

A NEW SPECIES OF *POMPHORHYNCHUS* (ACANTHOCEPHALA: PALAEACANTHOCEPHALA) IN FRESHWATER FISHES FROM CENTRAL CHILE

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ABSTRACT: This study describes a new species of *Pomphorhynchus* collected from *Percilia gillissi* Girard, 1855 from the Zañartu canal, between the sister basins of the Itata and Laja rivers, in central Chile. *Pomphorhynchus moyanoi* n. sp. is characterized by an asymmetrical, well-differentiated subspherical bulb and 12–14 longitudinal rows of 13–14 hooks; the third and the fourth hook in each row are stout. Among South American species, *P. moyanoi* n. sp. shows some similarities to the Chilean species *P. yamagutii* Schmidt & Huggins, 1973, but it differs in having a longer neck, larger bulb, and different proboscis armature arrangement. *Pomphorhynchus moyanoi* n. sp. differs from *P. patagonicus* Ortubay, Ubeda, Semenas & Kennedy 1991, in the bulb shape (protuberances), number of rows, fourth hook size and basal hook size. *Pomphorhynchus moyanoi* n. sp. also differs from *P. sphaericus* in the arrangement of hooks (number of rows and hooks per row), length and width of the proboscis, neck width, and symmetry of the bulb.

Species of *Pomphorhynchus* Monticelli, 1905 are widely distributed, occurring in the Middle East, south of Asia, Europe, and North and South America (Petrochenko, 1956; Yamaguti, 1963; Amin et al., 2003). Members of this genus are mostly parasites of freshwater fishes. Only 1 species, *P. dubious* Kaw, 1941, occurs in amphibians, and 4 species parasitize marine or estuarine fishes (Amin, 1985; Amin et al., 2003). In South America, 3 species have been described: *P. yamagutii*, *P. patagonicus*, and *P. sphaericus*. *Pomphorhynchus yamagutii* Schmidt & Huggins, 1973, was reported once in *Percichthys melanops* Girard, 1854 from the Malleco River in Chile. *Pomphorhynchus patagonicus* Ortubay, Ubeda, Semenas & Kennedy 1991 is a widespread freshwater species throughout the Patagonian region of Argentina. It has been described in 4 autochthonous fish species, i.e., *Patagonina hatcheri* (Eigenmann, 1909), *Percichthys trucha* (Valenciennes, 1833), *Galaxias plattei* Steindachner, 1898, and *Hatcheria macraei* (Girard, 1855), and in 2 introduced salmonids, i.e., *Oncorhynchus mykiss* (Walbaum, 1792) and *Salvelinus fontinalis* (Mitchill, 1814). *Pomphorhynchus sphaericus* Pertierra, Spatz & Doma, 1996 is a coastal species found in several fishes from De La Plata River, Argentina; in freshwater autochthonous fishes, i.e., *Pimelodus maculatus* Lacépède, 1803, *Pimelodus albicans* (Valenciennes, 1840), *Iheringichthys platanus* Steindachner, 1908, and *Lucioperca pati* (Valenciennes, 1836) (Siluriformes: Pimelodidae). *Pomphorhynchus sphaericus* has a symmetrical bulb, like all North American species, i.e., *Pomphorhynchus bulbocollis* Linkins in Van Cleave, 1919, *Pomphorhynchus rocci* Cordonier & Ward, 1967, and *Pomphorhynchus lucyi* Williams & Rogers, 1984, as in the most species of the genus. Recently, Lunaschi (1997) described *Pomphorhynchus patii*. However, Amin et al. (2003) suggested that *P. patii* is a junior synonym of *P. sphaericus* because they have similar morphometric measurements. Moreover, the description of *P. patii* did not include comparisons with *P. sphaericus* or the North American species *P. bulbocollis*, *P. rocci*, and *P. lucyi*.

A new freshwater acanthocephalan species, with an asymmetrical subspherical bulb, found in freshwater fishes from Zañartu canal in Central Chile, is described herein.

MATERIALS AND METHODS

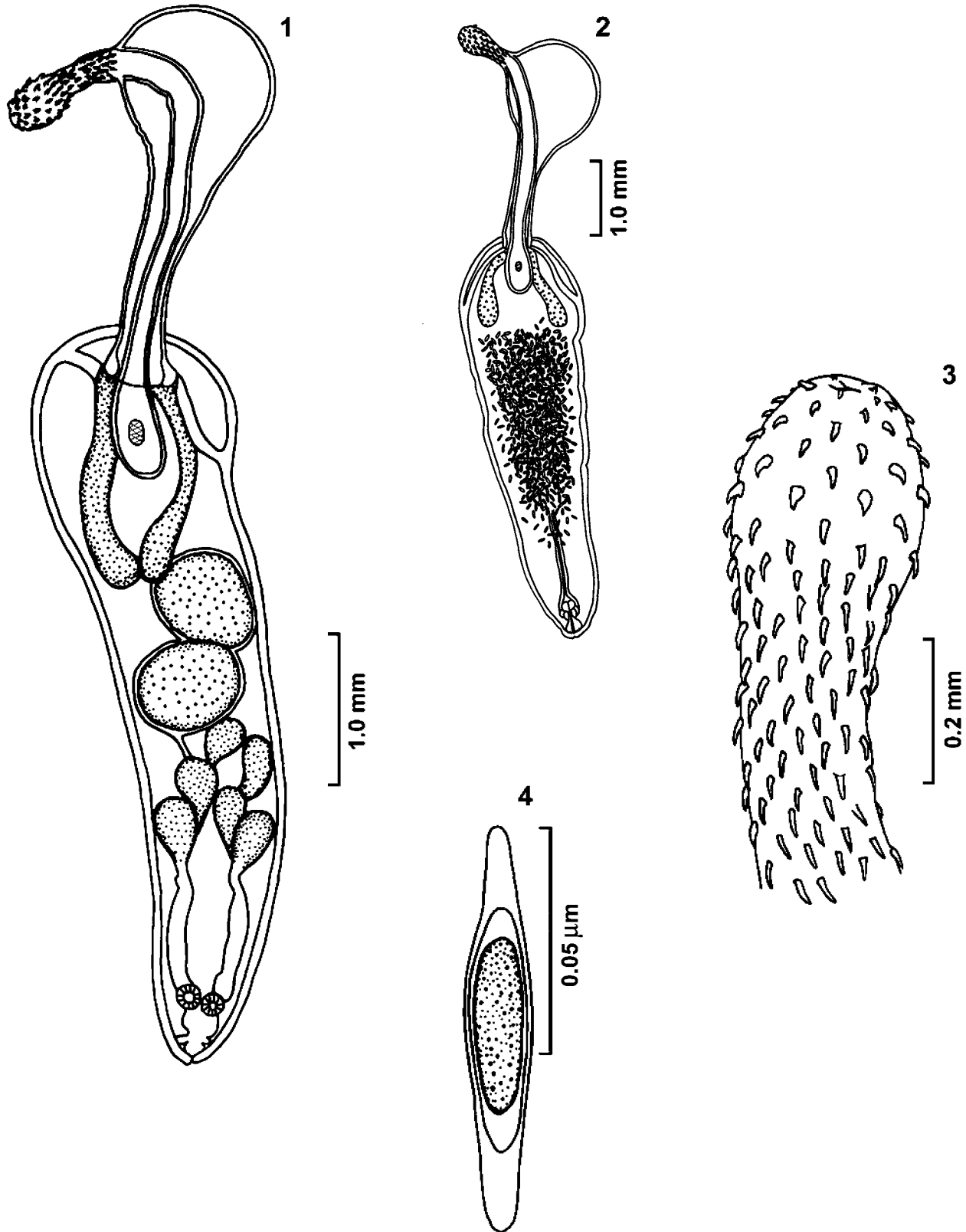
In June 2005, 15 *Percilia gillissi* Girard, 1855, were collected from the Zañartu irrigation canal (37°06'S; 72°13'W), which connects the 2 sister basins of the Laja and Itata rivers, in central Chile. Fish were collected using an electrofishing device, taken alive to the laboratory, and examined within 4 to 6 hr after the capture. The acanthocephalans were removed from the intestinal wall, washed with saline solution, refrigerated in cold water for 12 hr, fixed in alcohol-formalin-acetic acid, stained with acid carmine, cleared with 4% HCl in 70% ethanol, dehydrated with ascending concentrations of ethanol, cleared in increasing concentrations of toluene in 100% ethanol to 100% toluene, placed in 50% toluene and 50% Canada balsam, and finally mounted in Canada balsam. Illustrations were made using a camera lucida. All morphometric measurements are in micrometers, unless otherwise indicated. The range is followed by the mean in parentheses. Length measurements are given before width. Specimens of this study were compared morphometrically with *P. patagonicus* from *Galaxias maculatus* (Jennyns, 1842) and *P. yamagutii* from *Percichthys trucha* (Valenciennes, 1833). The samples of *P. patagonicus* were given by L. Semenas (Universidad Nacional del Comahue, Bariloche, Argentina). from her personal parasitological collection. Three specimens of *P. yamagutii* were obtained from the Museum of Zoology, Universidad de Concepción (MZUC-UCCC 29184). Scanning electronic microscopy (SEM) was applied for 3 South American species, i.e., the new species of this study, *P. yamagutii*, and *P. patagonicus*. The original descriptions of the last 2 species do not include any SEM micrographs.

DESCRIPTION

Pomphorhynchus moyanoi n. sp. (Figs. 1–4)

Diagnosis (based on 21 specimens): Pomphorhynchidae Yamaguti, 1939, with characteristics of genus. Fresh individuals orange, more intense in older worms. Body wall particularly thick and did not allow observation of internal structures by light microscopy. Four specimens were considered as juvenile because they did not exhibit distinct sexual characters. Trunk cylindrical with anterior region swollen (Fig. 1); 2.15–6.75 mm (3.8) long and 0.55–1.65 mm (890) wide. Proboscis (Fig. 3) enlarged in anterior third, slightly cylindrical 440–840 (655) long, and 95–265 (190) wide, with 12–14 longitudinal rows of each 13–14 hooks (rarely 12 and 13). Armature nearly equal in both sexes. Hooks with simple root slightly spiral between alternating longitudinal rows (Fig. 5A). First and second hooks in shorter row and first, second, and third hooks in longer row, short, 16–47 (33) long and 5–5 (11) wide. Third hook in shorter row, and fourth hook in longer row characteristically stout; 31–44 (38) long and 10–21 (15) wide. Fourth and fifth hooks in shorter row and fifth and sixth hooks in longer row shorter and more slender than in preceding series; 34–59 (44) long and 8–16 (11) wide. Seventh and subsequent hooks in shorter row and eighth and subsequent hooks in longer row 31–62 (48) long and 8–16 (10) wide. Last hook of each row longest, 49–62 (55) long and 10–13 (12) wide. Neck (between proboscis and body, sensu Petrochenko, 1956) uniformly cylin-

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FIGURES 1–4. *Pomphorhynchus moyanoi* n. sp. from *Percilia gillissi* in Chile. (1) Male (holotype). (2) Mature female. (3) Proboscis. (4) Egg.

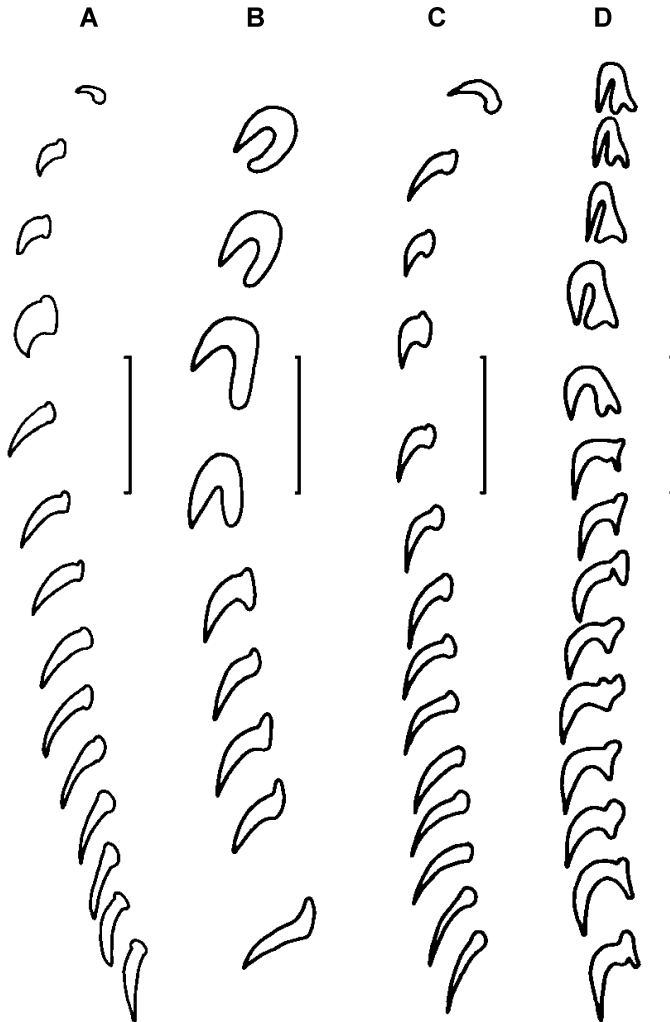


FIGURE 5. Entire longitudinal row of proboscis hooks. (A) *Pomphorhynchus moyanoi* n. sp. (B) *Pomphorhynchus yamagutii* taken from Schmidt and Huggins (1973). (C) *Pomphorhynchus patagonicus* taken from Ortubay et al. (1991). (D) *Pomphorhynchus sphaericus* taken from Perterra et al. (1996). Bar = 100 μ m.

dricular from trunk, forming unusual and well-differentiated dorsal asymmetric bulb (Fig. 6A) posterior to proboscis. Bulb without protuberances or other irregularities. Same characteristics of bulb observed in all specimens before and after fixation. Mean neck: body ratio 0.3. Proboscis receptacle extends from neck deeply into trunk, 0.210–1.05 mm (470). Lemnisci subequal, about 0.45–1.35 mm (735) long and 65–260 (140) wide, claviform, and extending beyond proboscis receptacle. Sexual dimorphism discernible.

Male (based on 12 mature males): Body 3.95–8.9 mm (6.3) long. Proboscis 440–790 (620) long and 95–265 (185) wide. Neck 1.2–2.5 mm (1.9) long and 210–370 (285) wide. Bulb 0.5–1.5 mm (1) long and 0.35–1.3 mm (825) wide. Trunk 2.15–6 mm (3.8) long and 0.55–1 mm (820) wide in anterior region and 230–525 (335) wide in posterior region; proboscis receptacle 1.4–3.5 mm (2.3) long and 75–370 (210) wide. Anterior testis 230–840 (420) long and 105–460 (260) wide, on the middle of trunk. Posterior testis 210–790 (410) long and 75–475 (260) wide. Six pyriform cement glands with cylindrical core 100–350 (245) long. Gonopore terminal.

Female (based on 9 gravid specimens): Body larger than male, 4.0–9.8 mm (6.4) long (Fig. 2). Proboscis 610–840 (705) long and 140–265 (200) wide. Neck 1.25–2.6 mm (2) long and 210–410 (290) wide. Bulb 0.85–1.8 mm (1.2) long and 0.3–1.25 mm (760) wide. Trunk 2.15–6.75 mm (3.8) long and 0.68–1.65 mm (980) wide in anterior region

and 285–850 (450) wide in posterior region; proboscis receptacle 1.4–3.6 mm (2.5) long and 95–410 (220) wide. Gonopore terminal. Eggs fusiform, 85–100 (88) long, and 10–16 (13) wide, with polar prolongation (Fig. 4). All specimens gravid; only 3 had a few eggs.

Taxonomic summary

Type host: Adults of *Percilia gillissi* Girard, 1855 (Perciliidae).

Type locality: Zañartu Canal (37°06'S; 72°13'W), central Chile.

Site of infection: Attached to intestinal wall, with body in intestinal lumen and neck and proboscis penetrating into or through intestinal wall. Some acanthocephalans produce strong encapsulation reaction, generating deformities in a few cases or atrophy of proboscis and/or bulb and/or body; 90% of the parasites and 100% of the mature parasites presented this encapsulation, and only 2 specimens showed deformities.

Prevalence and intensity: Prevalence 33% (n = 15) and intensity 4 (2–15). There was not a significant correlation between fish body size and parasite intensity (Spearman correlation, n = 15, $R = 0.053$, $P = 0.93$).

Specimens deposited: Parasite Collection, Museum of Zoology, Universidad de Concepción, Concepción, Chile, MZUC-UCCC 29182, holotype, and MZUC-UCCC 29183, paratypes. Fish Collection, Museum of Zoology, Universidad de Concepción, Concepción, Chile, MZUC-UCCC 29185, symbiotype.

Etymology: The species is named in honor to a Chilean invertebrate zoologist, Hugo I. Moyano, Universidad de Concepción, Concepción, Chile.

Remarks

Pomphorhynchus moyanoi n. sp. has sufficient distinct morphological and morphometric characteristics to be recognized as a new species. This species of acanthocephalan is distinguished mainly by the long neck forming a large, asymmetrical, and subspherical sharply delimited bulb, and by the arrangement of the hooks on the proboscis. *Pomphorhynchus moyanoi* n. sp. differs from previously described species in having 12 to 14 slightly spiraling alternated longitudinal rows of 13 and 14 hooks each. The most distinctive morphological characteristic is the large, subspherical, and asymmetrical dorsal bulb that has not been described in any other species of the genus. *Pomphorhynchus* and *Pyriproboscis* are the only genera of Pomphorhynchidae that form a true bulb (see Yamaguti, 1963; Amin, 2003). The bulb and all praesoma structures are responsible for the attachment of the worm to the intestinal mucosa (Miller and Dunagan, 1985). Therefore, variations in the characteristics of the bulb could have a strong impact in the persistence of the host species in which it occurs.

The long neck, asymmetrical bulb, and lower number of hooks per row distinguish *P. moyanoi* from North American species. *Pomphorhynchus bulbocollis* and *P. rocci* have short necks and symmetrical bulbs, whereas *P. lucyi* has a small bulb and greater number of hooks per row (20–23 vs. 13–14). The South American species of *Pomphorhynchus* include 1 Chilean species (*P. yamagutii*) and 2 Argentinean species (*P. patagonicus* and *P. sphaericus*). They are characterized by an asymmetrical bulb (besides *P. sebastichthydis* Yamaguti, 1939). *Pomphorhynchus moyanoi* n. sp. is clearly distinguished from *P. yamagutii* in that *P. moyanoi* has a long neck and shorter body length than *P. yamagutii* (Table I). Thus, the neck body ratio greatly varied between these 2 species; the neck length proportion was one third for *P. moyanoi* and one eighth for *P. yamagutii* (Fig. 6A, B). The description of Ortubay et al. (1991) confirms that *P. patagonicus* (Fig. 6C) possesses 2 protuberances on the bulb, a regular number of hooks per row (13–14 vs. 14), and the absence of basal hooks (Table I), in contrast to *P. moyanoi*. *Pomphorhynchus sphaericus* differs from *P. moyanoi*, particularly in the length and width of the neck, symmetry of the bulb, and the number of hook rows (12–14 vs. 12) (Table I). Additionally, *P. sphaericus* is the only species that has roots of hooks formed by a wide sheet that splits into 2 parts (Fig. 5D) within the all American species. Among the non-American species, *P. sebastichthydis* of marine fish from Japan shows some similarities to *P. moyanoi* with respect to its long neck, asymmetric bulb, and proboscis armature. However, the descriptions and illustrations by Yamaguti (1963) and Schmidt and Huggins (1973) reveal that *P. moyanoi* differs from *P. sebastichthydis* by possessing more hook rows (12–14 vs. 11–12), more hooks per row

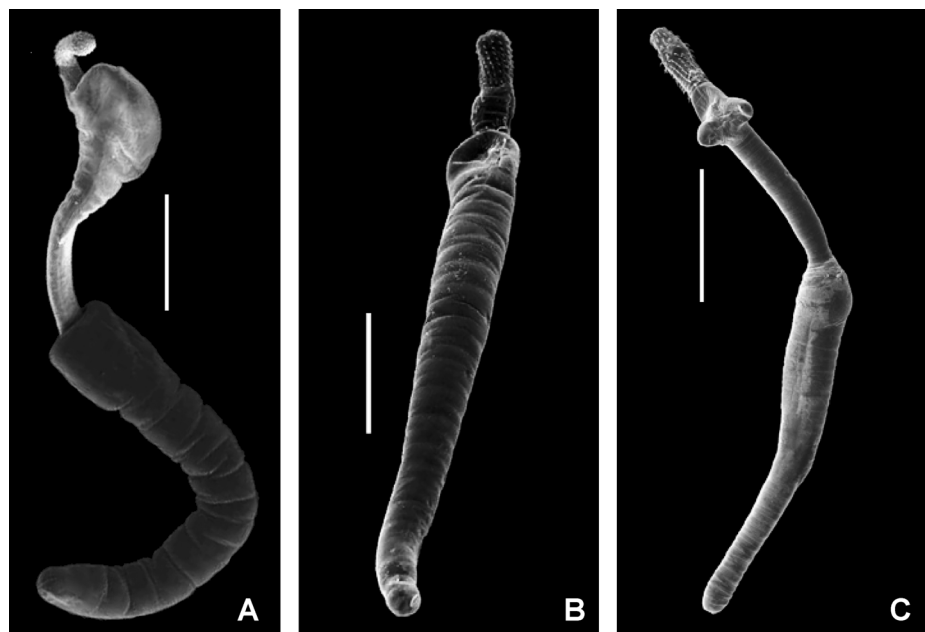


FIGURE 6. SEM of the body of an adult (A) *Pomphorhynchus moyanoi* n. sp. from *Percilia gillissi* in Chile. (B) *Pomphorhynchus yamagutii* from *Percichthys trucha* in Chile. (C) *Pomphorhynchus patagonicus* from *Galaxias maculatus* in Argentina. Bar = 1 mm.

(13–14 vs. 10–12), and a stout fourth hook (vs. a normal slender). Thus, this structure of *P. moyanoi* is unique among the species of the genus.

Two kinds of evidence suggest that *P. moyanoi* n. sp. is autochthonous. First, species of *Pomphorhynchus* have not yet been found in any introduced fish species (Torres, 1995; Olmos and Muñoz, 2006). Second, the most probable intermediate host is the endemic amphipod *Hyalessa costera* González & Watling, 2001. *Hyalessa* is the only epigeic freshwater amphipod genus recorded in Chile (González and Watling,

2001; Jara et al., 2006). Therefore, we consider *Hyalessa* as the only most suitable intermediate host for *P. moyanoi* n. sp. The restricted presence of *P. moyanoi* n. sp. in native fishes strongly suggests that it is an autochthonous species.

Like *P. patagonicus*, the new species is confined to the Austral sub-region of South America. *Pomphorhynchus moyanoi* n. sp. occurs in rivers located in the south central ichthyogeographic endemic area (sensu Dyer, 2000), i.e., the Itata and Laja rivers, which belong to the Itata

TABLE I. Morphometric ranges of *Pomphorhynchus moyanoi* n. sp. and South American species of *Pomphorhynchus*.

| Character | <i>P. moyanoi</i> n. sp. | <i>P. yamagutii</i> Schmidt & Huggins, 1973 | <i>P. patagonicus</i> Ortubay et al., 1991 | <i>P. sphaericus</i> Perterra et al., 1996 |
|--------------------------------|-----------------------------|---|--|--|
| Body length | 3,950–9,800 (6,400) | 7,000–12,500 | 5,900–16,600 (11,500) | (7,860)* |
| Trunk length | 2,150–6,750 (3,800) | (5,200)* | 2,800–14,300 (7,750) | 2,600–9,500 (5,700) |
| Trunk width | 550–1,650 (890) | 600–920 | 600–2,400 (1,300) | 400–1,100 (800) |
| Proboscis length | 440–840 (655) | 640–920 | 500–1,100 (800) | 510–810 (637) |
| Rows | 12–14 | 12–14 | 14 | 12 |
| Hooks per row | 13–14 | 9–10 | 13–14 | 14–15–16 |
| Hooks 1–3/1–2 length | 16–47 (33) | 32–70 | 26–64 (41) | 24–36 (28) |
| Hooks 4°/3° length | 31–44 (38) | 50–70 | 29–50 (42) | 23–39 (30) |
| Hooks 5°/4° length | 34–59 (44) | 50–70 | 38–76 (51) | 21–38 (27) |
| 6° and 7° hooks length | 31–62 (48) | 60–65 | 38–93 (60) | 22–36 (27) |
| 8° and subsequent hooks length | 31–62 (48) | 60–65 | 38–93 (60) | 23–38 (31) |
| Basal hooks length | 49–62 (55) | 55–70 | —† | 35–44 (38) |
| Mean neck:body ratio | 0.31 (1/3) | 0.125 (1/8) | 0.31 (1/3) | 0.2 (1/5)‡ |
| Bulb length | 500–1,800 (1,100) | 400–575 | 700–2,580 (1,300) | 642–1,645 (1,130) |
| Bulb width | 300–1,300 (825) | 440–550 | 500–12,190 (1,300) | 665–1,587 (1,284) |
| Neck length | 1,200–2,600 (2,000) | 800–1,300 | 1,800–4,900 (3,500) | 968–2,392 (1,667) |
| Proboscis receptacle length | 1,410–3,650 (2,470) | 1,200–1,400 | 2,200–6,450 (4,050) | 1,900–4,200 (3,150) |
| Lemnisci length | 450–1,350 (735) | 2–2.5* | 130–800 (400) | 758–2,043 (1,282) |
| Anterior testis length | 230–840 (420) | 600–880 | 300–1,400 (700) | 420–1,237 (699) |
| Eggs length | 85–100 (88) | 66–70 | 85–130 (106) | 34–57 (47) |
| Eggs width | 10–16 (13) | 8–10 | 12–21 (15) | 7–9 (8) |

* Based on the figure of the original description.

† Does not apply.

and Biobío basins, respectively. The distribution of *P. moyanoi* n. sp. seems to be highly restricted. It is probably associated with 2 aspects of this host–parasite system, i.e., low movement capacity of *P. gillissi*, which is a strictly freshwater species that completes its life cycle within streams (Arratia, 1982) and the presence of intermediate host in the same habitats.

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