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Two species of the *conifera*-subgroup of *Triconia* (Copepoda, Oncaeidae) from the northeastern equatorial Pacific, with a description of the unknown male of *T. hirsuta*

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Abstract

We describe two species from the genus *Triconia* Böttger-Schnack, 1999 in the family Oncaeidae from the northeastern equatorial Pacific, both belonging to the *conifera*-subgroup. Both sexes of *T. derivata* (Heron & Bradford-Grieve, 1995) are redescribed, including morphological features not noted in earlier descriptions, such as the posterior face of the labrum. Specimens of *T. derivata* from the northeastern equatorial Pacific differ slightly from the original descriptions in some morphometric characters, and their differentiation from *T. furcula* (Farran, 1936), which is closely related, is summarized. The male of *T. hirsuta* Wi, Böttger-Schnack & Soh, 2010 is described for the first time and the morphology of the female is redescribed. The female holotype of *T. hirsuta* from Korean waters is reexamined and discrepancies between text and figures in the original description regarding the endopodal spine lengths on swimming leg 2 are clarified. A revised version of the respective part of the original figure is included in the present paper. An indication of the variation in endopodal spine lengths on swimming legs 2 to 4 is provided for both sexes of the two species. It is pointed out that morphometric characters required for unequivocal identification of species of the *conifera*-subgroup are still not sufficiently well defined. The records of *T. derivata* and *T. hirsuta* to date are summarized and indicate a wide zoogeographical distribution of the former species.

Key words: Cyclopoida, marine biology, taxonomy, zoogeography, zooplankton

Introduction

The pelagic copepod family Oncaeidae is a diverse copepod taxon (Boxshall & Halsey 2004), occurring widespread in the oceans (reviewed by Nishibe 2005 and Cho *et al.* 2013). Currently, over 100 species are described in the family (Walter *et al.* 2015a), which includes many small species, measuring between 0.17–1.40 mm total body length as adults (Böttger-Schnack & Schnack 2013). Within the family Oncaeidae, the genus *Triconia* was established by Böttger-Schnack in 1999 based on the autapomorphic character of a conical process on the distal margin of the endopods of swimming legs P2–P4. The genus *Triconia* currently comprises 26 valid species (Walter *et al.* 2015b), which has been subdivided into three subgroups for practical purposes: the *conifera*-, the *similis*-, and the *dentipes*-subgroup (Böttger-Schnack 1999, p.44; Böttger-Schnack & Schnack 2013). Both sexes of the *dentipes*-subgroup (5 species) can be distinguished from the other two subgroups by the absence of integumental pockets on the anterior face of the labrum (Böttger-Schnack 1999). In the *conifera*-subgroup (13 species), females can easily be separated from those of the other two subgroups by the presence of a dorso-posterior projection (“hump”) on the second pedigerous somite in lateral view, which is a sexually dimorphic character not found in males (Böttger-Schnack 1999). So, to identify males of the *conifera*-subgroup, those of the *similis*-subgroup (8 species) have to be considered as well, in order to avoid misidentifications. Major support for a positive species identification of males is provided by the occurrence of mating pairs (“couples”), in which the male clasps the female urosome with its maxillipeds (e.g. Heron 1977, fig. 4b).

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Species of the *conifera*-subgroup are very similar in morphology and comprise many sibling species, which differ only slightly in morphometric characters. Both sexes have been described or redescribed (Heron 1977; Heron *et al.* 1984; Boxshall & Böttger 1987; Heron & Bradford-Grieve 1995; Böttger-Schnack 1999; Heron & Frost 2000; Wi *et al.* 2010), except for two species, such as *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010 and *T. pararedacta* Wi, Böttger-Schnack & Soh, 2012, whose males are unknown (Wi *et al.* 2010, 2012). *Triconia* males are usually smaller than their females and morphological characters used for their identification include total body length, length relations of exopodal setae on P5, and characters of the maxilliped and the genital somite. In addition, the relative spine lengths on the endopods of P2–P4, which are important to differentiate between females of *Triconia* (e.g. Heron 1977; Heron *et al.* 1984; Böttger-Schnack & Schnack 2015), have also been used for the identification of *Triconia* males (Heron *et al.* 1984; Heron & Frost 2000). However, the sexual dimorphism in these morphometric characters, with relative spine lengths being somewhat smaller in males as compared to females (Böttger-Schnack 1999, p. 58), was not noticed in earlier studies and has been described and/or figured in detail only in more recent taxonomic descriptions (e.g. Wi *et al.* 2010, 2011, 2012; Cho *et al.* 2013). Also, the intraspecific variation of such morphometric characters, which is required for assessing their usefulness for male identification has not yet been examined in detail; some information has been provided only recently for the first time (Cho *et al*. 2013).

Taxonomic studies of oncaeid copepods in the Pacific Ocean have been carried out in detail for larger and medium-sized species collected in the northwestern, northeastern and southwestern regions (Heron 1977; Heron *et al.* 1984; Heron & Bradford-Grieve 1995; Heron & Frost 2000; Wi *et al.* 2010, 2011, 2012), whereas the oncaeid fauna of the equatorial Pacific is poorly known. The only taxonomic information available for large and medium-sized oncaeid species in the tropical Pacific dates back as far as the late nineteenth century (Giesbrecht 1891, 1893 ["1892"]), and in Heron & Bradford-Grieve´s study a zoogeographical record was included for a single *Triconia* species only. More recently, a detailed taxonomic study of oncaeid copepods in the epipelagic zone of the northeastern equatorial Pacific was carried out, based on fine-mesh nets to include small species and males of medium-sized species (Cho 2011; Cho *et al.* 2013). The study was part of an environmental risk program conducted in the waters above a mining area for manganese nodules in the central part of the Clarion-Clipperton Zone (MOMAF 2009). In the study area, oncaeid copepods have been found to contribute a high proportion (around 10%) to total mesozooplankton abundance sampled with nets with the mesh size of 300 µm in the surface mixed layers, above the thermocline (Kang *et al.* 2004, 2007, 2008). By using a net with the mesh size of 100 µm, a large number of small oncaeid species and males of medium-sized and larger species were sampled, including many undescribed species (Cho 2011).

During the study, both sexes of two large species of the *conifera*-subgroup, *Triconia derivata* and *T. hirsuta*, were found. Females of *T. derivata* were originally described from the southwestern Pacific and recorded from various localities in the equatorial/subtropical Pacific and the Atlantic (Heron & Bradford-Grieve 1995), whereas males were described in a subsequent study from the northeastern Pacific (Heron & Frost 2000). The female of *T. hirsuta* had been described from Korean waters (NW Pacific) and was recorded also from the southeastern Indian Ocean (cf. Wi *et al.* 2010, p. 679); it is recorded from the equatorial Pacific for the first time in the present account together with its hitherto unknown male, which was pre-identified from mating pairs.

This paper presents a detailed redescription of both sexes of *T. derivata*, including morphological details of the labrum not fully described in the original description by Heron & Bradford-Grieve (1995), as well as ornamentation details on the surface of all appendages (micro-structures). The hitherto unknown male of *T. hirsuta* is described and the morphology of the female is redescribed, including a reexamination of the female holotype of *T. hirsuta* from the Korean waters in order to clarify discrepancies between text and figures of the original description in the lengths of endopodal spines on P2. Also, first information on the variation in endopodal spine lengths on swimming legs 2 to 4 is provided for both sexes of the two species. The zoogeographical records of *T. derivata* and *T. hirsuta* to date are summarized. The present detailed taxonomic study of Oncaeidae in the northeastern tropical Pacific contributes to information on the diversity of this family in the area and provides an important basis for the comparison of oncaeid species from the Pacific with those from other regions in the oceans, by including first data on within species variability.

Material and methods

Zooplankton samples were taken during a cruise of the RV 'Onnuri' at Station KOMO (KORDI Long-term Monitoring Station) (10°30'N, 131°20'W) located in the KODOS (Korea Deep Ocean Study) area in the northeastern equatorial Pacific during August 21, 2009 (Fig. 11). Samples were collected with a fine-mesh conical net, 60 cm in mouth diameter and 60 µm in mesh size. The nets were hauled vertically from 100 m depth to the surface. The specimens were immediately fixed with 99.9% ethyl alcohol on board. *Triconia* species were sorted out under a stereomicroscope (Zeiss Semi 2000-C) in the laboratory. For taxonomic analysis, specimens were dissected with tungsten needles and mounted in lactophenol, and sealed with transparent nail-varnish. All drawings were prepared using a drawing tube attached to an Olympus BX51 or Leica DM 2500 differential interference contrast microscope.

Total body length and the ratio of prosome to urosome (including caudal rami) were measured in lateral view (or sometimes in dorsal view) from the anterior margin of the prosome to the posterior margin of the caudal rami, not considering the various degrees of telescoping of somites (traditional method). The length to width ratio of the caudal rami was computed from the length measured along the inner margin in dorsal view and the width measured at the insertion point of lateral seta II. The relative lengths of spines on the distal endopod segments of P2–P4 were computed in relation to the length of the distal spine; the position of the tips of the distal and outer distal endopodal spines is described relative to the tip of the distal conical process. Scale bars in the figures are indicated in micrometers (µm).

Some morphological characters were examined using scanning electron microscopy (Hitachi S2380N). The method of dehydration through graded alcohol solutions was skipped because the specimens were immediately fixed with 99.9% ethyl alcohol; the specimens were merely immersed in three changes of absolute ethyl alcohol at 30-minute intervals. The ETOH was replaced by iso-amyl acetate as follows: 1, 5, 10, 30 min in 100% iso-amyl acetate, followed by 100% iso-amyl acetate for 1 h. After the final step, the samples were dried by the critical-point method using liquid carbon dioxide. The dried specimens were mounted on stubs and coated with gold using an ion sputter.

The descriptive terminology is adapted from Huys *et al.* (1996). Abbreviations used in the text are as follows: Al, antennule; A2, antenna; ae, aesthetasc; CR, caudal ramus; P1–P6, first to sixth thoracopod; exp, exopod; enp, endopod; exp (enp)-1 (2, 3) to denote the proximal (middle, distal) segment of a three-segmented ramus. Pores and other integumental structures (e.g. pits, scales) on the body surface were figured or mentioned only if discernible under the light microscope.

In this study, Oncaeidae is placed to the order Cyclopoida following Boxshall & Halsey (2004), although this taxonomic assignment is not universally accepted (Ho *et al.* 2006).

The family Oncaeidae was established by Wilhelm Giesbrecht in his comprehensive monograph on the pelagic copepods of the Gulf of Naples (Giesbrecht (1893 ["1892"]). Following the arguments given by Holthuis & Vervoort (2006), the actual date of publication of Giesbrecht´s monograph appears to be different (1893) from the date specified in the work (1892). According to Article 22A.2.3. of the International Code of Zoological Nomenclature, it is recommended to cite both dates with the actual date cited first, followed by the imprint date for information and enclosed in parentheses or other brackets and quotation marks.

All materials were deposited in the National Marine Biodiversity Institute of Korea (MABIK) at Seochun-gun in Chunchungnam-do.

Results

Order Cyclopoida Burmeister, 1835

Family Oncaeidae Giesbrecht, 1893 ["1892"]

Genus *Triconia* Böttger-Schnack, 1999

Triconia derivata (Heron & Bradford-Grieve, 1995)

(Figs. 1–4, 9A, B, C)

Synonymy. *Oncaea conifera* Moulton, 1973, ("bumped" only) p. 142, 145, 147, 148, 150–154, Figs. 4Ac, g, k, 4Bo, s, w (female).

Oncaea derivata Heron & Bradford-Grieve, 1995, p. 25, 29 (female), Figs. 9h–j, 10a–l, 11a, 25c (female).

Oncaea derivata Heron & Frost, 2000, p. 1021, 1028–1032, Figs. 1C (P2–P4 endopod terminal spine set in female), 8F–I (male).

Type locality. Southwest Pacific, off New Zealand, 36°18.5'S, 165°05.5'E

Material examined. Four females (MABIK CR000235312 – CR000235315) dissected on ten slides. Two males (MABIK CR000235316 – CR000235317) dissected on ten slides. All specimens collected from NE equatorial Pacific, station BN09-02-01 (10°30'N, 131°20'W) in August 2009 by D.J. Ham.

Description of female. Body length (measured in dorsal view): 1160-1244 μm, based on 4 specimens (illustrated female: 1244 μm).

Exoskeleton moderately chitinized. Prosome about 1.9 times length of urosome excluding caudal rami, about 1.7 times urosome length including caudal rami. P2-bearing somite with dorsoposterior projection viewed in lateral aspect (Fig. 1B). Numerous integumental pores and sensilla on prosome (Fig. 1A, B). Pleural areas of P4-bearing somite with pointed posterolateral corners in dorsal view.

Genital double-somite (Fig. 1C) elongate flask-shaped; about 1.95 times as long as maximum width (measured in dorsal aspect) and 2.1 times as long as postgenital somites combined; largest width measured at about 1/4 the distance between anterior and posterior, posterior part tapering gradually. Paired genital apertures located at about 1/3 the distance from anterior margin of genital double-somite. Pore pattern on dorsal surface as indicated in Fig. 1C.

Anal somite slightly wider (about 1.4) than long; about as long as caudal rami (Fig. 1C). Caudal rami (Fig. 1C) 2.3 times as long as wide; caudal seta VI about 3/4 length of seta IV, seta VII longer than seta III, plumose and bi-articulate at base. Inner margin of CR with fringe of long, fine spinules.

Antennule (Fig. 2A) six-segmented. Armature formula: 1-[3], 2-[8], 3-[5], 4-[3+ae], 5-[2+ae], 6-[6+(1+ae)].

Antenna (Fig. 2B) three-segmented, distinctly reflexed. Coxobasis with row of long, fine spinules along outer and inner margins and with few additional denticles on proximal and distal part of outer margin. Endopod segments unequal in length; proximal endopod segment subtriangular forming outer lobate outgrowth bearing spinular patch, with row of denticles along posterior inner margin. Distal endopod segment distinctly shorter than proximal endopod segment, with narrow cylindrical base and two patches of short spinules along outer margin; lateral (proximal) armature with four elements: 1 bipinnate spiniform seta (III) and 3 curved setae, setae I and IV sparsely pinnate; distal armature consisting of 7 elements: 1 long curved unipinnate seta (E), curved setae A and B similar in length, length decreasing from seta C to D, all elements unipinnate, slender bare setae F and G nearly equal in length, slightly shorter than seta D.

Labrum (Fig. 2G, H) distinctly bilobed. Each lobe with row of minute denticles around outer ventral margin and dentiform processes converging and decreasing in size medially. Lobes separated by medial concavity covered anteriorly by several transverse hyaline lamellae, which are undulating. Posterior wall of medial concavity ornamented with four long, sclerotized, dentiform processes ("teeth"). Anterior surface (Fig. 2H) with paired row of long setules either side of median swelling and paired integumental pockets latero-posteriorly (arrowed in Fig. 2H), free margin of pockets surrounded by minute denticles [the three-dimensional shape of these pockets is difficult to discern and illustrate under a light microscope, but has been shown in detail for other oncaeid species, such as *Oncaea venusta*, by scanning electron microscopy (cf. Böttger-Schnack 2001, fig. 9A, C, D]; large secretory pore posterior to median swelling (not figured). Posterior surface (Fig. 2G) with group of three secretory pores located on proximal part of each lobe and an additional one on midregion.

Mandible (Fig. 2C) with surface of coxa ornamented with row of spinules. Gnathobase with 5 elements, numbered using capital letters in Fig. 2C: element A subdistal ventral corner much shorter than ventral blade B, with long setules along dorsal margin; ventral blade B strong and broad, with row of setules on posterior surface; dorsal blade (C) strong and broad, with dentiform processes around distal margin and along distal two-thirds or half of dorsal margin; dorsal elements setiform, the shorter spinulose (D), the longer multipinnate (E).

Maxillule (Fig. 2D) indistinctly bilobed, with numerous spinules on anterior and posterior surfaces. Inner lobe subcylindrical, with 3 elements; outermost one spiniform, swollen at base, fringed with coarse spinules, other two setiform and bipinnate; innermost one multipinnate and located along concave inner margin at some distance from other elements. Outer lobe with 4 elements; 2 outermost elements setiform and pectinate, longer than other 2 elements, which are pectinate or with sparse spinules; innermost element shortest.

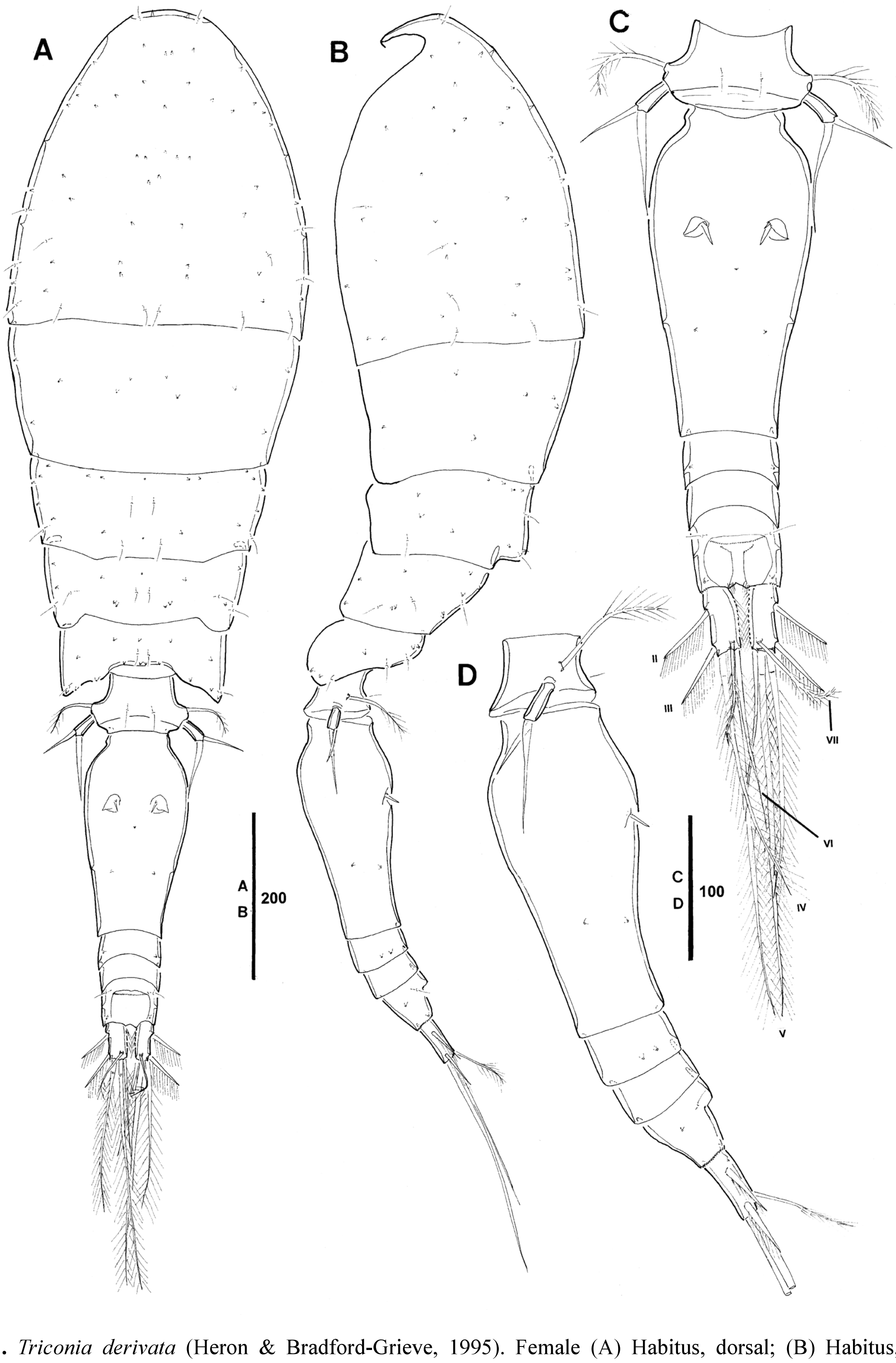

FIGURE 1. *Triconia derivata* (Heron & Bradford-Grieve, 1995). Female (A) Habitus, dorsal; (B) Habitus, lateral; (C) Urosome, dorsal, setae on caudal rami are numbered using Roman numerals; (D) Urosome, lateral. Scale bars in µm.

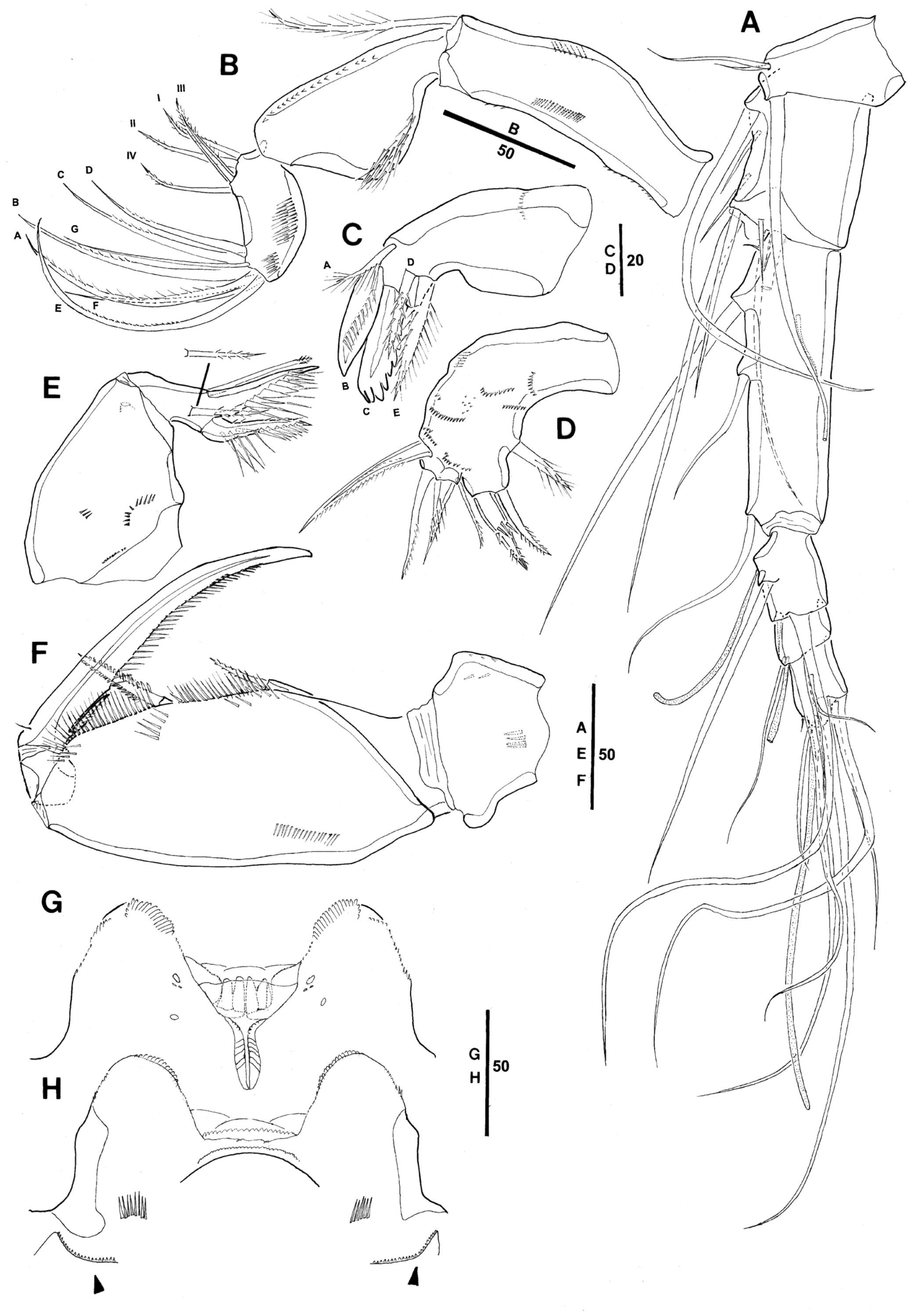

FIGURE 2. *Triconia derivata* (Heron & Bradford-Grieve, 1995). Female (A) Antennule; (B) Antenna, posterior, distal elements on distal endopod segment numbered using capital letters, lateral elements indicated by Roman numerals; (C) Mandible, individual elements indicated by capital letters; (D) Maxillule; (E) Maxilla; (F) Maxilliped; (G) Labrum, posterior; (H) Labrum, anterior, arrows indicating integumental pockets. Scale bars in μm.

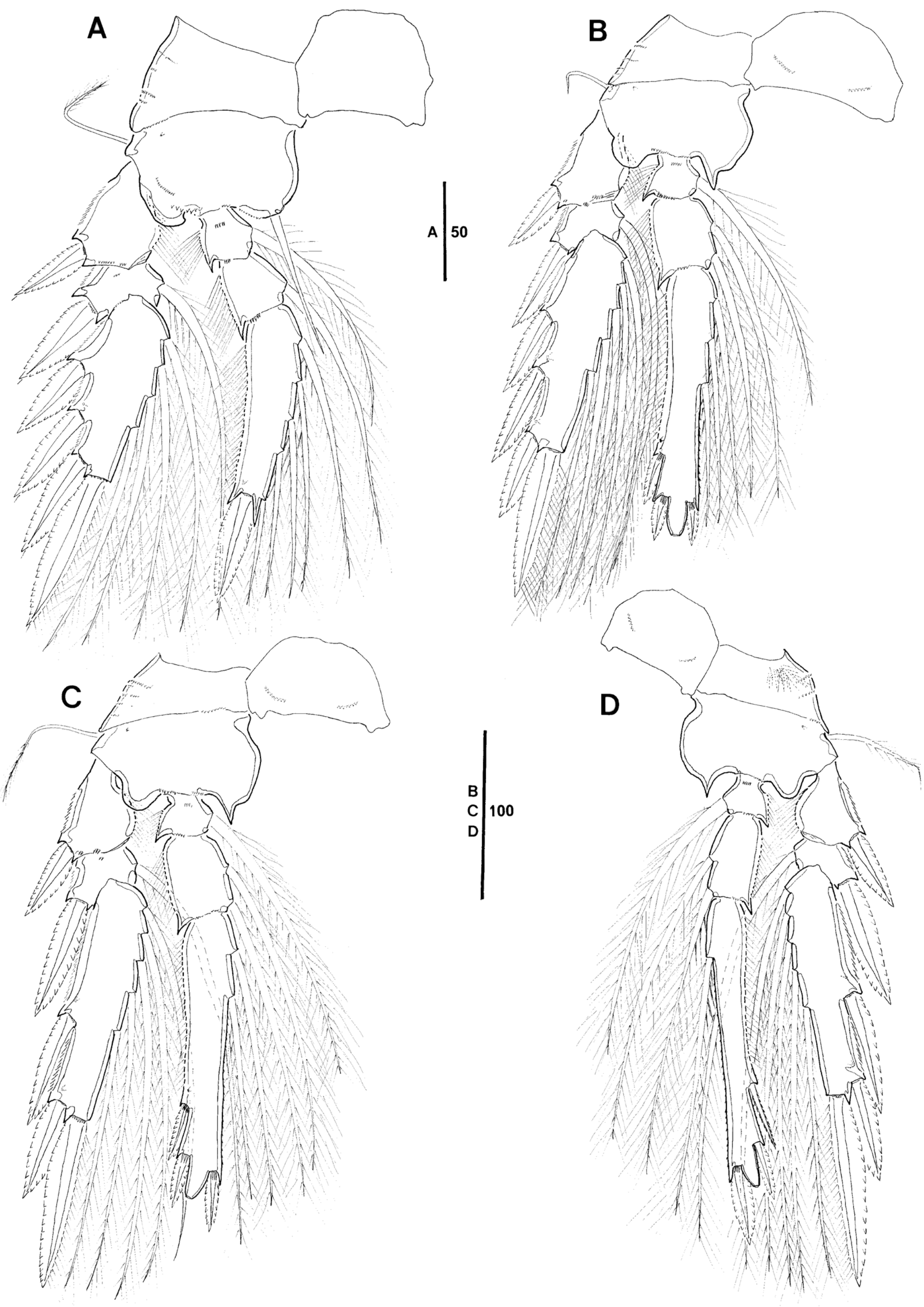

FIGURE 3. *Triconia derivata* (Heron & Bradford-Grieve, 1995). Female (A) P1, anterior; (B) P2, anterior; (C) P3, anterior; (D) P4, anterior. Scale bars in µm.

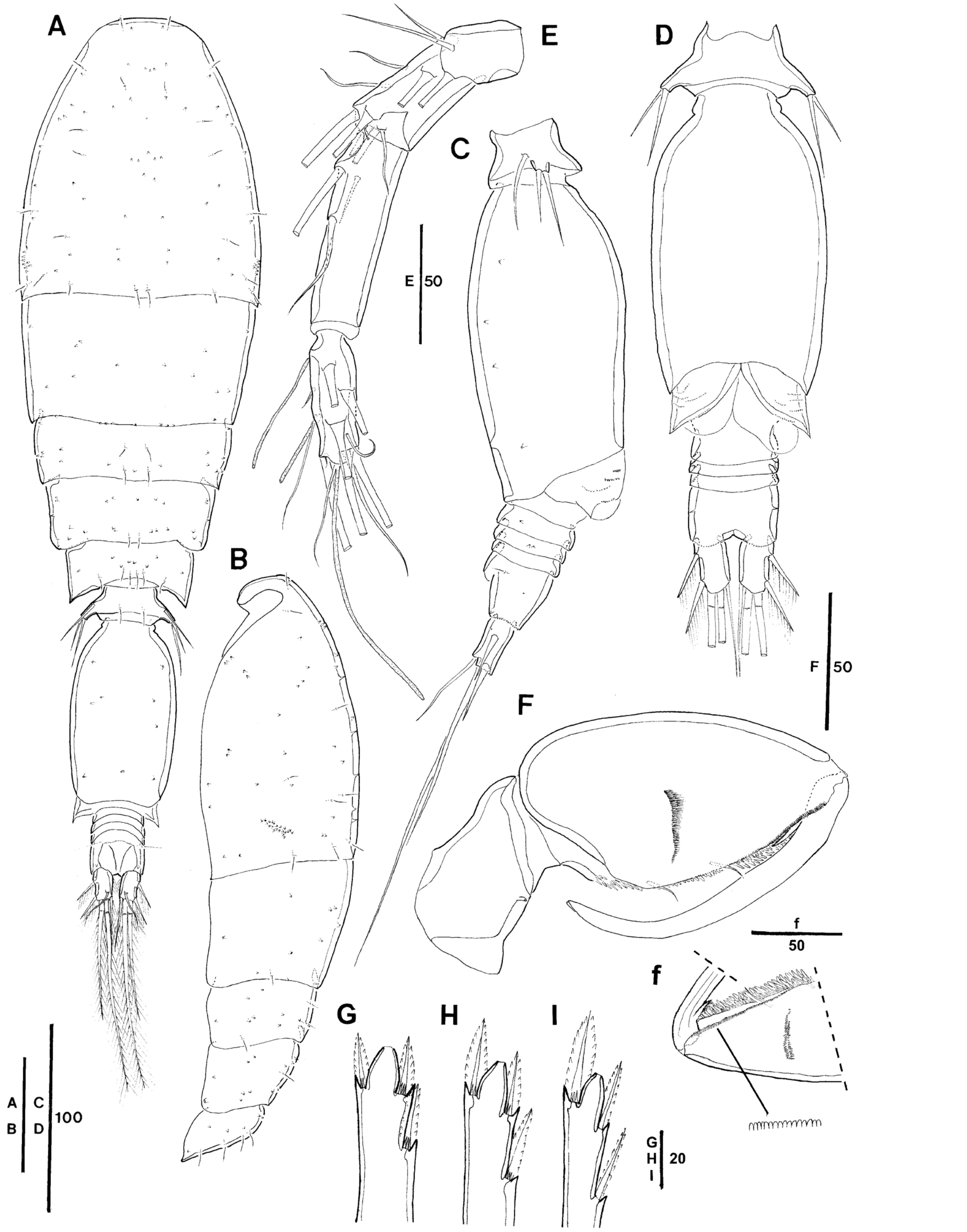

FIGURE 4. *Triconia derivata* (Heron & Bradford-Grieve, 1995). Male (A) Habitus, dorsal; (B) Prosome, lateral; (C) Urosome, lateral; (D) Urosome, ventral; (E) Antennule; (F) Maxilliped, anterior; (f) Distal part of maxilliped basis from another specimen, enlarged ornamentation of inner margin figured separately; (G) P2, tip of enp-3; (H) P3, tip of enp-3; (I) P4, tip of enp-3. Scale bars in μm.

Maxilla (Fig. 2E) with surface of syncoxa ornamented with spinule rows and one large secretory pore. Allobasis produced distally into slightly curved claw bearing 2 rows of very strong spinules along medial margin; outer margin with strong seta extending almost to tip of allobasal claw, ornamented with few strong spinules distally, tip of seta with tubular extension; inner margin with slender pinnate seta (figured separately in Fig. 2E) and strong basally swollen spine, which is ornamented with single row of shorter spinules along outer margin in addition to double row of very strong spinules along the inner margin.

Maxilliped (Fig. 2F) with surface of syncoxa ornamented with few spinules. Basis robust, inner margin with 2 spiniform spinulose setae, distal seta 1.5 times longer and stouter than proximal one; fringe of long pinnules between distal seta and articulation with endopod, row of long spinules between proximal and distal seta; few short transverse rows of setules on anterior surface and additional longitudinal row near outer margin. Proximal endopod segment unarmed. Distal endopod segment (claw) with row of pinnules on proximal 5/6 of concave margin; accessory armature consisting of minute, naked seta on outer proximal margin and unipectinate spine fused basally to inner proximal corner of claw.

Swimming legs 1–4 biramous (Fig. 3A–D), with 3-segmented rami. Intercoxal sclerites well developed, posterior face ornamented with paired row of denticles near distal corner in P2–P4. Coxae and bases of P1–P4 with surface ornamentation as in Fig. 3A–D. Coxae of P1–P4 with raised secretory pore on posterior face near outer distal corner. Bases with short naked (P2) or plumose (P1, P3, P4) outer seta; with anterior secretory pore near outer proximal corner; inner portion slightly produced medially in P2–P4. Coxa of P4 with tuft of long fine setules posteriorly at outer posterior surface. Inner basal seta on P1 spiniform and naked. Respective legs without distinct length differences between exopod and endopod (P1) or with endopod slightly longer than exopod (P2–P4). Bases of spines on exopod and endopod segments anteriorly surrounded by small spinules.

Leg armature formula (Roman numerals indicate spines, Arabic numerals indicate setae):

	Coxa	Basis	Exopod	Endopod
P1	0-0	1-I	I-0; I-1; III,I,4	0-1; 0-1; 0,I,5
P2	0-0	1-0	I-0; I-1; III,I,5	0-1; 0-2; I,II,3
P3	0-0	1-0	I-0; I-1; II,I,5	0-1; 0-2; I,II,2
P4	0-0	1-0	I-0; I-1; II,I,5	0-1; 0-2; I,II,1

Exopods. Outer margin of exopod segments with well-developed serrated hyaline lamella; inner margin of proximal exopod segments with long setules. Secretory pore located on posterior surface of distal segments. Hyaline lamellae on outer spines well developed; outer and distal spines of P1 with subapical tubular extension; this extension lacking on proximalmost spine of P1 exp-3. Distal spine shorter than distal exopod segment in all legs.

Endopods. Outer margin of endopod segments with fringe of long setules. Distal endopod segments with single secretory pores on posterior surface; distal margin of P2–P4 produced into conical process, process with apical pore. Distal (inner) spine reaching only slightly beyond tip of conical process in P2, clearly reaching beyond the tip in P3 and P4. Length data of endopodal spines of four females as shown in Table 1; length ranges of outer subdistal spine (OSDS) and outer distal spine (ODS) relative to distal spine (DS) are given in Table 2.

P5 (Figs. 1C, D, 9B) comprising long, free exopod segment and plumose outer basal seta, which is about same length as inner exopodal seta. Exopod about 2.3 times longer than wide, bearing 2 naked, spiniform setae, inner seta 1.7 times longer than outer seta.

P6 (Figs. 1C, 9C) represented by operculum closing off each genital aperture; armed with long spine and three minute processes (arrowed in inset of Fig. 9C).

Description of male. Body length: 768-791 µm, based on 2 specimens (illustrated male: 768 µm). Sexual dimorphism in antennule, maxilliped, P5, P6, genital segmentation and CR; slight dimorphism in endopodal spine lengths on P2.

Prosome 1.9 times length of urosome, excluding caudal rami, 1.7 times urosome length, including caudal rami (Fig. 4A). Integumental pores on prosome and urosome as figured (Fig. 4A). Cephalosome with conspicuous posterolateral pattern of about 20 hooded pores (Fig. 4B).

TABLE 1. Variation of morphometric data among individuals of *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010 and *T. derivata* (Heron & Bradford-Grieve, 1995) from the northeastern equatorial Pacific: comparison of the length of spines on P2–P4 enp-3 (unit: µm). Abbreviations: dmgd = damaged; DS = distal spine; ODS = outer distal spine; OSDS = outer subdistal spine; spec = specimen.

		Triconia hirsuta						
		Female				Male		
		spec 1	spec 2	spec 3	spec 4	spec 1	spec 2	spec 3
P2	OSDS	27.9	31.3	31.6	31.3	19.9	21.0	20.0
	ODS	27.9	30.1	32.1	30.5	18.8	19.9	18.4
	DS	14.0	17.6	17.3	16.2	11.8	11.8	12.5
P3	OSDS	33.8	33.1	33.5	32.7	21.3	22.4	20.2
	ODS	31.6	32.0	33.1	33.8	21.3	22.1	18.8
	DS	20.2	23.9	23.9	22.8	15.4	15.8	14.7
P4	OSDS	35.3	36.8	dmgd	39.3	23.5	26.8	24.8
	ODS	33.8	33.8		39.7	23.0	24.6	21.3
	DS	39.4	37.9		38.6	25.7	25.4	22.8

continued.

		Triconia derivata					
		Female				Male	
		spec 1	spec 2	spec 3	spec 4	spec 1	spec 2
P2	OSDS	34.9	32.4	34.3	31.3	22.1	20.6
	ODS	29.4	28.7	32.7	28.7	19.9	18.4
	DS	27.0	25.7	27.6	23.9	19.1	17.3
P3	OSDS	36.8	34.9	37.5	32.4	25.0	22.1
	ODS	33.8	33.8	35.7	29.8	21.3	21.3
	DS	37.1	35.3	36.8	34.9	26.1	22.1
P4	OSDS	36.8	39.3	47.4	38.6	25.7	22.1
	ODS	35.7	35.7	39.0	34.2	24.1	21.3
	DS	50.7	49.3	57.7	50.0	32.7	29.0

Length to width ratio of genital somite 1.7:1. Caudal rami (Fig. 4C, D) relatively shorter than in female, about 1.4 times longer than wide. Surface of genital flaps ornamented with several rows of small spinules. Anal somite 1.7 times wider than long, relatively wider than that of female.

Antennule (Fig. 4E) with distal segment corresponding to fused segments 4–6 of female, including minute element. Armature formula 1-[3], 2-[8], 3-[4], 4-[11+2ae+(1+ae)].

Maxilliped (Fig. 4F) 3-segmented, comprising syncoxa, basis and 1-segmented endopod. Syncoxa without surface ornamentation, with single secretory pore at inner distal margin. Basis robust, particularly inflated in proximal half forming bulbous swelling; anterior surface with 1-2 transverse spinular rows and small flat spinules (with rounded tips) along distal part of inner margin (figured separately in Fig. 4f); posterior surface with rows of spatulate setules of graduated length along palmar margin; with 2 small naked setae of equal length inserted within longitudinal cleft. Endopod drawn out into long curved claw, concave margin unornamented; accessory armature consisting of short, unipectinate spine basally fused to inner proximal corner of claw; claw with minute hyaline apex (Fig. 4F).

Swimming legs 1–4 (Fig. 4G–I, only P2–P4 enp-3) with armature and ornamentation as in female, length data of endopodal spines of two males as shown in Table 1; length ranges of outer subdistal spine (OSDS) and outer distal spine (ODS) relative to distal spine (DS) are given in Table 2. Relative spine lengths of OSDS and ODS on P2 slightly shorter than that of female (Table 2).

TABLE 2. Comparison of morphometric ratios for both sexes of *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010 and *T. derivata* (Heron & Bradford-Grieve, 1995) from the equatorial Pacific (present study) with specimens from other regions. Abbreviations: AS = anal somite; BS = outer basal seta; CR = caudal ramus; DS = distal spine; IS = inner exopodal seta; L = length; OS = outer exopodal seta; ODS = outer distal spine; OSDS = outer subdistal spine; W = width.

		Triconia hirsuta			*Triconia derivata*				
		NW Pacific[1)]	Equatorial Pacific		SW Pacific[2)]	NE Pacific[3)]	Equatorial Pacific	NE Pacific[3)]	Equatorial Pacific
		Female	Female	Male	Female	Female	Female	Male	Male
size range (mm)		0.95-1.04	1.07-1.16	0.72	1.11-1.20	1.05–1.15	1.16–1.24	0.67–0.74	0.77–0.79
genital (double-)somite (dorsal view)	L:W ratio	1.73	1.63	1.61	1.83		1.95	1.62	1.72
L ratio spines P2 enp-3	OSDS:DS	1.58–1.78**	1.77–2.00*	1.60–1.78*	1.22	1.35	1.25–1.31*		1.15/1.19*
	ODS:DS	1.68–1.79**	1.71–2.00*	1.47–1.69*	1.22	1.15	1.09–1.20*		1.04/1.06*
L ratio spines P3 enp-3	OSDS:DS	1.27–1.47**	1.38–1.67*	1.38–1.42*	0.93	1.05	0.93–1.02*		0.96/1.00*
	ODS:DS	1.32–1.38**	1.34–1.56*	1.28–1.40*	0.93	0.87	0.85–0.97*		0.82/0.97*
L ratio spines P4 enp-3	OSDS:DS	0.91–1.04**	0.90–1.02*	0.91–1.09*	0.83	0.80	0.73–0.82*		0.76/0.79*
	ODS:DS	0.86–0.91**	0.86–1.03*	0.89–0.97*	0.67	0.65	0.68–0.72*		0.73/0.74*
P5-bearing somite	L ratio seta BS:IS:OS	1.68:2.21:1	1.75:2.10:1	1.43:1.4:1	1.40:2:1		1.91:1.73:1	1.60:1.80:1	1.29:1.50:1
L ratio seta of CR	IV:VI:VII	2.50:1:1	2.56:1.11:1	2.39:1.14:1	2.07:1.20:1		2.43:1.79:1		2.67:1.17:1
AS	W:L	1.5	1.58	1.57	1.46		1.41	2.3	1.72
CR	L:W	1.75	1.67	1.61	1.78		2.29	1.5	1.4
L ratio CR:AS		0.88	0.81	0.88	0.81		0.94	0.88	0.75

[1)] Wi *et al.* 2010; [2)] Heron & Bradford-Grieve 1995; [3)] Heron & Frost 2000

* = for number of specimens measured see Table 1

** = values from reexamination of type material (see under "Remarks" of *T. hirsuta*)

P5 (Figs. 4A, C, 9A) exopod not delimited from somite, shorter than that of female, outer basal seta about as long as inner exopodal seta; length ratio between inner and outer exopodal setae smaller (1.5:1) than that of female.

P6 (Fig. 4D) represented by posterolateral flap closing off genital aperture on either side; covered by pattern of spinules; posterolateral corners protruding laterally and discernible in dorsal aspect (Fig. 4A).

Remarks. The morphology of female *T. derivata* from the tropical Pacific agrees in most parts with the original description of the species by Heron & Bradford-Grieve (1995). Yet the present specimens appear to differ in a few morphometric characters, which seem to be more similar to its sibling *T. furcula* (Farran, 1936) as redescribed in detail by Heron & Bradford-Grieve (1995). The aforementioned authors separated co-occurring females of *T. derivata* and *T. furcula* in New Zealand waters by a number of slightly different morphometric characters, such as (1) the size of the dorsal "hump" of the P2-bearing somite, (2) the length of the genital double-somite relative to the total length of three posterior segments of the prosome, (3) the length to width ratio of the anal somite, (4) the length of the anal somite relative to the length of the CR, (5) the length of the outer basal seta on P5, and also by (6) the presence or absence of a sclerotised ridge on the prosome near the apex in lateral view (Heron & Bradford-Grieve 1995, p. 24, key p. 14). Our female specimens from the tropical Pacific are similar to *T. derivata* from the New Zealand waters in the first two characters, but appear to be more similar to *T. furcula* in characters (3) and (4). Some characters of the females from our study were intermediate between the two species (character 5) or were not clearly discernible (character 6). Moreover, the form of the genital double-somite in dorsal view had a more tapering posterior part than that figured by Heron & Bradford-Grieve for *T. derivata* (their figs. 9i, 10b), suggesting some similarity to *T. furcula* (their fig. 8c & d). Slight morphometric differences were also found in the proportional lengths of the innermost element on the outer lobe of the maxillule, which is slightly shorter in our specimens than that figured by Heron & Bradford-Grieve for either *T. derivata* (their fig. 10g) or *T. furcula* (their fig. 8i).

Support for a positive species identification of *T. derivata* in our study was given by the observed differences in endopodal spine lengths between the two sibling species, which were not mentioned in Heron & Bradford-Grieve´s study. The proportional lengths of endopodal spines on P4 reported for *T. derivata* from the New Zealand waters (calculated from Heron & Bradford-Grieve 1995, fig. 11a) and the northeastern Pacific (calculated from Heron & Frost 2000, fig. 1C) both fall into the range of variation examined in our specimens from the equatorial Pacific (Table 2). The spine lengths on P4 enp-3 of *T. furcula* are different, with the outer subdistal spine (OSDS) and outer distal spine (ODS) being similar in length to the distal spine (DS) (cf. Heron & Bradford-Grieve 1995, fig. 9c), while in *T. derivata* both spines are shorter than the distal spine (Table 2). The proportional spine lengths on the endopods of P2 and P3 are not informative in this respect, because they are similar for both species in question and fall in the range of variation indicated for our specimens from the equatorial Pacific. More individuals from different locations need to be studied for intraspecific variation in morphometric characters in order to define the interspecific differences between *T. derivata* and related species more clearly.

The present study includes additional morphological characters not described, mentioned or figured in earlier descriptions of *T. derivata*. Most notably, a complete description of the labrum is provided, including the number of blunt "teeth" on the posterior wall of the medial concavity in *T. derivata* (Fig. 2G), as well as the paired integumental concavities ("pockets") on the anterior face (arrowed in Fig. 2H). Both characters are of significance for the classification of the genus *Triconia* within the family Oncaeidae, and support the morphological definition of the *conifera*-subgroup (Böttger-Schnack & Schnack 2013, table 3). Other additional micro-structural characters described for *T. derivata* in the present account include ornamentation details of the female antenna, as well as those on the intercoxal sclerite(s) of P2–P4 (posterior view), which were not provided by Heron & Bradford-Grieve (1995), but might be of importance for species identification in the future.

The male of *T. derivata* was first described by Heron & Frost (2000) based on specimens collected in coastal waters at high latitudes in the NE Pacific (Juan de Fuca Strait, Washington DC). They were seemingly identified by the proportional lengths of endopodal spines on P2–P4, which were described as "being similar to the female", but not figured for the male. In the present account, we also used this character to assist in preliminary identification of the males of *T. derivata*, although the proportional spine lengths of OSDS and ODS on the endopod of P2 were relatively shorter than that of the female, which was not noted by Heron & Frost (2000). Heron & Frost´s figure of the male (their fig. 8F-I) also showed minor morphometric differences as compared to specimens from our study: (1) the width to length ratio of the anal somite is smaller in the equatorial Pacific (1.7 times wider than long), compared to the northeastern Pacific (about 2.3 times wider than long), and (2) the length of the inner exopodal seta on P5 of our specimens was relatively shorter (only 1.5 times longer than outer seta) compared to the northeastern Pacific, where the inner seta was about 2 times longer than the outer one. However, the length ratios of the outer basal seta to the inner exopodal seta on P5 of male specimens are similar for both areas (about 1.1 times, calculated from Table 2).

All females of *T. derivata*, originally described from the southwestern Pacific Ocean had various sizes of a tumorous growth on the mid-dorsal surface of the cephalosome (Heron & Bradford-Grieve 1995, their fig. 9h), an abnormality which had also been recorded by Moulton (1973, "bumped form") for about half of the specimens collected in the Indian Ocean, while it was absent in the other half of the individuals (cf. Moulton 1973, his table 5). Heron & Bradford-Grieve (1995) noted that the "bump" was absent on specimens from the Panama Basin (their fig. 9j) and was found only in 2 out of 3 specimens examined in the western Atlantic (Florida Strait); the same authors recorded *T. derivata* also from the western equatorial Atlantic (off Liberia, sample 10-0-20 in their table 4) and from the eastern equatorial Pacific (sample 1 and sample 2 in their table 4), which is close to the sampling area of the present study, but gave no information about the presence or absence of a "bump" in these specimens. In the present study from the northeastern equatorial Pacific, none of the females of *T. derivata* examined had a tumorous growth on the cephalosome, and it was also absent in females collected in the northeastern Pacific (inland waters of Washington DC; Heron & Frost 2000). Thus it may be concluded that the "bump" only irregularly occurs in the species and cannot be used for separating it from its congeners during routine counts.

The records of *T. derivata* to date are summarized in Fig. 11, indicating a wide zoogeographical distribution.

Triconia hirsuta Wi, Böttger-Schnack & Soh, 2010

(Figs. 5–8, 9D, E)

Synonymy. *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010, p. 674, 678, 679, Figs. 2, 3, 4A, B (female).

Type locality. The Western Channel of Korea Strait, 34°05.97'N, 129°47.32'E.

Material examined. Four females (MABIK CR000235318 – CR000235321) dissected on ten slides. Three males (MABIK CR000235322 – CR000235324) each dissected and mounted on seven or nine slides.

All specimens collected from the NE equatorial Pacific (10°30'N, 131°20'W) on 21 August 2009 by D.J. Ham.

Description of female. Body length (measured in lateral aspect): 1070–1160 µm, based on 4 specimens (illustrated female: 1156 µm).

Exoskeleton well chitinized. Prosome about 1.8 times length of urosome length excluding caudal rami, about 1.6 times urosome including caudal rami. P2-bearing somite with conspicuous dorso-posterior projection in lateral aspect (Fig. 5B). Numerous integumental pores and sensilla on prosome (Fig. 5A, B). P3-bearing somite with row of about 10 pores near dorso-posterior projection (Fig. 5A). Pleural areas of P4-bearing somite with more or less rounded posterolateral corners in lateral view (Fig. 5B).

P5-bearing somite with paired dorso-posterior pore, each with sensillum (Fig. 5C).

Genital double-somite (Fig. 5C) barrel-shaped, with paired patches of setules on antero-lateral margins (Figs. 5C, D, 9D); about 1.6 times as long as maximum width (measured in dorsal aspect) and about 2 times as long as postgenital somites combined; largest width measured at anterior 1/3, posterior part tapering gradually. Paired genital apertures located at 2/5 the distance from anterior margin of genital double-somite. Pore pattern on dorsal surface as indicated in Fig. 5C.

Anal somite about 1.6 times wider than long; slightly longer than caudal rami (Fig. 5C).

Caudal rami (Fig. 5C) about 1.7 times as long as wide; caudal seta VI less than half length of seta IV; seta VII about same length as seta VI, plumose and bi-articulate at base.

Antennule (Fig. 6A) six-segmented. Armature formula as for *T. derivata*.

Antenna (Fig. 6B) three-segmented, distinctly reflexed. Distal endopod segment with armature and ornamentation as in *T. derivata*, except for ornamentation of setae B–D being bipinnate; seta G shorter than setae A–D and about same length as seta F.

Labrum (Fig. 6G, H) as described for *T. derivata*, except for shape of lobes being less elongate and ornamentation of three secretory pores on proximal part of posterior surface orientated in a row and not as a group.

Mandible (Fig. 6C) as described for *T. derivata*, with minor differences in the surface ornamentation of the coxa, showing three spinular rows.

Maxillule (Fig. 6D) similar to *T. derivata*, except for length of innermost element on outer lobe similar to the strong element next to innermost.

Maxilla (Fig. 6E) similar to *T. derivata*. Proximal inner margin with slender pinnate seta and strong basally swollen spine on inner margin, ornamented with single row of shorter spinules along outer margin in addition to double row of very strong spinules along the inner margin.

Maxilliped (Fig. 6F) similar to *T. derivata*, with slight differences in ornamentation. Surface of syncoxa and basis ornamented with several spinule rows and distal element on basis with longer spinules than in *T. derivata*. Distal endopod segment with stout spinules along entire length of concave margin, decreasing in size distally.

Swimming legs (Fig. 7A–D) with armature and ornamentation as in *T. derivata*, except for intercoxal sclerites being without ornamentation. Coxae and bases of legs 1–4 with surface ornamentation as in Fig. 7A–D.

Endopods. Distal margin of P2–P4 produced into conical process, process with apical pore. Distal spines shorter than in *T. derivata* and not (P2), or only slightly (P3), reaching beyond tip of conical process. Length ratios of spines different from *T. derivata* with length data of spines of four specimens as shown in Table 1; length ranges of outer subdistal spine (OSDS) and outer distal spine (ODS) relative to distal spine (DS) are given in Table 2.

P5 (Figs. 5C, D, 9D) with outer basal seta long and plumose distally; exopod segment free, with few denticles on distal margin (Figs. 5D, arrowed in inset of Fig. 9D). Exopod 2.4 times longer than wide, bearing short seta (outer) and long seta (inner) ornamented with minute spinules; outer seta half length of inner seta (Figs. 5C, D, 9D).

P6 (Figs. 5C, 9E) represented by operculum closing off each genital aperture; armed with long spine and 2 small processes (arrowed in inset of Fig. 9E).

TABLE 3. Length ratios of endopodal spines on P2–P4 enp-3 of *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010, based on reexamination of the type material. Abbreviations as in Table 2.

		Holotype female		Paratype female	
Leg endopod	Spines length ratio	left side	right side	left side	right side
P2 enp-3	OSDS : DS	1.58	1.65	1.78	1.71
	ODS : DS	1.79	1.72	1.74	1.68
P3 enp-3	OSDS : DS	1.32	1.27	1.42	1.47
	ODS : DS	1.38	1.33	1.32	1.37
P4 enp-3	OSDS : DS	1.04	1.10	0.92	0.91
	ODS : DS	0.90	0.99	0.91	0.86

Description of male. Body length: 716–720 µm, based on 3 specimens (illustrated male: 716 µm). Sexual dimorphism in antennule, maxilliped, P5, P6, genital segmentation and CR; slight differences in endopodal spine lengths on P2.

Prosome 2.4 times length of urosome, excluding caudal rami, about 2.1 times urosome length, including caudal rami (Fig. 8A). Integumental pores on prosome and urosome as figured (Fig. 8A). Cephalosome with conspicuous posterolateral group of over 20 pores (Fig. 8B). P3- and P4-bearing somites with conspicuous dorsal patches of pores (Fig. 8A).

Genital somite (Fig. 8A, E, F) about 1.6 times longer than wide. Dorsal surface of genital somite covered with numerous pores as figured (Fig. 8A). Caudal rami (Fig. 8A, F) similar to female. Surface of genital flaps ornamented with rows of minute spinules (Fig. 8E, F). Anal somite about 1.6 times wider than long, similar to female.

Antennule (Fig. 8C) four-segmented; armature formula as for *T. derivata*.

Maxilliped (Fig. 8D) three-segmented (damaged, syncoxa not figured). Basis robust, with 2 small naked setae of similar length within longitudinal cleft; anterior surface with 1-2 transverse spinule rows in additional to row of small flat spinules along inner margin between distal seta and endopod; posterior surface with rows of spatulate setules of graduated length along palmar margin.

Swimming legs with armature and ornamentation as in female, lengths of endopodal spines on P2–P4 as shown in Fig. 8G–I, with distal spine not (P2), or only slightly (P3), reaching beyond tip of conical process as in female. Variation of endopodal spine lengths of three male specimens as listed in Table 1; length ranges of outer subdistal spine (OSDS) and outer distal spine (ODS) relative to distal spine (DS) are given in Table 2. Relative spine lengths of OSDS and ODS on P2 slightly shorter than that of female (Table 2).

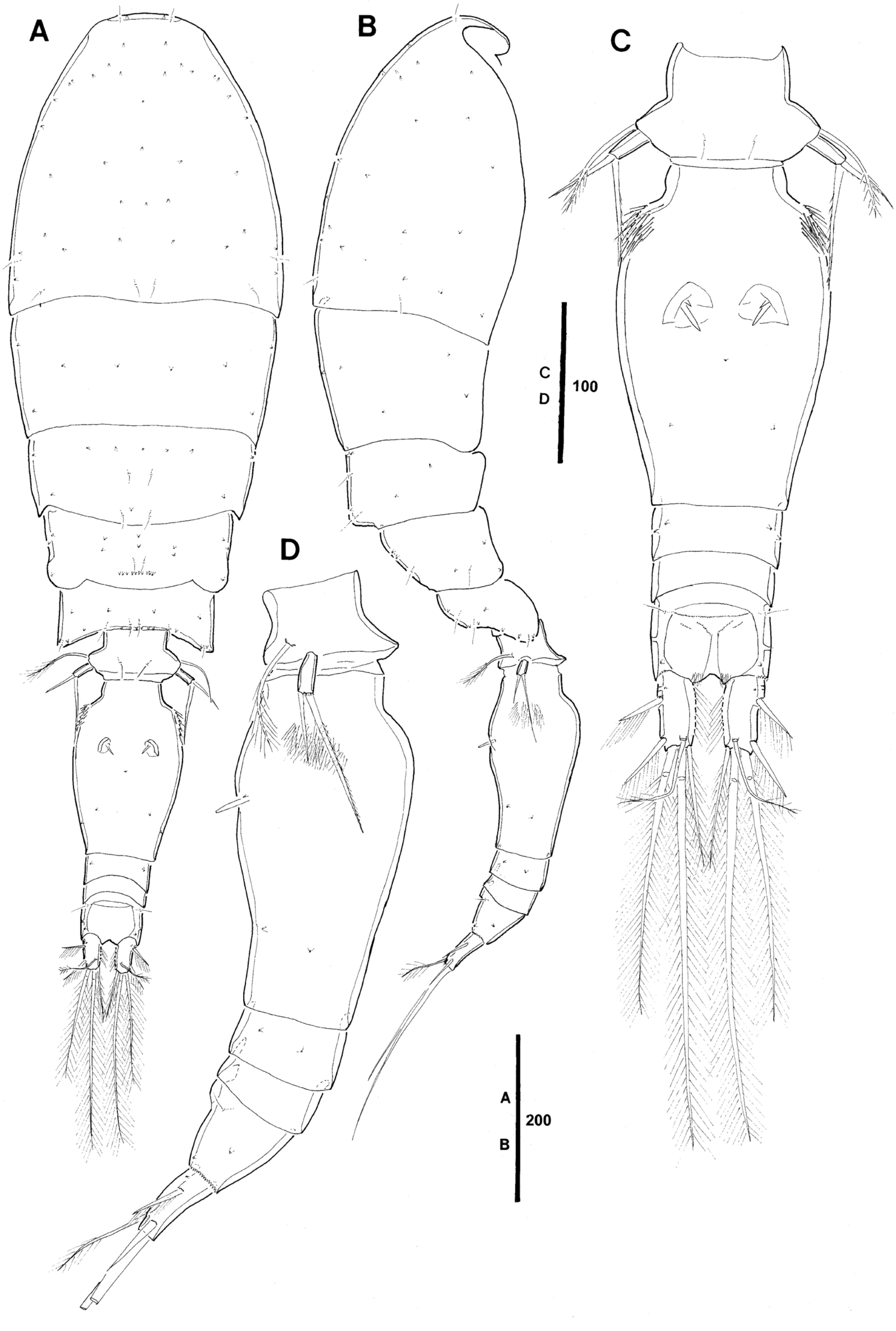

FIGURE 5. *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010. Female (A) Habitus, dorsal; (B) Habitus, lateral; (C) Urosome, dorsal; (D) Urosome, lateral. Scale bars in μm.

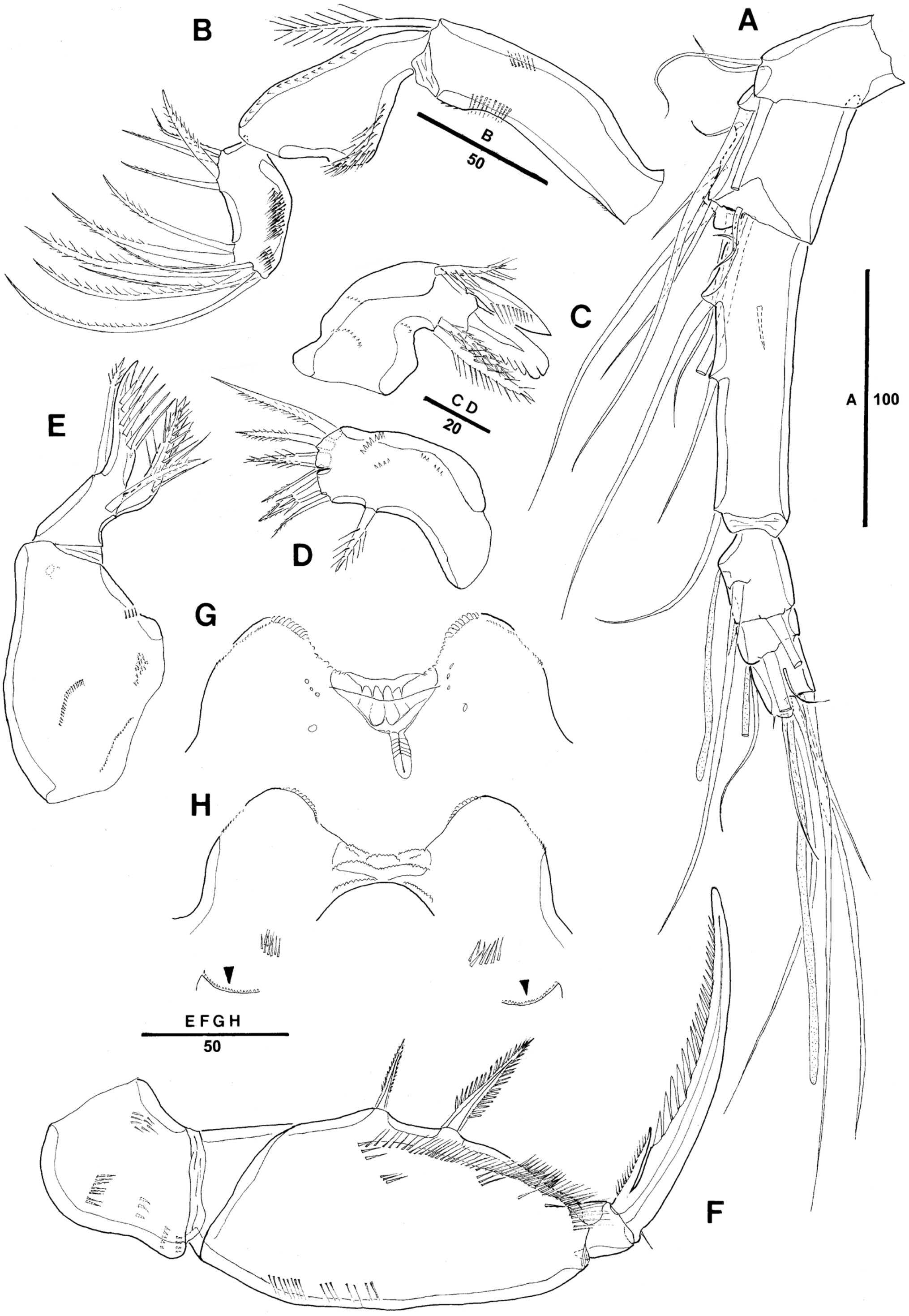

FIGURE 6. *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010. Female (A) Antennule; (B) Antenna, posterior; (C) Mandible; (D) Maxillule; (E) Maxilla; (F) Maxilliped; (G) Labrum, posterior; (H) Labrum, anterior, arrows indicating integumental pockets. Scale bars in µm.

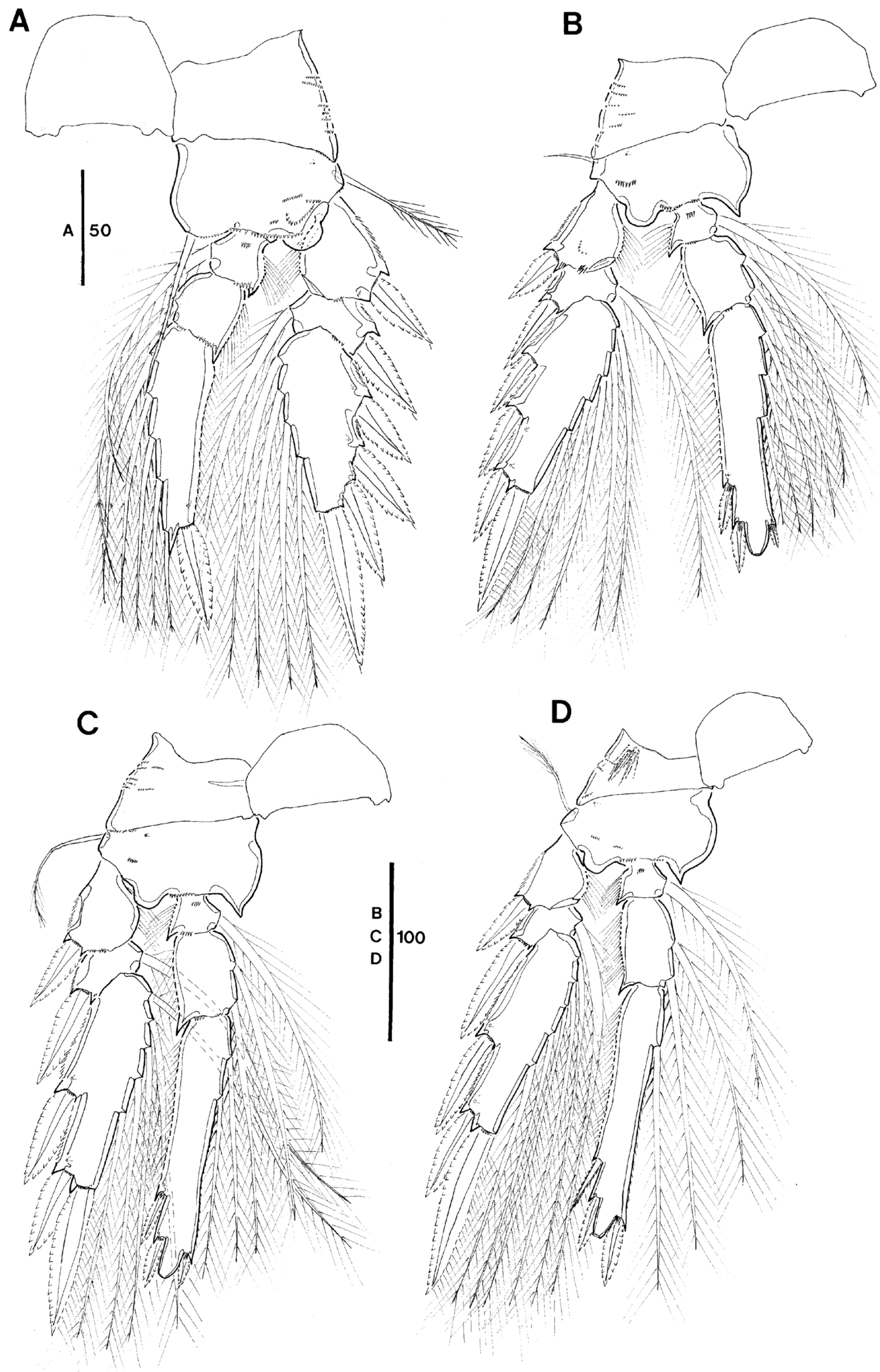

FIGURE 7. *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010. Female (A) P1, anterior; (B) P2, anterior; (C) P3, anterior; (D) P4, anterior. Scale bars in μm.

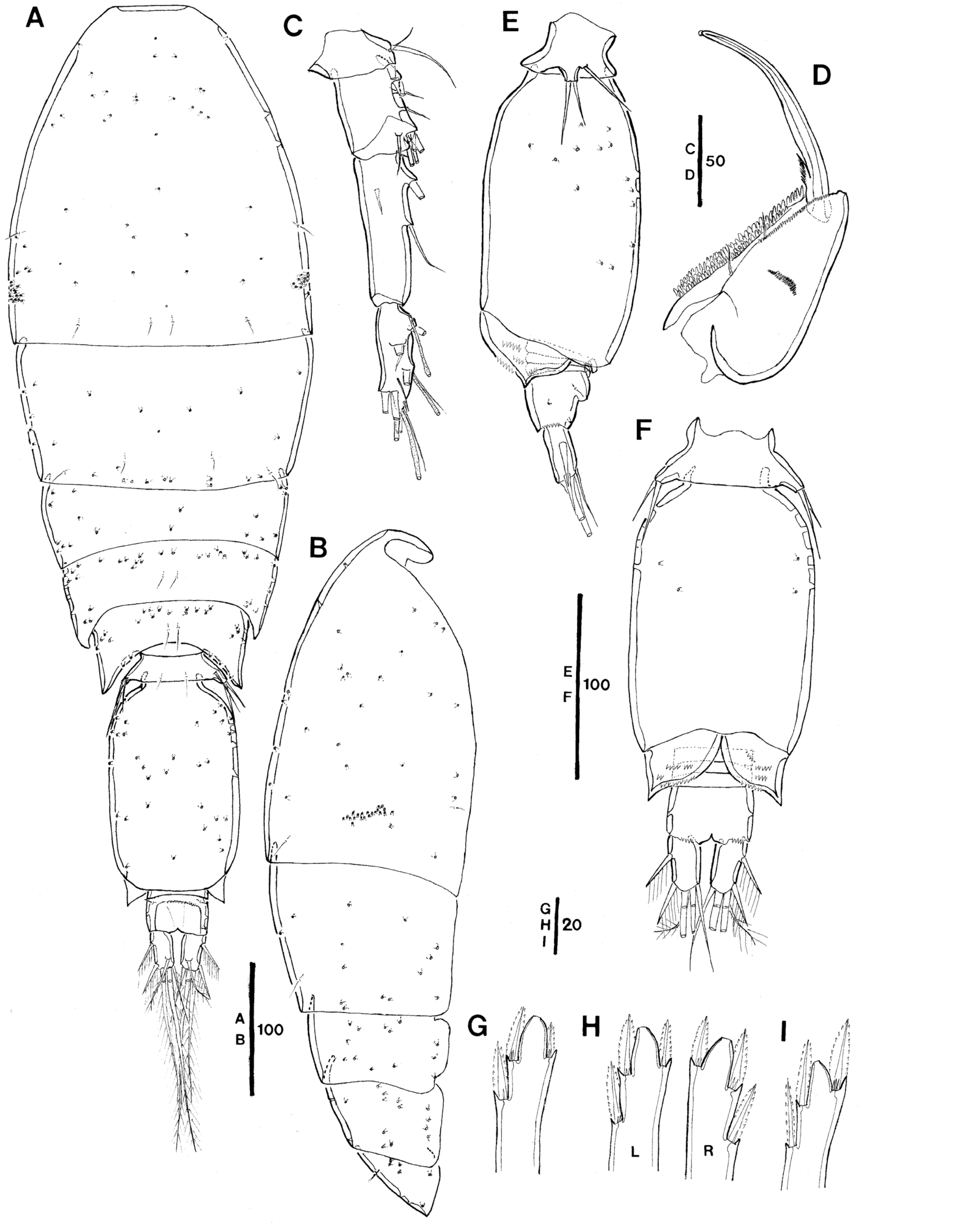

FIGURE 8. *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010. Male (A) Habitus, dorsal, postgenital somites telescoped; (B) Prosome, lateral; (C) Antennule; (D) Maxilliped, anterior, syncoxa missing; (E) Urosome, lateral, postgenital somites telescoped; (F) Urosome, ventral; (G) P2, tip of enp-3; (H) P3, tip of enp-3, L: left, R: right; (I) P4, tip of enp-3. Scale bars in µm.

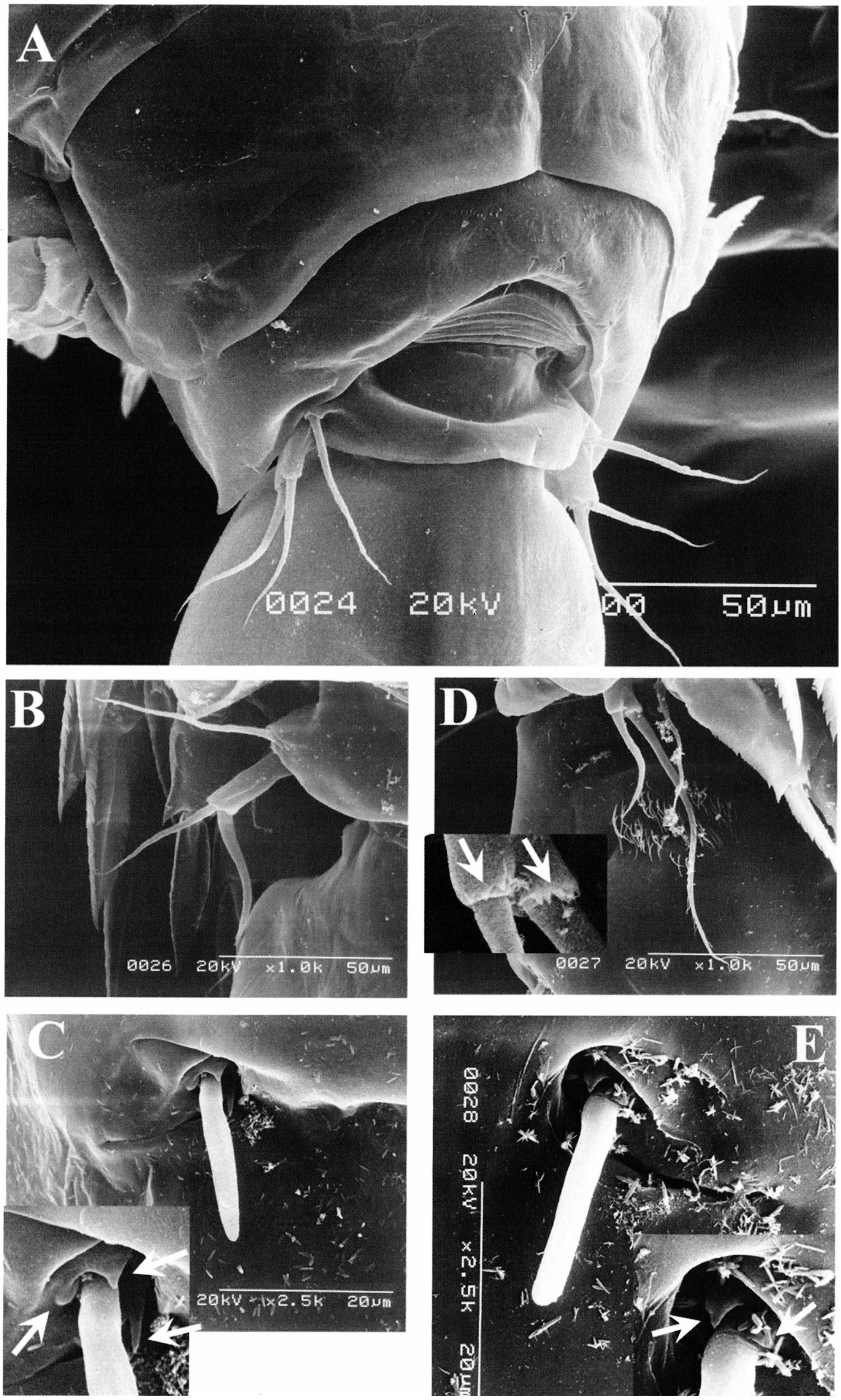

FIGURE 9. *Triconia derivata* (Heron & Bradford-Grieve, 1995). Male (A) P3-, P4- and P5-bearing somites and anterior part of genital somite, dorsal. Female (B) P5 left, and anterior part of genital double-somite, dorsal; (C) Genital aperture, inset showing enlarged basis of P6 spine, arrows indicating 3 spinous processes. *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010. Female (D) P5 right, and anterior part of genital double-somite, lateral, inset showing ornamentation of distal margin of P5 exopod; (E) Genital aperture, inset showing enlarged basis of P6 spine, arrows indicating 2 spinous processes.

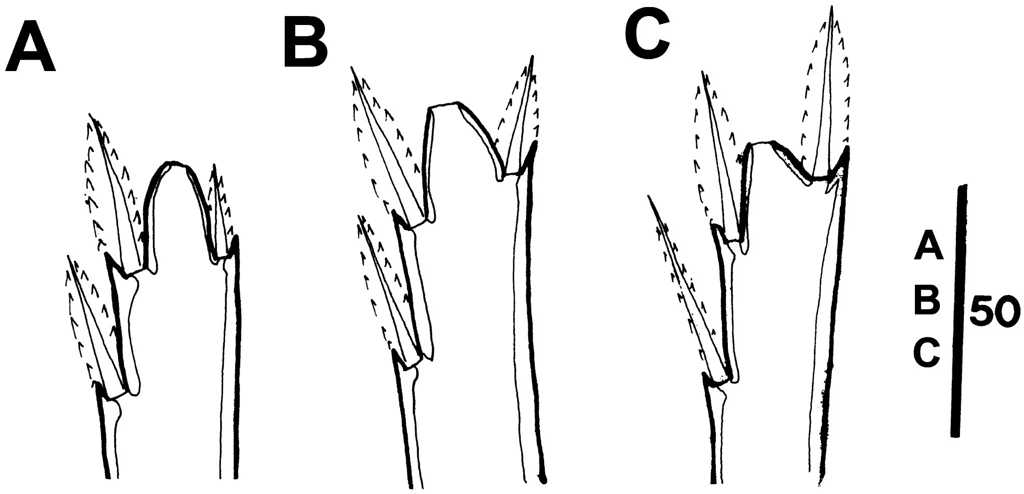

FIGURE 10. *Triconia hirsuta* Wi, Böttger-Schnack & Soh, 2010. Holotype female (Korean waters) (A) P2, tip of enp-3; (B) P3, tip of enp-3; (C) P4, tip of enp-3. Scale bar in µm.

P5 (Fig. 8E) exopod not delimited from somite, shorter than that of female, outer exopodal seta about 3/4 length of inner exopodal and outer basal setae, relatively longer than that of female.

P6 (Fig. 8F) represented by posterolateral flap closing off genital aperture on either side; covered by pattern of spinules; posterolateral corners protruding laterally so that they are discernible in dorsal aspect (Fig. 8A).

Remarks. Females of *T. hirsuta* were originally described from the Korean waters (Wi *et al.* 2010). Females from our study in the northeastern equatorial Pacific were identified by the conspicuous surface ornamentation of the genital double-somite, showing paired patches of long setules on the antero-lateral margin, which is a unique character not found in any other species of the *conifera*-subgroup known so far. The morphology of the females from the equatorial Pacific agree in almost all morphological characters with the original description, except for the proportional lengths of spines on the endopod of P2: in our specimens the distal spine was very short, not reaching the tip of the conical process (cf. Fig. 7B), while in the original description the distal spine was figured as being much longer, reaching beyond the tip of the conical process (Wi *et al.* 2010, their fig. 3B). Nevertheless, the text of the original description says: "…terminal spine on P2 enp-3 hardly as long as conical process." (Wi *et al.* 2010, p. 679).

In order to account for the discrepancy between the text and figures in the original description of *T. hirsuta*, the female holotype was borrowed from the collections of the National Institute of Biological Resources (NIBR), Incheon, as well as a paratype female held in the personal collection of R. Böttger-Schnack. Both were reexamined and compared. As a result, the distal spine of P2 enp-3 proved to be shorter than the conical process in the holotype; a new figure showing the distal part of the endopods of P2–P4 of the holotype female is given here (Fig. 10A–C). The resulting length ratios of the outer subdistal spine (OSDS) and outer distal spine (ODS) relative to distal spine (DS) of the holotype and the paratype are given in Table 3. The corrected ratios are within or very close to the range of values reported for specimens from the equatorial Pacific (cf. Table 2).

Our study further adds to the earlier description of female *T. hirsuta* by providing ornamentation details which were not noted or figured by Wi *et al.* (2010). These include (1) the conspicuous pore pattern on the prosome, especially the P3-bearing somite, (2) the ornamentation of the inner exopodal seta on P5, with minute spinules on the inner margin, and (3) the microstructures on the cephalic appendages, such as antenna, mandible, maxillule, maxilla, and maxilliped. The anterior face of the labrum has not been examined by Wi *et al.* (2010, p. 678) and is described in the present study for the first time. Thereby, the presence of integumental pockets typical for species of the *conifera*-subgroup of *Triconia* was confirmed. The description of the female genital apertures, examined using scanning electron microscopy, seemed to be slightly different between our study and Wi *et al.*'s description: the armature of the genital aperture was described as a spine and a bended process near the base of the spine by Wi *et al.* (2010, arrowed in their fig. 4B), whereas in our specimens two minute spinous processes close to the spine were apparent (cf. inset of Fig. 9E), but neither of them was bended. It may be concluded, that the bended process in Wi *et al.*'s specimen was caused during its treatment for scanning electron microscopy, but does not seem to be a common characteristic of *T. hirsuta*. The conspicuous position of CR seta II, articulating almost at right angle in females from Korean waters (Wi *et al.* 2010, fig. 2A, p. 678) was less pronounced in specimens from the NE equatorial Pacific (Fig. 5A, C).

The hitherto unknown male of *T. hirsuta* is described in the present account. It was pre-identified from mating pairs, where the male was attached to the female. The male was also assigned to *T. hirsuta* by the short distal spine on P2 enp-3, which does not reach as far as the tip of the distal conical process. This is a distinct character, similar to that of the female, and not affected by the slight sexual dimorphism in spine lengths observed during the present study.

Among males of the *conifera*-subgroup, *T. hirsuta* males are most similar to those of *T. antarctica* (Heron, 1977). Both species share a very short distal spine on P2 enp-3 which does not reach as far as the tip of the conical process (cf. Heron 1977, fig. 3d). However, males of *T. antarctica* differ from *T. hirsuta* in the proportional spine lengths on the endopods of P3 and P4: the distal spine on P3 enp-3 reaches far beyond the tip of the conical process and is longer than the outer distal spine in *T. antarctica* (cf. Heron 1977, fig. 3e), while in *T. hirsuta* the distal spine hardly reaches beyond the tip of the conical process and is shorter than the outer distal spine. Also, on P4 enp-3 the distal spine of *T. antarctica* is much longer than the outer distal spine (cf. Heron 1977, fig. 3f), while the two spines are almost equal in length in *T. hirsuta*. In both studies, identification of the males was corroborated by the occurrence of mating pairs (cf. Heron 1977, fig. 4b). In *T. antarctica* the sexual dimorphism in body length is rather pronounced, as males measure only about half the size of females (670 μm, range: 640–700 μm in males, as compared to 1260 μm, range: 1160–1400 μm in the female). In *T. hirsuta* sexual dimorphism is less pronounced as males reach about 60–70% of the female´s size (720 μm in males as compared to 1070–1160 μm in the female).

Males of the *similis*-subgroup of *Triconia* do not have to be considered for a more detailed comparison with *T. hirsuta*, because no species of this subgroup exhibits a very short distal spine on P2 enp-3 as observed in *T. hirsuta*.

Within the *conifera*-subgroup of *Triconia*, other five species, such as *T. conifera* (Giesbrecht, 1891), *T. inflexa* (Heron, 1977), *T. quadrata* (Heron & Bradford-Grieve, 1995), *T. pararedacta*, and *T. thoresoni* (Heron & Frost, 2000), exhibit a fairly (but not very) short distal spine on P2 enp-3. The same is found in four species of the *similis*-subgroup [*T. gonopleura* Böttger-Schnack, 1999, *T. minuta* (Giesbrecht, 1893 ["1892"]), *T. parasimilis* Böttger-Schnack, 1999, and *T. umerus* (Böttger-Schnack & Boxshall, 1990)]. For one of these species (*T. gonopleura*) the male has not yet been described. In all these species, however, the distal spine on P2 enp-3 reaches as far as the tip of the conical process or slightly beyond, thus being somewhat different from the above mentioned two species (*T. antarctica* and *T. hirsuta*). Further differences can be found in the proportional spine lengths of the endopods of P3 and P4, which separate them from *T. hirsuta.* It remains uncertain, however, whether a clear distinction of males can be achieved between these species within the frame of not yet known natural variability of the specific morphometric characters on P2-P4 enp-3.

The zoogeographical records of *T. hirsuta* are summarized in Fig. 11, indicating a fairly wide distribution in the Indo-Pacific region.

Conclusion

The present detailed taxonomic study of *Triconia* species of the *conifera*-subgroup in the tropical Pacific partially resolves which characters may be used for the identification of *T. derivata.* The hitherto unknown male of *T. hirsuta* is described and provisionally distinguished from its close relatives using morphometric characters. These characters (e.g. proportional lengths of urosomites and of endopodal spine lengths on the swimming legs) are essential for a positive identification, yet the intraspecific variability of morphometric characters is not sufficiently well known for conclusions to be drawn concerning the definitive suite of characters needed to distinguish species. Retrieval of morphometric data from earlier published drawings is unsatisfactory and confusing when these data differ from those given in the text (cf. "Remarks" of *T. hirsuta*). As a consequence, there is a need for further studies in the field of variability and the statistical difference between species, based on a larger number of individuals from different oceanic locations in order to more clearly define characters indicative of interspecific differences versus those indicative only of phenotypic plasticity.

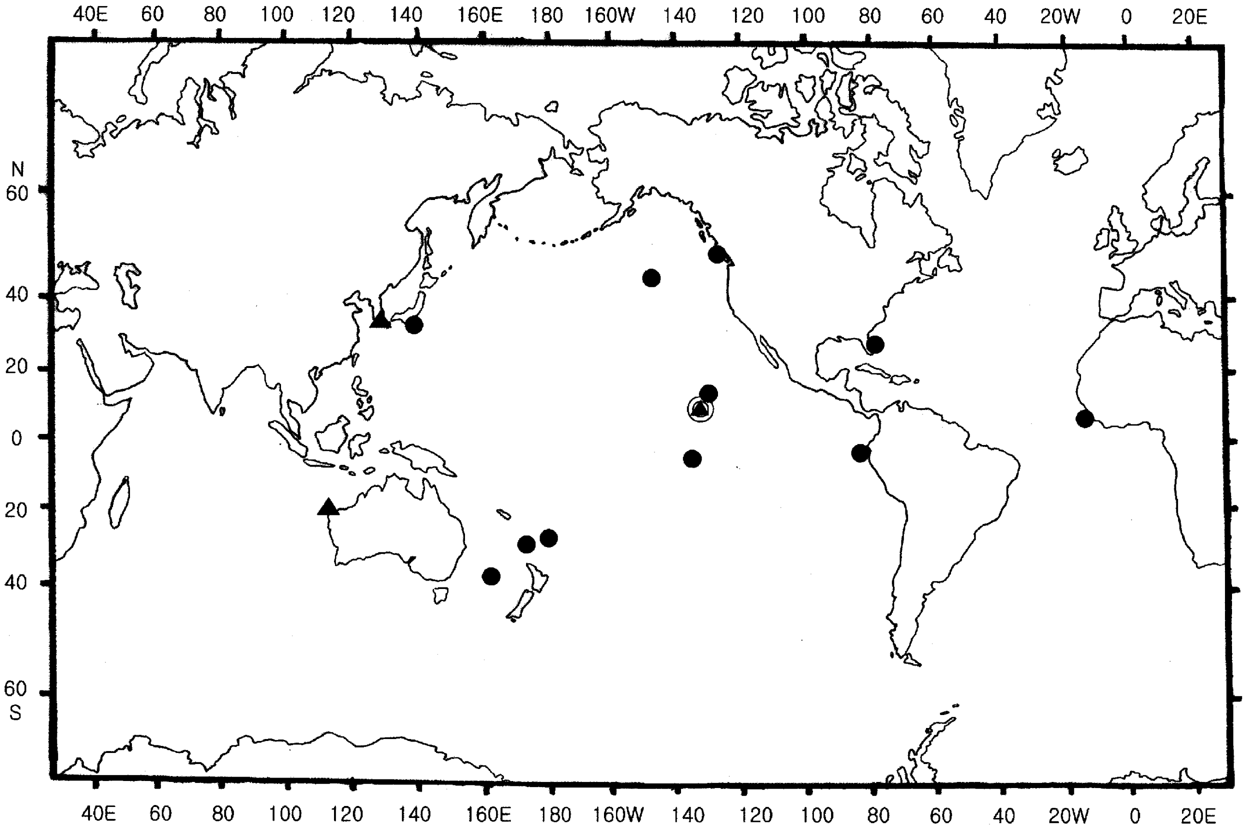

FIGURE 11. Distribution of *Triconia derivata* (Heron & Bradford-Grieve, 1995) and *T. hirsuta* Wi, Böttger-Schnack & Soh, 2010 based on the present study (sampling station KOMO ◬) and on previous records. References are: *T. derivata* (●) Heron & Bradford-Grieve (1995), Heron & Frost (2000), Nishibe *et al.* (2009); *T. hirsuta* (▲) Wi *et al.* (2010), Böttger-Schnack, unpublished.

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