

Research note

Larval trypanorhynch (Cestoda) infecting *Euphausia americana* (Euphausiacea) collected in the Mexican Caribbean Sea

Larva trypanorhynchida (Cestoda) infectando *Euphausia americana* (Euphausiacea) recolectado en el mar Caribe mexicano

David González-Solís^{1✉}, Iván Castellanos-Osorio¹ and Ian Beveridge²

¹El Colegio de la Frontera Sur, Unidad Chetumal. Av. Centenario Km. 5.5, 77014 Chetumal, Quintana Roo, México.

²Department of Veterinary Science, University of Melbourne, Veterinary Clinical Centre, Werribee, Victoria 3030, Australia.

✉ dgonzale@ecosur.mx

Abstract. Euphausiids are marine pelagic crustaceans widely distributed in all latitudes and oceans of the world. They are parasitized by a wide spectrum of parasite species. Cestodes of the Order Trypanorhyncha are endoparasitic helminths that as adults exclusively parasitize elasmobranchs and use euphausiids, and other planktonic crustaceans, as paratenic or intermediate hosts. From a zooplankton sample collected in Banco Chinchorro, Mexican Caribbean Sea, at depth of 941.2 m, one male of *Euphausia americana* was infected with a plerocercoid with a blastocyst of a trypanorhynch larval cestode hosted in the cephalothorax, which was identified as Eutetrarhynchidae gen. sp. This is the first record of a trypanorhynch larval cestode in *Euphausia americana* and the first geographical report in the Caribbean coast of Mexico.

Key words: *Euphausia americana*, Cestoda, Trypanorhynch, Caribbean Sea.

Resumen. Los eufáusidos representan un grupo de crustáceos pelágicos marinos que están ampliamente distribuidos en todas las latitudes y océanos del mundo. Estos organismos son infectados por un amplio espectro de parásitos. Los céstodos del orden Trypanorhyncha, parasitan exclusivamente a elasmobranquios e involucran a los eufáusidos, y otros crustáceos planctónicos, como hospederos paraténicos o intermediarios. A partir de una muestra de zooplankton recolectada en Banco Chinchorro, a una profundidad de 941.2 m, se detectó un macho adulto de la especie *Euphausia americana* parasitado por un plerocercoides con blastocisto de una larva de céstodo trypanorhynchida, alojado en el cefalotórax del eufáusido, al cual identificamos como Eutetrarhynchidae gen. sp. Este es el primer registro de este tipo de céstodos en *E. americana* y el primer reporte geográfico para la costa del Caribe mexicano.

Palabras clave: *Euphausia americana*, Cestoda, Trypanorhyncha, mar Caribe.

The Order Euphausiacea includes 86 extant species, all of them are marine holoplanktonic, pelagic crustaceans with several species inhabiting up to depths of 3 000 m in oceanic waters and being widely distributed in all latitudes and oceans worldwide. The euphausiid fauna of the Mexican Caribbean is numerically dominated by the presence of 3 species: *Euphausia tenera* Hansen, 1905, *E. americana* Hansen, 1911, and *Stylocheiron carinatum* Sars, 1883, that represent about 95% of the total regional euphausiid abundance (Castellanos, 1998). There is evidence that species of the genus *Euphausia* Dana, 1852 are parasitized by the isopod *Heterophryxus appendiculatus* Sars, 1885 (Lo Bianco, 1901; Sebastian, 1970; Mauchline, 1980);

ellobiopsid *Thalassomyces fagei* (Boschma) (Jones, 1964; Komaki, 1970; Gómez-Gutiérrez et al., 2010), apostome (*Chromidina* sp.), exuviotrophic (*Gymnodinioides* sp.) and endoparasitoid ciliates (*Pseudocollinia brintoni*) (Gómez-Gutiérrez et al., 2010, 2012; Landers et al., 2006); and helminths (Shimazu, 1975a, b, 1982, 1999, 2006; Smith, 1983; Smith and Snyder, 2005; Gómez-Gutiérrez et al., 2010). Despite this information, relatively little is known about the parasites that infect euphausiids from Mexican waters (Shields and Gómez-Gutiérrez, 1998; Gómez-Gutiérrez et al., 2010). The present work deals with the occurrence of a larval cestode in the euphausiid *E. americana* from the Caribbean coast of Mexico.

A total of 6 zooplankton samples were collected during oceanographic cruises carried out in the Mexican Caribbean Sea in March 2006. Zooplankton was captured

using a MOCNESS net (1 m per side with a filtering mesh of 300 μm), hauled at different depths between 0-1 000 m, and fixed and preserved in 90% ethanol. The euphausiid and cestode were deposited in the zooplankton collection of El Colegio de la Frontera Sur (ECO-CHZ 05516, ECO-CHZ 05517, respectively).

The sample collected on 31st March 2006 (20:05 h) from the southern sector of Banco Chinchorro, Mexican Caribbean Sea (18°18'33.84" N, 87°25'6.96" W) at 941 m depth, harbored 1 125 individuals belonging to 6 krill species of euphausiids: *Thysanopoda tricuspida*, *Euphausia americana*, *E. tenera*, *E. mutica*, *Stylocheiron carinatum*, and *S. affine*. From all euphausiid specimens collected in this haul, only 1 male (8 mm total length) of *E. americana* was found to harbor a rounded, yellowish, blastocyst of a larval trypanorhynch cestode, within the cephalothorax. The cestode specimen has the tentacular bulbs elongate with a pre-bulbar organ and the retractor

muscle attaching at the base of the bulb; there are no gland cells attached to the retractor muscle (Figs. 1, 2). Some of the available measurements were: scolex length 0.80; pars bothriialis 0.24; pars vaginalis 0.36, pars bulbosa 0.48 long, 0.07 wide (all measurements are in mm). Unfortunately, the tentacles were invaginated within the scolex of the specimen examined, which prevented the observation of hook sizes; their distribution patterns required to identify the parasite to genus or species level.

Invaginated hooks were homeomorphous (of the same shape) and appeared to be arranged in a homeoacanthous pattern (hooks arranged in quincunxes-one at each corner of a rectangle and one at the center). They were solid and triangular in shape, resembling those seen at the commencement of the principal rows of *Hemionchos* (Campbell and Beveridge, 2006); although in this genus the hooks are arranged in a heteroacanthous pattern (bilaterally distinct half-spiral rows instead of quincunxes) (Campbell

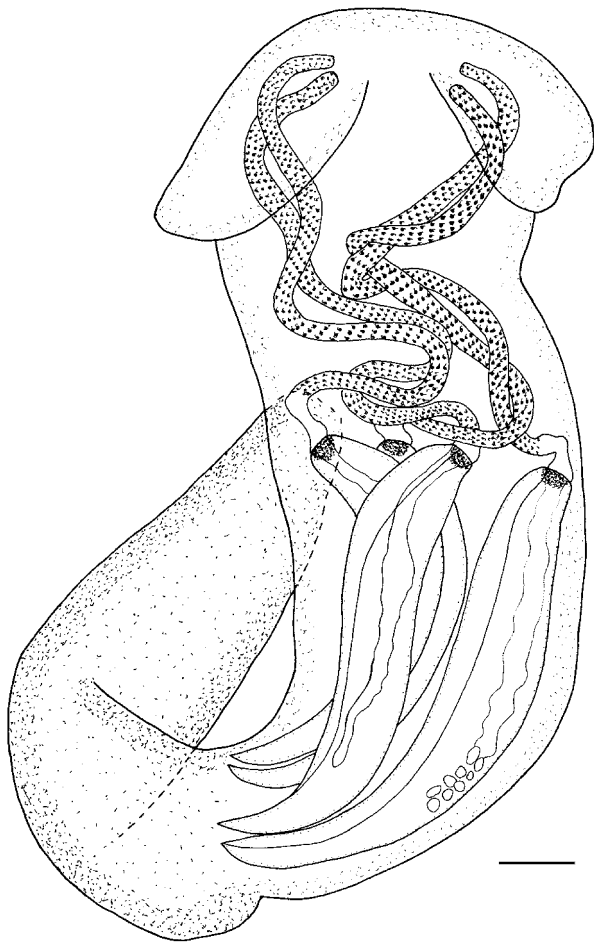


Figure 1. Line drawing of larval cestode from *Euphausia americana*. Scale bar: 0.06 mm.



Figure 2. Micrograph of the larval cestode from *Euphausia americana*. Scale bar: 0.06 mm.

and Beveridge, 2006). The presence of a small scolex, 2 bothria in opposite arrangement, pars bulbosa outside pars bothrialis, pars vaginalis long, and arrangement and shape of hooks most closely resembles Eutetrarhynchidae Guiart, 1927, a family recognized in the recent taxonomic arrangement of Palm (2004), but unrecognized by Campbell and Beveridge (1994). However, since this is a species rich family, consisting of 13 genera (Palm, 2004) and because important features in our specimen were poorly evident, therefore it was only possible to

specimens. This larval cestode is interesting because it has some differences in the hook shape from those of any known species of that family, but until new material is collected, it should be only assigned to Eutetrarhynchidae gen. sp.

Apparently, these larval cestodes complete their life cycle in rays and sharks using euphausiids and other planktonic crustaceans as paratenic or intermediate hosts. The plerocercoid with a blastocyst found infecting *E. americana* could eventually be transmitted to small

Table 1. Summary of the infection reports of larval cestodes in euphausiid hosts (Order Euphausiacea) in the world

<i>Krill host</i>	<i>Larval cestode</i> (plerocercoids or cysticeroids)	<i>Sampling location</i>	<i>Reference</i>
<i>Thysanoessa inermis</i>	<i>Nybelinia sumernicola</i>	North Pacific Ocean	Shimazu (1975b)
	Unidentified cestode	North Pacific Ocean	
	<i>Anomotaenia</i> spp.	Bering Sea	Shimazu (2006)
<i>T. longipes</i>	<i>Nybelinia sumernicola</i>	Off Aleutian Islands	
	<i>Nybelinia sumernicola</i>	North Pacific Ocean	Shimazu (1975b)
	<i>Pelichnibothrium caudatum</i>	North Pacific Ocean	
	<i>Nybelinia sumernicola</i>	Off Aleutian Islands	Shimazu (2006)
<i>T. raschii</i>	<i>Pelichnibothrium caudatum</i>	Bering Sea	
	<i>Nybelinia sumernicola</i>	North Pacific Ocean	Shimazu (1975b)
<i>Nyctiphanes simplex</i>	<i>Tetrarhynchobothrium</i> "Echinobothrium" unidentified cestode	Bahía Magdalena, Mexico Gulf of California, Mexico Gulf of California, Mexico	Gómez-Gutiérrez et al. (2010)
<i>Euphausia pacifica</i>	<i>Nybelinia sumernicola</i>	North Pacific Ocean	Shimazu (1975b)
	<i>Nybelinia sumernicola</i>	Iwate Prefecture, Japan	Shimazu (1999)
	<i>Nybelinia sumernicola</i>	Off Aleutian Islands	Shimazu (2006)
	<i>Pelichnibothrium caudatum</i>	Bering Sea Alaska	Smith and Snyder (2005)
	<i>Nybelinia</i> sp.?		
<i>E. similis</i>	<i>Echinobothrium</i> sp.	Suruga Bay, Japan	Shimazu (1975a, 2006)
	Eutetrarhynchidae gen. sp.	Suruga Bay, Japan	
	<i>Tetrarhynchobothrium</i> sp.	Suruga Bay, Japan	
	Phyllobothriidae gen. sp.	Suruga Bay, Japan	
<i>E. recurva</i>	<i>Pseudonybelinia odontacantha</i>	East China Sea	Shimazu (2006)
<i>E. diomedae</i>	<i>Tetrarhynchobothrium</i> sp.	Suruga Bay, Japan	Shimazu (2006)
<i>E. americana</i>	Eutetrarhynchidae gen. sp.	Banco Chinchorro, Mexico	This study
Unknown species of euphausiid	<i>Nybelinia sumernicola</i>	North Pacific Ocean	Shimazu (1975b)

assign it to Eutetrarhynchidae gen. sp. This is a major problem with trypanorhynch and many other cestodes, since unless the hook patterns are visible, their taxonomic identification becomes very difficult. It is not always easy to get the tentacles everted even in those organisms that are still alive and almost impossible in dead preserved

pelagic fish that could act as the intermediate or paratenic host and where the larval cestode loses its blastocysts and transforms into an adult when it infects the final host. It is not clear how the euphausiids become infected, but since they feed on detritus, plankton, and particularly on nauplii and copepods by raptorial and filtering feeding

(Shimazu, 1999), the trophic transmission seems to be the most parsimonious infection mechanism.

Pathological effects of parasites on euphausiids range from almost negligible to mild or severe damage (Gómez-Gutiérrez et al., 2010). During this survey, evident pathological effects and morphological deformities were not observed in the parasitized *E. americana* specimen, although it is necessary to examine more euphausiids with single or multiple parasite infections in order to determine the negative effects of these parasites in their hosts.

Cestodes in larval stage (plerocercus or plerocercoid), including trypanorhynchs, have been described from several *Euphausia* species and other euphausiid genera around the world (Table 1). As far as we know, no previous records of cestodes have been reported in *E. americana*. In Mexico, only Gómez-Gutiérrez et al. (2010) have reported larval cestodes infecting the sac-spawning euphausiid *Nyctiphanes simplex* at both coasts of the Baja California Peninsula. Therefore, our finding represents the first host species (*E. americana*) and geographical report of a trypanorhynch cestode in this euphausiid species in the east coast of Mexico and the Caribbean Sea.

This project was partly financed by CONACyT (S026 project), NOAA/UM (project 517/520 04) and ECOSUR (project 41007). It was also partially supported by the sabbatical stay of DGS provided by CONACYT and the Institute of Parasitology of the Academy of Sciences of the Czech Republic (projects Nos. Z60220518 and LC 522).

Literature cited

- Campbell, R. A. and I. Beveridge. 1994. Order Trypanorhyncha Diesing, 1863. In Keys to the cestode parasites of vertebrates, L. F. Khalil, A. Jones and R. A. Bray (eds.). Commonwealth Agricultural Bureaux International: Wallingford. p. 51-148.
- Campbell, R. A. and I. Beveridge. 2006. Three new genera and 7 new species of trypanorhynch cestodes (family Eutetrarhynchidae) from manta rays, *Mobula* spp. (Mobulidae) from the Gulf of California, Mexico. *Folia Parasitologica* 53:255-275.
- Castellanos, I. 1998. Distribución y abundancia de los eufáusidos del estrato superficial del Mar Caribe mexicano. *Caribbean Marine Studies* 6:1-11.
- Gómez-Gutiérrez, J., C. J. Robinson, S. Kawaguchi and S. Nicol. 2010. Parasite diversity of *Nyctiphanes simplex* and *Nematoscelis difficilis* (Crustacea: Euphausiacea) along the northwestern coast of Mexico. *Diseases of Aquatic Organisms* 88:249-266.
- Gómez-Gutiérrez, J., M. C. Strüder-Kypke, D. H. Lynn, T. C. Shaw, M. J. Aguilar-Méndez, A. López-Cortés, S. Martínez-Gómez and C. J. Robinson. 2012. *Pseudocollinia brintoni* gen. nov., sp. nov. (Apostomatida: Collinidae), a parasitoid ciliate infecting the euphausiid *Nyctiphanes simplex*. *Diseases of Aquatic Organisms* 99:57-78.
- Jones, L. T. 1964. A new host and location for the euphausiid parasite *Thalassomyces fagei* (Boschma) (Protozoa, Ellobiopsidae). *Crustaceana* 7:148-150.
- Komaki, Y. 1970. On the parasitic organisms in a krill, *Euphausia similis*, from Suruga Bay. *Journal of the Oceanographical Society of Japan* 26:283-295.
- Lo Bianco, S. 1901. La pesche abisalli eseguite dal Maja nelle vicinanze di Capri. *Mitteilungen aus der Zoologischen Station zu Neapel* 15:413-482.
- Mauchline, J. 1980. The biology of mysids and euphausiids. *Advances in Marine Biology* 18:1-681.
- Palm, H. W. 2004. The Trypanorhyncha Diesing, 1863. PKSPL-IPB Press: Bogor, 710 p.
- Sebastian, M. J. 1970. On two isopod parasites of Indian euphausiids. *Journal of Natural History* 4:153-158.
- Shimazu, T. 1975a. On the parasitic organisms in a krill, *Euphausia similis*, from Suruga Bay. V. Larval cestodes. *Japanese Journal of Parasitology* 24:122-128.
- Shimazu, T. 1975b. Some cestode and acanthocephalan larvae from euphausiid crustaceans collected in the northern North Pacific Ocean. *Bulletin of the Japanese Society of Scientific Fisheries* 41:913-921.
- Shimazu, T. 1982. Some helminth parasites of marine planktonic invertebrates. *Journal of the Nagano-ken Junior Collection* 37:11-29.
- Shimazu, T. 1999. Plerocercoids with blastocysts of the trypanorhynch cestode *Nybelinia surmenicola* found in the euphausiid crustacean *Euphausia pacifica*. *Otsuchi Marine Science* 24:1-4.
- Shimazu, T. 2006. Trematodes and cestodes parasitic in euphausiids. *Bulletin of the Plankton Society of Japan* 53:45-53.
- Smith, J. W. 1983. Larval *Anisakis simplex* (Rudolphi, 1809, det. Krabbe, 1878) and larval *Hysterothylacium* sp. (Nematoda: Ascaridoidea) in euphausiids (Crustacea: Malacostraca) in the north-east Atlantic and northern North Sea. *Journal of Helminthology* 57:167-177.
- Smith, J. W. y J. M. Snyder. 2005. New locality records for third-stage larvae of *Anisakis simplex* (sensu lato) (Nematoda: Ascaridoidea) in euphausiids *Euphausia pacifica* and *Thysanoessa raschii* from Prince William Sound, Alaska. *Parasitology Research* 97:539-542.