abundance of infestation 0.63

ZooBank registration: The Life Science Identifier (LSID) for *Jainus sardinae* **n. sp.** is urn:lsid:zoobank.

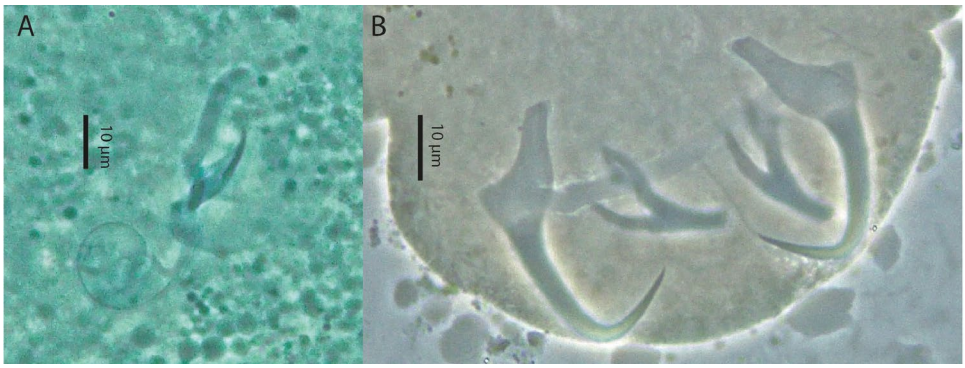

Fig. 5 Photomicrography of sclerotized structures in *Jainus loretoensis* **n. sp.** A. Copulatory complex, B. Structures of the haptor.

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Etymology: The specific name refers to the locally common name of the host (sardina).

Description (Fig. 6A–H)

[Based on 10 adult specimens; four stained in Gomori's Trichrome and six clarified in Hoyer's medium] Body robust, fusiform, 286–354 (325; n = 8) long (Fig. 6A); greatest width (at the level of the germarium) 146–199 (180; n = 8). Two bilateral cephalic lobes poorly developed. Four bilateral pairs of conspicuous head organs. Eyes present, being the posterior par bigger than anterior one. Pharynx spherical 10–12 (10; n=6) long, 6–10 (8; n =8) wide. MCO 22–33 (31; n = 8) long, slender small J-shaped tube. Accessory piece 14–23 (20; n = 8) long, unarticulated to MCO base, small, sigmoid, folded in its middle part forming two projections, one directed anteriorly and the other posteriorly (Fig. 6B). Testis subspherical, dorsal to germarium 44–50 (48; n = 4) long, 20–24 (22; n = 4) wide. Prostatic reservoir and prostatic glands not observed. Egg elongated 36–42 (40; n = 2) (Fig. 6C), germarium elongate 46–54 (52; n = 8) long, 20–24 (22; n = 4) wide; oviduct, oötype, uterus, vagina, and seminal receptacle not observed. Haptor subovate, 12–28 (16; n = 8) long; 31–64 (43; n = 8) wide. Ventral bar 4–8 (6; n = 8) long, cross-shaped; with long medial anterior projection, smaller posterior projection (Fig. 6D). Dorsal bar elongated, 25–46 (36; n = 8) long, with rounded end (Fig. 6E). Anchors dissimilar in shape and size. Ventral anchor Y-shaped, 7–14 (9; n = 8) long, 4–9 (8; n = 8) wide; inconspicuous deep root, finger-shaped; superficial root with rounded ending with a chin-shaped projection; straight shaft and small rounded point (Fig. 6F). Dorsal anchor 22–29 (23; n = 8) long, 12–19 (16; n = 8) wide, with superficial root approximately five times longer than deep root; straight shaft and curved point, deep root small (Fig. 6G). Hooks similar in shape and size 8–13 (10; n = 6) long; each hook with right thumb, slender shank, and short and recurved point; filamentous hook (FH) not observed (Fig. 6H).

Remarks *Jainus sardinae* **n. sp.** shares the characteristic of a ventral bar with antero- and posteromedial projections with *J. hexops* Kritsky and Leiby, 1972, *J. robustus* Mizelle, Kritsky & Crane, 1968, and *J. iquitensis* **n. sp.** However, it can be differentiated from *J. hexops* and *J. iquitensis* **n. sp.** by the morphology of the MCO and the accessory piece, which in *J. sardinae* **n. sp.** is a slender, small and unarticulated J-shaped tube and a sigmoid accessory piece (Fig. 7A). Additionally, the ventral bar in *J. sardinae* **n. sp.** (Fig. 7B) differs from the ventral bar of *J. robustus* in its morphology, presenting an elongated and thin anteromedial projection, as well as a short postero-medial projection. *Jainus robustus* presents a short and thick anteromedial projection and a thin postero medial projection, widening in its final part, giving the appearance of a tail.

Discussion

Three undescribed species of *Jainus* (*Jainus* sp1., *Jainus* sp2., and *Jainus* sp3.) have been reported infesting *T. angulatus* in Peru by Rengifo-Chota

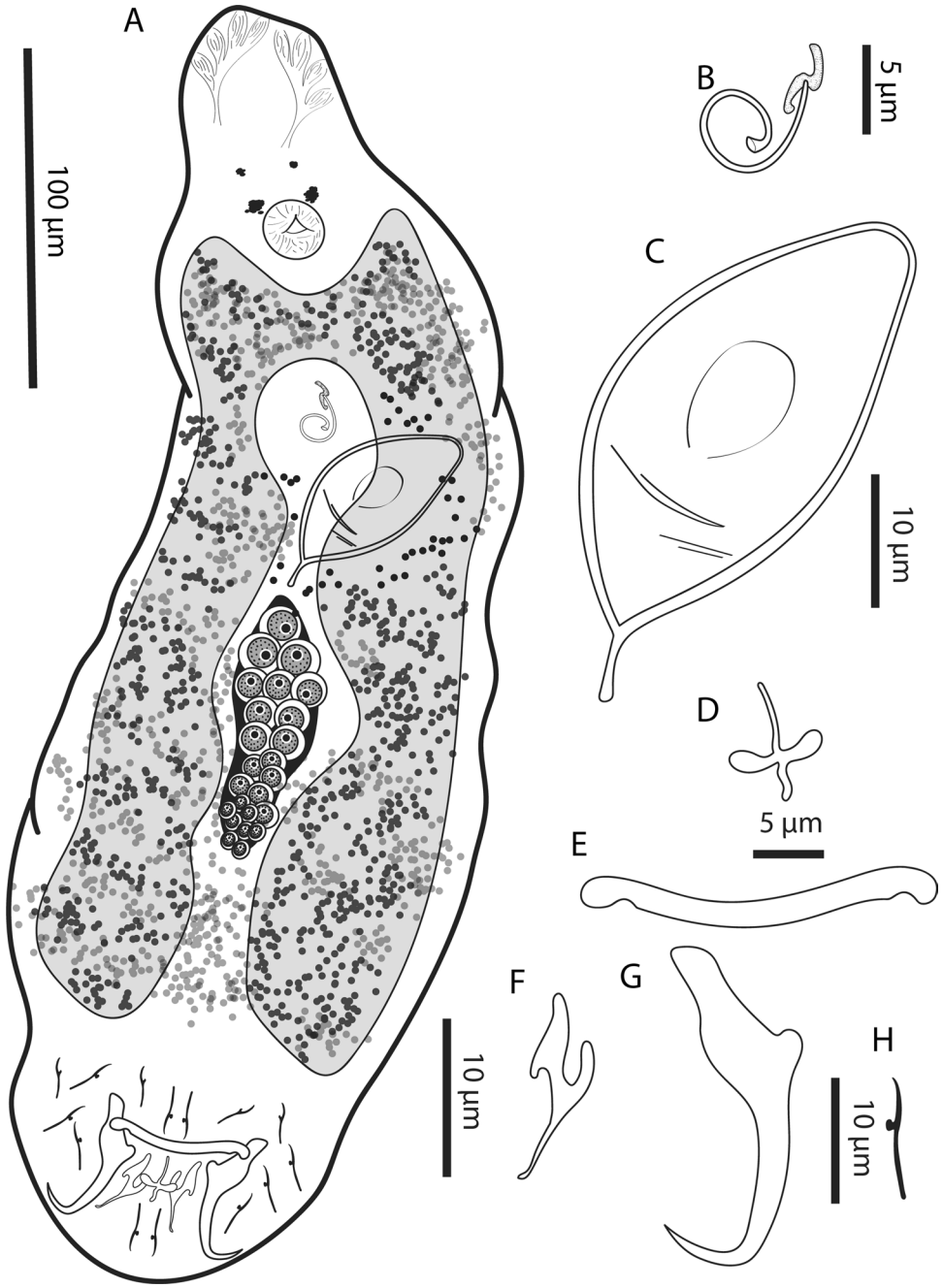

Fig. 6 *Jainus sardinae* **n. sp.** ex *Triportheus angulatus*. A, Whole mount, ventral view; B, copulatory complex; C, egg; D, Ventral bar; E, Dorsal bar; F, ventral anchor; G, dorsal anchor; H, hook pair I.

et al. (2022). An analysis of the voucher specimens deposited in the LAPYSA, along with the photographs provided by Rengifo-Chota et al. (2022), indicates that *Jainus* sp1 is conspecific with the new species described in the present work. Consequently, *Jainus* sp1. is referred to as *J. iquitensis* **n. sp.**

Due to the morphological differences observed in the microphotographs of *Jainus* sp. 2 and *Jainus* sp. 3 presented by Rengifo-Chota et al. (2022),

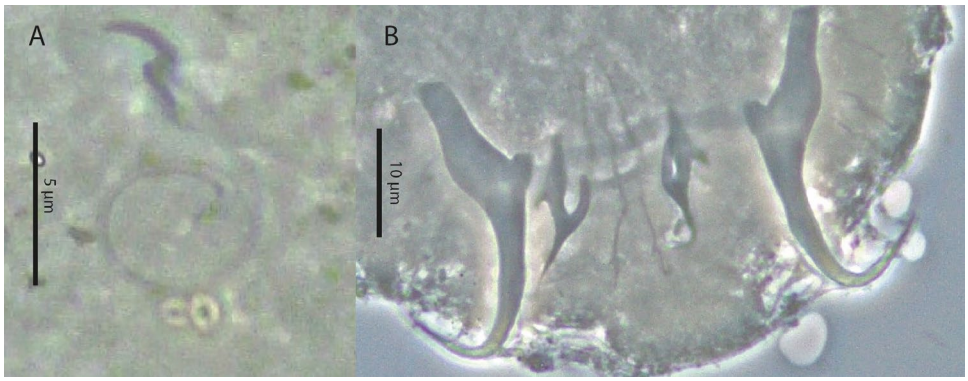

Fig. 7 Photomicrography of sclerotized structures in *Jainus sardinae* **n. sp.** A. Copulatory complex, B. Structures of the haptor.

the possibility that *J. loretoensis* **n. sp.** corresponds to *Jainus* sp. 2 and *J. sardinae* **n. sp** corresponds to *Jainus* sp. 3 is ruled out, so it can be concluded that *Jainus* sp. 2 and *Jainus* sp. 3 correspond to species of *Jainus* not yet described. Moreira et al. (2017) recorded an undescribed species of *Jainus*, referred to as *Jainus* sp1., on *T. angulatus* in Brazil. However, the morphological characteristics of this species are conspecific with *J. iquitensis* **n. sp.** (Morey, personal communication). The presence of *J. iquitensis* **n. sp.** in both Peru and Brazil is not surprising given the distribution of its host, which is endemic to the Amazon River basin (García-Dávila et al., 2018; Froese & Pauly, 2023). These findings emphasize the potential richness of the dactylogyrid fauna within the fish populations in the Peruvian Amazon, highlighting the need for further exploration and detailed taxonomic studies. Furthermore, this work contributes to a better understanding of the diversity of Dactylogyridae in the Peruvian Amazon by describing three new species that until the present study remained without a formal description and identification.

In the diagnosis of the genus *Jainus* proposed by Mizelle et al. (1968), it is pointed out that the MCO and the accessory piece are not articulated. However, subsequent studies reported species of *Jainus* presenting the MCO articulated with the base of the accessory piece: *J. amazonensis* Kritsky, Thatcher & Kayton, 1980 (Kritsky et al., 1980) from *Brycon amazonicus* (Spix & Agassiz); *J. piava* Karling, Bellay, Takemoto & Pavanelli, 2011 from *Schizodon borellii* (Boulenger); *J. iocensis* Cohen, Khon & Boeger, 2012 (Cohen et al., 2012) from *Salminus brasiliensis* (Cuvier); *Jainus ornatus* Yamada, Müller, Zago, Yamada, Elbert, Franceschini & Silva, 2023 from *Leporinus friderici* (Bloch)*; J. radix-elongatus* from *L. striatus* Kner (Yamada et al., 2023), and *J. loretoensis* **n. sp.** described in the present study. In that sense, the articulation of the accessory piece to the base of the MCO can be considered as a potential diagnosis amendment for the genus *Jainus*.

Among the similarities between these studies, we can highlight the shape of the MCO which is a J-shaped tube or forming a ring at the proximal end in all mentioned species. Divergences can be noticed in the morphology of the accessory pieces that vary among species. Another divergence is observed in hook pair VII, which in *J. loretoensis* **n. sp.** is modified and different from the other hook pairs, a feature not observed in other species of the genus. This justifies the need to continue taxonomic studies to discover and describe other species of *Jainus* that may present similar characteristics related to the expansion of the base of hook pair VII.

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Author contribution GAMM formal analysis, methodology, writing, supervision, DCV, HRC and JDC formal analysis, investigation, methodology

Data availability The data that support the findings of this study are available from the corresponding author upon reasonable request. No datasets were generated or analysed during the current study.

Declarations

Conflict of interest The authors declare no competing interests.

Ethical approval All applicable institutional, national, and international guidelines for the care and use of animals were followed.

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