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First report of *Lernaea cyprinacea* (Crustacea: Lernaeidae) parasiting *Rhamdia quelen* (Pisces: Heptapteridae) in Santa Fe (Argentina) under hatchery conditions[□]

Primer reporte de Lernaea cyprinacea (Crustacea: Lernaeidae) parasitando Rhamdia quelen (Pisces: Heptapteridae) bajo condiciones de cultivo en Santa Fe (Argentina)

Primeiro registro de Lernaea cyprinacea (Crustacea: Lernaeidae) em Rhamdia quelen (Pisces: Heptapteridae), em condições de cultura em Santa Fe (Argentina)

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Abstract

Background: *Lernaea cyprinacea* was introduced in South America with cyprinids. To the best of our knowledge, this ectoparasite has not been reported in Santa Fe province (Argentina). **Objective:** To report *Lernaea cyprinacea* presence in *Rhamdia quelen* under hatchery conditions in Santa Fe province (Argentina). **Methods:** In May 2014, samples of *L. cyprinacea* attached to the fins and flanks of *R. quelen* were obtained in the Chronobiology Laboratory of the Veterinary Sciences School at Esperanza (Santa Fe, Argentina) where they were collected and identified. **Results:** A description of *L. cyprinacea* is presented along with detailed records previously reported in this and other regions. **Conclusions:** Presence of this parasite constitutes evidence of the introduction of exotic species through commercialization of their natural hosts and the potential pathogen colonization of natural environments, which constitutes a threat to the integrity of aquatic ecosystems.

Keywords: Fish diseases, freshwater catfish, host parasite relations, introduced species, neotropical region.

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Resumen

Antecedentes: la *Lernaea cyprinacea* fue introducida en América del Sur a través de los ciprinidos, no habiendo siendo previamente registrada en la provincia de Santa Fe (Argentina). **Objetivo:** reportar la presencia de *Lernaea cyprinacea* en *Rhamdia quelen* en condiciones de acuicultura. **Método:** en mayo de 2014, se obtuvieron ejemplares de *L. cyprinacea*, parasitando aletas y flancos de *R. quelen* en el laboratorio de Cronobiología de la Facultad de Ciencias Veterinarias, en Esperanza (Santa Fe, Argentina), donde fueron colectados e identificados. **Resultados:** se brinda una descripción de *L. cyprinacea* y se detallan antecedentes del ectoparasito en ésta y otras regiones. **Conclusiones:** la presencia de este parásito constituye evidencia de introducción de una especie exótica mediante la comercialización de sus hospedadores naturales y de la potencial colonización por patógenos introducidos en ambientes naturales, lo cual amenaza la integridad de estos ecosistemas.

Palabras clave: bagre de agua dulce, enfermedades de los peces, especies exóticas, región neotropical, relaciones huésped-parásito,

Resumo

Antecedentes: *Lernaea cyprinacea* foi introduzido na América do Sul através de ciprinídeos, não sendo registrado na província de Santa Fe. **Objetivo:** relatar a sua presença no *Rhamdia quelen*, em condições de crescimento. **Método:** em maio de 2014, foram obtidas indivíduos de *L. cyprinacea*, parasitando nadadeiras e flancos em *R. quelen*, no Cronobiologia Laboratório da Faculdade de Ciências Veterinárias, Esperanza (Santa Fe, Argentina), que foram coletados e identificados. **Resultados:** uma descrição de *L. cyprinacea* é relatada, e detalhes prévios da presença deste parasito na região. **Conclusões:** a presença neste parasito é evidência de introdução de espécies exóticas através da comercialização de seus hospedeiros naturais. O potencial de colonização de patógenos introduzidos em ambientes naturais é uma ameaça à integridade dos ecossistemas.

Palavras-chave: doença dos peixes, parasita hospedeiro, peixe-gato (água doce), região neotropical, relação espécies introduzidas.

Introduction

Lernaea cyprinacea (Crustacea, Lernaeidae) is an ectoparasite, which has been reported in Africa, central Asia, southwest Siberia, Europe, Japan and Israel (Plaul *et al.*, 2010). Originally, *L. cyprinacea* was not present in South America, but it has been introduced to many countries by translocation of cyprinids (Piasecki *et al.*, 2004). Currently, *L. cyprinacea* is a common parasite infecting aquaculture species in Brazil, and is also very common in wild fish in main drainage basins throughout the country (Piasecki *et al.*, 2004). Reports of lernaeid parasites infecting freshwater fish in Argentina are very scarce (Plaul *et al.*, 2010); the first record dates from 1993, parasitizing *Odontesthes bonariensis* captured in San Roque Reservoir, Córdoba (Mancini *et al.*, 2008b).

L. cyprinacea has great morphological plasticity depending on environmental characteristics, host species, and even the insertion site on the host (Moreno *et al.*, 1986). It has a high pathogenic potential and is rapidly disseminated, posing a serious health threat to the fish farming industry. It produces

skin lesions in fishes, generating direct damage and facilitating the occurrence of secondary infections (Fischer *et al.*, 2003). The present study reports the presence of *L. cyprinacea* parasitizing *Rhamdia quelen* (Pisces, Heptapteridae) under captivity in the Santa Fe province. A detailed description and previous records in the region, are also provided.

Materials and Methods

Bioassay

In May 2014, a bioassay was performed with thirty samples of *Rhamdia quelen* ("bagre sapo") in the Chronobiology Laboratory of the, Veterinary Sciences School at, Universidad Nacional del Litoral, Esperanza (Santa Fe, Argentina). Approval was obtained from the CAES-FCV-UNL 268 protocol, following recommendations from the National Research Council (2011). Average length of fishes was 12.461 cm (± 0.280) and average weight was 30.88 g (± 11.72). One month before the bioassay with *R. quelen* and in order to cycle the water of

two aquariums, two samples of *Prochilodus lineatus* (Pisces, Prochilodontidae) were incorporated in each aquarium together with a sponge filter from ponds stabilized with fishes captured in the Salado River (Esperanza, Santa Fe). Their faeces provided the substrate for the growth of the bacteria supplied by the filter, thus securing the biological cycle of nitrogen to develop in the culture system. Prior to incorporation of *R. quelen*, the *P. lineatus* samples were removed and returned to their original ponds. Male and female specimens of *R. quelen* from the city of Paraná (Entre Ríos) were distributed in 100 L ponds, three specimens per pond, and kept under isolation conditions at constant temperature.

Separation and identification of ectoparasites

To extract crustaceans, fish were subjected to immersion for 10-30 minutes with 1% sodium chloride. Parasites that did not detach on their own were removed with dissecting forceps. Once removed, the affected area was treated with a mild disinfectant.

Ectoparasites were preserved in 70% ethanol for subsequent identification in the Laboratory of Natural Sciences Department, School of Humanities and Sciences (UNL, Santa Fe). The taxonomic determination was based on published references (Yamaguti, 1963; Demaree, 1967; Moreno *et al.*, 1986; Thatcher, 2006). Measurements are expressed in mm.

Results

A detailed description of *L. cyprinacea* is presented, including the corresponding measurements (Figure 1, Table 1). Representative samples were deposited in the Florentino Ameghino Provincial Museum of Natural Sciences (Santa Fe), under N° MFA-ZI 579.

Lernaeidae Family

Lernaea cyprinacea (Linnaeus, 1758)

Description: General morphology, post metamorphic females: elongated body segmented into cephalothorax, neck and genito-abdomen. Total Length (TL) cephalothorax 0.965 (0.594-1.752; N=9),

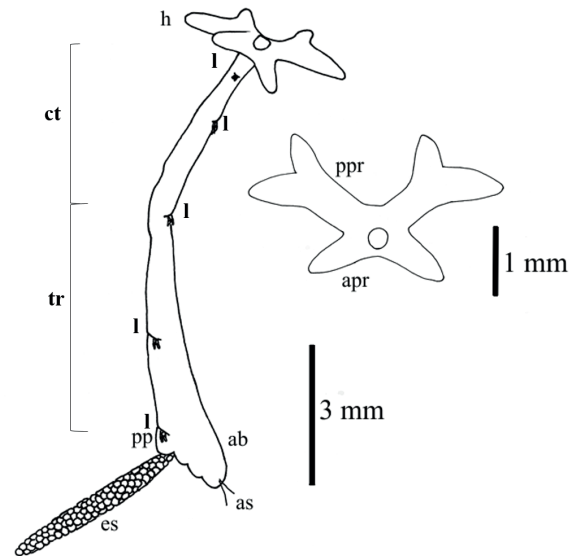


Figure 1. *Lernaea cyprinacea* (to scale, modified according to Demaree, 1967). (A) Side view: ab=abdomen; as= anal setae; ct= cephalothorax; es= egg sac; h= head; pp= pregenital prominence; l= legs; tr=trunk. (B) Detail of cephalic structures: apr= anterior protuberance; ppr= posterior protuberance.

TL neck 8.527 (6.528-11.184; N=10), TL genito-abdomen 1.022 (0.600-1.656; N=10), TL body 10.666 (8.181-12.810; N=9).

Cephalothorax composed of head, mouth structure, four cylindrical projections, lobes or horns and first pair of legs. Anterior lobes are simple and smaller [L 0.980 (0.696-1.368; N=11) and Maximum Width (MW) 0.533 (0.306-0.861; N=9)]. Posterior lobes are larger, with a smaller ramification each [L 1.899 (1.445-2.267; N=11), MW 0.565 (0.297-0.720; N=6), TL of the smaller ramification 0.499 (0.346-0.792; N=6) and TL of the larger ramification 0.794 (0.574-0.999; N=6)]. Mouth structure with bi-segmented maxillipeds; the basal segment is longer and presents one horn, while the terminal segment presents five unequal horns.

First pair of three-segmented antennae or antennules, second pair of bi-segmented antennae, with a horn in the second segment and a stout terminal claw. TL 0.307 (0.240-0.405; N=10) and MW 0.249 (0.217-0.316; N=10). Swimming legs, typical of copepods, reduced in size.

Slim, cylindrical, long neck, gradually enlarging towards the rear end, TL 8.527 (6.528-11.184; N=10)

and MW 1.305 (1.008-1.488; N=10), in which 2 to 5 biramous legs are arranged, which are reduced in size, typical of copepods: Distance (D) between 1st and 2nd is 1.185 (0.720-2.496; N=8); D between 2nd and 3rd is 2.337 (1.440-2.928; N=8); D between 3rd and 4th is 3.056 (2.424-3.600; N=9); and D between 4th and 5th is 2.179 (1.008-4.488; N=10).

Cylindrical conical genito-abdomen, TL 1.022 (0.600-1.656; N=10) and MW 0.913 (0.600-1.108; N=10), with 2 terminal setae. Gonopores with a pair of egg sacs with rows 3-4-serial eggs, always with and

odd ending, TL 4.088 (2.740-5.090; N=13) and MW 0.381 (0.310-0.576; N=14). Eggs, D 0.124 (0.089-0.264; N=10).

Infestation location: on the sides of the body and at the insertion of the fins.

Prevalence: 53 %

Site: Laboratory of Chronobiology FCV-UNL, Esperanza (Santa Fe), (31°26'32'' S, 60° 56'28'' W).

Table 1. Previous records of hosts for *Lernaea cyprinacea* in Argentina.

Province	Location (original names in Spanish)	Hosts	References
Buenos Aires	Four lakes without name, Bahía Blanca (38°64'S, 62°16'W)	<i>Rhamdia sapo</i> (= <i>Rhamdia quelen</i>)	Vanotti & Tanzola, 2005
	Lagoon without name, Bahía Blanca (38°44'S, 62°15'W)	<i>Rhamdia quelen</i>	Mancini <i>et al.</i> , 2008b
	Arroyo Napostá Grande, Bahía Blanca (38°48'S, 62°14'W)	<i>Oligosarcus jenynsii</i>	Garibotti & Guagliardo, 2004; Mancini <i>et al.</i> , 2008b
	Lagoon without name, Monte Hermoso (38°59'S, 61°15'W)	<i>Oligosarcus jenynsii</i>	Mancini <i>et al.</i> , 2008b
	Río Luján y valle de inundación, Tigre (34°26'S, 58°32'W)	<i>Astyanax bimaculatus</i>	Plaul <i>et al.</i> , 2010
	Río de La Plata, Punta Lara (34°49'S, 57°59'W)	<i>Odontesthes bonariensis</i> <i>Cyprinus carpio</i>	Plaul <i>et al.</i> , 2010
	Laguna del Burro, Río Salado (35°41'S, 57°55'W)	<i>Rhamdia quelen</i>	Plaul <i>et al.</i> , 2010
	Lagoon without name, La Plata (34°55'S, 57°57'W)	<i>Carassius auratus</i> <i>Corydoras paleatus</i> <i>Hypostomus plecostomus</i>	Plaul <i>et al.</i> , 2010
	Embalse La Viña (31°17'S, 65°01'W)	<i>Odontesthes bonariensis</i>	Mancini <i>et al.</i> , 2008a
	Río de los Sauces, Nono (31°47'S, 65°01'W)	<i>Odontesthes bonariensis</i>	Mancini <i>et al.</i> , 2008b
Córdoba	Arroyo, Tanti (31°21'S, 64°35'W)	<i>Astyanax sp.</i> <i>Jenynsia sp.</i>	Mancini <i>et al.</i> , 2008b
	Embalse Río Tercero (32°14'S, 64°25'W)	<i>Cyphocharax voga</i> <i>Odontesthes bonariensis</i> <i>Oligosarcus jenynsii</i> <i>Oncorhynchus mykiss</i> <i>Rhamdia quelen</i>	Mancini & Grosman, 1998; Mancini <i>et al.</i> , 2008b
	Embalse Los Molinos (31°50'S, 64°30'W)	<i>Odontesthes bonariensis</i>	Mancini <i>et al.</i> , 2008b
	Embalse Piedras Moras (32°10'S, 64°14'W)	<i>Astyanax eigenmanniorum</i> <i>Bryconamericus iheringii</i> <i>Odontesthes bonariensis</i> <i>Oligosarcus jenynsii</i>	Mancini <i>et al.</i> , 2008b

Córdoba	Urban lake, General Levalle (34°00'S, 63°55'W)	<i>Odontesthes bonariensis</i>	Mancini <i>et al.</i> , 2008b
	In aquarius / pisciculture, Río Cuarto (33°06'S, 64°20'W)	<i>Botia macracantha</i> <i>Carassius auratus</i> <i>Cyprinus carpio</i> <i>Poecilia sp.</i>	Mancini <i>et al.</i> , 2008b
	Lagoon without name, Uchacha (33°02'S, 63°30'W)	<i>Xiphophorus helleri</i> <i>Cyphocharax voga</i> <i>Cyprinus carpio</i> <i>Odontesthes bonariensis</i> <i>Oligosarcus jenynsii</i> <i>Rhamdia quelen</i>	Mancini <i>et al.</i> , 2008b
	Lago San Roque (31°22'S, 6°27'W) Río Cosquín (31°18' S; 64°27'W)	<i>Odontesthes bonariensis</i> <i>Astyanax hermosus</i>	Mancini <i>et al.</i> , 2008b Ramallo & Terán, 2014
Corrientes	Río Paraná, Itá Ibaté (27°26'S, 57°20'W)	<i>Prochilodus lineatus</i>	Roux <i>et al.</i> , 2000
La Rioja	Dique de Olta (30°38'S, 66°16'W)	<i>Odontesthes bonariensis</i> <i>Odontesthes jenynsii</i>	Mancini <i>et al.</i> , 2008b
Mendoza	Río Atuel, Embalse Valle Grande (34°53'S, 68°40'W)	<i>Odontesthes bonariensis</i>	Mancini <i>et al.</i> , 2008b
	Río Atuel, Embalse El Nihuil (35°04'S, 68°44'W)	<i>Odontesthes bonariensis</i> <i>Oncorhynchus mykiss</i> <i>Percichthys trucha</i> <i>Cheirodon interruptus</i>	Mancini <i>et al.</i> , 2008b; Plaul <i>et al.</i> , 2010
Río Negro	Río Negro, Isla Choele-Choele (39°22'S, 65°43'W)		Plaul <i>et al.</i> , 2010
San Luis	Pisciculture and Embalse La Florida (33°06'S, 66°00'W)	<i>Odontesthes bonariensis</i> <i>Oncorhynchus mykiss</i>	Mancini <i>et al.</i> , 2008b
	Embalse San Felipe, Renca (32°49'S, 65°28'W)	<i>Odontesthes bonariensis</i>	Mancini <i>et al.</i> , 2008b
	Embalse Río del Rosario, La Toma (33°02'S, 65°39'W)	<i>Rhamdia quelen</i>	Mancini <i>et al.</i> , 2008b
Santa Fe	Hatchery conditions, Esperanza (31°26'S, 60°56'W)	<i>Rhamdia quelen</i>	This work

Discussion

The morphological characteristics observed here are typical of *L. cyprinacea* (Demaree, 1967; Thatcher, 2006). There are precedents of leaneosis associated with *R. quelen* and other hosts, both in wild and hatchery fish species from Argentina (Table 1). However, even though *R. quelen* had already been reported as host of *L. cyprinacea*, there were no records from the province of Santa Fe. Therefore, this paper contributes to building knowledge about its distribution in the region.

Lernaea cyprinacea was introduced into South America in the beginning of the 20th century via

importation of the common carp, *Cyprinus carpio* (Piasecki *et al.*, 2004). Whether accidental or deliberate, the introduction of exotic species is one of the major reasons for the loss of biological diversity, habitat alteration, and overexploitation of natural resources. About 40% of aquatic species extinctions is caused by introduced species (Agostinho *et al.*, 2007).

Exotic species can have a negative impact by transmitting diseases or etiological agents into native communities. Therefore, colonization of exotic pathogens in aquatic systems constitutes a permanent threat to the integrity of natural environments (Agostinho *et al.*, 2007). It is suspected that this ectoparasite has colonized native fish species and is

dangerously invasive when environmental conditions are favorable, as reported in this work. Further research efforts are needed to elucidate the ecological role currently played by *L. cyprinacea* in this region.

Conflicts of interest

The authors declare they have no conflicts of interest with regard to the work presented in this report.

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