Riggia puyensis n. sp. (Isopoda: Cymothoidae) parasitizing Chaetostoma breve and Chaetostoma microps (Siluriformes: Loricariidae) from Ecuador

C. Rodríguez-Haro, M.M. Montes, P. Marcotegui, S.R. Martorelli

ARTICLE INFO

Article history:
Received 18 November 2016
Accepted 17 December 2016
Available online 21 December 2016

Keywords:
Parasites
Crustacea
Riggia
Ecuador
Armoured catfish

ABSTRACT

A new isopod was found parasitizing Chaetostoma breve and Chaetostoma microps from the Puyo and Bobonaza rivers. The parasite was found to belong to the Cymothoidea family and could be located within the genus Riggia instead of Artystone by the presence of abdominal plates fused with the telson. The specimens found represent a new species, Riggia puyensis n. sp., and could be distinguished from Riggia cryptocularis by the presence of developed eyes. The main difference of the new species from Riggia nana and Riggia brasiliensis is the size, bigger compared with the first and smaller compared with the last species. Riggia acuticaudata have the maxilliped with simple setae, the palp without spination, and maxillule with five spines (two terminal and three subterminal) instead in R. puyensis n. sp. the maxilliped have plumose setae, the palp have spination (with one apical spine, two setae on middle article and one in the basal article) and the maxillule have five spines: two terminal, two subterminal and other spine lower to the others. Riggia paraenaensis have similar size, same number of segments in the antenna, and similar maxilla to R. puyensis n. sp., but the antennule in the new species have seven segments instead 6 in R. paraenaensis, the antennule and antenna present spines not mentioned in R. paraenaensis. Besides, the relative position of the mandible in R. puyensis n. sp. is different compared with R. paraenaensis, the maxillule have the same number of spines but with different disposition, and the maxilliped have simple setae in R. paraenaensis but those are plumose in the new specie.

© 2016 Elsevier B.V. All rights reserved.

Contents

1. Introduction .................................................. 50
2. Materials and methods ........................................ 51
3. Results .......................................................... 51
3.1. Taxonomy .................................................. 51
3.2. Description ............................................... 52
4. Discussion .................................................. 53
Acknowledgments .............................................. 57
References ..................................................... 58

1. Introduction

In South America, the family Cymothoidea is well represented in freshwaters fishes. There exist two similar genera, Artystone and Riggia. The main difference between them are the five abdominal plates fused, with the unciform and convex telson, forming an abdominal plate in Riggia; by the other hand are the abdominal segments are free, independent one from the others and big hart-shaped telson in Artystone (Szidat, 1948).

At the moment the genus Riggia Szidat, 1948 includes five species, all parasites of freshwater fish distributed in South America: Riggia paraenaensis described on Cyphocharax planatus from...
Argentina (Szidat, 1948) and later reported on Cyphocharax gilbert from Brazil (Bastos and Thatcher, 1997; Lins et al., 2008); Riggia brasiliensis on Leporinus capelandii, Leporinus octofasciatus, Leporellus vitattus, and Schizodon nasutus from Brazil (Szidat and Schubart, 1960); Riggia nana on L. vitattus, L. striatus, and S. nasutus from Brazil (Szidat and Schubart, 1960); Riggia acuticaudata on Ancistrus sp. from Brazil (Oda et al., 2015; Thatcher et al., 2002); and Riggia cryptocularis on Odontostilbe paraguayensis and Ancistrus sp. from Brazil (Thatcher et al., 2003).

Since the finding of Asotana splendida from the Napo River (Leigh-Sharpe, 1937), only two other isopods were reported on fishes from Ecuador: Riggia sp. parasitizing Chaetostoma sp. and Rhamdia quelen (Anagavo-Yancha and Brito, 2015) and Artystone tryobia on a loricarid Chaetostoma Dermorphynchum from the Amazonian region of Ecuador (Junoy, 2015).

The main objective of this paper is to describe a new species of Riggia on Chaetostoma breve and Chaetostoma microps from two rivers of Ecuador.

2. Materials and methods

Specimens of Chaetostoma breve and Chaetostoma microps (Table 1) were obtained by an artisanal fishermen and collected by hand and cast nets, between January 2013 and March 2016 from the Bobonaza (1°35’06.8” S, 77°44’15.5” W) and Puyo (1°35’22.7” S, 77°54’13.6” W) Rivers (Fig. 1). Those rivers are in the Pastaza Province, located near to Peru and almost in the middle of Ecuador, in the Ecuadorian Amazon region. The headwaters of the rivers are located in the middle-central and high-central Andes Mountain flowing to the south and discharge into bigger rivers, first in the Pastaza, then in the Marañon, and finally in the Amazonas (Ortega et al., 2012). There is an alternation of seasons: the rainiest season (from May to June), a dry season (from July to September), a small rainy season (from September to January) and lastly a second dry season (from February to May). There is a “fish season” when the migratory fishes from the south arrive, this occurs between August and January (Siren, 2004).

The fishes were inspected macroscopic and only the parasitized were carried to the lab and then sacrificed. The pleopod of the female Riggia was searched for the males, but only three was found. The appendices of the female were removed, cleared in Lactophenol, observed, photographed and drawn with Olympus microscope Bx51 equipped with a drawing tube and with an AmScope MU 1000 10 MP digital microscope camera. To calculate the prevalence, mean intensity and abundance were used only the females of Riggia sp.

The type material was deposited in the Invertebrate Collection of the Museo de la Plata.

3. Results

The host specie, provenance, prevalence, mean intensity and abundance are provided in Table 1. The isopod was located behind the pectoral fins in the right or left side of the fishes (Fig. 2A–B).

3.1. Taxonomy

Order Isopoda Latreille, 1817
Suborder Cymothoida Wägele, 1989
Family Cymothoidea Leach, 1818
Genus Riggia, Szidar, 1948
Riggia puyensis n. sp. (Fig. 2–7, Table 2).

3.2. Description

**Riggia puyensis** n. sp.
(Figs. 3–11)

*Diagnosis:* Riggia puyensis n. sp. is characterized by a large female size; presence of developed eyes; pleotelson sharp; orientation and conformation of mandible and palp; presence of plumose setae in maxilliped; scales with hairs on maxilla; maxillule, pereopods and pleopods spines conformation.

*Female description* (measurements Table 2): Body convex dorsally, high in lateral view (Fig. 3A–D), with pigmentation in the outer face of pereonites. Pleotelson subtriangular, base subquadrangular.

Cephalon immersed in pereonite 1 with notable eyes, Antennule 7 segmented with a seta and finishing spine. (Figs. 4 A and 5 A). Antenna with 8 segments, the last reduced and with numerous apical setae (Figs. 4 B and 5 B). Mouthparts: Maxilliped (Fig. 4C) with lateral, long and plumose setae (4D) and a small, terminal, robust spine, apically softly bifid (Fig. 4E). Maxillule with 5 recurved spines, three terminals, one subterminal and other bellow (Fig. 4F and G). Maxilla bilobed terminally with two prominent spines on each lobe, with scales carrying fine and numerous setae like “hairs” (Fig. 4H) on outer margin, and a row of spines on the inner margin distally. Mandible bipartite, rounded distally and densely covered with spines, mandible looking to the sagittal plane. Palp shorter than mandible, with three articles; apical with a spine. Two setae on middle article inner side, basal article with one setae, palp looking outside (Fig. 6).

Pereon with pereopods (Fig. 7A–G), curved, 1–6 with five articles and apical strong claw. Pereopod 7 without claw and longer, inner side of 3rd, 4th, and 5th articles with bifurcate spines distributed in 2–3 rows across 4th and 5th articles, 3rd article only on apical first third. Myxal area of pereopods with little structures like papillae, 1st pereopod with four papillae, 2nd pereopod with seven, 3rd with twelve, 4th with four, 5th with six, 6th with two, and 7th with none. (Table 3).

Pleon with pleopods (Fig. 8A–E) elongated, rounded, bilaminated (except 2nd pleopod, trilaminated), exopods ovoidal, endopods shorter than exopods. First pleopods sharper than the others. First and second pleopod base with five spines, third pleopod with one spine, and fourth and fifth pleopod without spines. Uropod (Fig. 8F) elongated with little spines like “hairs” on the edge, pleotelson covering dorsally.

*Male description* (based on three specimens, measurements Table 2): Small, cephalon, not immersed in pereonite 1. Melanophores dorsally-laterally. Developed eyes (Fig. 9A–C). Antennules with 7 segments, penultimate segment with a spine, last segment with an apical spine (Fig. 10A). Antenna (Fig. 10B) with 8 segments, distal segment with a crown of spines.

Pereopods 1–6 (Fig. 11A–E) curved, with a distal segment ending in a claw. Pereopods with five segments. The penultimate segment
of 3rd, 4th and 5th pereopods cover with little scales, similar to the female but without hairs. Claw myxal area with bifid spines, 1st and 2nd pereopod with five spines; 3rd pereopod with four spines in the myxal area and one in the articulation of the claw, 4th pereopod with three spines, and 5th pereopod with four spines. Pleopods margin with long hairs (not drawn). Appendix masculinum in 2th pleopod barely visible.

**Etymology:** The species name “puyensis” references the principal site where fish were collected, the River Puyo.

**Specimens deposited:** Holotype MLP 27154, Allotype MLP 27155 collection of the Museo de La Plata, Argentina (MLP).

### 4. Discussion

The isopod specimens agree with the description of *Riggia* (Szidat, 1948; Bastos and Thatcher 1997 and Thatcher et al., 2002) by the presence of coxal plates fixed to pereonite I, seven pair of legs with simple dactyls and pleon – pleotelson fused.

*Riggia puyensis* n. sp. was found in *C. breve* and *C. microps* from the Puyo and Bobonaza rivers in Ecuador, and represents a novel site and host for this genus (the sixth reported), and the northern species of the genus.
Fig. 6. Female Riggia puyensis n. sp. mandible and palp. Scale bar = 300 μm.

Table 2
Measurements of Riggia puyensis n. sp. compared with other species of genus.

|                | Riggia puyensis n. sp. | R. paranensis | R. acuticantula | R. cyptocularis | R. brasilensis | R. nama |
|----------------|------------------------|---------------|-----------------|-----------------|----------------|--------|
| FEMALES        |                        |               |                 |                 |                |        |
| Body L         | 27,8 (25–29,9)         | 21 (14–28)    | 13,3 (11–16)    | 20              | 33             | 14     |
| Body A         | 20,24 (17,4–23)        | 16 (10–20)    | 8,4 (6–10)      | 11              | 23             | 10     |
| Body D         | 11,31 (10,21–13,5)     | 4,3 (3–5)     |                 |                 |                |        |
| Pleotelson L   | 13,16 (10,83–15,5)     | 7,7 (5–10)    | 3 (2,5–4)       | 6,5             |                |        |
| Pleotelson A   | 8,14 (7,2–9,5)         | 7,2 (4–9)     | 3 (2,5–3,5)     | 5,3             |                |        |
| MALES          |                        |               |                 |                 |                |        |
| Body L         | 4,37                   | 6 (4–8)       |                 |                 |                |        |
| Body A         | 1,87                   | 3,5 (2–5)     |                 |                 |                |        |
| Body L         | 1,07                   | 3 (1,8–4,5)   |                 |                 |                |        |
| Pleotelson A   | 1,12                   | 1,5 (1–2)     |                 |                 |                |        |

Table 3
Bifid spines and sensory setae (in parenthesis) in each pereopod and segment.

|       | I   | II  | III | IV  | V   | VI  | VII |
|-------|-----|-----|-----|-----|-----|-----|-----|
| Propodus | 4 (6) | 6 (6) | 12 (10) | 4 (8) | 4 (4) | 2 (3) | 0 (0) |
| Carpus   | 0 (3) | 0 (1) | (1)  | 0 (5) | 2 (2) | 0 (2) | 51 (0) |
| Mersus   | 0 (5) | 0 (8) | (5)  | 0 (8) | 0 (3) | 0 (7) | 47 (0) |
| Ischium  | 0 (7) | 0 (15) | (4)  | 0 (0) | 0 (16) | 0 (0) | 20 (0) |
| Basis    | 0 (2) | 0 (8) | (5)  | 0 (10) | 0 (1) | 0 (0) | 0 (0) |
| Coxa     | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
The new species can be differentiating from the *R. nana* by the size. The first was poorly described by Szidat and Schubart (1960) and is smaller.

Female and male of *R. brasiliensis* are bigger than *R. puyensis* n. sp., but they appendages was poorly described by Szidat and Schubart (1960).

*Riggia cryptocularis* described by Thatcher et al. (2003) can be differentiates by the absence of pigmented eyes, that condition is not seen in *R. puyensis* n. sp. That specie was described on one female and one male, both with non functional eyes. The female antenna has 7 segments but in *R. puyensis* n. sp. that structure has 8 segments. The plumose setae in the maxilliped are similar to the new specie, the palp have two spines (only one in *R. puyensis* n. sp.), and the maxillule recurved spines are three terminal and two subterminal (in the new specie the conformation is different, with two terminal, two subterminal and another spine lower). The maxilla is bi-lobed in the two species but in *R. puyensis* n. sp. have two spines in each lobe different to the unique spine in *R. cryptocularis*. The male size is quite similar in both specie.

*Riggia acuticauda* is smaller than *R. puyensis* n. sp., but they have well development eyes, the same number of segments in the antennule and maxilla bilobated with two spines each lobe.

In *R. acuticauda* the maxilliped have simple setae, the palp without spination, maxillule with five spines (two terminal and three subterminal) but in *R. puyensis* n. sp. the maxilliped have plumose setae, the palp have spination (with one apical spine, two setae on middle article and one in the basal article) and the maxillule have five spines: two terminal, two subterminal and another spine lower to the others. Thatcher et al. (2002) described the pereopods without spines, which are present in the new species. The male of *R. acuticauda* is unknown.

*Riggia paranaensis* poorly described by Szidat (1948) was redescribed by Bastos and Thatcher (1997) and this last work was used for the present comparison. The size of the new specie, the number of segments in the antenna, and maxilla are similar between *R. paranaensis* and the new species. The antennule in *R. puyensis* n. sp. have 7 segments, one less than the type specie of the genus. Bastos and Thatcher (1997) when describe the antennule and antenna do not mention any spine, which are present in the new specie. The relative position of the mandible in *R. puyensis* n. sp. is different compared with *R. paranaensis*. The maxillule have 5 spines, four terminal and one subterminal in *R. paranaensis*, but in *R. puyensis* n. sp. the disposition of the 5 spines are different: two terminal, two subterminal and another spine lower to the others.

---

**Fig. 7.** Female *Riggia puyensis* n. sp. A, first pereopod. B, second pereopod. C, third pereopod. D, four pereopod. E, fifth pereopod. F, sixth pereopod. G, seventh pereopod. Scale bars: A–G = 1 mm.
Fig. 8. Female Riggia puyensis n. sp. A, first pleopod, B, second pleopod, C, third pleopod, D, fourth pleopod, E, fifth pleopod, H, uropod. Scale bars: A–F = 1 mm.
Fig. 9. Male Riggia puyensis n. sp. A, dorsal view. B, ventral view. C, Lateral view. Scale bars: 1 mm.

Fig. 10. Male of Riggia puyensis n. sp. antennule (A) and antenna (B). Scale bars: A = 20 μm, B = 50 μm.

The maxillipeds have simple setae in *R. paranaensis* but those are plumose in the new specie. Bastos and Thatcher (1997) draw the pereopods with setae but those were not mentioned in the text. The male is similar size in both species.

Thatcher et al. (2002) report the isopod parasitizing only the left side of the abdominal cavity of the host fish, but *R. puyensis* n. sp. was found parasitizing both side.

The Riggia genus was recorded from different hosts (*Ancistrus* sp., *Leporinus* sp., *Leporellus* sp., *Cyphocharax* sp., *Odontostilbe* sp., *Schizodon* sp. and now *Chaetostoma* sp.) belonging to the Characiformes and Siluriformes orders. Some of those fishes are in the bottom and with low motion, but others do not share that characteristics, and only came to the bottom to feed, that could be the moment used by the isopod to be attached to the host.

Acknowledgments

We thanks to Centro de Estudios Parasitológicos y Vectores (CEPAVE), Consejo Nacional de Investigaciones Científicas y Técnicas, Universidad Nacional de La Plata (UNLP), Secretaría Nacional de Educación Superior Ciencia Tecnología e Innovación (SENECYT) Ecuador, Instituto Nacional de Pesca (INP) Ecuador and Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA) Argentina by permits issued of export and import of samples, Adriana Almiron and Jorge Casciotta from Facultad de Ciencias Naturales y Museo (UNLP) for fish species determination, and finally we are also grateful to Ross Procter for English editing of the manuscript.
References

Anaguano-Yancha, F., Brito, M.J., 2015. Parasitismo de Riggia sp. (Isopoda; Cymothoidae) en dos especies de peces Curimatidae sp. y Rhamdia quelen del suroriente del Ecuador. Av. en Cs. e Ingen. Sec. B, 27: 13–16.

Bastos, P.B., Thatcher, V.E., 1997. A redescription of Riggia paranensis Szidat, 1948 (Isopoda, Cymothoidae) based on thirty-two specimens from Curimatid Fish of Rio de Janeiro, Brazil, with an emendation of the genus. Mem. Inst. Oswaldo Cruz 92, 755–760.

Junoy, L., 2015. Parasitism of the isopod Aristeon trisulba in the fish Chaetostoma demorphynchum from the Tena River (Amazonian region, Ecuador). Acta Trop. 153, 26–45.

Leigh-Sharpe, W.H., 1937. Rastreadoradoura splendida n. g. et sp.: a new parasitic isopod from Ecuador. Parasitology 29, 391–394.

Lins, D.C., Meirelles, M.E., Malm, O., Lima, N.R.W., 2008. Mercury concentration in the freshwater bonefish Cyprichromis rufus (Cichlidae) and its parasite the crustacean Riggia paranensis (Cymothoidae). Neotrop. Ichthyol. 6, 281–288.

Oda, F.H., Da Graca, R.J., Tencatt, L.F., Tavares, L.E., Froehlich, O., Takemoto, R.M., 2015. The poorly known Riggia acuticaudata (Crustacea; Isopoda) parasitizing Ancistrus sp. (Siluriformes; Loricariidae) from the Paraná River Basin, Brazil, with comments on its reproductive biology. Comp. Parasitol. 82, 25–28.

Ortega, H., Hidalgo, M., Trevejo, G., Correa, E., Cortijo, A., Meza, V., Espino, L., 2012. Lista anotada de los peces de aguas continentales del Perú. Estado actual del conocimiento, distribución, usos y aspectos de conservación. Ministerio del Ambiente, Dirección General de Diversidad Biológica, Museo de Historia Natural, UNMSM. Lima, Perú, pp. 58.

Sirén, A., 2004. Changing interactions between humans and nature in Sarayaku, Ecuadorian Amazon. 447. Acta Universitatis Agriculturae Sueciae. Agraria. Szidat, L., Schubart, O., 1960. Neue und parasitische Süsswasser-Asseln der Familie Cymothoidae aus dem Rio mogi guassu, Brasilien (Isopoda). An. Acad. Bras. Cienc. 32, 107–124.

Szidat, L., 1948. Riggia paranensis n. g. n. sp., a isopod parasite of the cavity of the body of Curimatidae pisiana Günther, deito Paraná. Rev. Inst. Inv. Cien. Natur.Cien. Zool. Buenos. Ares, 1, 45–56.

Thatcher, V., Lopes, L., Froehlich, O., 2002. Riggia acuticaudata sp. nov. (Isopoda, Cymothoidae) from the body cavity of a freshwater fish of Mato Grosso do Sul, Brazil. Rev. Bras. Zool. 19, 495–501.

Thatcher, V., Lopes, L., Froehlich, O., 2003. Riggia cryptocularis sp. nov. (Isopoda, Cymothoidae) from the body cavity of a freshwater fish of Mato Grosso do Sul State, Brazil. Revista Brasileira de Zoologia 20, 285–289.