Journal of the Marine Biological Association of the United Kingdom, 2017, 97(1), 141–149.
doi:10.1017/S0025315416000187

A new deep-water species of *Trischizostoma* (Crustacea: Amphipoda: Gammaridea: Trischizostomatidae) from western Mexico, NE Pacific Ocean

IGNACIO WINFIELD[1], MICHEL E. HENDRICKX[2] AND MANUEL ORTIZ[1]

[1]Laboratorio de Crustáceos, Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México, Avenida de los Barrios 1, Los Reyes Iztacala, Tlalnepantla, Estado de México, [2]Laboratorio de Invertebrados Bentónicos, Unidad Académica Mazatlán, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, México, PO Box 811, Mazatlán, 82000 Sinaloa, Mexico

A new species of Trischizostoma *collected at depths of 1392–1420 m from western Mexico is described. It represents the first record of the genus in the NE Pacific. The new species is morphologically similar to* T. circulare, T. tohokuense *and* T. richeri. *These species all share a large rostrum, expanded eyes and an entire telson. Distinctive characters of the new species include a dorsally unnotched urosomite 1, a subconical coxa 2, a subtriangular propodus of gnathopod 1, a single seta and one protuberance on the palm of gnathopod 2, the presence of 10 spine-teeth in the outer plate of maxilla 1 and of a large, 1-articulate maxilla 1 palp, and the telson with 2 minute simple setae and 2 minute projections distally.*

Keywords: Crustacea, Amphipoda, *Trischizostoma* new species, Pacific Mexico, taxonomy

Submitted 14 January 2016; accepted 21 January 2016; first published online 22 February 2016

INTRODUCTION

As a result of life-history strategies, some groups of marine amphipods have specialized as facultative ecto-parasites of fish, living freely on the bottom or in the water column (Bousfield, 1982; Vader & Romppainen, 1985). Some species of lysianassoidean, pardaliscoidean, lafystiidean and trischizostomatidean groups are known as 'hitch-hikers', attaching temporarily to the body surface or gills of the fish hosts by means of clamp-like gnathopods (Bousfield, 1987).

The family Trischizostomatidae Lilljeborg, 1865 contains one genus, *Trischizostoma* Boeck, 1861, with 17 species of pelagic or bathypelagic amphipods inhabiting depths from 22 to 3655 m as hyperbenthic components or ecto-parasites of fish and are widespread worldwide (Freire & Serejo, 2004). Bousfield (1987) considered the trischizostomatid amphipods to be relatively host-specific, sometimes occurring in juvenile stages on benthic invertebrates and, as adults, on a narrow range of fish hosts.

Species of the genus *Trischizostoma* Boeck, 1861 are characterized by their mouthparts, including their styliform upper lip, mandibles and maxillae, the absence of a molar process, the reduction of coxa 1, which is partially covered by coxa 2, the strongly subchelate and robust gnathopod 1, with propodus inverted in the adult stage, palm with stout setae, dactylus large, and a small telson, which is either entire or cleft (Barnard & Karaman, 1991). Prior to this study, 17 nominal species of *Trischizostoma* have been described worldwide (Horton, 2015).

Based on the structure of the rostrum, mouthparts and telson, Barnard (1961) organized the *Trischizostoma* genus in two groups: one with a large rostrum, strongly styliform mouthparts, and an entire telson, and another group with a smaller rostrum, less styliform mouthparts, and a notched telson. According with Freire & Serejo (2004), Tomikawa & Komatsu (2009), and the present study, all species of *Trischizostoma* belonging to the entire telson group have been documented from the North-east and South-west Atlantic Ocean, the North-west and North-east Pacific Ocean, and the Indo-Pacific. The notched telson group occurs in the South-east Atlantic and South-west Indian Ocean.

During a long-term survey focused on deep-water benthic communities inhabiting below the Oxygen Minimum Zone in western Mexico (the TALUD project), a specimen of *Trischizostoma* was collected. It represents a new species, which is described herein and increases to 18 the number of species of *Trischizostoma* documented worldwide. A global geographic distribution pattern of the genus *Trischizostoma* is also provided.

MATERIALS AND METHODS

The material on which this study is based was collected by the RV 'El Puma' of the Universidad Nacional Autónoma de México (UNAM). The specimen of *Trischizostoma* was captured during a sampling cruise off the west coast of Mexico

Corresponding author:
M.E. Hendrickx
Email: michel@ola.icmyl.unam.mx

(TALUD XII, March–April 2008) with a benthic sledge (2.35 m wide, 0.9 m high) equipped with a modified shrimp net (~5.5 cm stretched mesh size) with a ~2.0 cm (3/4″) internal lining net. Depth was measured with a SIMRAD digital recorder.

Temperature, salinity and oxygen were measured close to the sea bottom with a Seabird 19 CTD. Rosette-mounted 10 L Niskin bottles were also deployed and dissolved oxygen concentration was estimated with the Winkler method (Strickland & Parsons, 1972). Sediment was sampled with a modified USNEL box core and organic carbon content was determined by oxidation following Loring & Rantala (1992).

The specimen of *Trischizostoma* was examined, dissected and illustrated in detail using a MOTIC SMZ–168 dissecting microscope equipped with a camera lucida. Mouthparts and small appendages were illustrated using a MOTIC BA–210 compound-microscope, also equipped with a camera lucida. Illustrations were completed using the Corel Draw V.12 program. All measurements of the holotype were made with the Motic Images Plus V.2 program. The terminology used for the body structures, setae, spines, the description, remarks and the morphological comparison were based on Lowry & Stoddart (1993, 1994) and Tomikawa & Komatsu (2009). The type material of this new species of *Trischizostoma* amphipod is deposited in the Regional Collection of Marine Invertebrates (ICML-EMU) at UNAM in Mazatlán, Mexico.

RESULTS

SYSTEMATICS

Order AMPHIPODA Latreille, 1816
Suborder GAMMARIDEA Latreille, 1802
Superfamily LYSIANASSOIDEA Dana, 1849
Family TRISCHIZOSTOMATIDAE Lilljeborg, 1865
Genus *Trischizostoma* Boeck, 1861
Trischizostoma unam sp. nov. (Figures 1–6)

TYPE MATERIAL

Holotype: one ovigerous female, 38 mm total length, carrying 14 eggs, RV 'El Puma', 29 March 2008 (ICML-EMU-10990).

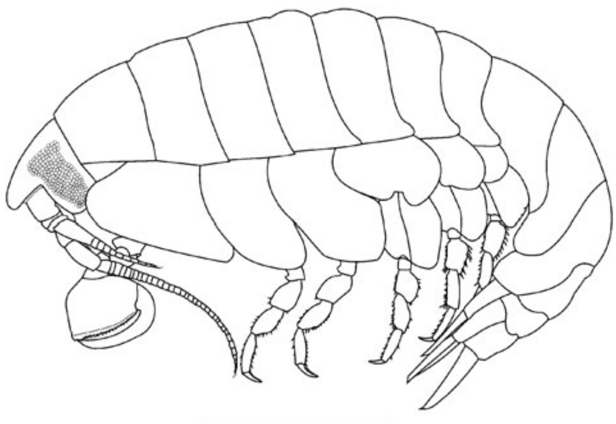

Fig. 1. *Trischizostoma unam* sp. nov., holotype female (38 mm): habitus. Scale bar: 10 mm.

TYPE LOCALITY

Western Mexico, NE Pacific Ocean, TALUD XII cruise station 9 (17°10′26″N 101°37′37″W), benthic sledge, 1392–1420 m.

ETYMOLOGY

The species is named after the Universidad Nacional Autónoma de México, a name used here as an acronym (UNAM).

DIAGNOSIS

Head slightly longer than deep, rostrum large, eyes covering most of head; urosomite 1 unnotched anterodorsally; antenna 1 shorter than antenna 2; antenna 2 flagellum 34-articulate; maxilla 1 outer plate narrow, large with 10 spine-teeth in modified 4/6 arrangement distally, palp narrow, large, 0.4× outer plate length, 1-articulate; maxilla 2 inner plate with row of minute, marginal setae; gnathopod 1 propodus subtriangular, palmar margin with 20 robust setae, anterodistal corner with 5 robust setae; gnathopod 2 minutely subchelate, coxa large, subconical, palm minute, a robust seta and small protuberance near base of dactylus; telson longer than broad, entire, apically truncate, with 2 minute simple setae and 2 minute crenulations distally.

DESCRIPTION

Based on holotype female, 38 mm total length; male unknown. Head (Figures 1 & 2A) slightly longer than deep; lateral cephalic lobe absent; rostrum large; eyes covering most of head, expanded dorsally and narrowing ventrally. Dorsal margins of pereonites 1–7 and pleonites 1–3 smooth (Figure 1), pereonite 4 with a small hump. Urosomites 1–3 dorsally smooth, urosomite 1 unnotched.

Antenna 1 (Figure 2B) short, almost 0.5× length of antenna 2, 0.22× body length; peduncular article 1 short, length 1.2× breadth, without tooth on distomedial margin, distoventral margin with plumose setae; peduncular articles 2–3 shortest, ventral margin of article 3 setose; accessory flagellum medium, subequal in length to article 1 of primary flagellum, 4-articulate, article 1 longest; primary flagellum 11-articulate, article 1 longest, articles 3 and 5 each with long seta (seta on article 5 broken), callynophore strong, one-field of dorsomedial brushes.

Antenna 2 (Figure 2C) about 2× length of antenna 1; peduncular article 3 short, length 0.33× article 4; peduncular article 4 with ventromarginal plumose setae and dorsomarginal simple setae; peduncular article 5 with dorsomarginal simple setae; flagellum 34-articulate.

Mouthpart bundle conical. Epistome and upper lip fused (Figure 3D), upper lip truncated distally; lower lip (Figure 3C) subtriangular, inner lobes present, outer lobes acute, mandibular process subtriangular. *Mandibles* (Figure 3A) with incisors symmetrical, small and sub-linguiform at tip of styliform projection; lacinia mobilis, accessory setal row, and molar absent. Mandibular palp attached proximally; article 1 shorter than 2 and 3, length 0.55× width; article 2 broad, length 1.2× article 3, with 34–35 A2-setae; article 3 falcate, with 15 D3-robust setae along posterior margin, with 5 apical E3-setae. *Maxilla 1* (Figure 3B) inner plate short with a simple apical seta; outer plate narrow, large with 10 spine-teeth in modified 4/6 arrangement, outer row with ST1 to ST3 large, with cusp distally, ST4 large and distal to ST1–ST3, ST5–ST7 absent, inner row with STA large, displaced

https://doi.org/10.1017/S0025315416000187 Published online by Cambridge University Press

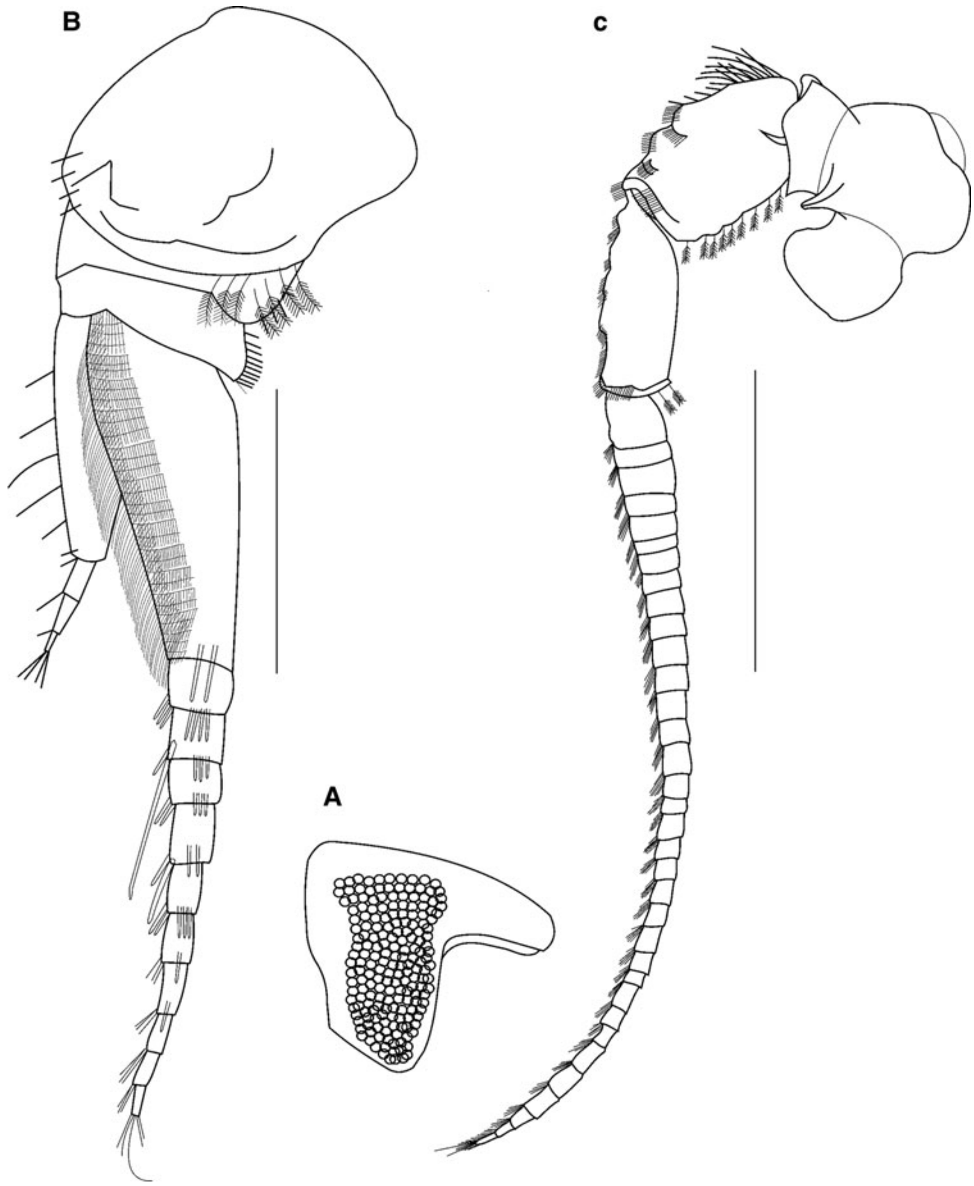

Fig. 2. *Trischizostoma unam* sp. nov., holotype female (38 mm): (A) head; (B) antennae 1; (C) antennae 2. Scale bars: B, 2.0 mm; C, 3.5 mm.

from STB-STF, without cusps, STB-STF short, without cusps; palp narrow and large, 0.4× outer plate length, 1-articulate, with 2 large apical setae, distomesial margin smooth. *Maxilla* 2 (Figure 3E) inner and outer plates narrow, inner with a row of minute setae marginally, one small and one minute apical setae, outer plate slightly larger than inner, with 3 robust setae subapically. *Maxilliped* (Figure 3F) inner plate narrow, subequal in length to outer plate, substyliform, with one apical minute seta; outer plate subovate, submarginal setae vestigial; palp large, 4-articulate, styliform, geniculate between articles 2 and 3; article 3 with marginal setae; dactylus longer than articles 1–3, slender, lanceolate, anterior margin smooth, unguis present.

Gnathopod 1 (Figure 4A) subchelate, coxa vestigial, triangular, margins smooth; basis long, slender, margins smooth; ischium short; merus and carpus rotated; propodus and dactylus inverted in adult, margins without setae; carpus subtriangular, compressed; propodus massive, subtriangular, palmar margin with 20 robust setae, anterodistal corner with 5 robust setae.

Gnathopod 2 (Figure 4B) minutely subchelate, coxa large, subconical, margins smooth; basis large, slender, posteroproximal corner serrate; ischium long, slender; merus subtriangular, posterodistal corner with minute simple setae; carpus long, slender, anterior and posterior margins covered with setae, including short distofacial row of setae; propodus subtriangular, with numerous setae; palmar margin with minute robust seta and small protuberance; dactylus short, with minute anteroproximal robust seta.

Peraeopod 3 (Figure 5A) coxa large, anterodistal margin weakly concave, and posterodistal concave, margins smooth, posteroproximal corner with spine-process; merus with robust setae distally; carpus with marginal robust setae; propodus slender with marginal robust setae; posterior margin of dactylus lined with minute simple setae. *Peraeopod* 4 (Figure 5B) coxa large, deeper than wide, with posterior lobe, posterodistal corner almost quadrate, anterior margin convex, margins smooth; merus with marginal robust setae, propodus slender, with marginal robust setae; posterior margin of dactylus lined with minute simple setae.

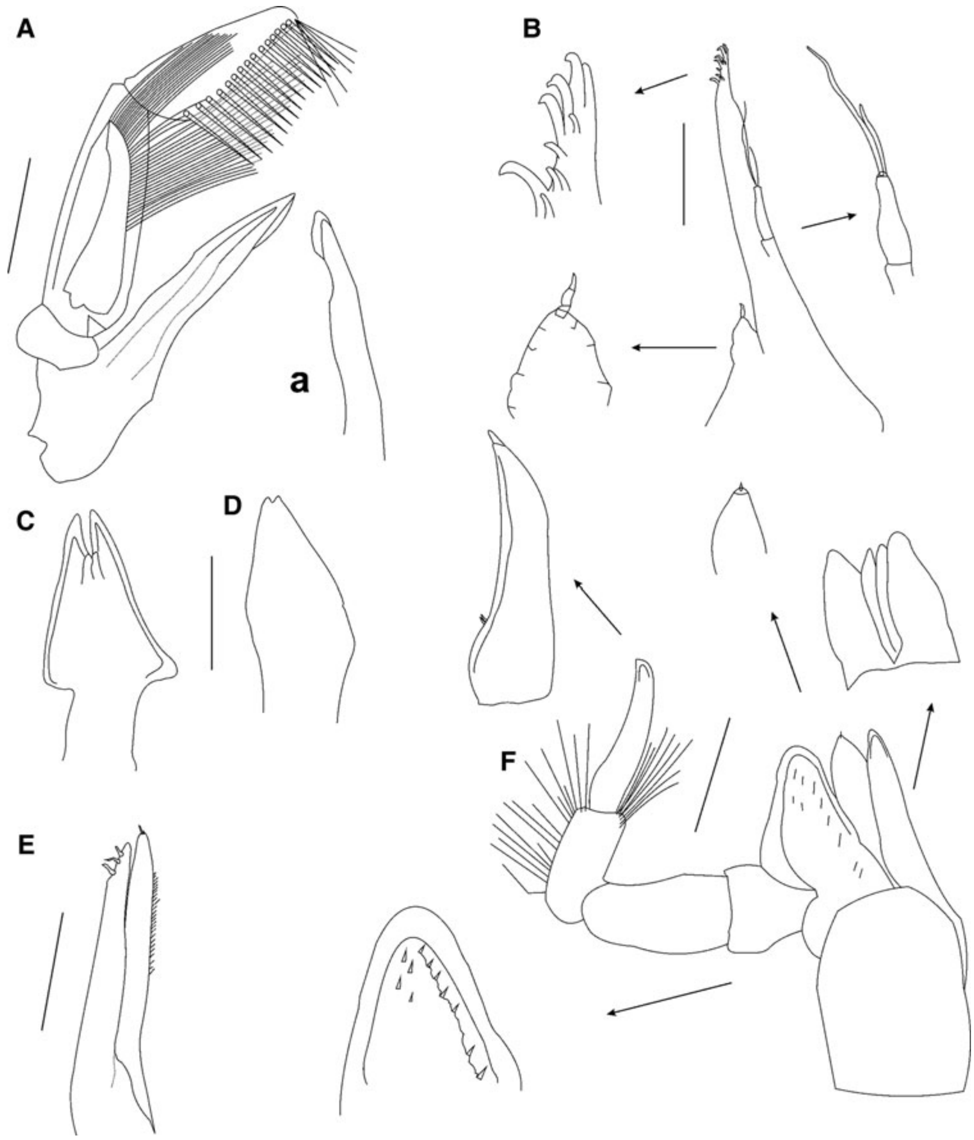

Fig. 3. *Trischizostoma unam* sp. nov., holotype female (38 mm): (A) mandible left; a, mandible right distal part; (B) maxilla 1; (C) lower lip; (D) upper lip; (E) maxilla 2; (F) maxilliped. Scale bars: A and F, 0.5 mm; B–E, 0.2 mm.

Peraeopod 5 (Figure 5C) coxa bilobed, marginally smooth, posterior lobe deeper than anterior; basis expanded, posterior lobe deeper than anterior; merus expanded, posterior margin rounded, with several marginal setae; carpus and propodus with marginal setae; dactylus short, slender. *Peraeopod* 6 (Figure 5D) coxa small, lobate posteriorly; basis expanded with broad posteroventral lobe, anterodistal corner with simple setae; merus expanded proximally, with marginal simple and robust setae; anterior margin of carpus and propodus with simple setae; dactylus short, slender. *Peraeopod* 7 (Figure 5E) coxa smallest, not lobate posteriorly; basis expanded posteriorly, posterior margin slightly rounded, minutely crenate; merus with marginal simple setae; anterior margin of carpus and propodus with simple setae; dactylus short, slender.

Oostegites from gnathopod 2 to peraeopod 5. *Gills* from gnathopod 2 to peraeopod 7.

Epimeral plates (Figure 6E). Anteroventral margin of epimeron 1 rounded, midventral margin pointed, posteroventral corner subquadrate; ventral margin of epimeron 2 rounded, posteroventral corner subquadrate; epimeron 3 minutely pointed midventrally, posteroventral corner subquadrate.

Uropod 1 (Figure 6A), peduncle with 10 dorsomedial robust setae; outer ramus slightly shorter than inner ramus, outer ramus with 11 minute, robust setae along outer margin, lined with minute, simple setae along inner margin; inner ramus with 4 robust setae on outer margin and 9 on inner margin, both margins lined with simple setae distally. *Uropod* 2 (Figure 6B) peduncle with 2 distal robust setae, outer ramus slightly shorter than inner ramus, outer ramus with 8 minute robust setae along outer margin, several minute simple setae on inner margin; inner ramus with both margins setose. *Uropod* 3 (Figure 6E) peduncle as wide as long, dorsolateral flange, rami subequal in length; outer ramus 2-articulate, article 2 short, rami without robust setae; several minute, simple marginal seta on both rami.

Telson (Figure 6D) longer than broad, entire, dorsally smooth, apically truncate, 2 minute simple setae and 2 minute crenulations distally.

https://doi.org/10.1017/S0025315416000187 Published online by Cambridge University Press

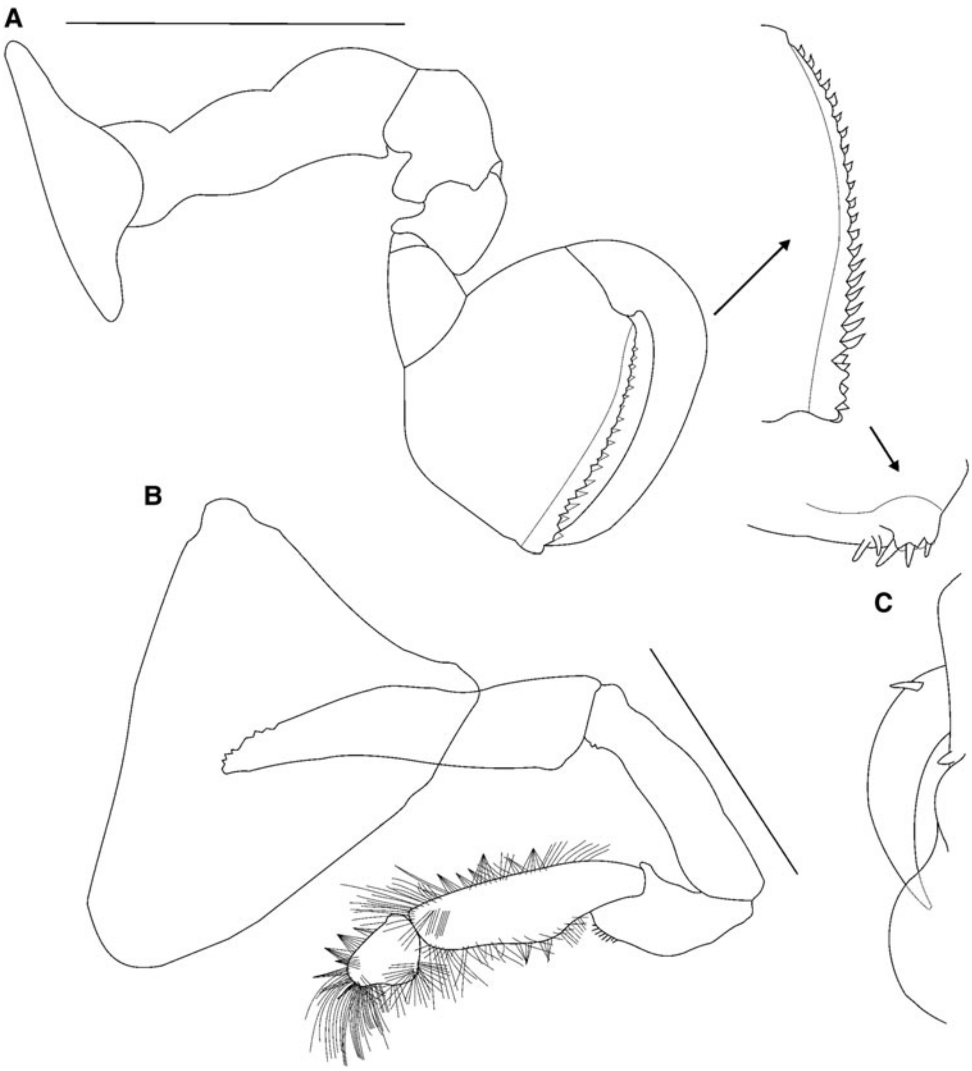

Fig. 4. *Trischizostoma unam* sp. nov., holotype female (38 mm): (A) gnathopod 1; (B) gnathopod 2; (C) detail of gnathopod 2 palm margin. Scale bars: A, 4.0 mm; B, 1.0 mm.

ECOLOGY

The only specimen available was collected in the following environmental conditions (measured at the bottom): salinity, 34.58 ppm; temperature, 3.29°C; dissolved oxygen 0.75 ml L^{-1}; organic carbon in muddy sediments, 1.70%. Although species of *Trischizostoma* are known as occasional ectoparasities on fish, there is no information on the possible host of *T. unam* sp. nov.

TAXONOMIC REMARKS

Female of *Trischizostoma unam* sp. nov., is morphologically most similar to females of *T. circulare* Barnard, 1961, *T. tohokuense* Tomikawa & Komatsu, 2009 and *T. richeri* Lowry & Stoddart, 1994. These species all share a large rostrum, expanded eyes, an entire telson, and margins of carpus and propodus covered with numerous simple setae. The female of *Trischizostoma unam* sp. nov., however, can be easily distinguished from those three species by the following characters: (1) in *T. unam* sp. nov. urosomite 1 is not notched anterodorsally *vs* notched in the other three species; (2) in *T. unam* sp. nov. coxa 2 is subconical *vs* suboval or subquadrate; (3) the propodus of gnathopod 1 is subtriangular in *T. unam* sp. nov. *vs* subcircular or subovate; (4) the palm of gnathopod 2 has one minute seta and one protuberance in *T. unam* sp. nov. *vs* no setae or 2 to 5 setae; (5) there are 10 spine-teeth at the outer plate of maxilla 1 and the palp is large in *T. unam* sp. nov. *vs* the outer plate with 8 teeth and a short palp; (6) the telson is apically truncate in *T. unam* sp. nov. *vs* rounded or subacute in the other three species. The main morphological differences are summarized in Table 1.

DISCUSSION

As in other groups of deep-water crustaceans, there is a significant lack of information on Amphipoda, although the number of species described over time has regularly increased to a figure close to 9700 species, all habitats considered (Coleman, 2015). While some regions have been intensively sampled (e.g. the Mediterranean Sea and the Antarctic) (e.g. Brandt, 1997; Cartes & Sorbe, 1999), others have partly been explored. Altogether, our knowledge of deep-water amphipod communities is particularly limited, although some areas have received much more attention. In the Mediterranean Sea, for

https://doi.org/10.1017/S0025315416000187 Published online by Cambridge University Press

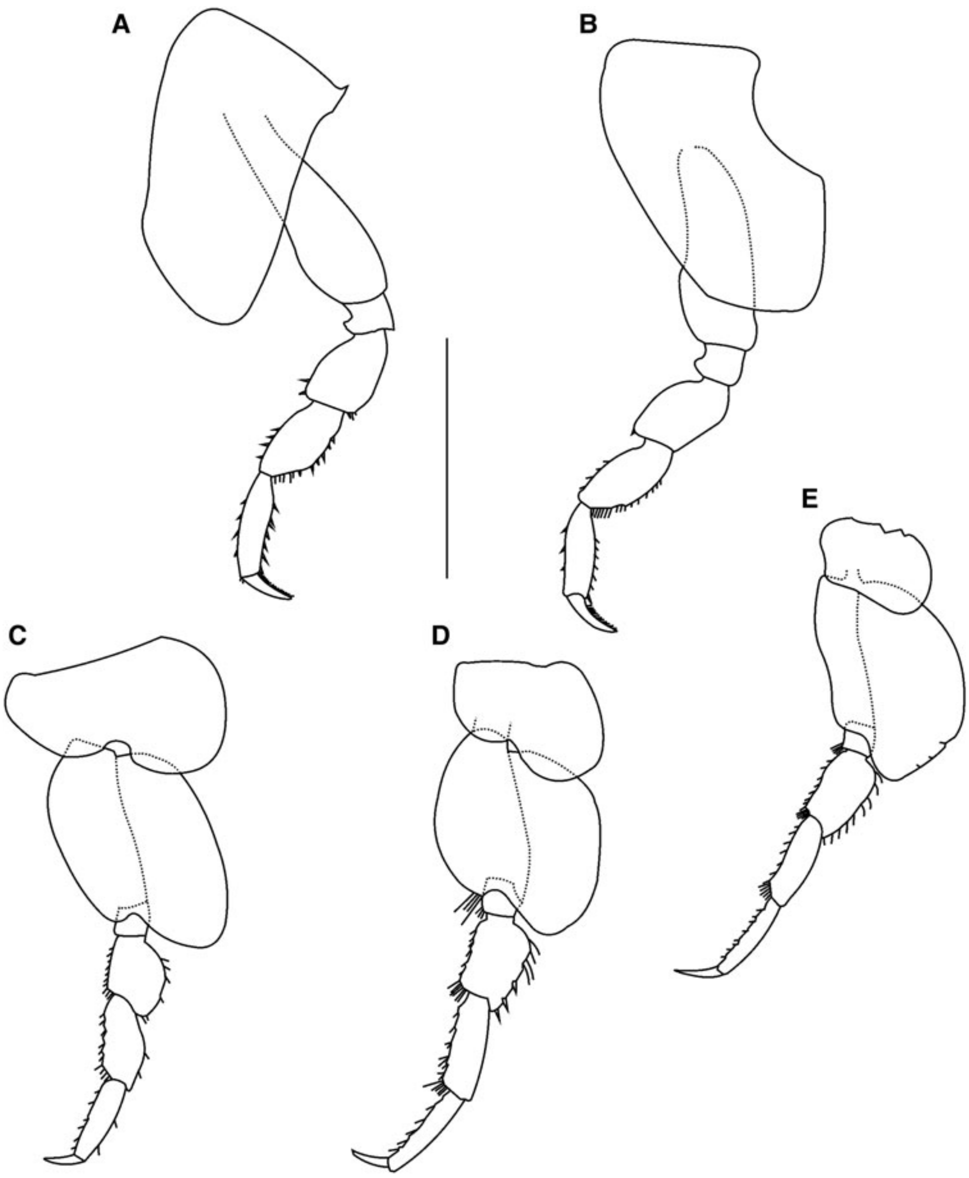

Fig. 5. *Trischizostoma unam* sp. nov., holotype female (38 mm): (A) pereopod 3; (B) pereopod 4; (C) pereopod 5; (D) pereopod 6; (E) pereopod 7. Scale bar: A–E, 5.0 mm.

example, of the 415 known species of Amphipoda on record 154 (37.1%) are from the deep water (>150 m), but only 11.3% inhabit below 1000 m (Bellan-Santini, 1990). In the Antarctic, 496 species had been registered in 2003 (Clarke & Johnston, 2003), but this number increases constantly due to a large sampling effort performed by several institutions. A recent census put the number of species of amphipods in the southern Ocean close to 650 (De Broyer *et al*., 2004, 2007; Zeidler & De Broyer, 2009). An estimated 1000 species from the Antarctic and sub-Antarctic region are awaiting description (d'Udekem d'Acoz, personal communication, January 2016). An analysis of bathymetric distribution of Antarctic amphipods performed by Brandt (1997) and based on three surveys, indicated a strong component of eurybathic genera (~40%), with depth range of 1000 m or more.

The matter of estimating richness of deep-water amphipods is further complicated by the existence of presumably cosmopolitan species that probably comprise multiple cryptic species. As in the case of species covering very large geographic ranges, species reported for wide depth-range might also represent a species complex (Havermans *et al*., 2013). Further sampling in the deep-water with adequate gear will certainly increase the number of known species exclusive to deep-water habitats. The use of baited traps, for example, has proved very effective in collecting large amounts of deep-water scavenging amphipods (e.g. France, 1994). Similar results have also been obtained using suprabenthic samplers (e.g. Lörz & Brandt, 2003).

In the eastern tropical Pacific, 494 species of amphipods have been recorded, of which 107 (21.7%) are restricted to deep water (>200 m), but a large number of species (183 or 37% of total) feature a rather undefined bathymetric range, with published records including very shallow (~ 0 m) and very deep water (>3700 m) (García-Madrigal, 2007). However, to our knowledge baited traps and suprabenthic sledges aimed at collecting deep-water Peracarida have not

https://doi.org/10.1017/S0025315416000187 Published online by Cambridge University Press

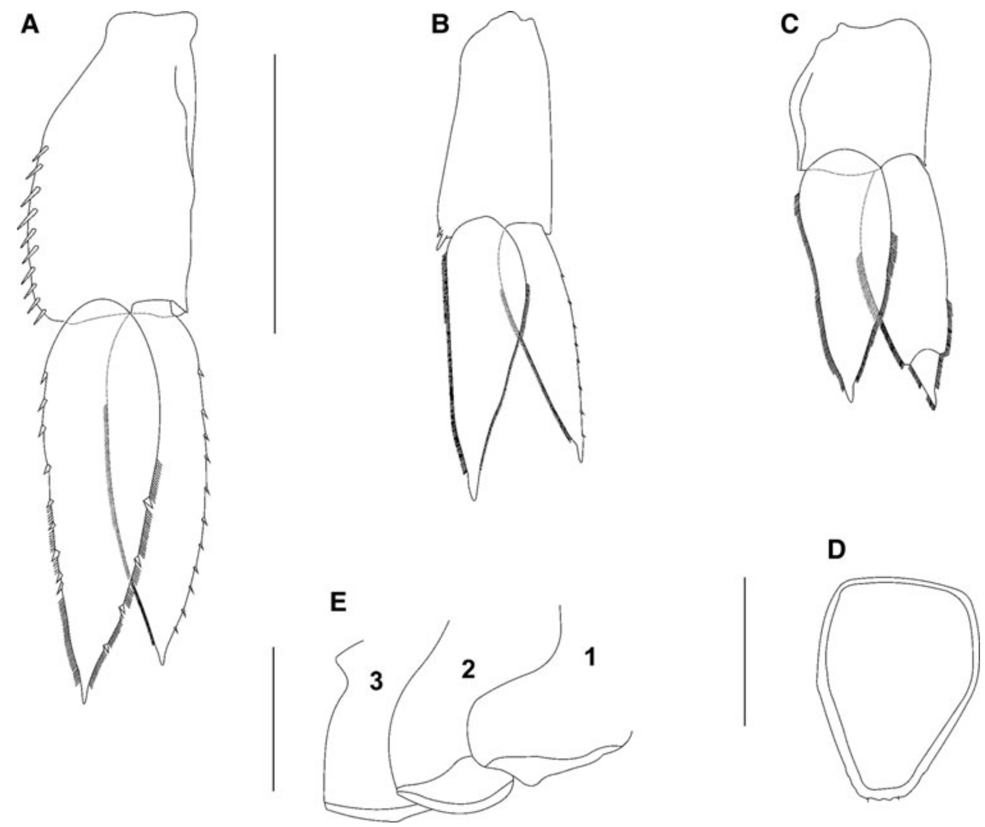

Fig. 6. *Trischizostoma unam* sp. nov., holotype female (38 mm): (A) uropod 1; (B) uropod 2; (C) uropod 3; (D) telson; (E) epimeral plates. Scale bars: A–C, 2.5 mm; D, 0.5 mm; E, 4.5 mm.

been regularly deployed in the region. Use of these gear would certainly improve our knowledge on amphipods in Pacific Mexico and elsewhere, for example in the Gulf of Mexico where box cores have often been used to study this fauna (e.g. Escobar-Briones & Winfield, 2003; Winfield *et al*., 2006).

With the addition of the new species, the genus *Trischizostoma*, established by Boeck (1861), now includes 18 nominal species: *T. nicaeense* (Costa, 1851); *T. raschi* Boeck, 1861; *T. remipes* Stebbing, 1908; *T. paucispinosum* K. H. Barnard, 1916; *T. longirostre* Chevreux, 1919; *T. serratum* K.H. Barnard, 1926; *T. circulare; T. denticulatum* Ledoyer, 1978; *T. barnardi* Vinogradov, 1990; *T. cristochelata* Vinogradov, 1990; *T. macrochela* Vinogradov, 1990; *T. nascaensis* Vinogradov, 1990; *T. tanjae* Vinogradov, 1991; *T. crosnieri* Lowry & Stoddart, 1993; *T. richeri; T. costai* Freire & Serejo, 2004, *T. tohokuense* and *T. unam* sp. nov.

As far as we know, the global geographic distribution of the genus *Trischizostoma* is concentrated in the southern hemisphere (15 species), compared with the northern hemisphere (seven species) (Figure 7). *Trischizostoma unam* sp. nov. is

Table 1. The more significant morphological characters used to distinguish females of *Trischizostoma unam* sp. nov. from those of the closely related species: *T. circulare, T. tohokuense* and *T. richeri*.

Character	*T. unam* sp. nov.	*T. circulare*	*T. tohokuense*	*T. richeri*
Urosomite 1	Not notched dorsally	Notched dorsally	Notched dorsally	Notched dorsally
Coxa 2	Subconical	Subovate	Subquadrate	Subovate
Gnathopod 1	Propodus subtriangular	Propodus subcircular	Propodus subcircular	Propodus subovate
Gnathopod 2	Palm with a minute robust seta and a small protuberance; another robust seta on dactylus	Palm with 2 robust setae; dactylus lacking setae	Palm with 5 simple setae; dactylus lacking setae	Palm lacking setae; a minute simple seta on dactylus
Maxilla 1	Inner plate with an apical seta; outer with 10 teeth; palp large and elongate	–	Inner plate lacking setae; outer with 8 teeth; palp short and broad	Inner plate with 1 setae; outer with 8 teeth; palp short and broad
Maxilla 2	Inner plate with a row of marginal minute setae, lacking facial setae	–	Inner plate lacking marginal and facial setae	Inner plate with a row of marginal minute and other facial setae
Upper and lower lips	Fused, conical	Fused, subtriangular	Fused, subtriangular	Fused, sinusoidal
Telson	Entire, apically truncate	Entire, apically rounded	Entire, apically rounded	Entire, apically subacute

https://doi.org/10.1017/S0025315416000187 Published online by Cambridge University Press

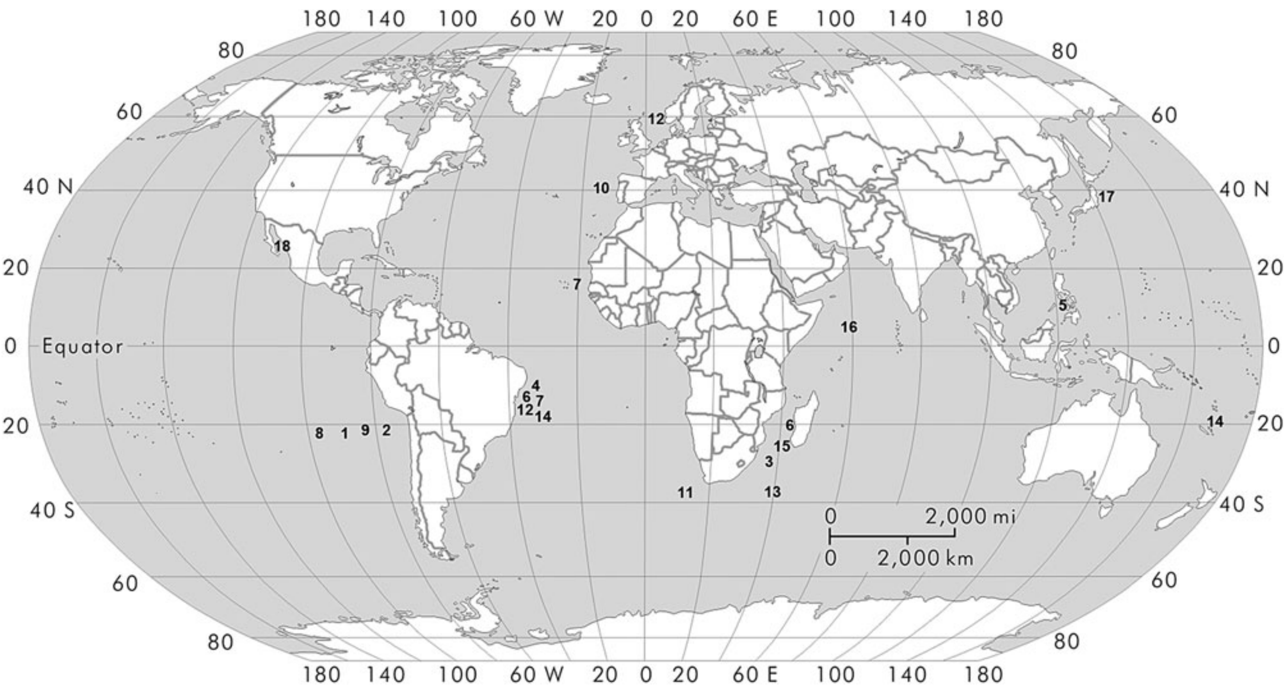

Fig. 7. Current global distribution of all species of genus *Trischizostoma*. Numbers refer to known species as listed (1–18), and correspond to the localities where these have been reported: (1) *T. barnardi*, (2) *T. christochelatum*, (3) *T. circulare*, (4) *T. costai*, (5) *T. crosnieri*, (6) *T. denticulatum*, (7) *T. longirostre*, (8) *T. macrochela*, (9) *T. nascaense*, (10) *T. nicaeense*, (11) *T. paucispinosum*, (12) *T. raschi*, (13) *T. remipes*, (14) *T. richeri*, (15) *T. serratum*, (16) *T. tanjae*, (17) *T. tohokuense* and (18) *T. unam* sp. nov.

the first species of the genus recorded for the NE Pacific. Distribution related to the oceans indicates that six species (*T. costai, T. denticulatum, T. longirostre, T. nicaeense, T. raschi* and *T. richeri*) have been documented for the Atlantic Ocean, eight species (*T. barnardi, T. cristochelata, T. macrochela, T. nascaensis, T. tohokuense, T. crosnieri, T. richeri* and *T. unam* sp. nov.) for the Pacific Ocean, and five (*T. circulare, T. denticulatum, T. remipes, T. serratum* and *T. tanjae*) for the Indian Ocean.

ACKNOWLEDGEMENTS

The authors would like to thank all scientists, students and crew members who helped with the sampling operations aboard the RV 'El Puma' during the TALUD XII cruise. Ship time of the research cruises TALUD XII carried out aboard the RV '*El Puma*' was funded by the Universidad Nacional Autónoma de México. We also thank Cris Serejo and an anonymous reviewer for their comments and suggestions to improve this manuscript, and Cédric d'Udekem d'Acoz for his comment on amphipods diversity and for providing pertinent literature.

REFERENCES

Barnard J.L. (1961) Gammaridean Amphipoda from depths of 400 to 6000 meters. *Galathea Report* 5, 23–128.

Barnard J.L. and Karaman G.M. (1991) The families and genera of marine gammaridean Amphipoda. *Records of the Australian Museum* 13, 1–866.

Bellan-Santini D. (1990) Mediterranean deep-sea amphipods: composition, structure and affinities of the fauna. *Progress in Oceanography* 24, 275–287.

Bousfield E.L. (1982) Amphipoda, Gammaridea. In Parker S.P. (ed.) *Synopsis and classification of living organisms*. New York, NY: McGraw-Hill, pp. 254–285.

Bousfield E.L. (1987) Amphipod parasites of fishes of Canada. *Canadian Bulletin of Fisheries and Aquatic Sciences* 217, 1–37.

Brandt A. (1997) Biodiversity of peracarid crustaceans (Malacostraca) from the shelf down to the deep Arctic Ocean. *Biodiversity and Conservation* 6, 1533–1556.

Cartes J.E. and Sorbe J.C. (1999) Deep-water amphipods from the Catalan Sea slope (western Mediterranean): bathymetric distribution, assemblage composition and biological characteristics. *Journal of Natural History* 33, 1133–1158.

Clarke A. and Johnston N.M. (2003) Antarctic marine benthic diversity. *Oceanography and Marine Biology* 41, 47–114.

Coleman C.O. (2015) Taxonomy in times of the taxonomic impediment – examples from the community of experts on amphipod crustaceans. *Journal of Crustacean Biology* 35, 729–740.

De Broyer C., Guerra-Garcia J., Takeuchi I., Robert H. and Meerhaeghe A. (2004) Biodiversity of the Southern Ocean: a catalogue of the Antarctic and sub-Antarctic Caprellidae and Cyamidae (Crustacea: Amphipoda) with distribution and ecological data. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie* 74, 61–99.

De Broyer C., Lowry J.K., Jazdzewski K. and Robert H. (2007) Catalogue of the Gammaridean and Corophiidean Amphipoda of the Southern Ocean with distribution and ecological data. In De Broyer C. (ed.). Census of Antarctic marine life: synopsis of the Amphipoda of the Southern Ocean, vol. 1. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie* 77 (Suppl. 1), 1–325.

Escobar-Briones E. and Winfield I. (2003) Checklist of benthic Gammaridea and Caprellidea (Crustacea: Peracarida: Amphipoda) from the Gulf of Mexico continental shelf and slope. *Belgian Journal of Zoology* 113, 37–44.

France S.C. (1994) Genetic population structure and gene flow among deep-sea amphipods, *Abyssorchomene* spp., from six California Continental Borderland basins. *Marine Biology* 118, 67–77.

Freire P. and Serejo C. (2004) The genus *Trischizostoma* (Crustacea: Amphipoda: Trischizostomidae) from the Southwest Atlantic, collected by the REVIZEE Program. *Zootaxa* 645, 1–15.

García-Madrigal M.S. (2007) Annotated checklist of the amphipods (Peracarida: Amphipoda) from the eastern tropical Pacific. In Hendrickx M.E. (ed.) *Contributions to the study of East Pacific Crustaceans*. [Contribuciones al Estudio de los Crustáceos del Pacífico Este], 5(1): 27–45. México: Instituto de Ciencias del Mar y Limnología, UNAM, pp. 63–195.

Havermans C., Sonet G., d'Udekem d'Acoz C., Nagy Z.T., Martin P., Brix S., Riehl T., Agrawal S. and Held C. (2013) Genetic and morphological divergences in the cosmopolitan deep-sea amphipod *Eurythenes gryllus* reveal a diverse abyss and a bipolar species. *PLoS ONE* 8, e74218. doi: 10.1371/journal.pone.0074218.

Horton T. (2015) Trischizostoma. In Horton T., Lowry J., De Broyer C., Bellan-Santini D., Coleman C.O., Daneliya M., Dauvin J.C., Fišer C., Gasca R., Grabowski M., Guerra-García J.M., Hendrycks E., Holsinger J., Hughes L., Jazdzewski K., Just J., Kamaltynov R., Kim Y., King R., Krapp-Schickel T., LeCroy S., Lörz A.N., Senna A.R., Serejo C., Sket B., Thomas J., Thurston M., Vader W., Väinölä R., Vonk R., White K. and Zeidler W. (eds) *World Amphipoda database*. Accessed through World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=101659 (accessed 16 November 2015).

Loring D.H. and Rantala R.T.T. (1992) Manual for the geochemical analyses of marine sediments and suspended particulate matter. *Earth-Science Reviews* 32, 235–283.

Lörz A.-N. and Brandt A. (2003) Diversity of Peracarida (Crustacea, Malacostraca) caught in a suprabenthic sampler. *Antarctic Science* 15, 433–438.

Lowry J.K. and Stoddart H.E. (1993) Crustacea Amphipoda: Lysianassoids from Philippine and Indonesian waters. In Crosnier A. (ed.) Résultats des campagnes MUSORSTOM, vol. 10. *Mémoires du Muséum National d'Histoire Naturelle* 156, 55–109.

Lowry J.K. and Stoddart H.E. (1994) Crustacea Amphipoda: Lysianassoids from the tropical western South Pacific Ocean. In Crosnier A. (ed.) Résultats des campagnes MUSORSTOM, vol. 12. *Mémoires du Muséum national d'Histoire naturelle* 161, 127–223.

Strickland J.D.H. and Parsons T.R. (1972) *A practical handbook of seawater analysis*. 2nd edition. Ottawa: Fisheries Research Board of Canada, Bulletin 167.

Tomikawa K. and Komatsu H. (2009) New and rare species of the deep-water gammaridea (Crustacea: Amphipoda) off Pacific coast of Northern Honshu, Japan. *Deep-water Fauna and Pollutants off Pacific Coast of Northern Japan, Monographs* 39, 447–466.

Vader W. and Romppainen K. (1985) Notes on Norwegian marine Amphipoda. Amphipods found in association with fishes. *Fauna Norvegica, Series A* 6, 3–8.

Winfield I., Escobar-Briones E. and Morrone J. (2006) Updated checklist and identification of areas of endemism of benthic amphipods (Caprellidea and Gammaridea) from offshore habitats in the SW Gulf of Mexico. *Scientia Marina* 70, 99–108.

and

Zeidler W. and De Broyer C. (2009) Catalogue of the Hyperiidean Amphipoda (Crustacea) of the Southern Ocean with distribution and ecological data. In De Broyer C. (ed.) Census of Antarctic Marine Life. Synopsis of the Amphipoda of the southern Ocean, vol. 3. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre* 79 (Suppl.), 1–96.

Correspondence should be addressed to:
M.E. Hendrickx
Laboratorio de Invertebrados Bentónicos,
Unidad Académica Mazatlán, Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México, México, PO Box 811, Mazatlán, 82000 Sinaloa, Mexico
email: michel@ola.icmyl.unam.mx