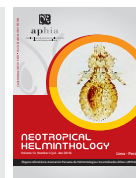




Neotropical Helminthology



ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

A NEW SPECIE OF BRANCHIURA (CRUSTACEA: ARGULIDAE) PARASITE OF *ARAPAIMA GIGAS* SCHINZ, 1822 FROM BRAZILIAN AMAZON

UMA NOVA ESPÉCIE DE BRANCHIURA (CRUSTACEA: ARGULIDAE) PARASITA DO *ARAPAIMA GIGAS* SCHINZ, 1822 (OSTEOGLOSSIFORMES: ARAPAIMATIDAE) DA AMAZÔNIA BRASILEIRA

UNA NUEVA ESPECIE DE BRANCHIURA (CRUSTACEA: ARGULIDAE) PARÁSITA DEL *ARAPAIMA GIGAS* SCHINZ, 1822 (OSTEOGLOSSIFORMES: ARAPAIMATIDAE) DE LA AMAZONÍA BRASILEÑA

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ABSTRACT

Argulus moratoi n. sp. was described from *Arapaima gigas* Schinz, 1822 collected in fish farms in the municipality of Abaetetuba, Pará, and a specimen collected in the municipality of Barcelos, in the state of Amazonas, Brazil. The new species is characterized by pronounced, deep, large, semi-rectangular and depigmented antero-lateral depressions delimiting the frontal kidney-shaped, region, supporting rods formed of two sclerites, first in the "J" shape and the second in "V" shape, heart shaped carapace, in the male the sexual modification of the 2nd leg being a parallelogram-shaped projection directed inward, and simple scales.

Keywords: Amazonas – *Arapaima gigas* – *Argulus moratoi* n. sp. – fish parasite

RESUMO

Argulus moratoi n. sp. foi descrito de *Arapaima gigas* Schinz, 1822 coletados em pisciculturas no município de Abaetetuba, Pará, e um espécime coletado no município de Barcelos, no estado de Amazonas, Brasil. A nova espécie é caracterizada por apresentar depressões pronunciadas, profundas, grandes, semi-retangulares e despigmentadas antero-laterais, delimitando a região frontal em forma de rim, apoiando bastões formados por dois escleritos, primeiro no formato "J" e o segundo em "V". "forma, carapaça é em forma de coração, no macho a modificação sexual da segunda perna é uma projeção em forma de paralelogramo direcionada para dentro e espinhos simples.

Palavras-chave: Amazonas – *Arapaima gigas* – *Argulus moratoi* n. sp. – parasita de peixes

RESUMEN

Argulus moratoi n. sp. se describió de *Arapaima gigas* Schinz, 1822 recolectadas en piscigranjas en el municipio de Abaetetuba, Pará, y un espécimen recolectado en el municipio de Barcelos, en el estado de Amazonas, Brasil. La nueva especie se caracteriza por presentar depresiones antero-laterales pronunciadas, profundas, semi-rectangulares y despigmentadas que delimitan la región frontal en forma de riñón, barras de soporte formadas por dos escleritos, el primero en forma de "J" y el segundo en "V". "La forma, el caparazón es en forma de corazón, en el macho, la modificación sexual de la segunda pata es una proyección en forma de paralelogramo dirigida hacia adentro y con escalas simples.

Palabras clave: Amazonas – *Arapaima gigas* – *Argulus moratoi* n. sp. – parásito de peces

INTRODUCTION

Branchiura is a group of parasitic crustaceans found as parasites on fresh and brackish water fishes around the globe (excepting Antarctica). Thirteen *Argulus* Muller, 1785 species occur in Brazil, only five of them have been reported in the Amazon all of freshwater environments (Souza *et al.*, 2018).

Modifications for different kinds of attachment are common among parasitic crustaceans, but the suction discs seen in most species of the Branchiura are among the most elaborate and fascinating of such structures. The term 'suction disc' is well-chosen since they operate by muscle-facilitated suction (Gresty *et al.*, 1993). Suction discs are found in three of the four currently recognized genera of the Branchiura, in *Argulus*, *Chonopeltis* Thiele, 1900, and *Dipteropeltis* Calman, 1912, and it is well known that these structures are modified first maxillae (Wilson, 1902; Thiele, 1904; Ringuelet, 1943; Fryer, 1964).

Branchiura species are ectoparasitic crustaceans of fish and, occasionally, of amphibians and reptiles. Each species has a preferred area of fixation, can be the gill or buccal cavity, the surface of the body or the base of the fins. In the gill cavity, they attach to the wall of the operculum or the posterior wall of the last branchial arch, rarely in the branchial filament, except the young individuals. Species fix their hosts by means of first and second maxillae, antennae, spines, hooks and teeth. In addition, the ventral part of the carapace is concave and functions as a suction cup which is compressed to the body of the host by the action of the water

stream passing through the dorsal surface of the crustacean (Malta, 1982a; 1982b; 1984, Malta & Varella, 2009). The objective of this work was to describe a new species of Branchiura of the genus *Argulus* parasitizing an Amazonian fish.

MATERIAL AND METHODS

On August 26, 2016, 85 specimens of *Argulus* were collected from an *Arapaima gigas* (Schinz, 1822) at a fish farm in the municipality of Abaetetuba, state of Pará, Brazil. *Argulus* were fixed in ethyl alcohol 70% later taken to the Laboratory of Fish Parasitology of the Instituto Nacional de Pesquisas da Amazônia - INPA.

Argulus studied by light and stereo microscopy. All measurements are in millimeters and shown as follows: range, minimum - maximum and arithmetic mean (within brackets). The description is based on the measurements of 10 adult females and 10 males. Drawings were made in light microscope Olympus BH-2 with camera lucida. Types, and were deposited, in the non-insect Invertebrate Collection of the National Research Institute of Amazonia (INPA), Manaus, Amazonas, Brazil. Paratypes: 10 females and 10 males (INPA-2446).

RESULTS

Taxonomy

Subclass Branchiura
Order Argulidea

Family Argulidae Leach, 1819
Genus *Argulus* Müller, 1785

***Argulus moratoi* n. sp.**

Material examined – Holotype: Female (INPA-CR 2445) from the body surface of *Arapaima gigas* Schinz, 1822, in liquid medium, from a fish farm in Abaetetuba, State of Pará, Brazil latitude: 01° 43' 05" S, longitude: 48° 52' 57" W.
Paratypes: 10 females and 10 males (INPA - 2446).

Description

Adult female. General body form squat (Fig. 1); carapace sub-oval and heart shaped, comprising about 64% of total body length. Total length range 5.1 - 3.91 (4.7) mm (based on 10 specimens) (Figure 1). Elongated body. Milk white colored dorsal surface with drawings formed by dots of brown pigments. Carapace longer than wide carapace length (cl) 3.4 - 2.72 (3.0) mm. Lateral lobes of carapace rounded cover the margin anterior of third leg, separated by V-shaped sinus less than 1/5 length of carapace, with a vertical band of dark pigments close and parallel to each lateral end. Suckers visible in dorsal view (Figure 1).

Pronounced, deep, large, semi-rectangular and depigmented antero-lateral depressions delimiting the frontal region kidney-shaped (Figure 1 and 2). Well defined interocular ribs, paired large compound eyes, found at the same height of the junction between the frontal region and the main part of the carapace. Small nauplius eye Y-shaped found on dorsal surface in center of carapace. Edge of suction cups visible in dorsal view.

Ventral side of carapace covered with simple scales similar the minute spinules, tending to be more numerous anteriorly and extending along the margin of the lateral lobes to the height of the 2nd pair of legs. Ventral surface of the carapace lateral lobes with two unequal respiratory areas (Figure 2): the largest oval area, with two notches, the first very small at the anterior margin and the second large and well defined at the anterior lateral margin; small respiratory area located in the anterior margin near the anterior notch.

Thorax distended with eggs but not in carapace alae and indistinctly 4-segmented. (Figures 1 and 2). Thorax with drawings consisting of dots of brown

pigments across the dorsal surface, lateral margins of the segments with a band made of dark brown pigments that extend to form a median stripe in the abdomen until near the distal part.

Abdomen (Figures 1 e 2) longer than broad, with a row of simple scales near the margins on the dorsal and ventral surface, posterior lobes tapering to point from behind anal sinus; separated by broad sinus about 1/3 length of abdomen. Paired spermathecae located at middle of abdomen; furcal rami small, located adjacent to midline at base of anal sinus.

First antenna (Figure 4) 5 segmented. First segment (basal segment) sclerotized, large with stout posteriorly-projecting posterior spine. Second segment sclerotized with anterior and medial spines, plus large lateral hook. Terceiro segmento com uma seta longa na porção distal. Fourth segment fleshy, cylindrical without ornamentation. Fifth segment fleshy, cylindrical with two posterior setae.

Second antenna (Figures 2 e 4) with four segments. First segment larger; remaining three thin, cylindrical. Third segment fleshy with a terminal simple seta. Fourth segment fleshy, cylindrical with two posterior setae (Figure 4).

First maxillae modified into suction cups in adults. (Figure 2). Supporting rods comprised of two sclerites, first in the "J" shape and the second in "V" shape (Figure 2C). Periphery of suckers fringed with tiny spinules (Figure 2C). Retractable pre-oral spine located midway between maxillary suckers; tip extending to midway between post-antennal spine when retracted. Mouth tube more than twice as long as broad without ornamentations. Pair of broad accessory spines located posterior to mouth-tube on either side of midline (Figure 2).

Second maxilla 5-segmented (Figure 2) proximal section 2-segmented; distal section 3-segmented. Basal segment with broad bearing 3 stout, digitate spines, usually larger space between lateral spine and central spine. Basal plate with elevated pad bearing coarse-pectinate scales and about three stouts, simple setae that extend over median posterior spine and space between central and lateral posterior spines. Second to 4th segments armed with simple and pectinate scales. Terminal

segment lacking scales and ending in a lobe and two small claws. Pair of broad post-maxillary spines present on ventral body surface either side of midline (Figure 8).

Four pairs of biramous swimming legs composed of a precoxa (protopod), coxa, basis, exopod, and endopod. First to 4th pairs of legs biramous, of near equal size (Figures 9 - 12). Sympods distinctly 3-segmented. Flagellum present on 1st and 2nd legs; extending medially from origin on dorsal surface at base of exopod. Rami and flagella armed with plumose setae (Figures 9 e 10). Third and 4th legs lacking accessory copulatory structures. Small, simple scales present on swimming legs. Natatory lobe on fourth leg produced laterally and armed with simple scales and plumose setae.

Adult male. Body form similar to that of female; carapace comprising about 65% of total length; (Figures 13 - 17 e Table 2). Total length range 3.79 – 2.8 (3.5) mm (based on 10 specimens), they are 25% smaller than the female (Figure 13 e Tab. 2). Cephalic appendages and first 2 pairs of legs similar to those of female.

Small, simple scales present on swimming legs. Sexually dimorphic characters' present in 2nd, 3rd and 4th legs, all on 2nd segment of sympods. Sexual modification of the 2nd leg (Figure 15) is a parallelogram-shaped projection directed inward with simple scales. Single cup-shaped socket on posterior margin of protopod of 3rd leg, located directly above copulatory peg on anterior surface of basis of 4th leg. Natatory lobes of leg 4 triangular, with 5 plumose setae.

Abdomen (Figure 13) broader than thorax, length range 0.8 – 1.19 (1.0) mm, comprising 28.57% of total body length; about twice as long as broad; posterior lobes tapering to slightly rounded points; separated by sinus 1/3 length of abdomen. Paired elongated testes that extend through almost the entire abdomen; dorsal and ventral surface of abdomen with simple scales. Furcal rami minute, situated on dorsal side at base of anal sinus.

Etymology: The specific name "moratoi" is a tribute to Celso Morato de Carvalho a great biologist who dedicated his life to the study of Amazonian herpetology.

DISCUSSION

There are described fourteen species of the genus *Argulus* recorded from the Brazil (Malta, 1998; Luque *et al.*, 2013). Six of them, namely: *A. multicolor* Stekhoven, 1937; *A. pestifer* Ringuélet, 1948; *A. juparanaensis* Lemos de Castro, 1950; *A. amazonicus* Malta & Silva, 1986; *A. chicomendesi* Malta & Varella, 2000 and *A. angelae* Souza, Porto & Malta, 2018 have been reported in the Amazon 2017 (Malta, 1982ab;1984;Souza *et al.*, 2018).

Argulus violaceus Thonsem, 1925 from Uruguay and *A. americanus* Wilson, 1902 from USA has the supporting rods of the first maxillae comprised of two sclerites in the "J" shape (Wilson, 1902; Thomsen, 1925). *Argulus patagonicus* Ringuélet, 1943 from Argentina has three sclerites, the J-shaped basal, the ovoid-shaped intermediate and the rounded terminal (Ringuélet, 1943). *Argulus carteri* Cunningham, 1931 from Paraguay has too three sclerites, the J-shaped basal and the rounded terminals. *Argulus moratoi* n. sp. has two sclerites, but the first has "J" shape and the second "V" shape. Only the five species has sclerites basal J-shaped.

Argulus moratoi n. sp. is the fifteenth species cited for Brazil and the seventh from Amazon region. *Argulus moratoi* n. sp. is from the group of Argulidae species in which modifications of the legs of males occur in the second, third and fourth pairs of legs. As *A. pestifer* Ringuélet, 1948 from Argentina; *A. ernsti* Weibezahn & Cobo, 1964 from Venezuela; *A. angelae* Souza, Porto & Malta, 2018 from Brazilian Amazon. But *A. moratoi* n. sp. is the unique species that the sexual modification of the 2nd leg is a parallelogram-shaped projection directed inward with simple scales.

The male of *A. moratoi* n. sp. has a paired elongated testis that extend through almost the entire abdomen; similar the *A. salmini* Kroyer, 1863 from Argentina and Brazil and *A. chicomendesi* Malta & Varella, 2000 from Brazilian Amazon. All the males of Branchiura are smaller than the females.

Argulus kosus, *A. fryeri* Rushton-Mellor, 1994, *A. izintwala* Van As & Van As, 2001, *A. multipocula* Barnard, 1955 and *A. angelae* present pronounced and deep antero-lateral depressions, forming a distinct frontal region (Avenant-Oldewage, 1994;

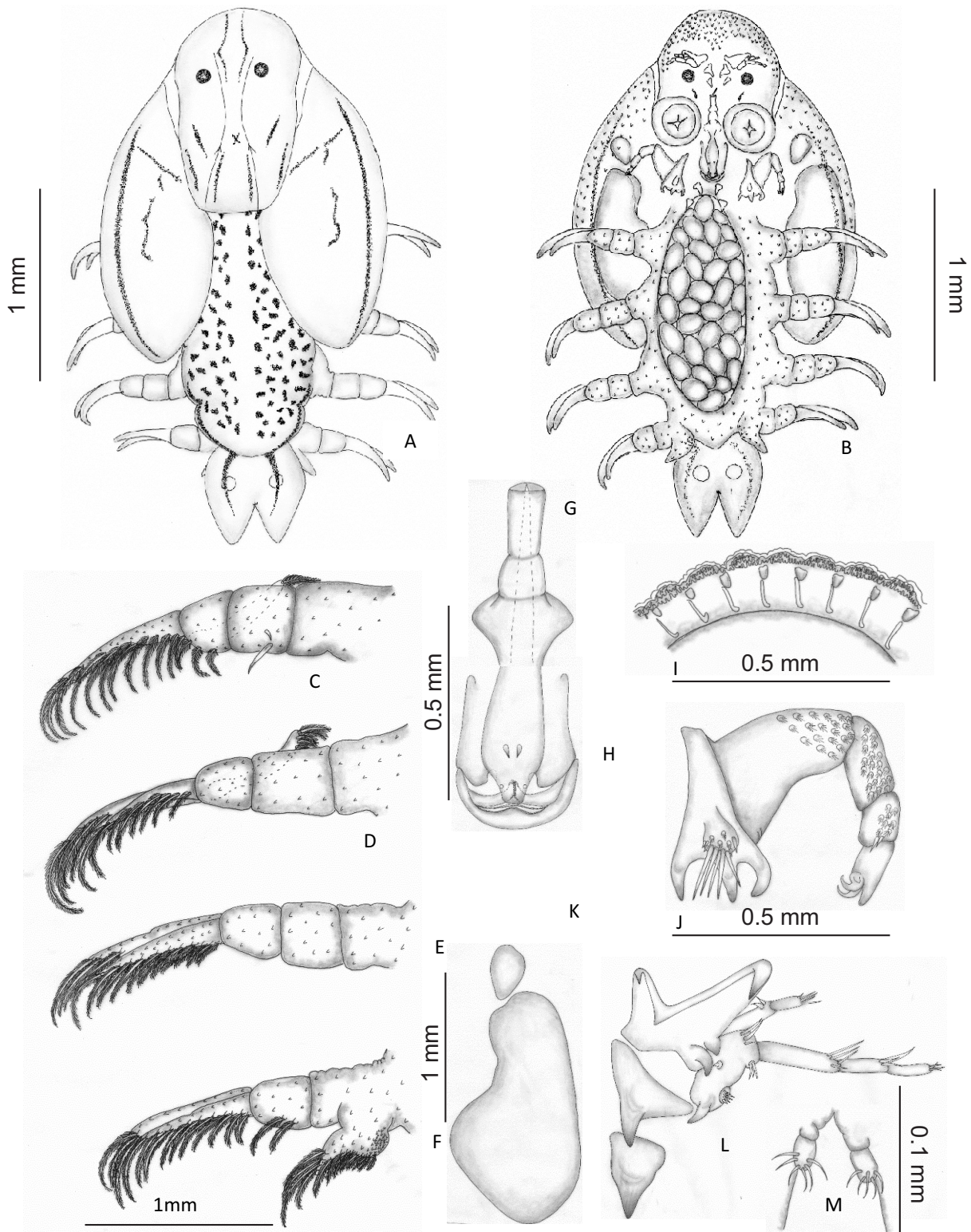
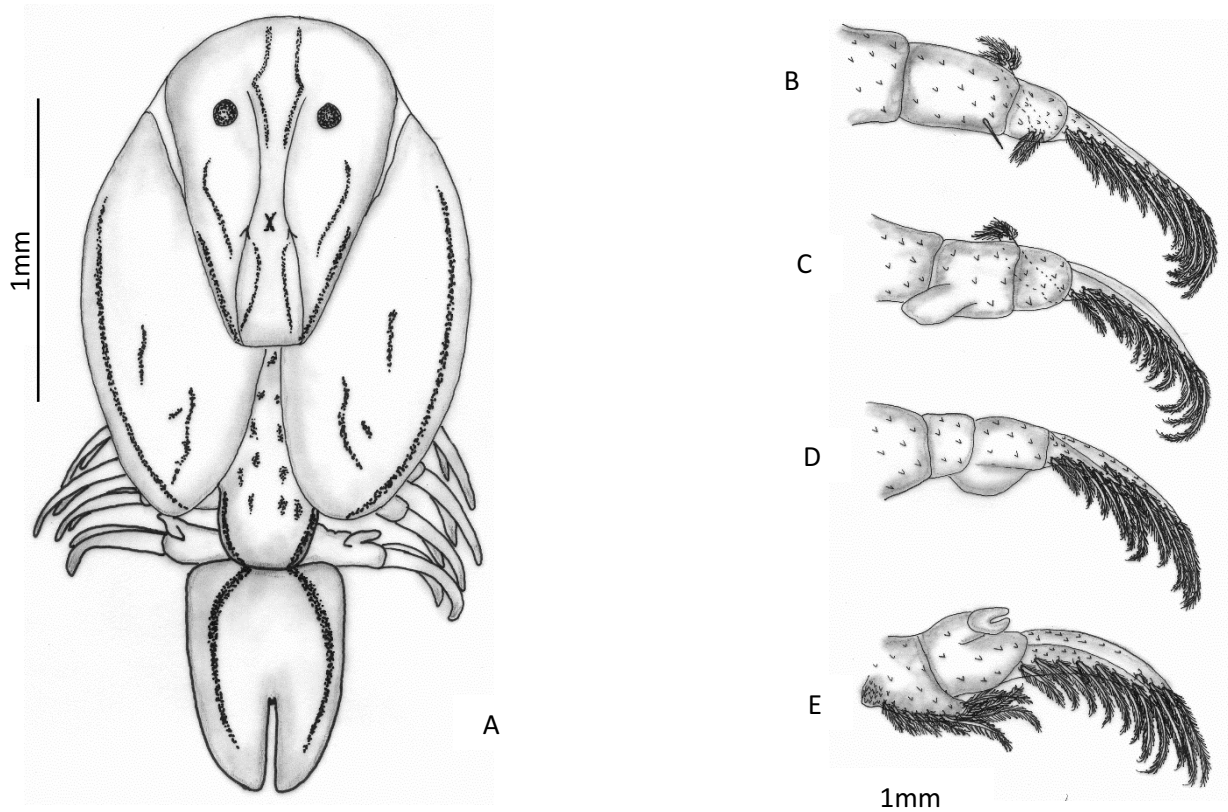


Figure 1. A-M: *Argulus moratoi* sp. n. (female), A–dorsal; B–ventral; C–F legs; G–pré-oral stilet; H–buccal cone; I–maxilla 1; J–maxilla 2; K–respiratory areas; L–antennas 1 and 2; M–caudal rami.



Figures 2. A-E: *Argulus moratoi* sp. n. (male), 1 – dorsal; 15-18 – legs.

Van As & Van As, 2001; Smith *et al.*, 2005; Souza *et al.*, 2018). In *A. angelae*, the antero-lateral depressions are delimited by the rectangular antero-lateral depressions (Souza *et al.*, 2018). In *A. moratoi* n. sp. the anterolateral depressions are very like those of *A. angelae*, are pronounced, deep, large, and depigmented, but are semi-rectangular and the frontal region is kidney-shaped, not rounded.

Argulus moratoi n. sp. was described from *A. gigas* of a farm fish in Brazil. The new species is characterized by shape and drawings of the carapace, abdomen and thorax by pronounced, deep, large, semi-rectangular and depigmented antero-lateral depressions delimiting the frontal region kidney-shaped, to present supporting rods formed of two sclerites, first in the "J" shape and the second in "V" shape, carapace is heart shaped, in the male the sexual modification of the 2nd leg is a

parallelogram-shaped projection directed inward and simple scales.

Argulus moratoi n. sp. is the fourth Branchiura species cited for *A. gigas*. The other three species cited are: *Dolops discoidalis* (Bouvier, 1897) (Malta, 1982ab; 1998; Luque *et al.*, 2013), *Argulus* sp.1 and *Argulus* sp.2 (Malta, 1981). Two species were mistakenly quoted as *A. gigas* parasites: *Argulus chicomendes* and *D. carvalhoi* Lemos de Castro, 1949 and Luque *et al.* (2013).

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