Two New Species of *Quadrisegmentum* (Phtisicidae: Amphipoda: Crustacea) from the Central Indo-Pacific, with Notes on the Type Species *Q. triangulum* Hirayama, 1988

LAUREN ELIZABETH HUGHES¹* and ICHIRO TAKEUCHI²

¹Australian Museum Research Institute, Australian Museum, 1 William Street, Sydney New South Wales 2010, Australia
²Department of Life Environment Conservation, and Center of Advanced Technology for the Environment, Faculty of Agriculture, Ehime University, 3-5-7 Tarumi, Matsuyama, Ehime 790-8566, Japan

lauren.hughes@austmus.gov.au · takeuchi@agr.ehime-u.ac.jp

**ABSTRACT.** Two new species of *Quadrisegmentum* (Phtisicidae: Amphipoda: Crustacea) are described from the Central Indo-Pacific. The new species *Quadrisegmentum ataura* sp. nov., is described from the Wetar Basin, Timor-Leste in the Lesser Sunda Region of the Western Coral Triangle. The new species name *Q. yirrgay* sp. nov., is established for material from Ashmore Reef in Queensland and Papua New Guinea originally reported under the name *Q. triangulum* Hirayama, 1998 (Guerra-García 2003, 2006; Guerra-García & Lowry 2009). Study of the type material of *Quadrisegmentum triangulum* described from Ashmore Reef in the Timor Sea, Western Australia confirms the absence of projections on pereonite 2, which prompted reassessment of subsequent identifications. Records of *Q. triangulum* are now limited to the type locality only. An updated key to the four known species of *Quadrisegmentum* is provided.

**KEYWORDS:** *Quadrisegmentum*; new species; Phtisicidae; Amphipoda; Crustacea; taxonomy


Much work remains to be done on the marine amphipod fauna of the Central Indo-Pacific. In the Western Coral Triangle where the species diversity of coral is the highest in the world (Veron *et al*., 2009), 28 caprellid species from 21 genera have been reported from shallow-waters in the Indonesian Archipelago (Mayer, 1903; McCain & Steinberg, 1970; Krapp-Schickel & Guerra-García, 2005; Scinto *et al*., 2008). In the Eastern Coral Triangle and Northeast Australian Shelf (Spalding *et al*., 2007), three previous studies documented 19 species and 15 genera from these two regions combine (Guerra-García, 2003, 2006; Lowry & Guerra-García, 2009).

The genus *Quadrisegmentum* was established by Hirayama, 1988 to account for one species, *Q. triangulum*, collected from Ashmore Reef in the Timor Sea. Research by Guerra-García (2006) described a second species of

The present study contributes an additional new species and generic record, Quadrisegmentum atavao, from Timor-Leste, which is part of the Lesser Sunda region within the Western Coral Triangle. Quadrisegmentum atavao has distinct projections of pereonite 2. Comparative examination of Q. triangulum type material confirmed the absence of projections on pereonite 2, yet in material subsequently attributed to Q. triangulum (see Guerra-Garcia, 2003, 2006), pereonite 2 projections were observed on male and female species from various locations. Following reassessment of the latter material, a second new species Q. yirrgay, is established for previous records of Q. triangulum reported throughout the Coral Sea and Bismark Archipelago (Eastern Coral Triangle and Northeast Australian Shelf, respectively).

Materials and methods

The material examined for this study included type material from the Museum and Art Gallery of the Northern Territory (NTM), Australian Museum (AM) collections of Quadrisegmentum and new collections made during the Australian Museum Timor-Leste Expedition in September 2012 (Hughes, 2015). Material was dissected in 80% ethanol. Temporary slides were made using 100% glycerol. Permanent slides were made using either Polyvinyl lactophenol or Aquatex (Merck, Darmstadt, Germany) mounting agent. Illustrations were made with a Laborlux K (Leitz Wetzlar, Germany) and Heerbrugg stereomicroscopes (Wilde, Switzerland) fitted with camera lucida. Specimens were prepared for scanning electron microscopy as follows: placed in an ultrasonic cleaning bath for 10 seconds in a 10% solution of Tween 80 surfactant; preserving solution was returned to 80% ethanol then sequentially advanced in 5% increments from 80% to 100% ethanol; critical point dried; returned to 80% ethanol then sequentially advanced in 5% ethanol. Microscope with Robinson Backscatter Detector (SEM) (Leitz Wetzlar, Germany) and Heerbrugg stereomicroscopes (Wilde, Switzerland) were used.

Systematics section

Phtisicidae Vassilenko, 1968

Quadrisegmentum Hirayama, 1988

Diagnosis. Head fused (suture absent) with pereonite 1. Antenna 1 well developed; flagellum with more than 2 articles. Antennae 2 well developed; flagellum with more than 2 articles. Mandible well developed; molar absent; palp 3-articulate; article 3 with 1 distal and 1 (or 2) lateral setae. Maxillipeds well developed; inner plate (basal endite) larger than outer plate (ischial endite); outer plate (ischial endite) well developed; palp article 3 with distal projection; palp article 4 well developed. Pereonite 4 clavate appendage absent. Pereonites 6 and 7 separated. Pereopod 3 well developed, with 7 articles. Pereopod 4 well developed, with 7 articles. Pereopod 5, with 4 articles, and well-developed dactylus. Pereopods 6 and 7 well developed, with 7 articles. Gills on pereonites 2 to 4. Uropods 2 pairs: Uropod 1 biarticulate, uniramous. Uropod 2 biarticulate, uniramous. Telson dorsal lobe present.

Included species: Quadrisegmentum triangulum Hirayama, 1988, type species; Q. atavao sp. nov.; Q. lowryi Guerra-Garcia, 2006; Q. yirrgay sp. nov.

Remarks. Characters which define the family Phtisicidae Vassilenko, 1968 are a fully fused head and pereonite 1, absence of a mandibular molar and 3-articulate palp, gills on pereonites 2–4 (3 pair), pereonites 5 and 6 separated and the urosomites 1 and 2 coalesced (see Takeuchi, 1993, 2015; Lim et al., 2012; Takeuchi and Lowry, 2016). The diagnosis of the genus was based observations of the type material of Q. triangulum Hirayama, 1988 by the present study with reference to description and figures of mouth parts in Hirayama (1988) and additionally the two new species described in the current study, Q. atavao sp. nov. and Q. yirrgay sp. nov. (map Fig. 11) provides the distribution of the four known Quadrisegmentum species.

Quadrisegmentum atavao sp. nov.

Figs 1–4

Type material. Holotype ♂, 10.5 mm (illustrated), dissected in part, 1 slide, AM P.98327, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); paratype ♀, 9 mm (illustrated), AM P.98328, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087). Paratypes: 1 ♂, 5.1 mm [a smaller specimen has been chosen for SEM as it is in better condition], whole animal SEM pin mount, AM P.91095, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♀, 10.5 mm, SEM pin mount, AM P.91091, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♂, AM P.91097, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♀, AM P.91099, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♀, AM P.91096, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); many specimens, AM P.91094, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♀, AM P.91093, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 4 ♀♀, AM P.91090, Timor-Leste, west of Dili, off Tabor, on outer side of reef, rubble and sandy reef slope (8°13′48″S 125°36′57″E), 14 m, mixed turfing algae, 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♀, AM P.91092, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♂, AM P.91096, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); many specimens, AM P.91094, Timor-Leste, east of Atauro Island, Outer Reef, dense coral reef slope (8°13′48″S 125°36′57″E), 17 m, green calcareous alga Halimeda sp., 20 September 2012, coll. L.E. Hughes (TM 2012-087); 7 specimens (6 ♀♀ and 1 mature ♂), AM P.91090, Timor-Leste, east of Atauro Island, Inner Reef, reef slope (8°14′30″S 125°36′57″E), 14 m, mixed turfing algae, 20 September 2012, coll. L.E. Hughes (TM 2012-087); 1 ♀, AM P.91099, Timor-Leste, west of Dili, off Tabor, on outer side of reef, rubble and sandy reef slope (8°33′48″S 125°28′31″E), 10–12 m, coral rubble and mixed algae, 21 September 2012, coll. A. Murray (TM 2012-037); 9 specimens (5 ♂♂ and 4 mature ♀♀), AM P.91098, Timor-Leste, east of Metinaro, Secret Garden Reef (8°29′15″S 125°49′53″E), 20 m, tufts of red algae, 22 September 2012, coll. L.E. Hughes (TM 2012-060).
Figure 1. *Quadrisegmentum atauro* sp. nov., holotype male habitus, 10.5 mm, AM P.98327 and paratype female, 9 mm, AM P.98328; Atauro Island, Timor-Leste.

Figure 2. *Quadrisegmentum atauro* sp. nov. holotype male, 10.5 mm, AM P.98327, Atauro Island, Timor-Leste, scales 0.1 mm.
Figure 3. *Quadrisegmentum atauro* sp. nov. holotype male, 10.5 mm, AM P.98327, Atauro Island, Timor-Leste, scales 0.1 mm.

**Type locality.** Timor-Leste, east of Atauro Island, Outer Reef (8°13′48"S 125°36′57"E).

**Etymology.** Named from the type locality, applied as a noun in apposition.

**Description.** (Based on male, body length, 10.5 mm, AM P. 98327, and male, body length, 10.5 mm, AM P.91901 for pereopod 5 and abdomen).

**Body** Somites slender. *Head and pereonite 1 combined, completely fused, suture absent. Pereonite 2 with small acute anterolateral projection. Pereonites 3–6 without anterior or mid-lateral projections.*

*Antenna 1 ½× body length; peduncle article 2 longest, 1.9× article 1; article 3 length 0.8× article 2; flagellum length 0.24× peduncle with 4–6 articles (left and right, respectively).*

*Antenna 2 0.9× Antenna 1; flagellum, 0.25× peduncle length, body with 8–9 articles (left and right, respectively).*
Figure 4. *Quadrisegmentum atauro* sp. nov. SEM image of paratype male, 5.1 mm, head and pereopod 4, AM P.91095; paratype male, 10.5 mm, gnathopod 2, pereopod 5 and urosome paratype male AM P.91091; Atauro Island, Timor-Leste. Scales: H and P4–5 scale 100 µm, Ur dorsal view scale 10 mm and Ur transverse view 20 µm.

*Mandible* right similar to left, incisor with 4 teeth, lacinia mobilis with 7 teeth followed by 2 plates; palp 3-articulate; article 2 longest, with 1 distal slender setae; article 3 with 1 distal and 1 midlateral slender setae, anterodistal margin pubescent. *Mandible* left, palp similar to right palp. *Lower lip* setose on outer lobe. *Maxilla 1* outer plate with 5–6 robust setae; palp 2-articulate, article 2 with 2 triangular projections, each with a robust seta, with 3–4 subapical slender setae. *Maxilla 2* inner plate short with 4 robust setae; outer plate long, with 4 apical and 1 subapical robust setae. *Maxilliped* basal endite (inner plate) larger than ischial endite (outer plate), rectangular, with 4 apically robust setae near distal margin; ischial endite (outer plate) several slender setae on inner margin; palp 4-articulate; article 2 laterally expanded, with 3–4 slender setae; article 3 with rounded distal projection with 2 setae.
**Quadrisegmentum triangulum** Hirayama, 1988

**Pereon.** *Gnathopod 1* basis similar in length to ischium, merus and carpus combined; carpus and merus subequal in length with anterior and posterior slender setae; propodus triangular; palm defined by prominent, curved, bifid process with 2 apical robust setae; dactylus falcate, inner margin lined with setules. **Gill 2** elongate, length 5× width, 0.6× pereonite 2 length. *Gnathopod 2* begins ½ along posterior margin of pereonite 2; basis length 1.9× pereonite 2 length, 1.6× ischium, merus and carpus combined; merus subrectangular, distally swollen (length 2.8× width), subequal to carpus; carpus subrectangular (length 3.1× width); propodus subovate, longer than wide (length 2.8× width); palm 60% of posterior margin, 3 proximal projections each with robust seta. **Gill 3** slender, 7× width, length 0.9× pereonite 3 length. **Pereopod 3** length 0.3× body length; basis longest, 0.4× pereopod 3 length; ischium 0.1× basis length; merus 0.6× basis length; carpus 0.27× basis length; propodus 0.9× carpus length with 3 large and 1 small robust setae along palm; dactylus recurved. **Gill 4** subequal to gill 3. **Pereopod 4** shorter than pereopod 3, length 0.35× body length; basis longest, 0.4× pereopod 4 length; ischium 0.06× basis length; merus 0.65× basis length; carpus 0.3× basis length; propodus shorter than carpus, length 0.9× carpus with 3 large and 1 small robust setae along palm; dactylus recurved. **Pereopod 5** with 4 articles; article 1 length 0.9× article 2; article 2 longest, 1.1× article 3; dactylus recurved. **Pereopod 6** slender, 0.5× body length; basis longest, 0.37× pereopod 6 length; ischium 0.08× basis length; merus 0.7× basis length; carpus 0.33× basis length, anterior margin with 2 robust setae; propodus 0.6× basis length, anterior margin with 3 groups of long robust setae (middle group only with paired robust setae) and distal small robust setae; dactylus recurved. **Pereopod 7** slender, smaller than pereopod 6, 0.4× body length; basis 0.27× pereopod 7 length; ischium 0.25× basis length; merus length subequal to basis; carpus 0.65× basis length, anterior margin with 2 robust setae; propodus 0.8× basis length, anterior margin with 3 groups of long robust setae (middle group only with paired robust setae) and distal small robust setae; dactylus recurved.

**Pleon.** **Uropod 1** elongate (length 6× width), with minute a line of lateral setae; ramus damaged. **Uropod 2** peduncle elongate (length 2.5× width), with a line of lateral setae; ramus 0.6× peduncle length. **Telson** small, with a pair of setae.

**Female.** (based on female paratype, body length 9 mm, AM P. 98328). Pereonite 4 without rounded anterolateral projection. **Antenna 1** article 2 subequal to article 3 length, 1.8× article 1 length; flagellum with 10 articles. **Antenna 2** near 2/3 length of antenna 1; flagellum 0.6× peduncle length with 7 articles.

**Remarks.** *Quadrisegmentum atuaro* sp. nov. and *Q. yirrgay* sp. nov. have long rectilinear gills which separates them from *Q. triangulum* where the gills are much shorter and subovate. The pereonite 2 in *Q. atuaro* sp. nov. has on one pair of acute anterior lateral projections which are not seen for *Q. yirrgay* sp. nov. and *Q. lowryi* Guerra-Garcia, 2006.

**Distribution.** Timor-Leste: Atauro Island, Tiber (current study).

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**Quadrisegmentum yirrgay** sp. nov.

**Figs 6–10**


**Type material examined.** Paratypes 1 ♂ (no. 1) 8 mm, and 2 ♀♀ (nos. 2–3) 5.2 mm and unmeasured, NTM Cr. 00447, taken from gorgonian host, *Isis hippuris* Linnaeus, 1758 in 18 m on west islet of Ashmore Reef, Northwest Australia (12°14.28'S 122°59.14'E), 24 July 1986, coll. H. K. Larson. (Holotype carcass and slide material not found, presumed lost).

**Type locality.** Ashmore Reef, Timor Sea, north-west Western Australia (12°14.28'S 122°59.14'E).

**Remarks.** Examination of *Q. triangulum* type material recognizes the absence of projections on pereonite 2 in both sexes and also records the presence of anterolateral projections on the male pereonite 3. These anterolateral projections on pereonite 3 were not recorded in the original description by Hirayama (1988). Additional material attributed to *Q. triangulum* by the first and second reviewer from Queensland, Australian and Papua New Guinea (Guerra-Garcia, 2003, 2006), contained specimens where pereonite 2 projections were observed on males and females. This latter material was reassessed as part of this study and determined to be a separate species. These records are transferred to the new species name *Q. yirrgay* described below. The name *Quadrisegmentum triangulum* is once again restricted to the original type material and presently known only from the type locality.

**Distribution.** Ashmore Reef (Hirayama, 1988).
Additional material examined. Australia. Queensland: 5 specimens (1 ♂ and 4 ♀♀), AM P.32302, off Mangrove Beach, Lizard Island (14°40'S 145°28'E), 2 m, mixed algae from bommie, 28 September 1978, coll. J.K. Lowry (QLD 1); 2 specimens (1 ♂ and 1 ♀), AM P.32314, off southern Point of Mermaid Cove, Lizard Island (14°39'S 145°27'E), 3–6.1 m, filamentous algae with stone washings and scrapings from crevices, 8 October 1978, coll. C. J. Short & P.C. Terrill (QLD-25); 1 ♀, AM P.32318, fringing reef between Bird Islet and South Island, Lizard Island (14°40'S 145°28'E), 25 m, green algae Halophila sp. and mixed algae from grass beds off reef base, 9 October 1978, coll. J.K. Lowry (QLD 29); 2 ♀♀, AM P.32320, reefs at western end of Blue Lagoon, Lizard Island (14°40'S 145°28'E), 3 m, sand near artificial reefs, 5 October 1978, coll. P.C. Terrill (QLD 33); 16 specimens (6 ♂♂, 9 ♀♀, 1 juvenile), AM P.32325, Mermaid Cove, Lizard Island (14°40'S 145°28'E), subtidal to 2 m, mixed algae, coral rubble and silt, 14 October 1978, coll. J.K. Lowry (QLD-48); 1 ♀, AM P.32326, off North Point, Lizard Island (14°39'S 145°27'E), 3–6.1 m, red algae (Galaxaura sp.) and coral rubble from subtidal caves, 14 October 1978, coll. J.K. Lowry (QLD 49); 9 specimens (7 ♂♂, 1 ♂, 1 juvenile), AM P.32327, off North Point, Lizard Island (14°39'S 145°27'E), 3–6.1 m, mixed algae, 14 October 1978, coll. J.K. Lowry (QLD 50); 7 specimens (4 ♂♂ and 3 ♀♀), AM P.32328, Lizard Island, off North Point, Lizard Island (14°39'S 145°27'E), 6.1 m, green calcareous alga Halimeda sp., 14 October 1978, coll. P.C. Terrill (QLD 52); 1 ♂, AM P.61626, Great Barrier Reef, inside outer barrier, Lizard Island (10°34'29"S 143°55'17"E), 15 m, rubble, 16 January 1993, coll. S.J. Keable (QLD 682); 1 ♂, AM P.61712, between Palfrey Island and Lizard Island, western side of Blue Lagoon, Lizard Island (14°41'S 145°27'E), 7 October 2001; 5 specimens (2 ♂♂ and 3 ♀♀), AM P.61713, between Palfrey Island and Lizard Island, western side of Blue Lagoon, Lizard Island (14°41'S 145°27'E), 7 October 2001; 1 ♀, AM P.61714, between Palfrey Island and Lizard Island, western side of Blue Lagoon, Lizard Island (14°41'S 145°27'E), 2–3 m, coral rubble, 7 October 2001, coll. J.M. Guerra-García & S.J. Keable (QLD 1469); 8 specimens (4 ♂♂ and 4 ♀♀), AM P.61715, Coconut Beach, Lizard Island (14°41'S 145°27'E), 6 m, fine live hard coral encrusted with calcareous red algae and filamentous red/green/brown algal turf, 8 October 2001, coll. J.M. Guerra-García & S.J. Keable (QLD 1470); 3 specimens (1 ♂ and 2 juveniles), AM P.61716, Crystal Beach, Lizard Island (14°41'S 145°27'E), 5 m, thick branching coral rubble encrusted with red algal turf and black sponge half buried in sediment, 9 October 2001, coll. J.M. Guerra-García & S.J. Keable (QLD 1483); 1 juvenile, AM P.61717, Crystal Beach, Lizard Island (14°41'S 145°27'E), 4 m, thin branching live coral heavily encrusted.
Figure 6. *Quadrisegmentum yirrgay* sp. nov., holotype male habitus, 9.0 mm, AM P.98563; paratype female, 6 mm, AM P.61624, Ashmore Reef, Coral Sea, Queensland, Australia.

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Figure 7. Quadrisegmentum yirrgay sp. nov., holotype male 9.0 mm, AM P98563, Ashmore Reef, Coral Sea, Queensland, Australia, scales 0.1 mm.


Tasman Sea: 7 specimens (6 ♀♀ and 1 ♂), AM P61581, patch reef in lagoon, Middleton Reef, Elizabeth and Middleton Reefs (29°27'42"S 159°05'24"E), prolific coral cover on top of binnies, 6 December 1987 (Site 12); 1 ♂, AM P61582, The Sound, large alcove near lagoon entrance, Middleton Reef, Elizabeth and Middleton Reefs (29°27'42"S 159°05'24"E), rubble wash, 5 December 1987 (Site 7); 1 ♂, AM P61475, reef front south of North Passage, straight out from Signal Point, Lord Howe Island (31°31'36"S 159°03'36"E) coralline algae, coll. G.D. Fenwick, 11 May 1977 (LHA 17).

**Type locality.** Ashmore Reef, off Great Barrier Reef, Coral Sea, Queensland, Australia (10°26′16″S 144°25′47″E). (The present “Ashmore Reef” is the different “Ashmore Reef”, Timor Sea, north-west Western Australia, type locality for *Q. triangulum*.)

**Etymology.** “Yirrgay” is the lost spoken language of a coastal indigenous group in Far North Queensland. Applied as a noun in apposition.

**Description.** (Based on holotype ♂, body length 9.0mm, AM P.98563 and male, body length, 6.1 mm, SEM AM P.97779 for abdomen).


**Antenna 1** more than \( \frac{1}{3} \times \) body length (broken); peduncle article 2 longest, \( 2 \times \) article 1; article 3 length \( 0.8 \times \) article 2; flagellum with more than 4 articles (broken).

**Upper lip** weakly notched. *Mandible* right, incisor with 4 teeth, lacinia mobilis with 5 teeth followed by 2 plates; palp 3-articulate; article 2 longest; article 3 with 1 distal and 2 midlateral slender setae, anterodistal margin pubescent. *Mandible* left, incisor with 5 teeth, lacinia mobilis followed by 2 plates; *Lower lip* setose on outer lobe. *Maxilla 1* outer plate with 6 robust setae; palp 2-articulate, article 2 with 3 long and 2 short robust setae. *Maxilliped* basal endite (inner plate) larger than ischial endite (outer plate), basal endite with 3 apically serrate robust setae; ischial endite (outer plate) margin with several slender setae; palp 4-articulate; article 2 lateral expanded, with 5 setae; article 3 with sub-triangular distal projection.

**Pereon.** *Gnathopod 1* basis similar in length to ischium, merus and carpus combined; carpus subequal to merus length, posterior margin with slender setae; propodus triangular; palm defined by prominent, curved, bifid process with 2 apical robust setae; dactylus falcate, inner margin lined with setules. *Gill 2* subovate, length \( 0.6 \times \) pereonite 2 length. *Gnathopod 2* begins \( \frac{1}{3} \) along posterior margin of pereonite 2; basis length \( 1.4 \times \) pereonite 2 length, 2.1 \( \times \) ischium, merus and carpus combined; merus subrectangular, distally swollen (length 2× width), longer than to carpus; carpus subrectangular (length 2× width); propodus subovate, longer than wide (length 2.1× width); palm 60% of posterior margin, 3 proximal projections each with robust seta.

*Gill 3* elongate, length \( 0.6 \times \) pereonite 3. *Pereopod 3* basis longest, \( 0.4 \times \) pereopod 3 length; ischium 0.1× basis length; merus \( 0.7 \times \) basis length; carpus \( 0.25 \times \) basis length; propodus 1.1× carpus length with 2 large robust setae along palm, dactylus recurved. *Gill 4* subequal to gill 3. *Pereopod*...
4 shorter than pereopod 3, length 0.30× body; basis longest, 0.6× pereopod 3 length; ischium 0.25× basis length; merus 0.6× basis length; carpus 0.3× basis length; propodus longer than carpus, length 1.1× carpus with 4 large robust setae along palm; dactylus recurved.

Pereopod 5 article 1 length 0.9× article 2; article 2 longest, 1.1× article 3; dactylus recurved. Pereopod 6 basis longest, 0.37× pereopod 6 length; ischium 0.08× basis length; merus 0.6× basis length; carpus 0.33× basis length, anterior margin without robust setae; propodus 0.6× basis length, anterior
margin with 4 groups of long robust setae (proximal group only with paired robust setae); dactylus recurved. **Pereopod 7** 0.8× pereopod 6; basis 0.27× pereopod 7 length; ischium 0.25× basis length; merus length subequal to basis; carpus 0.65× basis length, anterior margin with 1 robust seta; propodus 0.8× basis length, anterior margin with 3 groups of long robust setae (middle group only with paired robust setae) and distal small robust setae; dactylus recurved.

**Pleon.** **Uropod 1** elongate, without setae (broken). **Uropod 2** (broken). **Telson** small, with a pair of setae (Based on SEM AM P.97779).
Figure 11. Distribution of world species of Quadrisegmentum Hirayama, 1988.

Female. (based on paratype AM P.61624). Pereonite 2 with small anterolateral and small acute mid-lateral projections. Pereonite 4 with rounded anterolateral projection. Antenna 1 long 0.75× body length; article 2 longest, 2× article 1 length; flagellum with 8 articles. Antenna 2 shorter than antenna 1; flagellum 4-articulated, length ½× antenna 1.

Remarks. See remarks for Q. atauro sp. nov.


Key to species of Quadrisegmentum Hirayama, 1988

1 Gnathopod 2 merus extremely elongate, more than 5 times carpus length (in males and females) ................................................................. Q. lowryi
   — Gnathopod 2 merus not elongate, similar or up to twice carpus length (in males and females) ................................................................. 2

2 Pereonite 2 without dorsal projections; pereonites 1–3 gills short, subovate ................................................................. Q. triangulum
   — Pereonite 2 with anterolateral and/or mid-lateral projections; pereonites 1–3 gills elongate, rectilinear ..................................................... 3

3 Male gnathopod 2 carpus shorter than merus; pereopod 6 carpus without robust setae (in males) ......................................................... Q. yirrgay sp. nov.
   — Male gnathopod 2 carpus subequal to merus length; pereopod 6 carpus with 2 robust setae (in males) ......................................................... Q. atauro sp. nov.
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