



A new dactylogyrid from *Myloplus asterias*

Germán Augusto Murrieta Morey^{1,2} · Jennifer Anaís Sarmiento² · Enrique Ríos Isern² · Jefferson Yunis Aguinaga^{3,4}

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Abstract

Introduction To deepen the knowledge of monogenoids associated with Amazonian fish, studies focused on description, identification and analysis are sought. In this way, the data on the parasitic fauna focused on this group of parasites can be kept up to date. Based on the above, the main objective of this research was to identify new species of monogenoids in the gills of *M. asterias* acquired in the Santa Clara Market, located in the lower area of Nanay, Loreto-Peru.

Materials and methods Thirty specimens of *M. asterias* were acquired in the “Santa Clara” Market, in the city of Iquitos, Loreto-Peru. According to fishermen, specimens were captured in the Nanay River. Samples were collected between August 2024 and February 2025 and analyzed in the “Laboratorio de Parasitología y Sanidad Acuicola” from “Instituto de Investigaciones de la Amazonía Peruana” (IIAP) in Iquitos, Loreto-Peru.

Results A new species of Monogenoidea was discovered parasitizing the gills of *M. asterias*. *Anacanthorus santaclarae* n. sp. is characterized by presenting a MCO as a straight grooved tube with a flared base, presenting a thin elongated expansion with a curved claw-shaped termination in its distal part; a long accessory piece, not articulated with the MCO base, presented as a rod in the form of a can opener.

Conclusions This is the first data on the parasites of *M. asterias*. *Anacanthorus santaclarae* n. sp. is the eighth documented species of the genus in Peru.

Keywords Ectoparasite · Monogenoidea · Pacu · Peruvian Amazon · Serrasalmid

Introduction

The Peruvian Amazon has a very diverse ichthyofauna; approximately 1000 species of freshwater fish have been recorded [1], which are commercial resources and human food. Belonging to the order Characiformes, *Myloplus asterias* (Müller & Troschel, 1844) commonly named as “redgill pacu” and locally named in Peru as “palometa curuhuara”

is a species highly demanded by artisanal fishermen in the Peruvian Amazon [2].

Freshwater fishes of the Amazon are parasitized by different parasitic groups, highlighting species of Monogenoidea, as parasites of direct life cycle, with numerous species described and others yet to be discovered [3]. Studies carried out in fish species commonly known as “pacus” (*Myleus* Müller & Troschel, 1844, *Mylesinus* Valenciennes, 1849, *Myloplus* Gill, 1896 and *Mylossoma* Eigenmann & Kennedy, 1903) show the presence of monogenoids corresponding to *Anacanthorus* Mizelle & Price, 1965, *Mymarothecium* Kritsky, Boeger & Jégu, 1998, *Notothecioides* Kritsky, Boeger & Jégu, 1997 and *Notothecium* Boeger & Kritsky, 1988 (Table 1).

To deepen the knowledge of monogenoids associated with Amazonian fish, studies focused on description, identification and analysis are sought. In this way, the data on the parasitic fauna focused on this group of parasites can be kept up to date. Based on the above, the main objective of this research was to identify new species of monogenoids in

✉ Germán Augusto Murrieta Morey
gmurrieta@iiap.gob.pe

¹ Instituto de Investigaciones de la Amazonía Peruana (IIAP), Laboratorio de Parasitología y Sanidad Acuicola. Carretera Iquitos-Nauta Km. 4.5, Iquitos, Loreto, Peru

² Facultad de Ciencias Biológicas (FCB), Departamento Académico de Hidrobiología, Universidad Nacional de la Amazonía Peruana (UNAP), Calle Faning 290 A, Iquitos, Loreto, Peru

³ Universidad Científica del Sur, Lima, Peru

⁴ Instituto del Mar del Perú (IMARPE), Callao, Peru

Table 1 *Anacanthorus santaclarae* n. sp. from the gills of *Myloplus asterias*. A, whole worm, ventral view; B, copulatory complex; C, Hook; D, 4 A Hook

Species	Type host	Country	References
<i>Notozothecium bethae</i> Kritsky, Boeger & Jégu, 1998	<i>Myleus pacu</i> (Jardine, 1841)	Brazil	Cohen et al. (2013)
<i>Notozothecium bethae</i> Kritsky, Boeger & Jégu, 1998	<i>Myleus rhomboidalis</i> (Cuvier, 1818)	Brazil	Cohen et al. (2013)
<i>Anacanthorus hoplophallus</i> Kritsky, Boeger & Van Every, 1992	<i>Myleus rubripinnis</i> (Müller & Troschel, 1844)	Brazil	Cohen et al. (2013)
<i>Anacanthorus pedanophallus</i> Kritsky, Boeger & Van Every, 1992			
<i>Anacanthorus spinatus</i> Kritsky, Boeger & Van Every, 1992			
<i>Anacanthorus stigmaphallus</i> Kritsky, Boeger & Van Every, 1992			
<i>Notothecioides llewellyni</i> Kritsky, Boeger & Jegu, 1997			
<i>Notothecioides llewellyni</i> Kritsky, Boeger & Jegu, 1997	<i>Myleus torquatus</i> (Kner, 1858)	Brazil	Cohen et al. (2013)
<i>Notozothecium bethae</i> Kritsky, Boeger & Jégu, 1998	<i>Mylesinus paraschomburgkii</i> Jégu, Santos & Ferreira, 1989	Brazil	Cohen et al. (2013)
<i>Notozothecium bethae</i> Kritsky, Boeger & Jégu, 1998	<i>Mylesinus paucisquamatus</i> Jégu & Santos, 1988	Brazil	Cohen et al. (2013)
<i>Anacanthorus toledoensis</i> Leão, São Clemente & Cohen, 2015	<i>Mylossoma duriventre</i> (Cuvier 1818)	Brazil	Gomes (2018)
<i>Anacanthorus cladophallus</i> Van Every & Kritsky, 1992			
<i>Anacanthorus</i> sp. 1			
<i>Anacanthorus</i> sp. 2			
<i>Anacanthorus</i> sp. 3			
<i>Anacanthorus camposbaci</i> Morey, Aliano & Grandez, 2019	<i>Myloplus schomburgkii</i> (Jardine, 1841)	Peru	Morey et al. (2019)
<i>Anacanthorus carmenrosae</i> Morey, Aliano & Grandez, 2019			
<i>Notozothecium nanayensis</i> Morey, Aliano & Grandez, 2019			
<i>Anacanthorus cladophallus</i> Van Every & Kritsky, 1992	<i>Mylossoma aureum</i> (Spix & Agassiz, 1829)	Brazil	Pelegriani et al. (2024)
<i>Anacanthorus paraspithulatus</i> Kritsky, Boeger & Van Every, 1992			
<i>Mymarothecium</i> sp. 1			
<i>Mymarothecium</i> sp. 2			
<i>Mymarothecium</i> sp. 3			
<i>Notozothecium minus</i> Boeger & Kritsky, 1988			
<i>Anacanthorus paraspithulatus</i> Kritsky, Boeger & Van Every, 1992	<i>Mylossoma duriventre</i> (Cuvier 1818)	Brazil	Pelegriani et al. (2024)
<i>Mymarothecium</i> sp. 1			
<i>Mymarothecium</i> sp. 2			
<i>Mymarothecium</i> sp. 3			
<i>Anacanthorus cultro</i> Morey, Sarmiento, Chu, Cruces & Chero, 2024	<i>Mylossoma albiscopum</i> (Cope, 1872)	Peru	Morey et al. (2024)
<i>Notozothecium palometae</i> Morey, Sarmiento, Chu, Cruces & Chero, 2024			
<i>Anacanthorus santaclarae</i> n. sp.	<i>Myloplus asterias</i> (Müller & Troschel, 1844)	Peru	Present study

the gills of *M. asterias* acquired in the Santa Clara Market, located in the lower area of Nanay, Loreto-Peru.

Materials and methods

Thirty specimens of *M. asterias* were acquired in the “Santa Clara” Market (3°47′00.1″S 73°20′26.3″W), in the city of Iquitos, Loreto-Peru. According to fishermen, specimens were captured in the Nanay River. Samples were collected

between August 2024 and February 2025 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 in boxes with ice to the Laboratory of Parasitology of the “Instituto de Investigaciones de la Amazonía Peruana” (IIAP), in Iquitos, Loreto-Peru. 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 [4].

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 [5]. 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 LAS EZ software from LEICA and following the procedures of [6]. Lengths of curved or bent structures (anchors, bars, and accessory piece) represent the straight-line distances between extreme ends. 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. 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

Dactylogyridae Bychowsky, 1937

Anacanthorus Mizelle & Price, 1965.

Anacanthorus santaclarae n. sp.

(Figs. 1A–D and 2A–D)

With the general characteristics of the genus as described by [7], the description (based on 08 adult specimens; four stained in Gomori’s Trichrome and four clarified in Hoyer’s medium) is presented: Body robust, 451–625 (542; $n=12$) long; greatest width (at the level of the germarium) 126–212 (162; $n=12$). Three cephalic lobes well developed. Three bilateral pairs of conspicuous head organs. Eyes present, being the posterior pair bigger than anterior one. Pharynx spherical 40–60 (45; $n=10$) long, 38–58 (42; $n=10$) wide. MCO 33–48 (36; $n=8$) long, as a straight grooved tube with a flared base, in its distal part it presents a thin elongated expansion with a curved claw-shaped termination. Accessory piece 20–26 (24; $n=8$) long, unarticulated to MCO base, presented as a rod in the form of a can opener, located behind the copulatory organ. Testis subspherical, posterior

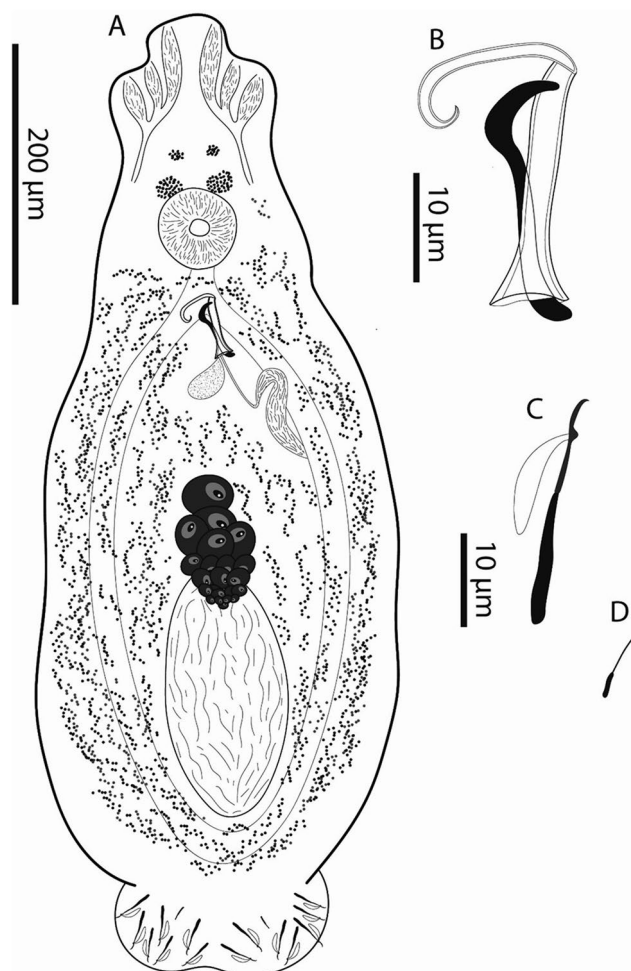


Fig. 1 *Anacanthorus santaclarae* n. sp. from the gills of *Myloplus asterias*. **A**, Whole worm, ventral view; **B**, copulatory complex; **C**, Hook; **D**, 4 A hook



Fig. 2 Compound micrographs of *Anacanthorus santaclarae* n. sp. from the gills of *Myloplus asterias*. **A**, whole body, ventral view; **B**, Hook; **C**, head; **D**, copulatory complex

to germarium 130–150 (110; $n=4$) long, 16–20 (18; $n=4$) wide. Prostatic reservoir piriform, seminal vesicle as an elongated sack. Germarium spherical 45–55 (50; $n=4$) long, 22–34 (26; $n=4$) wide; oviduct, oötype, uterus, and seminal receptacle not observed. Haptor bilobed, 35–65 (45; $n=8$) long; 86–114 (100; $n=8$) wide, manatee shaped. Hooks similar in shape and size 35–54 (36; $n=8$) long, with erected thumb, slender shank with inflated termination, short and recurved point; filamentous hook (FH) $\frac{1}{2}$ the shank size; 4 A hooks 15–25 (20; $n=8$), with small base an elongated shank.

Taxonomic Summary

Type-host: *Myloplus asterias* (Müller & Troschel, 1844) (Characiformes: Serrasalminidae).

Site in host: Gill filaments.

Type-locality: Santa Clara Market, in Loreto, Peru (3°47'00.1"S 73°20'26.3"W).

Type-material: Holotype (MUSM 5376), three paratypes (MUSM 5377 a-c) and two vouchers (LAPYSA M-18 a-b).

ZooBank registration: The Life Science Identifier (LSID) for *Anacanthorus santaclarae* n. sp. is urn:lsid:zoobank.org:pub:CEEBC722-13DE-4C72-BF39-14604461EB62

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

Etymology: The specific name refers to the community of Santa Clara where the species was found.

Remarks

Anacanthorus santaclarae n. sp. most closely resembles *A. penilabiatus* Boeger, Husak & Martins, 1995 based on the morphology of the MCO that presents a subterminal aperture with long, posteriorly recurved lip, and by the morphology of the hooks. However, the new species is differentiated from *A. penilabiatus* by the presence of a can-opener-shaped accessory piece not articulated to the base of the MCO, while in *A. penilabiatus* the accessory piece is articulated to the MCO by a copulatory ligament.

Discussion

According to the characteristics described by [8, 9], *Anacanthorus santaclarae* n. sp. is classified within *Anacanthorus* by presenting a bilobed haptor with seven pairs of hooks and two pairs of reduced hooks (4 A's), lack anchors and bars, have tandem gonads, a post-ovarian testis, a modified (thickened or sclerotized) distal uterine wall or metraterm, and no vagina.

The copulatory complex of *Anacanthorus santaclarae* n. sp. appears not to have specificity in terms of morphology regarding to other serrasalmids belonging to the group of “pacus”. *Anacanthorus* species that parasitize members of the family Serrasalminidae present the characteristic of a J-shaped MCO, an accessory piece that is not articulated to the MCO [9–11], with exception of *A. paraspathulatus*, *A. tolodensis* and *A. cultro* that presents the MCO as a flattened tube. The finding of the new species of *Anacanthorus* in *M. asterias* presented morphological characteristics like the three previously mentioned species, pointing out the need to study these parasites phylogenetically, to establish possible lineages between *Anacanthorus* species present in serrasalmids.

Anacanthorus species are exclusively parasites of Neotropical characiforms, being considered specific to this taxonomic order. Species of this genus have been found in five countries in the Neotropical Region (Brazil, Bolivia, Colombia, Peru, and Venezuela), and Brazil stands out as the country with the largest number of occurrences (156) [12]. For the Peruvian Amazon, seven species of *Anacanthorus* have been described from native fish species: *A. camposbaci* Morey, Aliano & Grandez, 2019 and *A. carmenrosae* Morey, Aliano & Grandez, 2019 from *M. schomburgkii* [13]; *A. femoris* Morey, Sol & Cachique, 2021, *A. kukamensis* Morey, Sol & Cachique, 2021, *A.*

rarus Morey, Sol & Cachique, 2021 and *A. sabalo* Morey, Sol & Cachique, 2021 from *Brycon amazonicus* (Spix & Agassiz, 1829) [14]; and *A. cultro* Morey, Sarmiento, Chu, Cruces & Chero, 2024 from *M. albiscopum* [15]. With the description of *A. santaclarae* n. sp. the number of species of *Anacanthorus* discovered from Peru increase from seven to eight species, increasing the knowledge about the diversity of monogenoids in this part of the Neotropical region. Additionally, the present study reports for the first time the presence of a species of Monogenoidea from the gills of *M. asterias*, revealing the need to continue studying fish in the Peruvian Amazon, whose parasites remain unknown.

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Author Contributions The study was designed by GAMM, JYA, Collection of parasites was performed by GAMM, JAS, Laboratory tests were performed by GAMM, JAS, and ERI, The manuscript was written by GAMM, and JYA and subsequently revised by all other authors.

Data Availability No datasets were generated or analysed during the current study.

Declarations

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

Competing Interests The authors declare no competing interests.

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