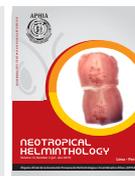




Neotropical Helminthology



ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

FIRST REPORT IN THE PERUVIAN AMAZON AND MORPHOLOGICAL DESCRIPTION OF THE ALIEN SPECIES *TRIANCHORATUS ACLEITHRIUM* PRIECE & BERRY, 1966 (MONOGENOIDEA: DACTYLOGYRIDAE) PARASITIZING THE GILLS OF *TRICHOPODUS TRICHOPTERUS* (PALLAS, 1770) (PERCIFORMES: ANABANTIDAE)

PRIMER REPORTE EN LA AMAZONÍA PERUANA Y DESCRIPCIÓN MORFOLÓGICA DE LA ESPECIE EXÓTICA *TRIANCHORATUS ACLEITHRIUM* PRIECE & BERRY, 1966 (MONOGENOIDEA: DACTYLOGYRIDAE) PARASITANDO LAS BRANQUIAS DE *TRICHOPODUS TRICHOPTERUS* (PALLAS, 1770) (PERCIFORMES: ANABANTIDAE)

Germán Augusto Murrieta Morey^{1*}; Kevin Morgan Ruíz Tafur²; Edgar Leonardo Dávila Panduro²; Carlos Tobias Chuquipiondo Guardia²; Carlos Alfredo Tuesta Rojas² & José Carlos Zumaeta Cachique²

¹ Instituto de Investigaciones de la Amazonía Peruana (IIAP), Laboratorio de Parasitología y Sanidad Acuícola, Av. José A. Quiñones, Km 2.5 – San Juan Bautista, 0784 - Iquitos, Loreto, Perú.

² Universidad Nacional de la Amazonía Peruana (UNAP), Sargento Lores, 385, Iquitos, Perú

* Corresponding author: germantiss1106@gmail.com

ABSTRACT

The three spot gourami, *Trichopodus trichopterus* (Pallas, 1770) is a species native to Southeast Asia which has been introduced in Peru as a biological controller of vectors of malaria and for ornamentation. Considering that alien host species may co-introduce their parasites into natural environments, the present study aims to identify the monogenoideans that parasitize the gills of the three spot gourami, giving a morphological description of its parasite species and its parasitological indices. Thirty specimens of *T. trichopterus* were captured in July 2018 from a natural pond in Iquitos, Peru. Specimens were sacrificed and then analyzed in the Laboratorio de Parasitología y Sanidad Acuícola of Instituto de Investigaciones de la Amazonía Peruana (IIAP), Iquitos, Peru. The monogenoidean *Trianchoratus acleithrium* Preece & Berry, 1966 was found parasitizing the gills of the three spot gourami *T. trichopterus* with a prevalence of 30%, 26 parasites collected, with an intensity ranged from 1-12, mean intensity of 2.89 parasites per infected host and a mean abundance of 0.87 per host.

Keywords: alien species – monogenoidean – parasite – three spot gourami – *Trianchoratus acleithrium* – *Trichopodus trichopterus*

RESUMEN

Trichopodus trichopterus (Pallas, 1770) es una especie nativa del sudeste asiático que se introdujo en el Perú como un controlador biológico de los vectores de la malaria y para la ornamentación. Teniendo en cuenta que las especies hospedadoras exóticas pueden co-introducir sus parásitos en ambientes naturales, el presente estudio tiene como objetivo identificar los monogenoideos que parasitan las branquias del gourami de los tres puntos, dando una descripción morfológica de sus especies de parásitos y sus índices parasitológicos. Treinta especímenes de *T. trichopterus* fueron capturados en julio de 2018 de un estanque natural en Iquitos, Perú. Las muestras se sacrificaron y luego se analizaron en el Laboratorio de Parasitología y Sanidad Acuícola del Instituto de Investigaciones de la Amazonía Peruana (IIAP), Iquitos, Perú. Se encontró al monogenoideo *Trianchoratus acleithrium* Preece & Berry, 1966, parasitando las branquias del gourami de los tres puntos *T. trichopterus* con una prevalencia del 30%, 26 parásitos recolectados, con una intensidad que osciló entre 1 y 12, con una intensidad media de 2.89 parásitos por huésped infectado y una abundancia media de 0,87 por huésped.

Palabras clave: especies exóticas – gourami de tres puntos – monogenoideos – parásitos – *Trianchoratus acleithrium* – *Trichopodus trichopterus*

INTRODUCTION

Activities associated with trade of non-native ornamental fish, transport, tourism, and fish farms for food production are the main means by which the introduction of exotic fish species and their parasites occurs around the world (Mendoza-Franco *et al.*, 2018). Furthermore, the same industries pose a growing threat to native wildlife if non-native fishes are later released into the wild (see Mendoza-Franco *et al.*, 2012).

The three spot gourami *Trichopodus trichopterus* (Pallas, 1770) is a species of gourami native to Southeast Asia. This fish inhabits standing or slow-moving freshwater and is abundant in Yunnan, China, Cambodia, Laos, Malaysia, Myanmar, Singapore, Thailand and Vietnam (Vidthayanon, 2001).

The interest to develop fish culture in the Peruvian Amazon, as well as the lack of technology for cultivating native species, determined the need to introduce species from other countries that already have proven technology for culturing. In this way, several species used in pisciculture were introduced; likewise, other species such as the three spot gourami *T. trichopterus* has been introduced in 1970 as biological control for vectors of malaria and for ornamentation (Alcántara, 1991; Ortega *et al.*, 2007).

In the Peruvian Amazon, the gouramis have reached the River Nanay, being captured in shallow areas of the river near the city of Iquitos. Their presence is significantly high compared to native species (Alcántara, 1991). Although a systematic study on species of gourami has not been carried out yet, it is considered that due to its mere presence and natural reproduction in the Peruvian Amazon, its evaluation is warranted. Considering that alien species may co-introduce their parasites into natural environments and these may cause alterations in natural populations of fish species, the present study aims to identify the monogenoideans that parasitize the gills of the introduced three spot gourami, giving a detailed morphological description of its parasite species and its parasitological indices.

MATERIAL AND METHODS

Thirty specimens of *T. trichopterus* (Fig. 1) with 5.39 ± 0.38 cm average standard length were collected in July 2018 from a natural pond located in the municipality of San Juan Bautista, in Iquitos, Peru. ($3^{\circ} 45'18.73''$ S / $73^{\circ} 16'40.72''$ O). Captured fish were placed into plastic bags and then transported to the laboratory of "Parasitología y Sanidad Acuícola" at the the "Instituto de Investigaciones de la Amazonía Peruana" (IIAP).

In the laboratory, fish were measured and then sacrificed following CONCEA (2013). Later, gill archers were removed and placed in vials containing heated water (68 °C). Each vial was shaken vigorously and 96% ethanol was added. The content of each vial was examined using a dissecting microscope and helminths were removed from the gills or sediment using dissection needles. Some specimens were cleared with Hoyer's medium for their identification based on the morphology of the sclerotized structures and others were stained with Gomori's trichrome (Humason, 1979; Boeger & Viana, 2006) and mounted in Dammar gum to determine internal soft structures.

Sclerotized structures of the species were photographed with a camera (Axiocam RC 5s) connected to a microscope (Zeiss Primo Star), and the images were used to obtain the measurements of the body, OCM and haptor sclerites. Measurements were made following the procedures of Mizelle & Klucka (1953). Measurements are in micrometers, using straight-line distances between extreme points of the structures measured and are expressed as the range followed by the mean and number (n) of structures measured in parentheses. Illustrations were prepared with the aid of microprojector. The ecological terms in parasitology followed those provided by Bush *et al.* (1997). Voucher specimens were deposited in the Helminthological Collection of the Museum of Natural History at the San Marcos University (MUSM) Lima, Peru (MUSM 3885a-d).

Conflict of interest: The authors declare that they have no conflict of interest.

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

RESULTS

The monogenoidean *Trianchoratus acleithrium* Price & Berry, 1966 was found parasitizing the gills of the three spot gourami *T. trichopterus* with a prevalence of 30%, 26 parasites collected, with an intensity ranged from 1-12, mean intensity of 2.89

parasites per infected host and a mean abundance of 0.87 per host.

The main morphological characteres used for its identification were: three anchors, being two posterolateral (ventral anchors) and the other medial (dorsal anchor); haptor bars lacking; copulatory complex composed of a male copulatory organ and an accessory piece. MCO tubular, arising from an expanded base, coiled forming one ring; accessory piece articulated to cirrus base, a sclerotized rod bifurcate into two distinct rami, one of which is recurved distally (Fig. 2).

Dactylogyridae Bychowsky, 1933

Trianchoratus Price & Berry, 1966

Trianchoratus acleithrium Price & Berry, 1966

Host: *Trichopodus trichopterus* (Pallas, 1770)

Locality: Iquitos, Peru. (3° 45'18.73" S / 73° 16'40.72"O).

Site in host: Gill filaments

Description (Fig. 3)

Based on 10 specimens – 4 stained, 6 cleared. Body elongate, 203 – 402 (306; n = 10) long, greatest width 74 – 154 (104; n = 10) cephalic lobes poorly developed. Four pairs of head organs lying in cephalic lobes; cephalic glands not observed. Four pairs of eyes present, granules elongate ovate, small. Pharynx muscular, oval; esophagus short; intestinal caeca two, confluent posteriorly, lacking diverticula. Peduncle short, narrow; haptor bilobate 49 – 80 (64; n = 10) long, 63 – 87 (76; n = 10) wide. Three anchors, one dorsal and two ventral. Dorsal anchor medial, 22 – 27 (25; n = 10) long, 18 – 23 (21; n = 10) wide, with expanded superficial root and short deep root; ventral anchors almost symmetrical, posterolateral, with well-developed superficial roots and short deep roots, elongate and curved shaft, and elongate point. Left ventral anchor, 33 – 42 (39; n = 10) long, 19 – 22 (20; n = 10) wide; right ventral anchor, 33 – 40 (37; n = 10) long, 22 – 26 (23; n = 10) wide. Hooks similar, each with proximal tip with knob resembling a pin-head, depressed thumb, slightly curved shaft; 12 – 16 (14; n = 40) long. Testis oval, dorsal to germarium; germarium elongate; vas deferens arises from anterior margin of testis, crosses diagonally along dorsal field of body; prostatic gland robust, placed dorsal to MCO; vagina dextral, opens laterally, a sclerotized tube

connected to seminal receptacle. Copulatory complex comprising male copulatory organ (MCO) and accessory piece. MCO 19–25 (23; n = 10) long, consisting of slightly coiled tube with rounded initial part, grooved accessory piece

bearing protruding sclerite, 21–26 (24; n = 10) long. Egg with filament, bell-shaped with slightly sclerotized walls, 52–62 (60; n = 3) long, 28–36 (33; n = 3) wide. Vitellaria dense, coextensive with caeca.



Figure 1. Lateral view of *Trichopodus trichopterus* (Pallas, 1770) captured in the Peruvian Amazon.



Figure 2. Sclerotized structures of *Trianchoratus acleithrium* Preece & Berry, 1966 from the gills *Trichopodus trichopterus* (Pallas, 1770). (1) copulatory complex, (2) dorsal anchor, (3-4) ventral anchors. Bar scale: (1) 20 μ m, (2) 15 μ m.

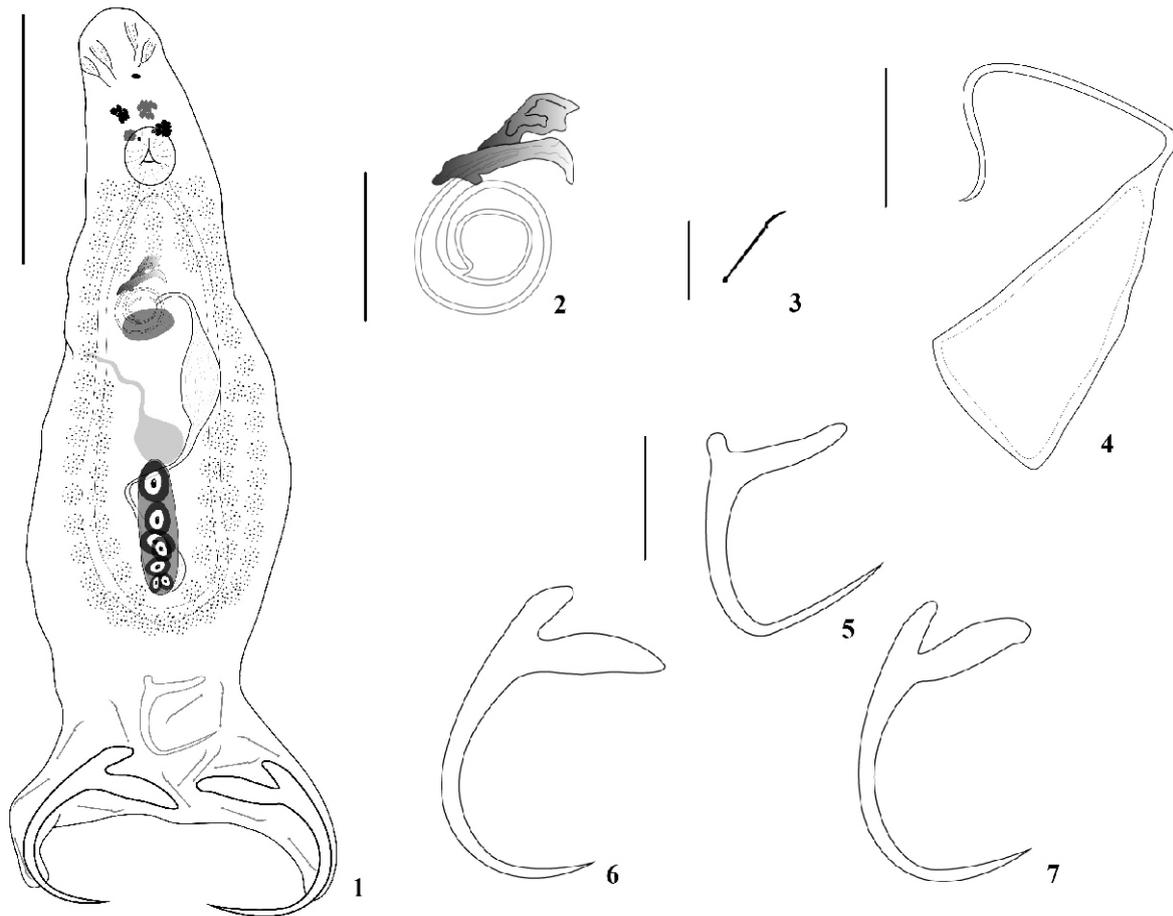


Figure 3. (1) Ventral view of *Trianchoratus acleithrium* Price & Berry, 1966 from the gills *Trichopodus trichopterus* (Pallas, 1770), (2) copulatory complex, (3) hook, (4) egg, (5) dorsal anchor, (6-7) ventral anchors. Bar scale: (1) 100 μ m, (2) 20 μ m, (3) 15 μ m, (4) 30 μ m, (5) 15 μ m.

DISCUSSION

Monogenoideans usually exhibit high host specificity in comparison with other parasite groups, parasitizing a single or few closely related host species (Braga *et al.*, 2014). *Trianchoratus* Price & Berry, 1966 was proposed from the gills of kissing gourami, *Helostoma rudolfi* (Machan, 1931) captured in Southeast Asia (Price & Berry, 1966). To date, 12 species of *Trianchoratus* are identified parasitizing only fish species from Asia (see Tan & Lim 2009; Chaudhary *et al.*, 2013). In the present study, *T. acleithrium* was the only monogenoidean found in the gills of *T. trichopterus*.

There are many reports dealing with the

introduction of parasites by ornamental fish from which the consequences of parasite introduction can be detrimental to native fish. For example, epizootics that may lead to extensive mortality as shown for several species of monogenoideans introduced into farms or aquariums, and from there to natural populations (Bakke *et al.*, 2002, 2007; García-Vásquez *et al.*, 2017). *Trianchoratus acleithrium* has been cited parasitizing exotic fish species imported from Asia to different countries, for example, in *T. trichopterus* collected in Mexico (Mendoza-Franco *et al.*, 2018), and in *T. trichopterus* collected in Australia (Trujillo-González *et al.*, 2018). Undetected parasites could present a threat to the profitability and sustainability of wild environments (Trujillo-González *et al.*, 2018). In the present study, *T. acleithrium* is cited for the first time in South

America, being specifically collected in the Peruvian Amazon. This finding represents an alert, being necessary future investigations in order to determine if this parasite is able to parasitize native fish species and its impacts on natural populations of fishes.

Phylogenetic dissimilarity of native and alien fishes is considered an important factor to avoid the co-invasion of alien monogeneans (Fletcher & Whittington, 1998). However, countries with native fauna phylogenetically similar to exotic fish species may be at a higher risk of co-introduced monogeneans invading native fishes (Lymbery et al., 2014). In the Peruvian Amazon, fish species belonging to Perciformes is represented with 8 families, 40 genera and 91 species (Ortega & Hidalgo, 2008). As *T. trichopterus* belongs to Perciformes, *T. acleithrium* would have the ability to parasitize species of Perciformes that cohabit in the same environments. Studies concerning to monogeneans of native fishes which cohabit in the same places where gouramis are captured would be necessary to determine if the alien parasite *T. acleithrium* is parasitizing native fish species from the Peruvian Amazon.

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