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ORIGINAL ARTICLE /ARTÍCULO ORIGINAL

FIRST RECORD OF *UNITUBULOTESTIS PELAMYDIS* (TREMATODA: DIDYMOZOIDAE) AND *SPHYRIOCEPHALUS TERGESTINUS* (CESTODA: SPHYRIOCEPHALIDAE) IN EASTERN PACIFIC BONITO, *SARDA CHILIENSIS* (PERCIFORMES: SCOMBRIDAE) IN PERU

PRIMER REGISTRO DE *UNITUBULOTESTIS PELAMYDIS* (TREMATODA: DIDYMOZOIDAE) Y *SPHYRIOCEPHALUS TERGESTINUS* (CESTODA: SPHYRIOCEPHALIDAE) EN EL BONITO DEL PACÍFICO, *SARDA CHILIENSIS* (PERCIFORMES: SCOMBRIDAE) EN PERÚ

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ABSTRACT

This study aims to report *Unitubulotestis pelamydis* (Taschenburg, 1879) (Trematoda: Didymozoidae) and *Sphyriocephalus tergestinus* Pintner, 1913 (Trypanorhyncha: Sphyriocephalidae) in Eastern Pacific bonito *Sarda chiliensis* (Cuvier) (Scombridae) from Chorrillos, Lima, Peru (12º09'23" S, 77º01'55" W). One hundred specimens of *S. chiliensis* were collected, 17 and 32 specimens were infected with *U. pelamydis and S. tergestinus* postlarvae in the gill filaments and stomach, respectively. The total prevalence was 49%. The total mean intensity of infection and abundance were 3.51 (1-12) and 1.72 (0-12), respectively. This is the first record of *U. pelamydis and S. tergestinus postlarvae in Peru.*

Keywords: fish parasite - *Sarda chiliensis* - *Sphyriocephalus tergestinus* - *Unitubulotestis pelamydis* - Peru.

RESUMEN

Este estudio tuvo como objetivo registrar *Unitubulotestis pelamydis* (Taschenburg, 1879) (Trematoda: Didymozoidae) y *Sphyriocephalus tergestinus* Pintner, 1913 (Trypanorhyncha: Sphyriocephalidae) en el bonito del Pacífico *Sarda chiliensis* (Cuvier, 1832) (Scombridae) en Chorrillos, Lima, Perú (12º09'23 "S, 77º01'55" W). Se colectaron cien especímenes de *S. chiliensis*, 17 y 32 especímenes fueron infectados con *U. pelamydis* y *S. tergestinus* en los filamentos branquiales y el estómago, respectivamente. La prevalencia total fue de 49%. La intensidad y la abundancia media total de la infección fueron de 3,51 (1-12) y 1,72 (0-12), respectivamente. Este es el primer registro de *U. pelamydis* y *S. tergestinus* en Perú. Además, *S. chiliensis* es un nuevo huésped para ambos endoparásitos.

Palabras clave: fish parasite - *Sarda chiliensis* - *Sphyriocephalus tergestinus* - *Unitubulotestis pelamydis* - Perú.

INTRODUCTION

Eastern Pacific bonito, *Sarda chiliensis* (Cuvier, 1832) is an epipelagic neritic fish distributed from Colombia to Chile and assessed by IUCN as Least Concern, but its current population trend is decreasing (Ancieta, 1964; Chirichigno & Vélez, 1998; Collette *et al.*, 2011). This species is very common in coastal zone of Punta Aguja (Peru) and Iquique (Chile) (Chirichigno & Vélez, 1998). Collette & Nauen (1983) indicated that Eastern Pacific bonito *S. chiliensis* is a marine, pelagic-neritic, oceanodromous and subtropical species. Length at first maturity is 47 cm. Also, the validity of the subspecies *S. chiliensis chiliensis* status is not supported by the molecular data (Viñas *et al*., 2010).

Scarce records of parasites of *S. chiliensis* are registered in the South Pacific (Tantaleán & Huiza, 1994; Pérez *et al.*, 1999; Kohn *et al.*, 2007; Muñoz & Olmos, 2008; Cohen *et al.* 2013). In this paper, we present the first record of two endoparasites species, *Unitubulotestis pelamydis* (Taschenburg, 1879) and *Sphyriocephalus tergestinus* Pintner, 1913 in Eastern Pacific bonito from Peru.

MATERIAL AND METHODS

Between January 2013 and December 2014, 100 specimens of *S. chiliensis* were necropsied, from the coast of Chorrillos, Lima, Perú (12º09'23" S, 77º01'55" W), to study their parasites. Trematodes and cestodes were extracted from the gills and stomach, respectively. The parasites obtained were placed in petri dishes with saline, fixed and preserved in ethanol (70%). For morphological study, the parasites were stained with Semichon's acetocarmine and mounted in Canada balsam for examination as whole mounts. The parasites were analyzed and measured using a Microscope leica - DM500 with camera LEICA - ICC50 HD Software LAS (Leica Application Suite)–EZ versión 1.80, 2009, Switzertland. Measurements were made in millimeters (mm). The taxonomic determination of the parasites was in accordance with the diagnosis proposed by Nikolaeva (1980) for trematodes and Costa *et al*. (2003) for cestodes. Scolex and hook measurements follow Palm (1999), Palm & Walter (2000) and Costa *et al*. (2003). The terminology of larval cestodes follows Chervy (2002). The ecological descriptors of

parasitism (prevalence, abundance and mean intensity of infection) were calculated according to Bush *et al*. (1997).

Part of the collected material is deposited in the Helminthological Collection and Related Invertebrates of the Museum of Natural History at the San Marcos University (MUSM-UNMSM) and in Scientific Collection of Protozoa and Metazoan Parasites of the Federico Villarreal University (CPMP-UNFV), Peru.

RESULTS

The mean total length and weight of the fish analyzed were 39.94 ± 2.98 (32 – 48) cm and 645.74 ± 161.15 (425-1100) g, respectively. Seventeen and thirty-two *S. chiliensis chiliensis* specimens were infected by *U. pelamydis* (prevalence = 17%) and *S. tergestinus* postlarvae (prevalence = 32%), respectively. One hundred and seventy one endoparasites were collected in the studied specimens and the total prevalence was 49%. The total mean intensity of infection and abundance were 3.51 (1-12) and 1.72 (0-12), respectively.

Phylum Platyhelminthes Minot, 1876
Class Trematoda Rudolphi, 1808
Subclass Digenea Carus, 1863
Order Plagiorchiida La Rue, 1957
Family Didymozoidae Monticelli, 1888
Genus *Unitubulotestis* Yamaguti, 1953
Unitubulotestis pelamydis (Taschenburg, 1879)
(Figure 1)

Description (Based on 6 adult specimens colored, mounted and five specimens measured): Trematodes with long body, cylindrical, filiform and hermaphrodite; with yellowish color, due to the presence of eggs, 35-51 (44±5.1) long, with a maximum width of 2.074-2.295 (2.181±0.11); posterior end slightly sharp. Cuticle thin and smooth. Oral sucker terminal, 0.230-0.259 (0.244±0.02) long by 0.225-0.263 (0.246±0.02) wide with poorly developed muscles. Pharynx 0.199-0.260 (0.233±0.03) long by 0.176-0.223 (0.202±0.02) wide. Short esophagus. Intestinal blind long, sinuous, reaching the posterior end of the body. Acetabulum absent. One tubular, long, sinuous testicle, located in the anterior end of the body; with the narrower posterior end, 1.385-2.631 (1.901±0.65) long by 0.282-0.907 (0.586±0.31) wide. Ovary tubular. vitelline gland tubular and single. Uterus very long, with long handles, occupying almost the entire length of the body. Eggs elliptical, rather thin-shelled and embryonated, 0.013-0.017 (0.015±0.002) long by 0.00 -0.010 (0.009±0.001) wide.

Host: *Sarda chiliensis* Eastern Pacific bonito.
Site of infection: Encysted in pairs on the gill filaments.
Locality: Chorrillos, Lima, Peru, 12º09'23" S, 77º01'55" W.
Specimens deposited: Voucher MUSM-UNMSM 3248. Voucher CPYMP-UNFV178a-c.
Mean Intensity of infection: 3.65.
Prevalence: 17%.

Remarks: Yamaguti (1953) erected the genus *Unitubulotestis*, with the original description of *Unitubulotestis carangis* Yamaguti, 1953 of the region pharynx-branchial from *Carax* sp. (Carangidae) in Indonesia. This genus is characterized by a single tubular, long and winding testicle, caeca simple reach close to posterior extremity, and gland-cells may surround anterior parts of alimentary system (Bray *et al*., 2008). *Unitubulotestis pelamydis* (Taschenburg, 1879) was initially described as *Didymozoon pelamydis* by Taschenberg (1879). Later, Ishii (1935) transferred *D. pelamydis* to genus *Nematobothrium*. Subsequently, Nikolaeva (1980) considered *N. pelamydis* within the genus *Unitubulotestis*, based on the presence of a single testicle.

Furthermore, He mentions that *U. sardae*, initially described as *N. sardae* by MacCallum & MacCallum (1916) and transferred to the genus *Unitubulotestis* by Yamaguti (1953), is synonymous of *U. pelamydis*. Seven species currently are recognized, they are: *U. carangis* (Type-species); *Unitubulotestis istiophorusi* Nikolaeva & Dubina, 1985; *Unitubulotestis laymani* Nikolaeva & Parukhin, 1971; *Unitubulotestis maris* Caballero & Caballero, 1971; *Unitubulotestis parupenei* Yamaguti, 1970; *Unitubulotestis pelamydis* (= *Unitubulotestis sardae*) (Taschenburg, 1879) and *Unitubulotestis spilonotopteri* Yamaguti, 1970 (Yamaguti, 1953; Yamaguti, 1970; Nikolaeva, 1981; Nikolaeva & Dubina, 1985; Bray *et al*., 2008). All species are registered in buccal and branchial tissues, body-cavity and mesenteries of carangid, istiophorid, scombrid, mulled and exocoetid fishes (Bray *et al*., 2008).

In South America, *U. pelamydis* (= *U. sardae*) has been registered on the gill filaments of *Sarda sarda* (Bloch, 1793) off the coast of Brazil (Hsu, 1968; Justo & Kohn, 2005; Alves & Luque, 2006; Kohn *et al.* 2007). In Peru, *Unitubulotestis* sp. has been registered on the gill filaments of *S. chilensis* and in the operculum of *Scomber japonicus* Houttuyn, 1782 from North Zone (Tantaleán & Huiza, 1994). However, species of the genus *Unitubulotestis* in the Peruvian coast are unknown (Gómez del Prado-Rosas *et al.*, 2007); *U. pelamydis* is the first species recorded and a new record to the South Pacific. Also, *S. chilensis* is a new host.

Clase Cestoda Rudolphi, 1808
Subclase Eucestoda Southwell, 1930
Orden Trypanorhyncha Diesing, 1863
Familia Sphyriocephalidae Pintner, 1913
Género *Sphyriocephalus* Pintner, 1913
Sphyriocephalus tergestinus Pintner, 1913
(Figura 2-4)

Description (Based on 10 postlarvae colored, mounted and five specimens measured): Body 5.94-11.2 (9.40±2.07) mm long. Scolex craspedote with two circular bothridia, 1.28-1.55 (1.42±0.13) mm in diameter. Four armed tentacules, 1.50-1.70 (1.61±0.07) mm in length. The apical portion of each tentacle is armed with four hooks in the center, these hooks measured 0.024-0.025 (24.67±0.5) mm long. The metabasal armature is composed of approximately 16-18 longitudinal rows of curved and point falciform shaped hooks. These hooks measured 0.054-0.068 (0.068±0.051) mm long. The hooks arrangement in the metabasal armature was in spiral rows. The basal armature has about 30-32 rows of falciform shaped hooks, smaller than those of the metabasal armature, measured 0.027-0.029 (0.028±0.014) mm long. Pars vaginalis and pars bulbosa short. The sheaths of the tentacles are curved and not sinuous.

Host: *Sarda chiliensis* Eastern Pacific bonito.
Site of infection: Stomach.
Locality: Chorrillos, Lima, Peru 12º09'23" S, 77º01'55" W.
Specimens deposited: Voucher MUSM-UNMSM 3249. Voucher CPYMP-UNFV179a-d.
Mean Intensity of infection: 3.41.
Prevalence: 32%.

Remarks: The specimens described in this paper show the scolex similar to those described in the genus *Sphyriocephalus* Pintner, 1913. This genus is characterized by having a scolex craspedote with velum. Two deep, oval bothridia encircled by thickened rims. Tentacules short and armature homeoacanthous. Pars vaginalis and pars bulbosa short (Heinz & Dailey, 1974; Beveridge & Campbell, 1996).

The genus *Sphyriocephalus* has not previously been reported from Peruvian waters (Table 1) (Tantaléan & Huiza, 1994). The specimens studied here are in accordance with the

description given by Costa *et al*. (2003) for postlarvae of *S. tergestinus*, except that the length of tentacles, hooks of the metabasal and basal armature in our specimens was slightly greater. However, based on the number of rows of hooks in the metabasal armature, circular bothridia (Costa *et al*., 2003) and the size of the bulbs (about twice as long as wide) these postlarvae are tentatively attributed to *S. tergestinus*.

The *S. tergestinus* postlarvae had been recovered of six marine fishes of five families of two different orders (Anguilliformes, Gadiformes and Perciformes) (Table 1). While adults have been recovered of three sharks: *Alopias vulpinus* (Bonnaterre, 1788) (Alopiidae); *Euprotomicrus bispinatus* (Quoy & Gaimard, 1824) (Dalatiidae) and *Isurus oxyrinchus* Rafinesque, 1810 (Lamnidae) from the Mediterranean and Pacific coast of Japan (Dollfus, 1942; Gómez, 1983). This indicates that *S. tergestinus* has low host specificity both at the postlarvae and adult stage (Costa *et al*., 2003).

Sphyriocephalus tergestinus postlarvae is a new record to the South America. Also, *S. chilensis* is a new host.

DISCUSSION

Sarda chiliensis from the coast of Chorrillos were highly parasitized by *U. pelamydis* and *S. tergestinus*. These two specimens are described for the first time off the Pacific coast of South America**.** Adults of *U. pelamydis* had showed histopathological effect by fusion of secondary lamellae of gills in the regions near the cyst and severe damage in the tissue where many cysts are present in *S. sarda* (Marino *et al.*, 2003; Justo *et al.*, 2013).

In this report, *S. tergestinus* postlarvae showed moderate values of prevalence in *S. chiliensis*, similar to those obtained for *Conger conger* Linnaeus 1758 by Costa *et al*. (2006). Santos *et al.* (2009) suggested that *S. tergestinus*, can be used as biological tags to discriminate stocks of *A. carbo*. A congeneric species the

Table 1. Fish species reported as hosts of *Sphyriocephalus tergestinus* postlarvae in the world. All parasites were found in the stomach of the fish. n= number of specimens examined.

Host	Family	n	Prevalence (%)	Country	Reference
Anguilliformes					
Conger conger Linnaeus 1758	Congridae	64	26,6	Portugal	Costa *et al*. (2009)
Gadiformes					
Macruronus novaezelandiae (Hector, 1871)	Merlucciidae	-	-	Australia	Beveridge & Campbell (1996)
Perciformes					
Aphanopus carbo Lowe, 1838	Trichiuridae	90	5,6	Portugal	Costa *et al*. (1996)
Aphanopus carbo Lowe, 1839	Trichiuridae	135	5,9	Portugal	Costa *et al*. (2003)
Aphanopus carbo Lowe, 1840	Trichiuridae	578	5,9	Portugal	Santos *et al*. (2009)
Brama dussumieri Cuvier, 1831	Bramidae	19	10,5	Indonesia	Jakob & Palm (2006)
Lepidopus caudatus (Euphrasen, 1788)	Trichiuridae	36	5,6	*	Klimpel *et al.* (2006)
Sarda chiliensis Cuvier, 1832	Scombridae	100	32	Peru	Present study
Thunnus alalunga (Bonnaterre, 1788)	Scombridae	-	-	USA	Love & Moser (1983)

* Referred to as the Great Meteor Seamount (North Atlantic).

Figure 1. Photomicrograph of *Unitubulotestis pelamydis* in *Sarda chiliensis* from Peru. A: Anterior end. B: Posterior end. C: Testicle.

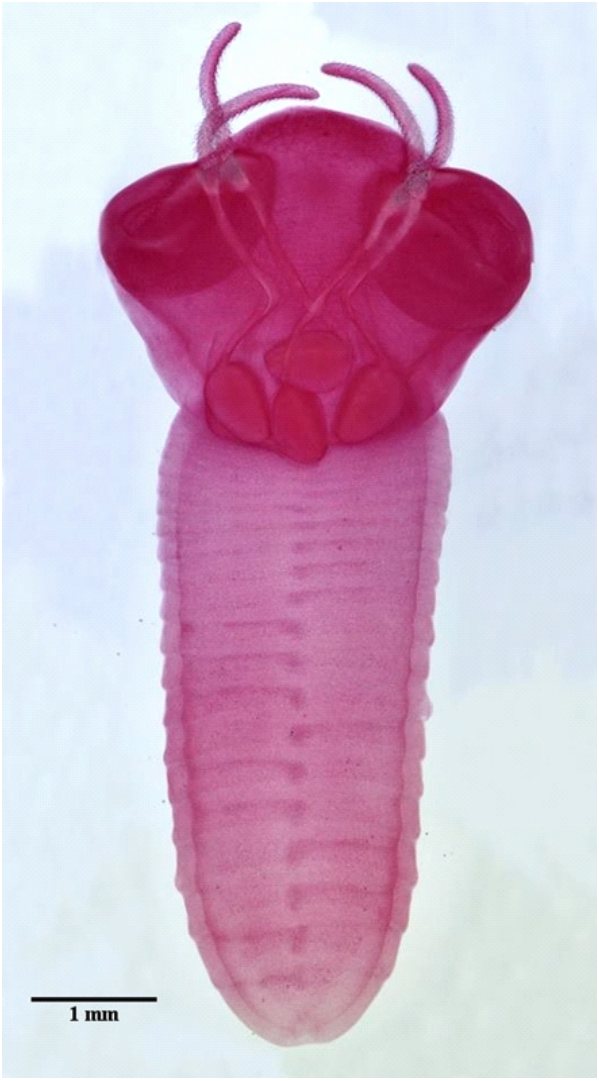

Figure 2. Photomicrograph of *Sphyriocephalus tergestinus* in *Sarda chiliensis* from Peru.

plerocercoid cestode *Sphyriocephalus viridis* (Wagener, 1854) was selected as suitable for use as biological tags of the swordfish *Xiphias gladius* Linnaeus, 1758 (Garcia *et al*., 2011).

All specimens of *S. chiliensis* surveyed for parasites in this research are less than 48 cm length and are juveniles because they reach sexual maturity over 47 cm length (Collete & Nauen, 1983).

This is the first record of *U. pelamydis* and *S. tergestinus* postlarvae in Peru. Also, Eastern Pacific bonito *S. chiliensis* is a new host for both endoparasites.

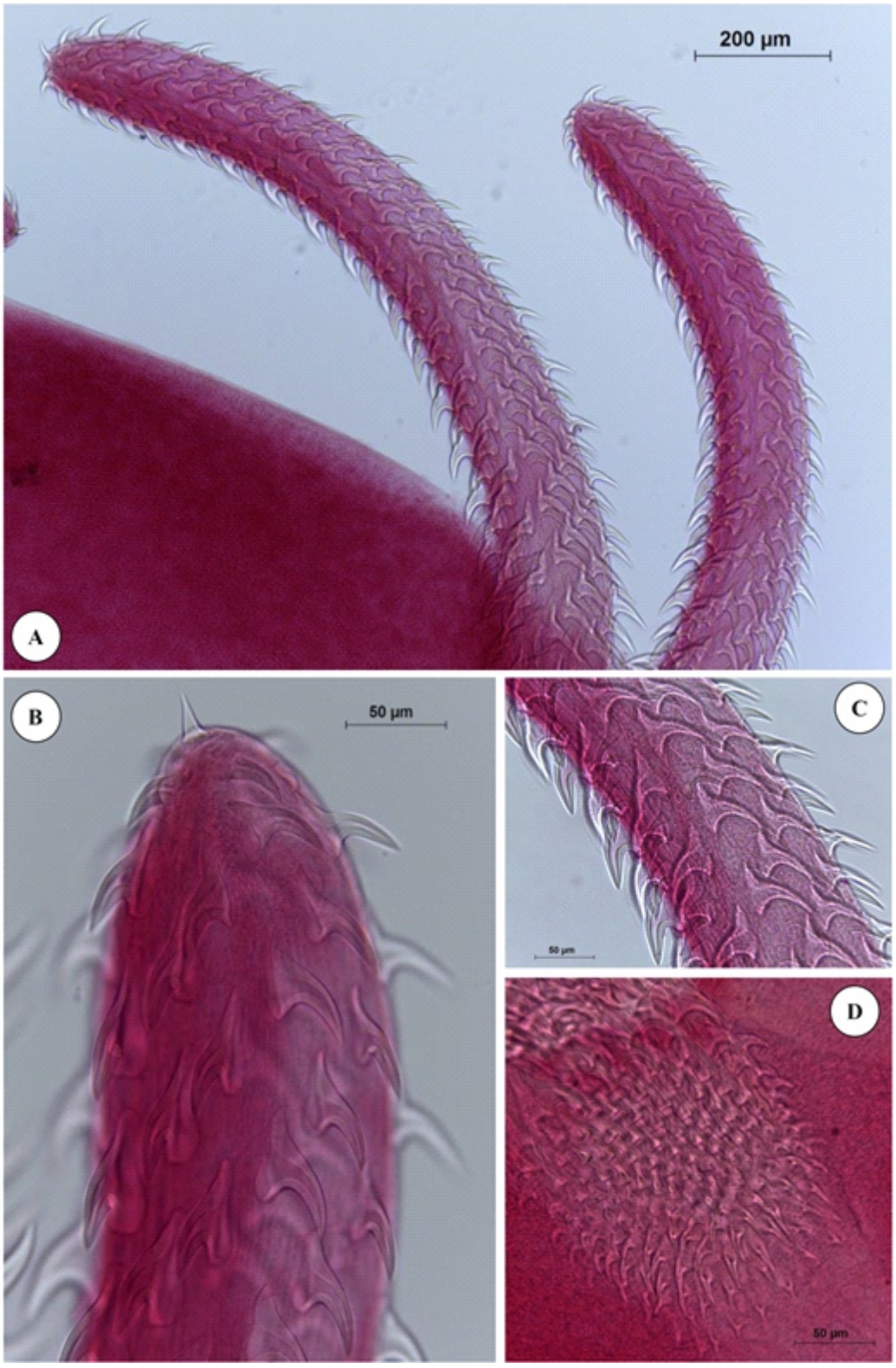

Figure 3. Photomicrograph of *Sphyriocephalus tergestinus* in *Sarda chiliensis* from Peru. A: Tentacles. B: Anterior end of the tentacle. C: Metabasal armature. D: Basal armature.

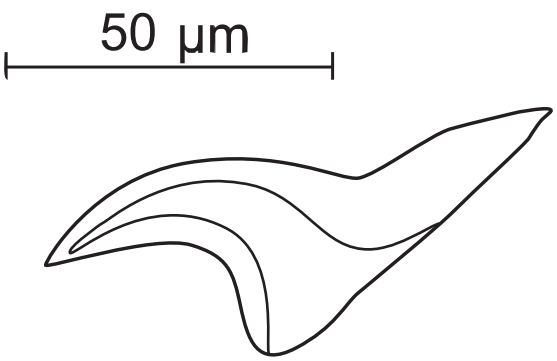

Figure 4. Hook from metabasal armature of *Sphyriocephalus tergestinus*.

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