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Ancistrohaptor forficata sp. n. (Monopisthocotyla, Dactylogyridae): A New Parasite of *Triportheus signatus* (Characiformes, Triportheidae) from the Salgado River, Brazil

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Abstract: The genus *Ancistrohaptor* was proposed to accommodate monopisthocotylans flatworms parasitic on the gills of species of the genus *Triportheus* in Manaus, Amazonas state, Brazil. Its main characteristics are (a) an accessory piece of the male copulatory organ composed of two distinct parts; (b) dextral or dextroventral vaginal openings; and (c) large ventral anchors with elongated shafts. A new species of *Ancistrohaptor* was found to parasitize the gills of *Triportheus signatus* collected from the Salgado River, Ceará State, Brazil. A new species of Monopisthocotyla was collected and described. *Ancistrohaptor forficata* sp. n. is primarily characterized by having a male copulatory organ with less than one turn, the presence of an articulated accessory piece with a concave rod-shaped termination, and a free accessory piece that is clamp shaped and bifurcated, as well as a dorsal bar with shading present in its medial part. This is the fourth species description of the genus *Ancistrohaptor* for fish of the genus *Triportheus* and the first record for *T. signatus* and the aquatic ecosystems of the Caatinga domain.

Keywords: Caatinga domain; freshwater fish; gill ectoparasites; Platyhelminthes; Monogenea

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1. Introduction

Triportheus signatus (Garman, 1890) (Characiformes: Triportheidae), commonly known as "Sardinha de água doce", is an endemic species of the northeast region, distributed throughout the Parnaíba river basin and some coastal drainages of northeastern Brazil [1,2]. It is a small species, ranging from 20 to 24 cm in size, with an elongated and narrow body, well-developed pectoral fins, and a well-developed keel in the pre-pelvic region [3–5].

Triportheids in South America serve as hosts for various parasites. In this region, there are 49 species from eight parasite groups associated with triportheids [6–18]. Among these parasites, monopisthocotylans stand out due to their host specificity and unique evolutionary adaptations, making them an excellent subject of study. These characteristics not only aid in understanding the evolutionary history of parasites and their hosts but also contribute to clarifying patterns of biogeographical distribution, providing insights into the historical and ecological processes that have shaped parasitic relationships in South America [19–21].

Monopisthocotylans are among the most widely studied groups of fish parasites in the neotropical region [22–37]. Until 2013, approximately 651 species of monopisthocotylans have been reported in fish, amphibians, and reptiles from South America, with 191 species

recorded in fish of the order Characiformes [23]. Research on monopisthocotylan diversity has expanded considerably in recent years, as reflected by an increase in the number of records and newly proposed species [24–27,38–40].

Currently, there are records of dactylogyrids parasitizing fish of the family Triportheidae belonging to four genera: twenty-one species of *Anacanthorus* Mizelle and Price 1998, three species of *Ancistrohaptor* Agarwal and Kritsky, 1998, three species of *Jainus* Mizelle, Kritsky and Crane, 1968, and one species of *Rhinoxenus* Kritsky, Thatcher, and Boeger, 1988. In addition, there are records of taxa from *Anacanthorus*, *Ancistrohaptor,* and *Jainus* Mizelle, Kritsky, and Crane, 1968, which have been recognized only at the genus level [9,11,12,16,41–47] (see Table 1).

Table 1. List of dactylogyrid species (Monopisthocotyla) found on triportheid fishes in the neotropical region.

Monopisthocotyla Species	Host	Country	Reference
Anacanthorus acuminatus Kritsky, Boeger, and Van Every, 1992	*Triportheus angulatus* *; *Triportheus elongatus*; *Triportheus albus*	Brazil, Peru	[11,41,45]
Anacanthorus alatus Kritsky, Boeger, and Van Every, 1992	*T. albus* *; *T. elongatus*	Brazil	[41]
Anacanthorus andersoni Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil	[41]
Anacanthorus bellus Kritsky, Boeger, and Van Every, 1992	*T. albus* *; *T. elongatus*; *Triportheus* sp.	Brazil	[41]
Anacanthorus calophallus Kritsky, Boeger, and Van Every, 1992	*T. elongatus* *	Brazil	[41]
Anacanthorus carinatus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil	[41]
Anacanthorus chaunophallus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil, Peru	[11,41,45]
Anacanthorus chelophorus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *; *Triportheus* sp.	Brazil, Peru	[11,41,45]
Anacanthorus cornutus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil	[41]
Anacanthorus euryphallus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil, Peru	[11,41,45]
Anacanthorus formosus Kritsky, Boeger, and Van Every, 1992	*T. elongatus* *; *Triportheus* sp.	Brazil	[41]
Anacanthorus furculus Kritsky, Boeger, and Van Every, 1992	*T. elongatus* *; *Triportheus rotundatus*; *Triportheus auritus*; *T. angulatus*	Brazil	[12,16,41]
Anacanthorus glyptophallus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil	[41]
Anacanthorus lygophallus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil, Peru	[11,41,45]
Anacanthorus nanus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *	Brazil	[41]
Anacanthorus pelorophallus Kritsky, Boeger, and Van Every, 1992	*T. elongatus* *	Brazil	[41]
Anacanthorus pithophallus Kritsky, Boeger, and Van Every, 1992	*T. angulatus* *; *T. rotundatus*; *T. auratus*; *Triportheus curtus*	Brazil, Peru	[11,12,16,41,44,45]
Anacanthorus quinqueramus Kritsky, Boeger, and Van Every, 1992	*T. albus* *; *T. elongatus*; *Triportheus* sp.	Brazil	[41]

Table 1. *Cont.*

Monopisthocotyla Species	Host	Country	Reference
Anacanthorus ramulosus Kritsky, Boeger, and Van Every, 1992	*T. albus* *; *T. elongatus*	Brazil	[41]
Anacanthorus spp.	*Triportheus signatus*; *Triportheus nematurus*	Brazil	[9,46]
Anacanthorus strongylophallus Kritsky, Boeger, and Van Every, 1992	*T. elongatus* *	Brazil	[41]
Anacanthorus tricornis Kritsky, Boeger, and Van Every, 1992	*T. elongatus* *	Brazil	[41]
Ancistrohaptor falcatum Agarwal and Kritsky, 1998	*T. elongatus* *	Brazil	[42]
Ancistrohaptor falciferum Agarwal and Kritsky, 1998	*T. angulatus*; *T. elongatus* *; *T. albus*; *Triportheus* sp.	Brazil, Peru	[11,42,45]
Ancistrohaptor falcunculum Agarwal and Kritsky, 1998	*T. angulatus*; *T. elongatus* *; *T. albus*	Brazil, Peru	[11,42,45]
***Ancistrohaptor forficata* sp. n.**	*T. signatus* *	Brazil	**Present study**
Ancistrohaptor sp.	*T. rotundatus*	Brazil	[12]
Jainus iquitensis Morey, Viana, Chota, and Chero, 2025	*T. angulatus* *	Brazil, Peru	[11,18,45]
Jainus loretoensis Morey, Viana, Chota, and Chero, 2025	*T. angulatus* *	Peru	[18]
Jainus sardinae Morey, Viana, Chota, and Chero, 2025	*T. angulatus* *	Peru	[18]
Jainus sp.	*T. angulatus*	Peru	[45]
Rhinoxenus anaclaudiae Domingues and Boeger, 2005	*T. angulatus*; *Triportheus* cf. *nematurus* *; *Triportheus* sp.	Brazil	[11,43]

* Type host.

Ancistrohaptor was erected by Agarwal and Kritsky [42] to accommodate the gill parasite of the freshwater fish of the genus *Triportheus* from the Amazonas basin, *Ancistrohaptor falciferum* Agarwal and Kritsky, 1998 (type species), on *Triportheus angulatus* (Spix and Agassiz, 1829), *Triportheus elongatus* (Günther, 1864), and *Triportheus albus* Cope, 1872; *Triportheus* sp. and *Ancistrohaptor falcatum* Agarwal and Kritsky, 1998, on *T. elongatus*, and *Ancistrohaptor falcunculum* Agarwal and Kritsky, 1998, on *T. angulatus*, *T. elongatus,* and *T. albus*.

During an investigation of the helminth fauna of fish from the Salgado River, Ceará State, Northeast Brazil, specimens of an undescribed species of *Ancistrohaptor* were recovered from the gills of *Triportheus signatus*. The present study describes this new species and compares it to closely related species in the genus.

2. Results

Taxonomic Summary of Ancistrohaptor forficate n. sp.

Class: Monopisthocotyla Brabec, Salomaki, Scholz, and Kuchta, 2023;
Subclass: Polyonchoinea Bychowsky, 1937;
Order: Dactylogyridea Bychowsky, 1937;
Family: Dactylogyridae Bychowsky, 1933;
Subfamily: Ancyrocephalinae Bychowsky, 1937;
Ancistrohaptor Agarwal and Kritsky, 1998.
Ancistrohaptor forficata sp. n.
(Figures 1A–G and 2A–C).

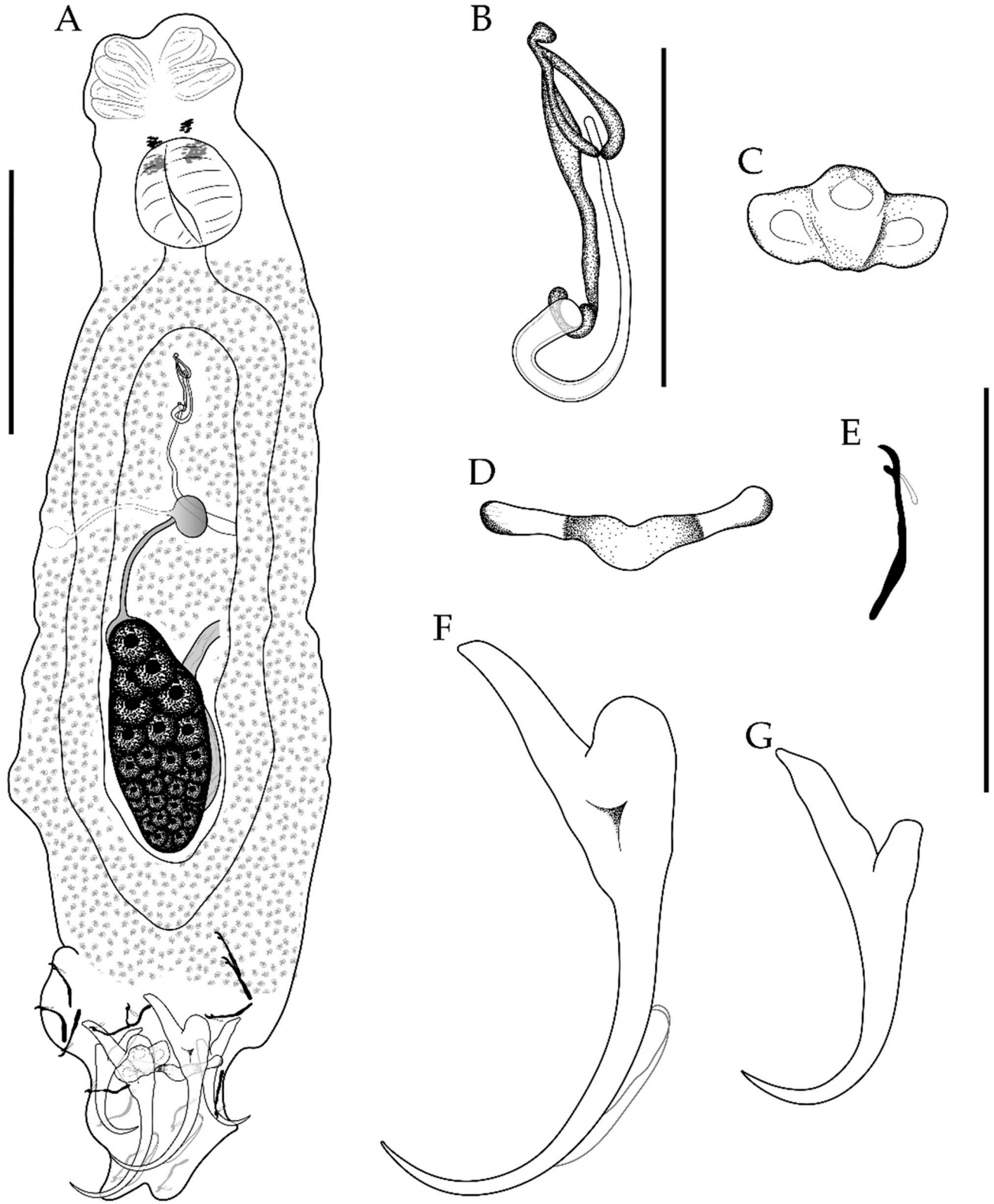

Figure 1. *Ancistrohaptor forficata* sp. n. (**A**) Composite drawing of whole mount (in ventral view) (CHIOC 40464, 40466); (**B**) copulatory complex (ventral view); (**C**) ventral bar; (**D**) dorsal bar; (**E**) hooks; (**F**) ventral anchor; (**G**) dorsal anchor. (Scale bars: A = 100 μm; B–G = 20 μm).

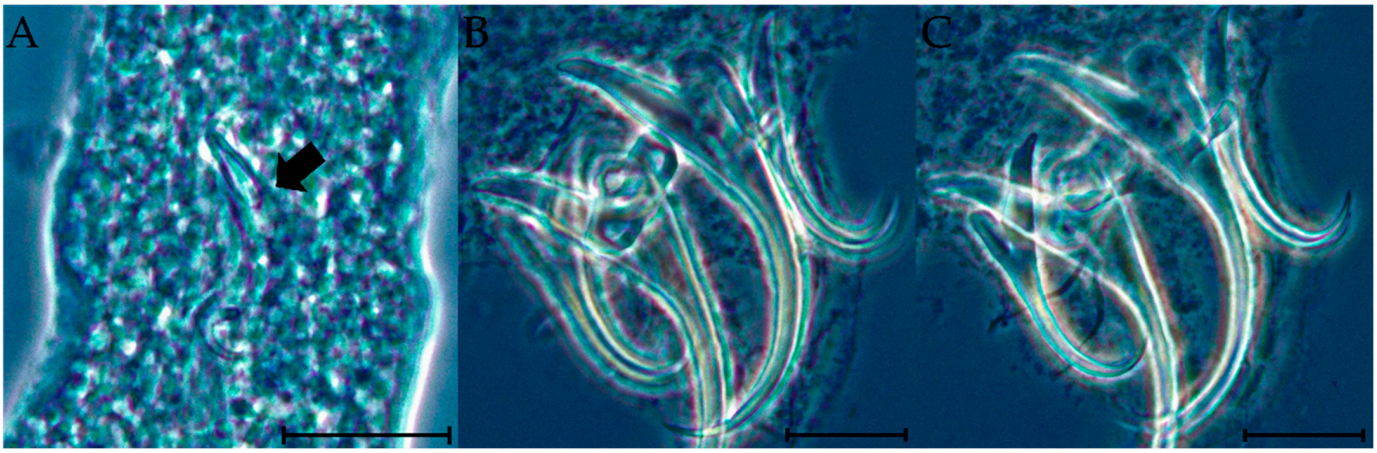

Figure 2. Photomicrographs of the specimen of *Ancistrohaptor forficata* sp. n. (**A**) Copulatory complex; (**B**) haptorial sclerites (ventral bar and ventral anchor); (**C**) haptorial sclerites (dorsal bar and dorsal anchor) (CHIOC 40464, 40466). Scale bar: 20 μm.

Type host: *Triportheus signatus* (Garman, 1890) (Characiformes, Triportheidae);

Type locality: Salgado River, municipality of Lavras da Mangabeira, Ceará State, Brazil (6°71′15.61″ S and 38°95′81.70″ W);

Site of infestation: Gill filaments;

Infestation parameters: Eight infested fish out of eighteen are analyzed (prevalence: 44.44%); the total number of parasites is eighteen; the mean intensity is 2.25 ± 1.49; and the range of intensity is 1–5;

Deposited material: CHIOC: holotype: 40464, paratypes: 40465, 40466, 40467, 40468 and 40469;

ZooBank registration: urn:lsid:zoobank.org:act:E67ACFD1-FFE2-473A-B0E9-9D0042C76768;

Etymology: The specific epithet is derived from Latin (*forficat* bifurcated) and refers to the morphology of the free accessory piece.

Description. [Based on seven specimens] Body elongated, fusiform 432 (358–484; *n* = 5) long, length including the haptor; 55 (46–67; *n* = 6) wide near midlength. Cephalic region elongated, terminally expanded; cephalic lobes moderately developed; four pairs of head organs; cephalic glands not observed. Four eyespots, posterior pair larger than anterior pair; granules ovate; few accessory granules in cephalic region. Pharynx spherical, 23 (18–31; *n* = 5) in diameter. The copulatory complex comprises a male copulatory organ (MCO) and two accessory pieces. MCO J-shaped, 40 (37–45; *n* = 6) long with less than one counterclockwise ring, 10 (9–11; *n* = 5) in diameter. Free accessory piece 12 (11–13; *n* = 5) long, clamp shaped, bifurcated, articulated distally with the posterior accessory piece; posterior accessory piece rod shaped, articulated with the MCO base by an articulation process slender. Vaginal aperture dextroventral, slightly sclerotized; seminal receptacle spherical and pre-germarial. Gonads are intercaecal, overlapping, and elongated. Germarium 64 (53–75; *n* = 2) long, 19 (15–23; *n* = 2) wide. Testis 44 (38–50; *n* = 2) long, 24 (*n* = 1) wide, dorsal to germarium, seminal vesicle a dilation of vas deferens. Prostatic reservoirs, oviducts, ootype, uterus, and eggs were not observed. Peduncle short and broad; haptor 84 (72–92; *n* = 4) long, 55 (46–61; *n* = 5) wide. Ventral anchor 63 (57–68; *n* = 6) long, with elongated superficial root, broad rounded deep root, elongated curved shaft, short, and curved point; base 16 (13–18; *n* = 6) wide. Dorsal anchor 39 (36–43; *n* = 6) long, with elongated superficial root, short deep root, slightly curved shaft and recurved point; base 9 (8–10; *n* = 6) wide. Ventral bar: 23 (21–26; *n* = 6) long, plate like. Dorsal bar 35 (34–36; *n* = 4) long, V shaped, with enlarged ends. Seven pairs of similar and marginal hooks,

22 (20–23; n = 4) long, with erect thumb, slightly curved point, shank divided into two subunits, proximal subunit inflated; filamentous hook loop extending to near beginning of shank dilation, with loop ¼ of shank length. Vitelline follicles are dense throughout the trunk and are absent in regions of reproductive organs.

Remarks. *Ancistrohaptor* Agarwal and Kritsky, 1998, includes a species of dactylogyrid parasites of triportheidae, which are characterized by overlapping gonads, an accessory piece composed of two distinct parts, dextral or dextroventral vaginal openings, and large ventral anchors with elongated shafts. *Ancistrohaptor forficata* sp. n. resembles other congeners by possessing a large ventral anchor shaped like a hook, a ventral bar shaped like a plate, and an accessory piece divided into two units, one articulated to the MCO base and one free. This species is similar to *A. falcunculum* in the morphology of the male copulatory organ, with less than one ring, a ventral bar in plate form, and a dorsal bar shaped like a V. However, it differs from other congeners by having a free, bifurcated accessory piece in the shape of a clamp, composed of two elongated and sclerotized subunits. It is distally articulated with the posterior accessory piece (i.e., distally expanded in *A. falciferum*, flattened in *A. falcatum*, and recurved with a pointed extremity in *A. falcunculum*). *Ancistrohaptor forficata* sp. n. differs from *A. falciferum* and *A. falcatum* by having a male copulatory organ with less than one turn, the presence of an articulated accessory piece, and a bifurcated free piece and from *A. falcunculum* by having a dorsal bar with shading present in its medial part, an articulated accessory piece with a concave rod-like termination, and a bifurcated free accessory piece.

3. Discussion

To date, the fauna of dactylogyrid monopisthocotylans in triportheids has been described in hosts from Brazilian and Peruvian aquatic ecosystems, comprising four genera: *Anacanthorus*, *Ancistrohaptor*, *Jainus*, and *Rhinoxenus* [11,12,18,42,45]. Dactylogyrids of the genus *Ancistrohaptor* have been proposed to accommodate triportheid gill parasites, specifically in the species of the genus *Triportheus* [45].

Agarwal and Kritsky [42] pointed out that members of the genus *Ancistrohaptor* do not appear to be closely related to any other dactylogyrid genera, and they are characterized by having a copulatory complex comprising a coiled and sclerotized MCO with counterclockwise rings and two accessory pieces (one posterior, articulated to the MCO base by an articulation process, and the second one free and nonarticulated), a vaginal aperture in the dextral or dextroventral position. The new species described here is the fourth member of the genus *Ancistrohaptor*, which possesses a free accessory piece that is clamp-shaped and bifurcated. It is articulated distally with the posterior accessory piece.

Ancistrohaptor forficata sp. n. presents significant morphometric differences compared to its congeners. The ventral anchors are smaller compared to those of *A. falcatum* and *A. falcunculum*, while the dorsal anchors are also reduced compared to *A. falciferum* and *A. falcunculum*. The ventral bar, on the other hand, is longer than that observed in *A. falciferum*, and its ventral bar is larger than all those of its congeners. The accessory piece is smaller than those of the other species of *Ancistrohaptor*. Finally, the MCO (muscular cephalic organ) stands out by having a smaller length and diameter, characteristics that particularly differentiate it from *A. falciferum* and *A. falcatum* (see Table 2). These combined attributes reinforce the uniqueness of *Ancistrohaptor forficata* sp. n. within the genus.

Table 2. Comparative measurements (in micrometers) of species of the genus *Ancistrohaptor* (Monogenea: dactylogyridae) on species of fishes of the genus *Triportheus* (Characidae) in the neotropical region.

Morphological Structures	*Ancistrohaptor falciferum* *	*Ancistrohaptor falcatum* *	*Ancistrohaptor falcunculum* *	*Ancistrohaptor forficata* **sp. n.** **
Body length	377 (308–441)	356 (295–411)	314 (257–360)	432 (358–484)
Body maximum width	64 (53–78)	91 (83–97)	68 (53–85)	55 (46–67)
Pharynx diameter	17 (15–21)	26 (23–29)	26 (21–33)	23 (18–31)
Haptor length	89 (79–100)	95 (91–99)	88 (83–92)	84 (72–92)
Haptor width	63 (43–75)	85 (75–94)	66 (55–79)	55 (46–61)
Ventral anchor length	63 (59–68)	72 (69–77)	70 (65–77)	63 (57–68)
Ventral anchor width (base)	23 (18–26)	30 (28–32)	26 (23–31)	16 (13–18)
Dorsal anchor length	55 (49–61)	38 (37–39)	44 (41–48)	39 (36–43)
Dorsal anchor width (base)	8 (6–10)	14 (13–15)	16 (15–20)	9 (8–10)
Ventral bar length	18 (16–21)	23 (21–25)	23 (22–25)	23 (21–26)
Dorsal bar length	19 (17–22)	20 (–)	26 (23–32)	35 (34–36)
Hook pairs (1, 5, 6, and 7)	17 (15–18)	17 (15–20)	—	—
Hook pairs (2, 3, and 4)	20 (17–24)	21 (18–22)	—	—
Hook pairs (1, 2, 3, 4, 5, 6, and 7)	—	—	19 (16–21)	22 (20–23)
Male copulatory organ (MCO) Long in total length	114 (102–130)	211 (190–225)	48 (43–58)	40 (37–45)
Proximal ring diameter of the MCO	20 (17–24)	22 (21–23)	–(11–12)	10 (9–11)
Free accessory piece	22 (18–25)	24 (22–26)	16 (15–19)	12 (11–13)
Testis length	35 (30–43)	27 (–)	35 (–)	44 (38–50)
Testis width	16 (13–20)	15 (–)	21 (–)	24 (–)
Germarium length	63 (50–77)	48 (–)	75 (–)	64 (53–75)
Germarium width	16 (12–20)	20 (–)	18 (–)	19 (15–23)

* Based on the description of the genus *Ancistrohaptor* by Agarwal and Kritsky [42]. ** Present study.

In this study, we have presented the first record of monopisthocotylans of the genus *Ancistrohaptor* in a fish host from the northeast region of Brazil in the state of Ceará. Studies on the ichthyoparasitic fauna in the semiarid region of Brazil are incipient when compared to other aquatic environments that have shown diverse fauna, especially for monopisthocotylans, although several taxa have already been identified, but only up to the genus level [27,46,48–52]. In Brazil, species of the genus *Ancistrohaptor* have only been reported as gill ectoparasites of triportheid fishes in the northern region of the state of Amazonas [11,12,42].

The present study contributes to the knowledge of this fauna in the semi-arid region of Brazil, corroborating the potential for new species descriptions in this environment. These results have expanded the geographical distribution of the genus *Ancistrohaptor* and also enhance our understanding of parasitic diversity and the dynamics of the parasite–host relationship in freshwater fish in the neotropical region.

4. Materials and Methods

Eighteen specimens of *T. signatus* (11.97 ± 1.48 cm in standard length and 37.09 ± 12.61 g in weight) were collected in February and May of 2023 in the Salgado River, municipality of Lavras da Mangabeira, Ceará state, Brazil (6°71′15.61″ S, 38°95′81.70″ W). All animal procedures were conducted in accordance with the guidelines of the Ethics Committee

for Animal Experimentation (CEUA/URCA #00165/2018.1), and the collection and transportation were authorized by SISBIO (Biodiversity Information and Authorization System, authorization #61328-2). Specimens were captured using a shrimp trawl, individually placed in plastic bags, and then frozen. During necropsy, the gills were removed and placed in Petri dishes containing water, and the helminths were identified using a stereomicroscope. The monopisthocotylans were mounted on slides using Gray and Wess's media [53].

The morphology and morphometry of the parasites were analyzed using an optical microscope equipped with a computerized system for phase-contrast image analysis (Leica ICC50W). Illustrations were made using a drawing tube mounted on a Leica DM750 microscope with phase-contrast optics and vectorized using Inkscape 1.4 software. Measurements were made following the procedures of Agarwal and Kritsky [42], and all of these measurements were in micrometers (μm), representing straight-line distances between the extreme points and expressed as the mean followed by the range and the number of specimens measured in parentheses. The specific terminology of the genus *Ancistrohaptor* was taken according to Agarwal and Kritsky [42], the numbering and distribution of hook pairs followed Mizelle and Price [54], and the direction of the male copulatory organ (MCO) rings followed Kritsky et al. [36]. The quantitative descriptors of the parasite (prevalence and mean intensity of infection) followed those of Bush et al. [55]. Type specimens were deposited in the Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro State, Brazil.

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Institutional Review Board Statement: All animal procedures were conducted in accordance with the guidelines of the Ethics Committee for Animal Experimentation (CEUA/URCA #00165/2018.1), and collection and transportation were authorized by SISBIO (Biodiversity Information and Authorization System, authorization #61328-2).

Informed Consent Statement: Not applicable.

Data Availability Statement: All data produced in this study are fully included in the publication.

Conflicts of Interest: The authors declare no conflicts of interest.

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