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TWO NEW SPECIES BELONGING TO THE *DENTIPES*- AND *CONIFERA*-SUBGROUPS OF *TRICONIA* (COPEPODA: CYCLOPOIDA: ONCAEIDAE) FROM THE EAST CHINA SEA

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ABSTRACT

Two new species of *Triconia* in Oncaeidae, including both sexes of *Triconia constricta* n. sp. and females of *Triconia pararedacta* n. sp., are described from south of Jeju Island in the East China Sea. *Triconia constricta* belongs to the *dentipes*-subgroup of *Triconia* characterized by the absence of integumental pockets on the anterior surface of the labrum. It is distinguished from the closely related species of this subgroup, *T. dentipes* (Giesbrecht, 1891), *T. elongata* Böttger-Schnack, 1999, and *T. giesbrechti* Böttger-Schnack, 1999, by the following combination of morphological features in females: 1) lateral margins of genital double-somite in dorsal view slightly constricted at midlength; 2) P5 with very long outer basal seta, reaching beyond paired secretory pores on posterior part of genital double-somite, as well as distinctive length ratios of exopodal setae; in both sexes; 3) length ratios of caudal setae, and 4) relative spine lengths on distal endopodal segments of swimming legs 2 to 4. *Triconia pararedacta* is a member of the *conifera*-subgroup characterized by a dorsal projection on the second pedigerous somite in the female. It differs from females of other species of this subgroup in the following: 1) very small-sized dorsal projection on second pedigerous somite, 2) different length to width ratio of P5 exopod, 3) relative lengths of outer basal seta and exopodal setae of P5, and 4) different length ratio of outer distal spine to distal spine on endopods of P2-P4. Additional character states are proposed for defining the *dentipes*-subgroup within *Triconia* and for recognizing three sets of species within the *conifera*-subgroup.

KEY WORDS: Copepoda, Oncaeidae, *Triconia*

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INTRODUCTION

Oncaeidae represents a diverse group of pelagic marine copepods occurring widespread in the oceans from low to high latitudes and from the surface to bathypelagic depths (Hopkins, 1985; Böttger, 1987; Paffenhöfer, 1993; Böttger-Schnack, 1999; Nishibe and Ikeda, 2004). They play an important ecological role in the copepod community due to their high numerical abundance (e.g. Krŝinić, 1998; Hopcroft et al., 2001). Detailed morphological and genetic studies have shown that several of the allegedly cosmopolitan oncaeid species, such as *Triconia conifera* (Giesbrecht, 1891), *Oncaea notopus* Giesbrecht, 1891, and "varieties" or "forms" such as those of *O. venusta* Giesbrecht, 1891 (redescribed by Farran, 1929) and *O. media* Giesbrecht, 1891 (redescribed by Sewell, 1947) in reality represent species complexes, including two or more closely related species (Heron, 1977; Heron and Bradford-Grieve, 1995; Elvers et al., 2006; Böttger-Schnack and Machida, 2010; Böttger-Schnack, 2011). *Triconia*, which presently includes 23 species (Böttger-Schnack et al., 2012), is characterized by a large conical process on the distal endopodal margins of swimming legs 2-4 (Böttger-Schnack, 1999). The genus was subdivided into 3 subgroups: the *similis*-, *conifera*-, and *dentipes*-subgroups. Females of the *conifera*-subgroup can be separated from those of the other two subgroups by the presence of a dorso-posterior projection ("hump") on the second pedigerous somite, which is not found in males. Differentiation between the *similis*- and the *dentipes*-subgroup is the presence or absence of integumental pockets on the anterior surface of the labrum (Böttger-Schnack, 1999). The *dentipes*-subgroup currently includes 3 described species: *T. dentipes* (Giesbrecht, 1891), *T. elongata* Böttger-Schnack, 1999, and *T. giesbrechti* Böttger-Schnack, 1999. *Triconia giesbrechti* and *T. elongata* had been reported as different form variants of *T. dentipes* during earlier ecological studies in the Red Sea (Böttger-Schnack, 1994, 1996). In a subsequent taxonomic study, the two forms were raised to species rank, and the parameters for defining the *dentipes*-subgroup were determined (Böttger-Schnack, 1999). All three described species of the *dentipes*-subgroup have been recorded in ecological studies from the NW Pacific Ocean (Nishibe and Ikeda, 2004; Nishibe et al., 2009). However, taxonomic descriptions are only available for *T. dentipes* (as *Oncaea dentipes*) from the East China Sea (Chen et al., 1974) and from Japanese waters (Itoh, 1997). According to Böttger-Schnack (1999) the former appears to be closer to *T. giesbrechti*. In the present paper, a new species of the *dentipes*-subgroup is described from the East China Sea and

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a detailed comparison between it and the other species of the subgroup described from the NW Pacific, the Mediterranean and the Red Sea is provided. The morphological characteristics differentiating the *dentipes*-subgroup from the other subgroups of *Triconia* are discussed and additional defining characters for this subgroup are proposed.

The *conifera*-subgroup of *Triconia* presently includes 12 species: *T. conifera* (Giesbrecht, 1891), *T. borealis* (Sars G. O., 1918), *T. furcula* (Farran, 1936), *T. antarctica* (Heron, 1977), *T. inflexa* (Heron, 1977), *T. rufa* (Boxshall and Böttger, 1987), *T. derivata* (Heron and Bradford-Grieve, 1995), *T. quadrata* (Heron and Bradford-Grieve, 1995), *T. redacta* (Heron and Bradford-Grieve, 1995), *T. canadensis* (Heron and Frost, 2000), *T. thoresoni* (Heron and Frost, 2000), and *T. hirsuta* Wi, Böttger-Schnack and Soh, 2010. They each can be identified by a combination of morphological characteristics including the form and the surface ornamentation of the genital double-somite, the size of the dorsal "hump" on the second pedigerous somite in lateral view and the shape of pleural areas of the fourth pedigerous somite in the female, as well as the shape and the length ratios of the distal endopodal spines and cones of swimming legs 2-4 in both sexes (Heron, 1977; Heron and Bradford-Grieve, 1995; Böttger-Schnack, 1999; Heron and Frost, 2000; Wi et al., 2010). In a recent taxonomic study on species of *Triconia* from Korean waters (Wi et al., 2010), three species belonging to the *conifera*-subgroup, *T. conifera*, *T. borealis*, and a new species, *T. hirsuta*, were described in detail and the earlier zoogeographical records of *conifera*-type oncaeids in the NW Pacific were summarized. In the present study, which is based on new copepod material from the East China Sea, *T. conifera* and *T. hirsuta* were found together with females of another new species of the *conifera*-subgroup, which is described in the present account. A detailed comparison of the new species with form variants of *T. conifera* described from this area by Farran (1936), and with sister and/or sibling species recorded by Heron (1977) and Heron and Bradford-Grieve (1995), is included. Additional character states for recognizing three sets of species within the *conifera*-subgroup are proposed.

Materials and Methods

Zooplankton samples were taken at a single station in the East China Sea south of Jeju Island, Korea (126°8′E, 32°00′N) on 10 September, 2010 (Fig. 1). A conical net (mesh size 100 μm, mouth diameter 45 cm) was towed vertically from near the bottom to the surface at the station (total depth 130 m). Vertical profiles of temperature and salinity were recorded using CTD (Seabird Co.). After collection, samples were preserved immediately on board ship in a 4% formaldehyde-seawater solution buffered with borax. Species of *Triconia* were sorted out from zooplankton samples. Each specimen was dissected under a dissecting microscope (Nikon, JP/E200) in CMC-10 aqueous mounting medium (Masters Company Inc., Wood Dale, IL), mounted on slides and sealed with high-quality nail-varnish. Drawings were done using a differential interference contrast microscope (Nikon AFX-II) equipped with a drawing tube. Scale bars are given in μm. Total body length (including the caudal rami) and the proportion of prosome to urosome was calculated as the sum of prosomal and urosomal length measured individually in lateral view, not considering the telescoping of somites, which corresponds to the traditional way of length measurements in oncaeid copepods (cf. Böttger-Schnack, 1999). For calculating the relative lengths of different urosomal segments, however, the new approach proposed by Böttger-Schnack (1999) was used: in lateral view, middorsal lengths of individual somites are measured from the anterior to the posterior margin in the case of telescoping somites and the proportional lengths are calculated from the sum of individual somites. The length ratios of setae II-VII on caudal rami are calculated by using the length of the longest seta V as a reference point. The relative lengths of spines on the distal endopodal segments of P2-P4 are calculated in relation to the length of the distal spine and the position of the tip of the distal and outer distal spines is described relative to the tip of the distal conical process. The descriptive terminology follows Huys and Boxshall (1991). Abbreviations used in the text and figures are as follows: ae – aesthetasc; CR – caudal rami; P1-P6 – first to sixth thoracopods; exp – exopod; enp – endopod; exp(enp)-1(-2,-3) is used to denote the proximal (middle, distal) segment of a ramus. Species of Oncaeidae have a number of secretory pores and other integumental structures (pits, scales) on body surfaces, but only those discernible with a light microscope were figured or mentioned. All type specimens were deposited in the National Institute of Biological Resources (NIBR), Incheon, Korea.

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 and 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.

Systematics

Order Cyclopoida Burmeister, 1835
Oncaeidae Giesbrecht, 1893 ["1892"]
Triconia Böttger-Schnack, 1999

***Triconia constricta* n. sp.**

(Figs. 2-5)

Material Examined.—8 females, 8 males collected from single station in East China Sea (south of Jeju Island) (126°8′E, 32°00′N) on 10 September 2010. (Surface temperature 29.1°C, salinity 34.6 psu.)

Type Material.—Holotype: Adult female dissected and mounted on 2 glass slides, total body length: 468 μm, NIBRIV0000245153.

Paratypes: 2 females dissected and mounted on 3 slides NIBRIV0000245155, and 2 females in total in vial, NIBRIV0000245156; 1 male mounted on 1 glass slide, NIBRIV0000245154, 2 males dissected and mounted on 3 slides, NIBRIV0000245157; 2 males in total in vial, NIBRIV0000245158.

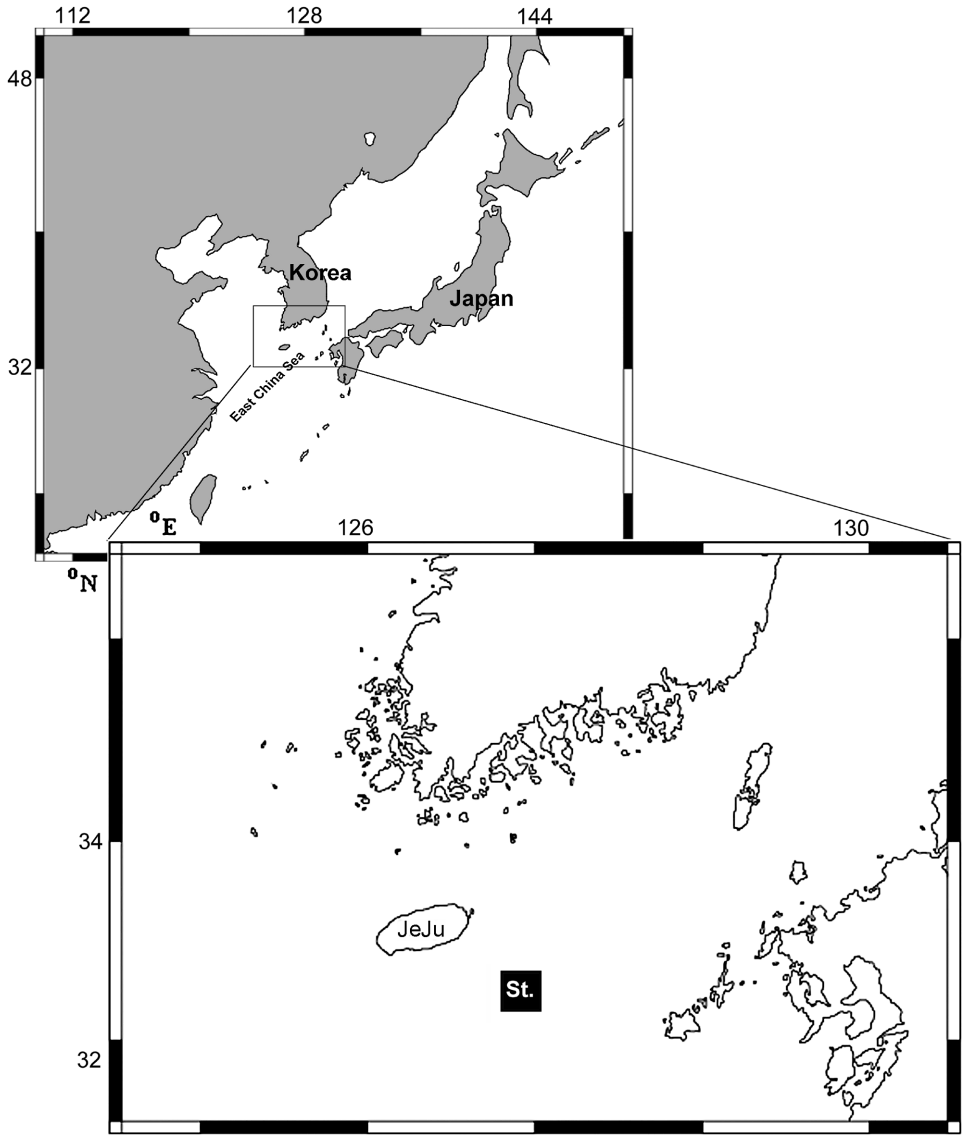

Fig. 1. Map showing the sampling station.

Female.—Body length in lateral aspect: Holotype, 468 μm; Paratypes, 455-479 μm (mean: 467 μm, n = 3 individuals), body surface densely covered with small pits (not figured). Prosome 1.7 times as long as urosome excluding caudal rami, 1.5 times length including caudal rami (Fig. 2A, B). Second pedigerous somite without conspicuous dorsoposterior projection in lateral view (Fig. 2B). Fourth pedigerous somite with elongated and pointed postero-lateral corners in dorsal and lateral view (Fig. 2A, B, G). Proportional lengths (%) of urosomites 13.6 : 59.2 : 9.5 : 7.1 : 10.6. Proportional lengths (%) of urosomites and caudal rami 12.5 : 54.3 : 8.7 : 6.5 : 9.8 : 8.2. Genital double-somite (Fig. 2A, C) 1.7 times as long as maximum width in dorsal view, lateral margins slightly constricted at midlength, largest width measured at about third distance from anterior margin, anterior part of genital double-somite distinctly narrowing and posterior part tapering distinctly in dorsal view; dorsal surface with single secretory pore at anterior quarter and paired pores at posterior third; paired genital apertures about 2/5 distance from anterior margin of dorsal surface, armed with spine and small spinous process near base of spine (Fig. 2A, C). Anal somite about 1.2 times as long as wide. CR 1.6 times as long as wide, inner margin unornamented; bearing 6 setae numbered using Roman numerals in Fig. 2A: setae II and III spiniform, unipinnate along medial margin, other setae IV-VII setiform and plumose; length ratios of setae II-VII approx. 11 : 18 : 54 : 100 : 23 : 50.

Antennule 6-segmented (Fig. 2D), relative lengths (%) of segments measured along posterior non-setiferous margin 9.8 : 17.9 : 43.9 : 13.8 : 5.7 : 8.9. Armature formula 1-[3], 2-[8], 3-[5], 4-[3 + ae], 5[2 + ae], 6-[6 + (1 + ae)]. Aesthetascs slender, apical one longest and fused basally to seta.

Antenna (Fig. 3A) 3-segmented, relative lengths (%) of segments 41 : 32 : 27. Coxobasis armed with bipinnate seta at inner distal corner, protruded area on outer margin orna-

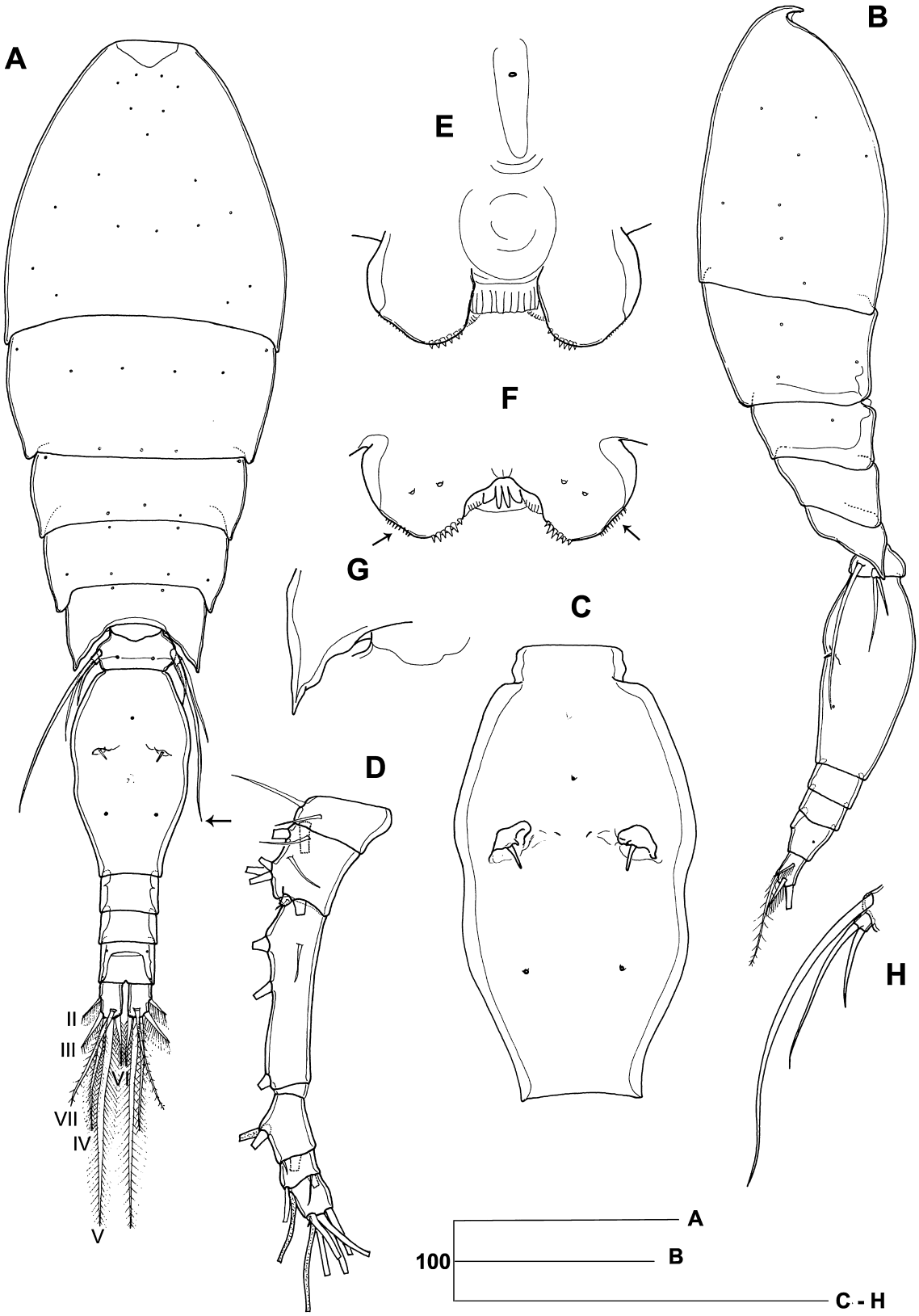

Fig. 2. *Triconia constricta* n. sp. Female (Holotype). A, habitus, dorsal view, caudal setae numbered using Roman numerals; B, habitus, lateral view; C, genital double-somite, dorsal view; D, antennule; E, labrum, anterior; F, labrum, posterior, arrow indicates small denticles on outer lateral margin; G, pleural area of 4th pedigerous somite, left side; H, P5, left side.

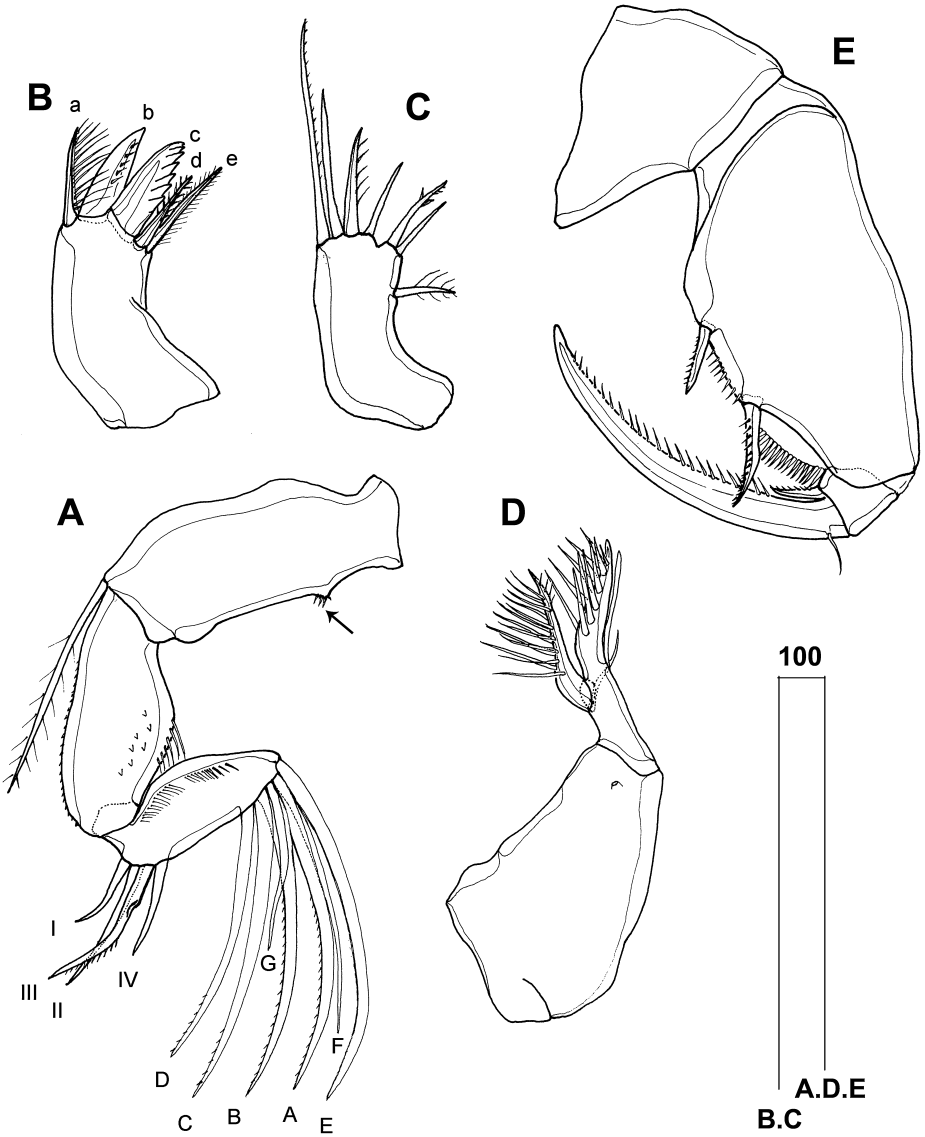

Fig. 3. *Triconia constricta* n. sp. Female (Holotype). A, antenna, individual elements on lateral margin of second endopodal segment numbered using Roman numerals, distal elements designated using capital letters; B, mandible, individual elements designated using small form letters; C, maxillule; D, maxilla; E, maxilliped.

mented with small denticles (indicated by arrow in Fig. 3A), other surface ornamentation not discerned. Proximal endopodal segment ornamented with row of denticles along inner margin and spinular row on convex outer margin. Distal endopodal segment with two rows of spinules along outer margin; armature arranged in mid-segment group of 4 elements numbered by using Roman numerals in Fig. 3A, and distal group of 7 elements, numbered using capital letters: seta III spiniform and pectinate, setae I, II and IV naked, seta I shortest; distal group with setae A-D unipinnate, seta D slightly shorter than setae A-C, seta E unornamented and longer than setae A-D, slender seta F and G unequal in length and shorter than seta D, seta G about 2/3 the length of seta F.

Labrum (Fig. 2E, F) distinctly bilobed. Outer margin of each lobe with row of short spinules (indicated by arrow in Fig. 2F), inner part of distal margin of lobe with 6 strong denticles. Medial concavity covered anteriorly by wrinkled hyaline lamella (Fig. 2E), anterior surface without integumental pockets and spinular patches. Posterior wall of medial concavity with 2 long and distinctly sclerotized dentiform processes and 2 short flat elements (Fig. 2F), posterior surface of each lobe with 2 secretory pores.

Mandible (Fig. 3B) represented by flattened gnathobase with 5 elements; ventral seta (a) stout, with row of long setules along dorsal margin, these gradually shortening distally; ventral blade (b) broad and tapering distally, ornamented with row of short spinules on posterior surface; dorsal blade (c) almost as long as ventral blade (b), with several dentiform processes along entire dorsal and distal margins; seta (d) short and bipinnate; seta (e) longer than seta (d) and setose.

Maxillule (Fig. 3C) weakly bilobed. Inner lobe (= praecoxal arthrite) with 3 setae unequal in length: innermost seta shortest, sparsely ornamented with spinules, located at some distance from others; outermost seta strong, and longer than

other two setae, fringed with few spinules. Outer lobe with 4 setae: outermost seta setiform and pectinate, longer than the other 3 setae; seta next to innermost seta unipinnate; innermost seta naked and shortest.

Maxilla (Fig. 3D) 2-segmented, comprising syncoxa and allobasis; allobasis produced distally into slightly curved claw with two rows of very strong spinules along medial margin; outer slender seta extending to just below the tip of allobasal claw; proximal medial margin with naked seta and curved spine with two rows of spinules along medial margin and single row of slender spinules along lateral margin.

Maxilliped (Fig. 3E) 4-segmented, syncoxa unarmed, surface ornamentation not discerned. Basis robust, with two spiniform, bipinnate elements on palmar margin, distal one about 1.5 times as long as proximal one; surface of basis ornamented with fringe of fine spinules between distal seta and articulation with endopod and row of short spinules between proximal and distal setae. Proximal endopodal segment unarmed. Distal endopodal segment drawn out into long curved claw, with strong spinules along entire concave margin; with small naked seta on outer proximal margin and unipectinate spine basally fused to inner proximal corner of claw (cf. also Fig. 5F).

Swimming legs 1-4 biramous (Fig. 4A-D), with 3-segmented exopods and endopods, intercoxal sclerites well developed, displaying different shapes as exemplified in Fig. 4A, C. Surface ornamentation on coxae and bases not examined. Armature formula of P1 to P4 as follows (Roman numerals indicate spines, Arabic numerals indicate setae):

Leg	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

Distal spines on exopods about as long as (P1-P3) or slightly longer than (P4) exp-3. Distal margin of P1 enp-3 with small pointed protrusion close to distalmost inner seta. Enp-3 of P2-P4 with large conical process between outer distal and distal spines. Length ratios of endopodal spines (distal spine : outer distal spine : outer subdistal spine) approx. 1 : 0.7 : 0.8 on P2 enp-3, approx. 1 : 0.4 : 0.56 on P3 enp-3, and approx. 1 : 0.3 : 0.55 on P4 enp-3. Distal spine on enp-3 reaching far beyond distal conical process in P2-P4; outer distal spine on enp-3 not reaching (P2 and P3) or almost reaching (P4) as far as tip of distal conical process; outer subdistal spine reaching as far as insertion point of outer distal spine (P2 and P3) or slightly beyond that point (P4).

P5 (Fig. 2H) with small free segment, representing exopod, and very long outer basal (= protopodal) seta reaching beyond paired secretory pores on genital double-somite (arrowed in Fig. 2A). Exopod with long outer seta, reaching almost as far as genital apertures, and short inner seta.

P6 (Fig. 2A, C) represented by external operculum closing off each genital aperture, armed with spine and small spinous process.

Male.—Body length measured in lateral view: 390-409 μm (mean: 399.5 μm, n = 3 individuals). Sexual dimorphism evident in antennule, antenna, maxilliped, endopods of P2-P4, P5, P6 and urosomal segmentation. Proportional lengths (%) of urosomites excluding CR 9.4 : 62.5 : 6.2 : 5.0 : 5.0 : 11.9. Proportional lengths (%) of urosomites including CR 8.6 : 57.6 : 5.7 : 4.6 : 4.6 : 10.9 : 8.0. Anal somite and CR with length to width ratio as in female, length ratios of CR setae II-VII approx. 7.6 : 12 : 53 : 100 : 20 : 42.

Antennule (Fig. 5C) 4-segmented. Distal segment corresponding to fused fourth to sixth segments of female. Armature formula: 1-[3], 2-[8], 3-[4], 4-[11 + 2ae + (1 + ae)].

Antenna (Fig. 5D) similar to that of female, except for seta II and III on mid-segment of distal endopodal segment almost equal in length to seta I and IV.

Maxilliped (Fig. 5E, F) 3-segmented, comprising syncoxa, basis, and 1-segmented endopod. Syncoxa with single secretory pore at distal medial margin. Basis robust, expanded, anterior surface with single row of short spinules along medial margin, posterior face with 1-3 rows of spatulated spinules of graduated length along medial margin; armed with 2 naked setae on palmar margin, almost equal in length. Endopod (claw) with concave margin unornamented, tip of claw with hyaline apex, small seta on outer proximal margin absent.

Swimming legs (Fig. 6A-D) with armature as in female. Length ratios of endopodal spines (distal spine : outer distal spine : outer subdistal spine) slightly different from female: approx. 1 : 0.55 : 0.7 on P2 enp-3, approx. 1 : 0.4 : 0.5 on P3 enp-3, and approx. 1 : 0.3 : 0.45 on P4 enp-3. Outer subdistal spine not reaching (P2 and P3) or almost reaching (P4) as far as insertion point of outer distal spine.

P5 (Fig. 5A, G) with exopod fused to first urosomal somite, with two setae different in length: outer seta slightly longer than inner one. Protopodal seta slightly longer than outer exopodal setae.

P6 (Fig. 5A, H) represented by posterolateral flap closing off genital aperture on either side; distal margin of genital flap ornamented with row of denticles (arrowed in Fig. 5H); posterolateral corners sharply protruding.

Etymology.—The specific name is derived from Latin *constrictus*, meaning constricted, and refers to the form of the female genital double-somite, showing constricted lateral margins in dorsal view.

Remarks.—*Triconia constricta* is closely related to *T. dentipes*, *T. elongata*, and *T. giesbrechti*, together forming the *dentipes*-subgroup. Böttger-Schnack (1999: table 2) compared *T. dentipes*, *T. elongata*, and *T. giesbrechti* from the Red Sea with earlier taxonomic descriptions of *dentipes*-type oncaeids from the Mediterranean Sea with respect to the form of the genital double-somite (erroneously called "urosome form" in her table), the lengths of the CR and caudal setae, the proportional lengths of spines on P2 and P4 enp-3, the morphology of P5, and the number of dentiform processes on each lobe of the labrum. In Tables 1 and 2 herein, the most distinctive morphological features separating the new Korean *T. constricta* from the three described species of *dentipes*-subgroup from the Red Sea are summarized. Females of the four species all differ from each other in the form of the genital double-somite (Table 1), which is a distinctive character separating other species of *Triconia* as well (Heron, 1977; Heron and Bradford-Grieve, 1995; Böttger-Schnack, 1999). Females of *T. constricta* can fur-

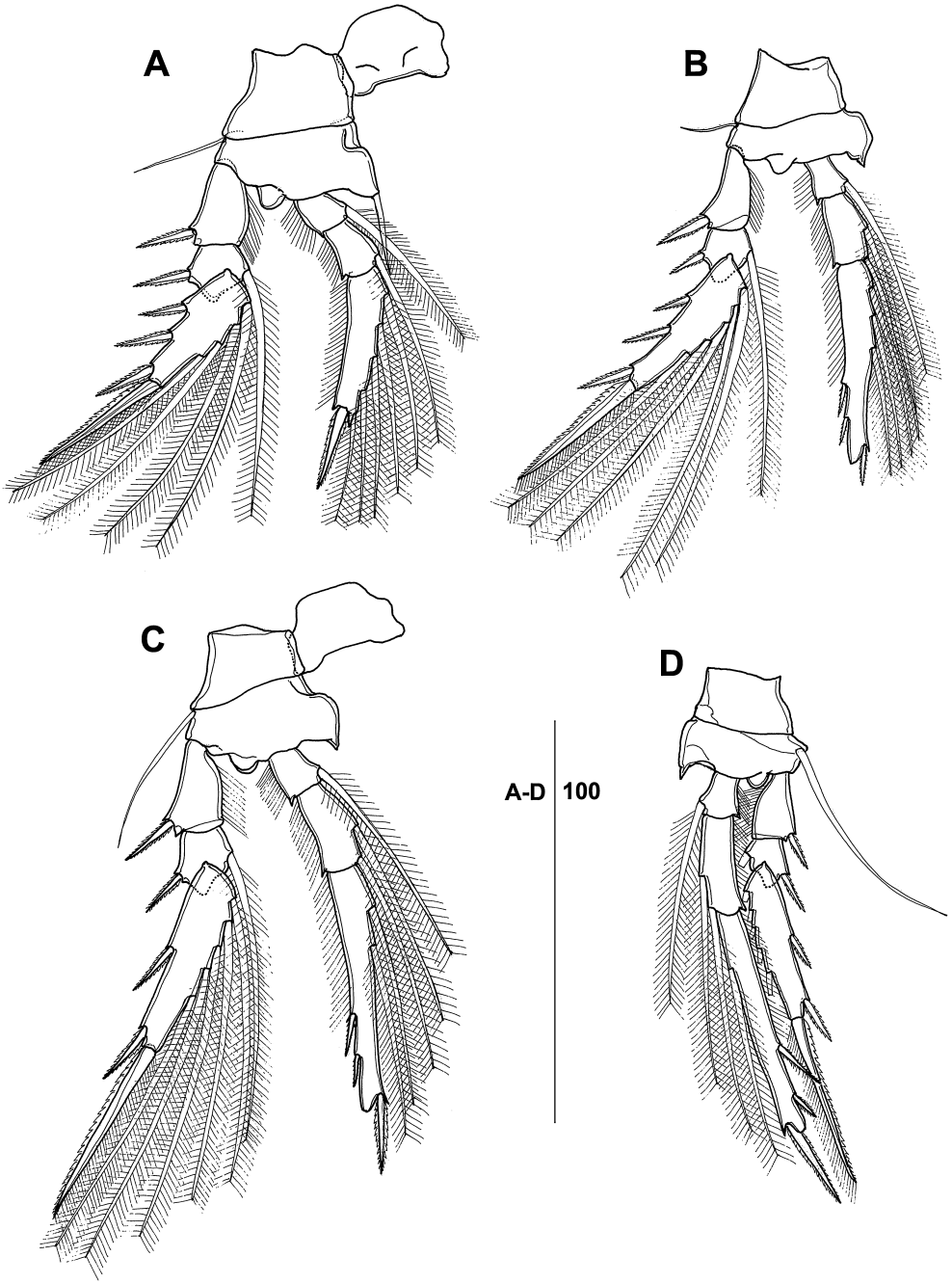

Fig. 4. *Triconia constricta* n. sp. Female (Holotype). A, P1, anterior view; B, P2, anterior view, intercoxal sclerite not shown; C, P3, anterior view; D, P4, anterior view, intercoxal sclerite not shown.

thermore be separated by the proportional spine lengths on P3 and P4 enp-3, and by the length of the outer basal seta on P5, which is the longest among the described species of the *dentipes*-subgroup. The length ratio of prosome to urosome appears to be slightly smaller in female *T. constricta* as compared to other species of the *dentipes*-subgroup, but the respective values recorded by Böttger-Schnack (1999) cannot be directly compared with the one in the present study, because the methods of calculating these ratios differ: In the present study, measurements were carried out not taking into account the telescoping of somites, whereas telescoping of invidual somites was considered by Böttger-Schnack (1999). Among the three described species of the *dentipes*-subgroup, *T. constricta* is most similar to *T. giesbrechti*. Both have a very long outer basal seta on P5 that reaches beyond the genital apertures and both also have similar relative lengths of the two exopodal setae. *T. dentipes* and *T. elongata*, on the other hand, have a relatively short outer basal seta which does not reach beyond the genital apertures. Further to the morphological characters presented in Table 1, the Korean *T. constricta* differs from *T. giesbrechti* by the length to width ratio of the anal somite to the CR, which is somewhat larger

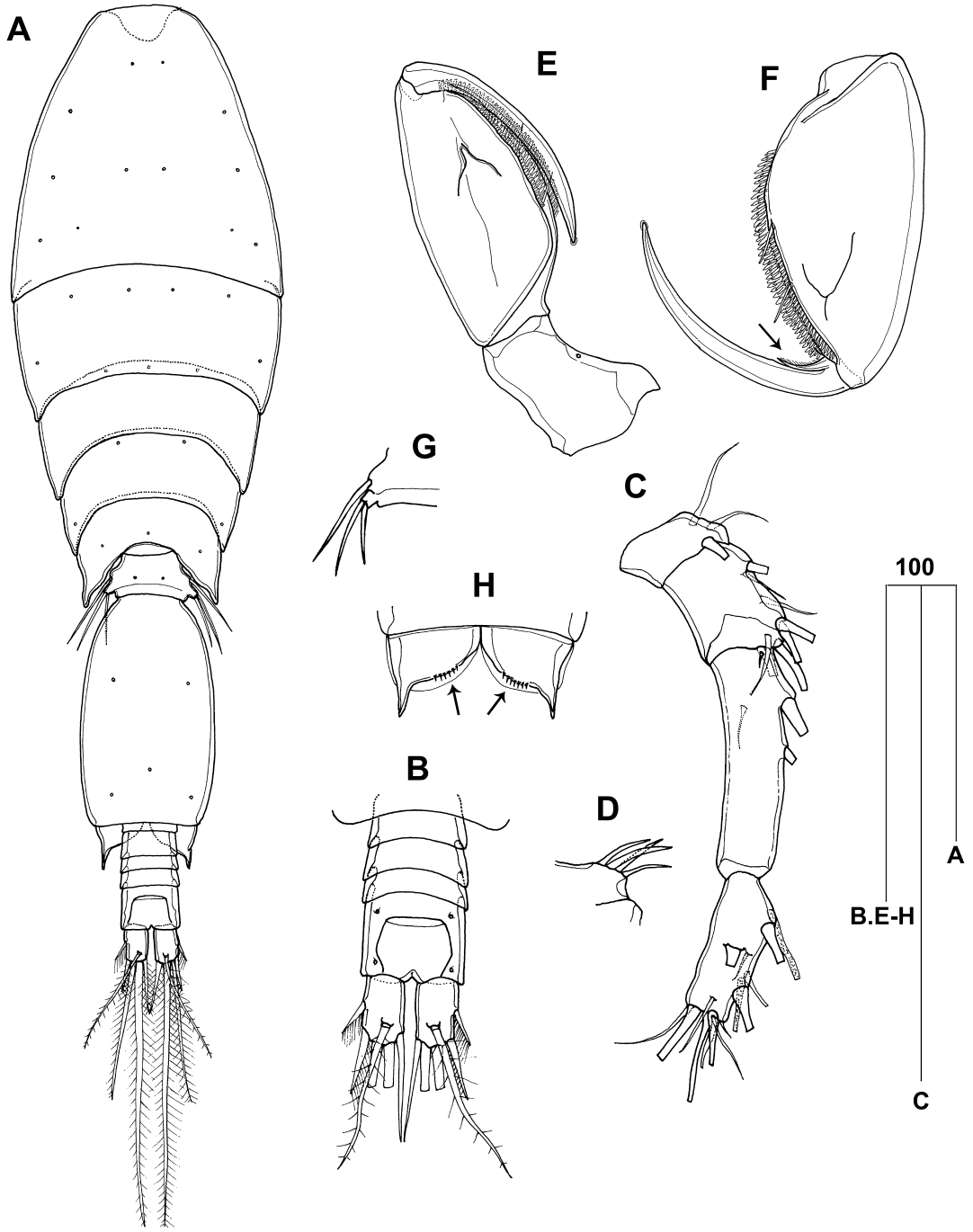

Fig. 5. *Triconia constricta* n. sp. Male (Paratype). A, habitus, dorsal view; B, anal somite and caudal rami, dorsal view; C, antennule; D, antenna, setae on mid-segment of distal endopodal segment; E, maxilliped, anterior; F, maxilliped, posterior, syncoxa omitted, arrow indicating spine basally fused to inner proximal corner of claw; G, P5, left side, dorsal; H, P6, arrows indicate small denticles on posterolateral margins.

(1.4 : 1) than that of *T. giesbrechti* (1.2 : 1) and by a larger length to width ratio of the CR (1.4 : 1) than that of *T. giesbrechti* (1.3 : 1).

The male of *T. constricta* is similar to males of *T. dentipes* and *T. elongata* described from the Red Sea in the proportional lengths of the body segments, but the former can be separated from other males of the *dentipes*-subgroup by: 1) the length ratio of the outer basal seta and the exopodal setae on P5; 2) the length of caudal seta VI relative to seta IV; and 3) the relative lengths of the outer distal spine and conical process on P4 enp-3 (Table 2). An additional sexually dimorphic character not hitherto reported for any species of the *dentipes*-subgroup (the male of *T. giesbrechti*, of course, being unknown) was found in the antenna of *T. constricta*: in the male, the 4 setae of the mid-segment group on the distal endopodal segment are almost equal in length, while in the female the mid-segment setae II and III are much longer than setae I and IV.

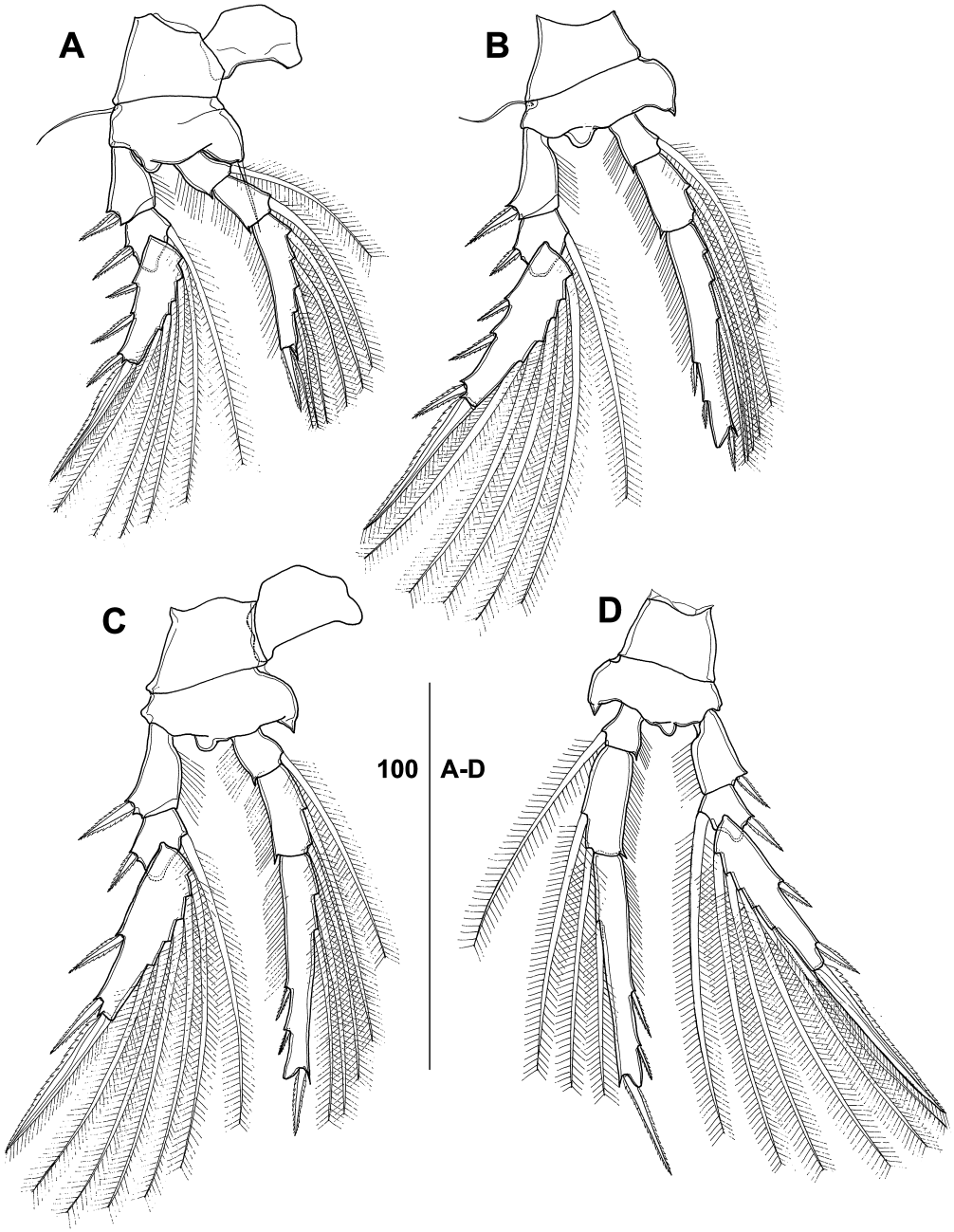

Fig. 6. *Triconia constricta* n. sp. Male (Paratype). A, P1, anterior view; B, P2, anterior view, intercoxal sclerite not shown; C, P3, anterior view; D, P4, anterior view, intercoxal sclerite not shown.

Within the *dentipes*-subgroup, *T. dentipes* is the only species in which the outer distal spine on P4 enp-3 reaches beyond the distal conical process (Böttger-Schnack, 1999: figs. 11D, 13E). In the description of *T. dentipes* from the Yellow Sea and East China Sea by Chen et al. (1974: plate 7, fig. 10), however, this spine on P4 was drawn shorter than the cone, which led Böttger-Schnack (1999) to suggest that the Chinese *T. dentipes* was more similar to *T. giesbrechti.* On the other hand, the length of the outer subdistal spine on P4 enp-3 was drawn reaching as far as the insertion of the outer distal spine in Chen's figure, which is longer than in *T. giesbrechti* and more similar to *T. constricta*. However, the genital double-somite of the Chinese *dentipes*-type oncaeid does not show constricted lateral margins (Chen et al., 1974: plate 7, fig. 8), which are typical for the Korean species. The Chinese species cannot be unequivocally identified at present, as it appears to combine characters of at least two species of the *dentipes*-subgroup.

***Triconia pararedacta* n. sp.**

(Figs. 7-9)

Material Examined.—9 females collected from single station in East China Sea (south of Jeju Island) (126°8′E,

Table 1. Comparison of morphological features of females of three species of the *dentipes*-subgroup from the Red Sea and *Triconia constricta* n. sp. from the East China Sea. * Calculated after Böttger-Schnack (1999: table 2, figs. 9, 11, 27, 29, 31, 33).

	Species (♀)			
	Red Sea*			East China Sea
	T. dentipes	*T. elongata*	*T. giesbrechti*	*T. constricta* n. sp.
Urosome				
Form of genital double-somite in dorsal view	weak flask-like	elongate flask-like	oval	oval, lateral margins slightly constricted at midlength
CR				
– length ratio of setae IV : VII	longer	longer	almost equal	longer
– length ratio of setae IV : VI	3.6 : 1	2.4 : 1	1.8 : 1	2.2 : 1
P2 enp-3				
– outer subdistal spine reaching beyond insertion of outer distal spine	no	yes	yes	no
P3 enp-3				
– outer subdistal spine reaching as far as insertion of outer distal spine	no	no	no	yes
P4 enp-3				
– outer subdistal spine reaching as far as insertion of outer distal spine	no	yes	no	yes
– outer distal spine reaching tip of distal conical process	yes, but longer	yes, about equal	no, shorter	no, shorter
P5				
– outer basal seta reaching as far as paired pores on dorsal surface of genital double-somite	no	no	no	yes

32°00′N) on 10 September 2010. (Surface temperature 29.1°C, salinity 34.6 psu.)

Type Material.—Holotype: Adult female dissected and mounted on 3 glass slides, total body length 1118 μm, NIBRIV0000245159.

Paratypes: 2 females dissected and mounted on 3 slides, N1 : NIBRIV0000245902; 2 females in total in 1 vial, N1 : NIBRIV0000245903.

Female.—Body length in lateral view: Holotype, 1118 μm; Paratypes, 1070-1120 μm (mean 1095 μm, n = 4 individuals). Prosome 2.2 times as long as urosome excluding caudal rami, 1.9 times as long as urosome including caudal rami (Fig. 7A, B). Second pedigerous somite with small dorsoposterior projection in lateral view (Fig. 7B). Fourth pedigerous somite with pointed posterolateral corners in dorsal view, slightly blunt in lateral view (Fig. 7A, B). Genital double-somite with almost straight ventral margin in lateral view (Fig. 7B). Proportional lengths (%) of urosomites 13.3 : 56.7 : 10.0 : 6.7 : 13.3. Proportional lengths (%) of urosomites and caudal rami 11.8 : 50.0 : 8.8 : 5.9 : 11.7 : 11.8. Genital double-somite (Fig. 7A, C) 1.6 times as long as maximum width in dorsal view, anterolateral margin rounded, largest width at anterior quarter, posterior part gradually narrowing; paired genital apertures located slightly anterior to midlevel of dorsal surface; surface ornamented with three secretory pores posterior to genital apertures: single pore at mid-region and paired pores at posterior quarter. Anal somite 1.6 times wider than long. CR twice as long as wide; inner margin without ornamentation; setae II and III spiniform, unipinnate along medial margin, setae IV-VII setiform and

Table 2. Comparison of morphological features of males of two species of the *dentipes*-subgroup from the Red Sea and *Triconia constricta* n. sp. from the East China Sea. * Calculated after Böttger-Schnack (1999: table 2, figs. 12, 30).

	Species (♂)		
	Red Sea*		East China Sea
	T. dentipes	*T. elongata*	*Triconia constricta* n. sp.
CR – length ratio of setae IV : VI	3.2 : 1	2.6 : 1	2.6 : 1
P2 enp-3 –outer subdistal spine reaching beyond insertion of outer distal spine	no	yes	no
P4 enp-3 – outer distal spine reaching tip of distal conical process	yes, but longer	yes, about equal	no, shorter
P5 – length ratio of outer : inner exopodal seta	1.3 : 1	1.6 : 1	1.3 : 1
– length ratio of outer basal seta : inner exopodal seta	2.1 : 1	2.0 : 1	1.75 : 1

plumose; length ratios of setae II-VII approx. 12 : 14 : 64 : 100 : 32 : 22.

Antennule (Fig. 8A) 6-segmented, relative lengths (%) of segments measured along posterior non-setiferous margin 12.7 : 18.6 : 41.1 : 12.7 : 3.7 : 11.2. Armature formula as in *T. constricta*.

Antenna (Fig. 8B) 3-segmented, relative lengths (%) of segments 45 : 34 : 21. Coxobasis ornamented with row of long, fine setules on the inner margin, armed with bipinnate seta at inner distal corner; proximal endopodal segment about 1.5 times longer than distal one, ornamented with row of denticles along inner margin and with protruding outer margin bearing patch of spinules; distal endopodal segment armed with 4 setae on mid-segment all almost equal in length, distal armature consisting of 7 elements (for numbering of elements cf. Fig. 3A): seta E longest and unornamented, setae A-D unipinnate and of graduated length, seta F and G almost equal in length and slightly longer than seta D, naked.

Labrum (Fig. 8C, D) similar to that of *T. constricta*, except anterior surface (Fig. 8C) with integumental pockets and paired rows of spinules. Denticles on distal margin of each lobe more numerous and less strong than in *T. constricta*. Posterior wall of median concavity (Fig. 8D) ornamented with 4 long and distinctly sclerotized teeth.

Mandible (Fig. 8E) similar to that of *T. constricta* (for numbering of elements cf. Fig. 3B), except slight difference in ornamentation of dorsal blade (c) as figured; seta (d) (Fig. 8F) inserting close to seta (e).

Maxillule (Fig. 8G) similar to that of *T. constricta*, except slight differences in proportional lengths of elements on inner lobe as well as ornamentation details of elements on outer lobe as figured.

Maxilla (Fig. 8H) similar to that of *T. constricta*.

Maxilliped (Fig. 8I) with armature as in *T. constricta*. Basis oval, palmar margin with two unequal spiniform setae: proximal seta more slender and indistinctly spinose, about 3/4 as long as distal one; distal seta strong and ornamented with longer spinules bilaterally.

Swimming legs (Fig. 9A-D) with armature as in *T. constricta*. Distal spines on exopods slightly (P1) or distinctly (P2-P4) shorter than exp-3. Distal margin of P1 enp-3 with small protrusion concealing insertion of distalmost inner seta. Enp-3 of P2-P4 with large conical process between outer distal and distal spines. Length ratios of endopodal spines (distal spine : outer distal spine : outer subdistal spine) are approx. 1 : 2 : 2 on P2 enp-3, approx. 1 : 1.4 : 1.55 on P3 enp-3, and approx. 1 : 1 : 1.4 on P4 enp-3. Distal spine on enp-3 reaching as far as tip of distal conical process (P2) or beyond the cone (P3-P4); outer distal spine on enp-3 reaching beyond distal conical process in P2-P4; outer subdistal spine reaching beyond insertion point of outer distal spine in P2-P4.

P5 (Fig. 7E) comprising outer basal (= protopodal) seta and free exopod. Exopod 1.8 times as long as wide, inner exopodal seta 1.5 times as long as outer one and slightly longer than outer basal seta.

P6 (Fig. 7D) represented by external operculum closing off each genital aperture, armed with spine and small process at basal region of spine.

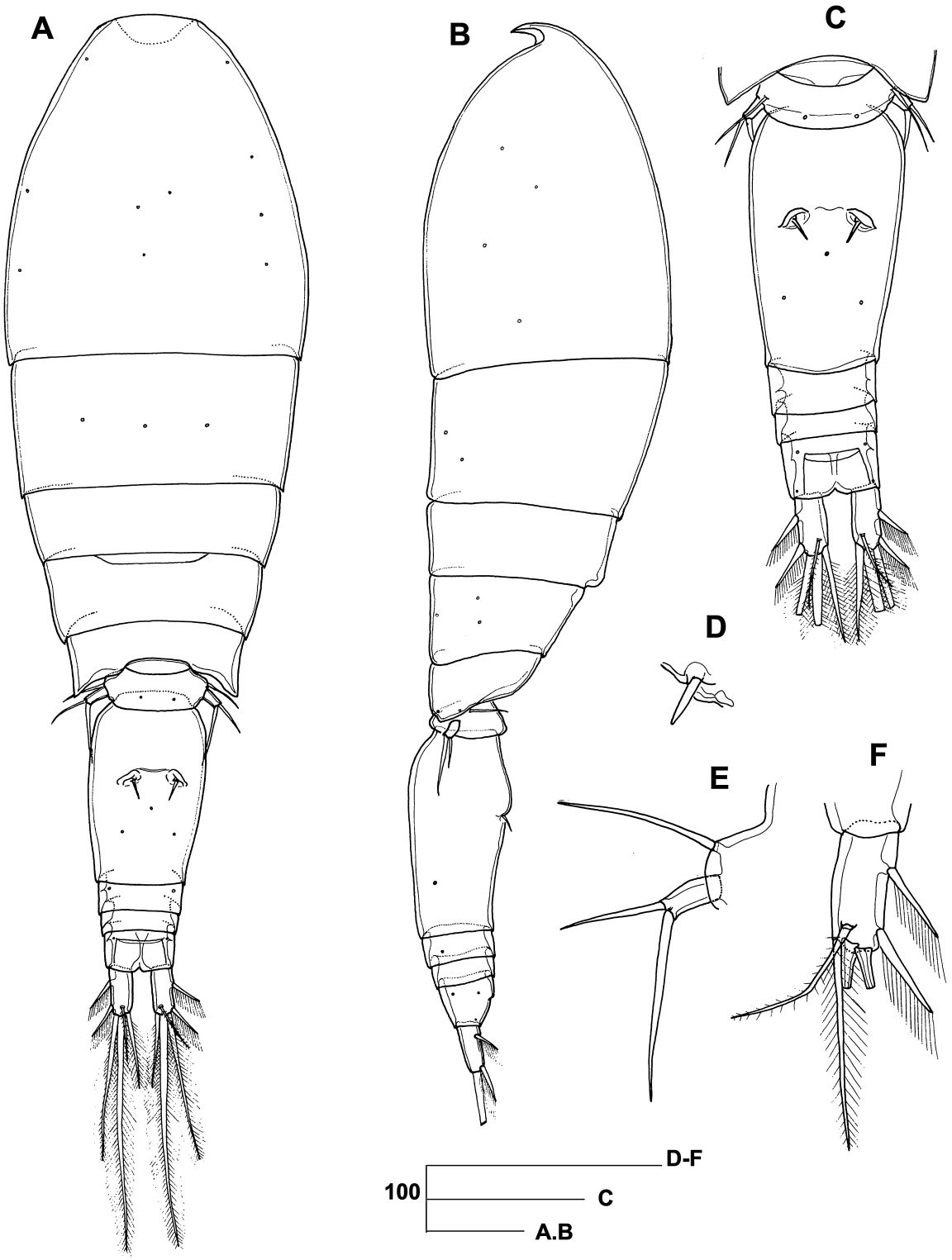

Fig. 7. *Triconia pararedacta*. n. sp. Female (Holotype). A, habitus, dorsal view; B, habitus, lateral view; C, urosome, dorsal view; D, P6, right side; E, P5, left side, dorsal; F, caudal ramus, right side.

Egg sac (Fig. 8J) paired, oblong with multiple egg layers, approx. diameter of single egg 41 μm and approx. number of eggs per sac 22.

Male.—Not found.

Etymology.—The Greek prefix *para*-, meaning beside, refers to the great similarity of the species with *T. redacta*.

Remarks.—Females of *T. pararedacta* show the typical morphological characters of the *conifera*-subgroup: a dorso-

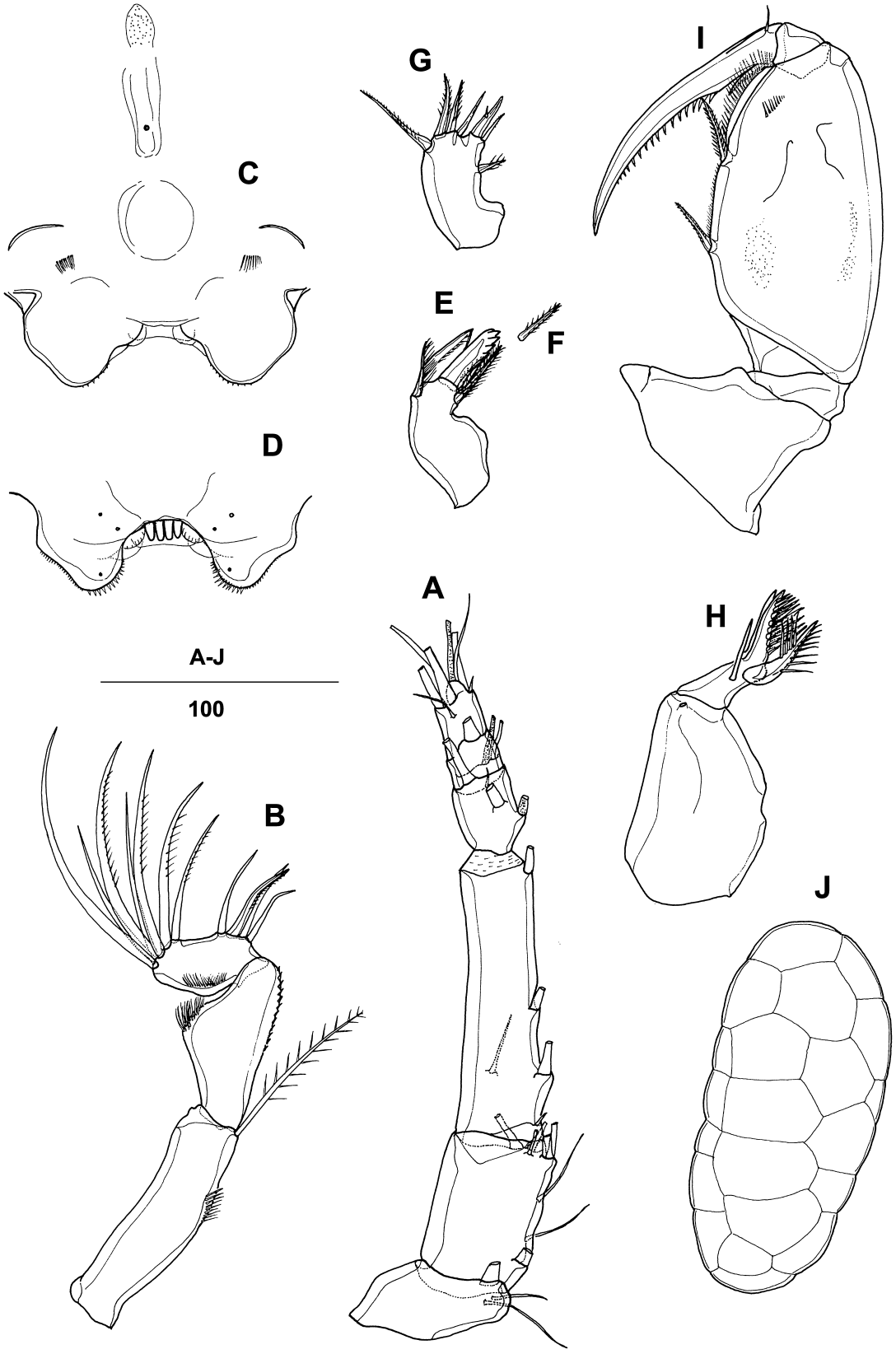

Fig. 8. *Triconia pararedacta* n. sp. Female (Holotype). A, antennule; B, antenna; C, labrum, anterior; D, labrum, posterior; E, mandible; F, 4th element (seta d) of mandible; G, maxillule; H, maxilla; I, maxilliped. Female (Paratype). J, egg sac.

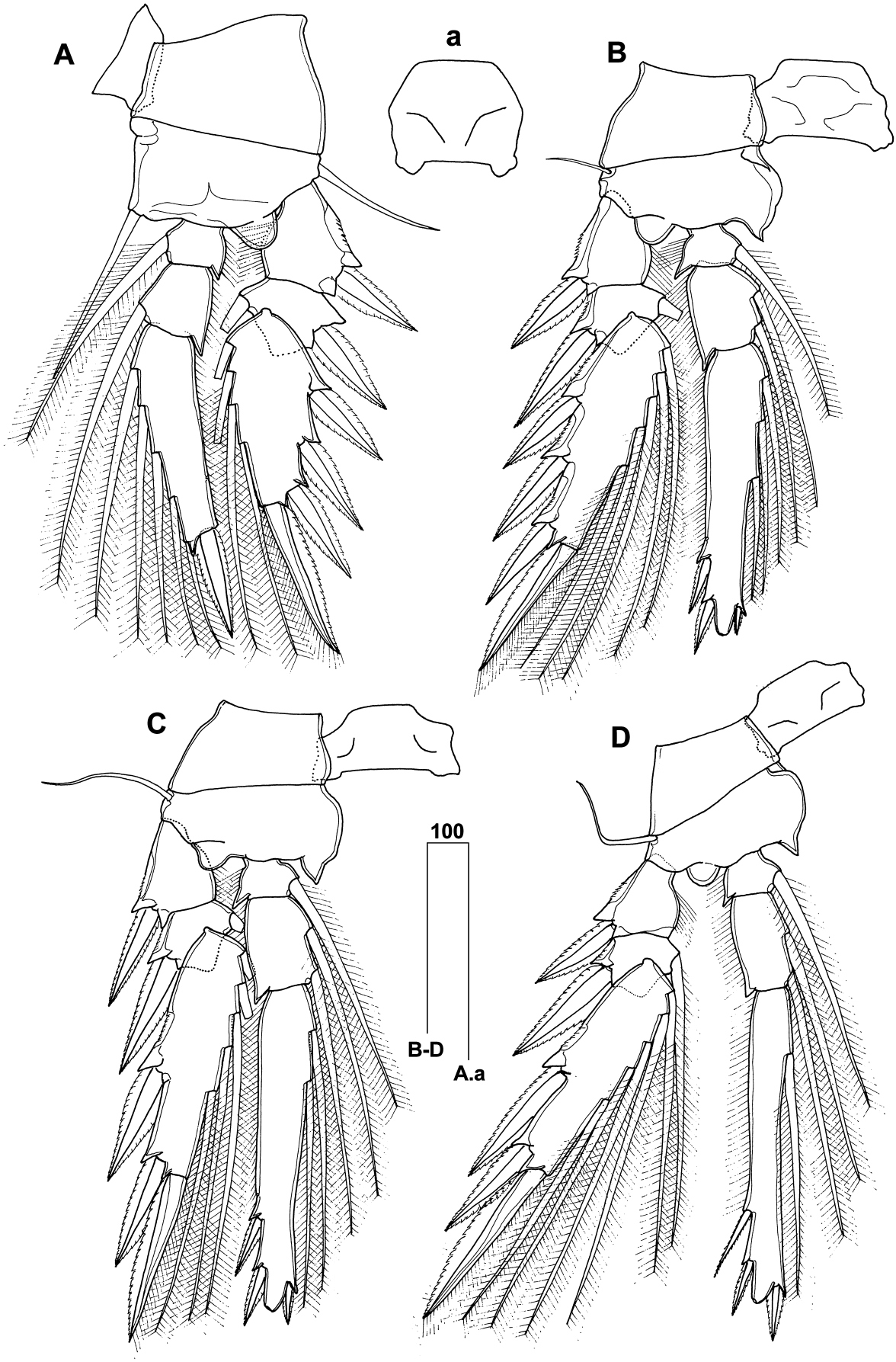
A
a
B
C
D
100
B-D
A.a

Table 3. Comparison of morphological features of females of three *Triconia* species of the *conifera*-subgroup characterized by a relatively small dorso-posterior projection ("hump") on the second pedigerous somite. * Calculated after Heron and Bradford-Grieve (1995: figs. 8, 9, 11, 12). ** Measured in lateral view, telescoping of somites not considered.

	Species (♂)		
	*T. furcula**	*T. redacta**	*T. pararedacta* n. sp.
Proportions of body** – length ratio of prosome to urosome including CR	1.6 : 1	1.9 : 1	1.9 : 1
– length ratio of prosome to urosome excluding CR	1.8 :1	2.2 : 1	2.2 : 1
Urosome – length to width ratio of genital double-somite	2.2 : 1	1.6 : 1	1.6 : 1
Anal somite – length to width ratio	1 : 2.1	1 : 1.6 (right side) 1 : 1.9 (left side)	1 : 1.9
P2 enp-3 – distal spine reaching beyond tip of conical process	yes	yes	no
– length ratio of distal spine to outer distal spine	approx. 1 : 1	1 : 1	1 : 2
P3 enp-3 – length ratio of distal spine to outer distal spine	1 : 1	1 : 1.3	1 : 1.4
– outer distal spine equal in length to outer subdistal spine	no	yes	yes
P4 enp-3 – distal spine equal in length to outer distal spine	yes	no	yes
P5 – length to width ratio of exopod	2 : 1	2.6 : 1	1.8 : 1

posterior projection on the second pedigerous somite and a conical process on the distal endopodal segments of P2 to P4. Among the 12 described species of the *conifera*-subgroup, *T. pararedacta* is most similar to *T. redacta* and *T. furcula*, based on the size of the dorsal projection ("hump") on the second pedigerous somite, which is quite small or indistinct in these species. In Table 3, a comparison of morphological features between the three species is given, which differ from each other in the length ratio of prosome to urosome, the length to width ratio of the genital double-somite, the proportional spine lengths of P2-P4 enp-3, and the length to width ratio of P5 exopod, as well as in some minor details on caudal setae (not included in the table). The new species can be differentiated from both *T. redacta* and *T. furcula* by a relatively short distal spine on P2 enp-3, being only about as long as the distal conical process, while the spine is longer than the process in the other two species, and by a shorter P5 exopod segment. From *T. furcula*, the species can be separated most easily by the different form of the genital double-somite, being relatively short and more squarish, while the genital double-somite is much more elongate in *T. furcula*. From *T. redacta*, it also differs slightly in the proportional lengths of caudal setae IV to seta VI (data not included in Table 3).

Farran (1936) described three forms of *T. conifera* (as *Oncaea conifera* form *a*, *b*, and *c*) from the Great Barrier Reef, of which form *c* is similar to the Korean *T. pararedacta* with regard to body proportions and the size of the dorsal projec-

Fig. 9. *Triconia pararedacta* n. sp. Female (Paratype): A, P1, anterior view; a, intercoxal sclerite; B, P2, anterior view; C, P3, anterior view; D, P4, anterior view.

tion on the second pedigerous somite. Heron and Bradford-Grieve (1995) synonymized Farran's *conifera* form *c* with *T. redacta*, however, in our view some morphological features, such as the form of the pleural area of the fourth pedigerous somite figured by Farran, appear to be more similar to *T. pararedacta*. The 'minus form' of three forms of *T. conifera* (as *O. conifera* bumped form, stocky form and minus form) described by Itoh (1997), of which only the lateral habitus was figured, is similar to *T. pararedacta* with respect to the proportional lengths of prosome to urosome (excluding/including caudal rami) and the presence of a small dorsal projection on the second pedigerous somite. However, the identification of the *conifera*-type oncaeids described by Farran (1936) and Itoh (1997) is still uncertain and can only be achieved after re-examination of their specimens, because neither of them included a description of the proportional spine lengths on the endopods of P2-P4, which is required for an unequivocal identification of these closely related species.

The proportional spine lengths on the distal endopodal segments of P2-P4 have been considered as important diagnostic characters for the differentiation between oncaeid species (Heron and Bradford-Grieve, 1995; Heron and Frost, 2000; Böttger-Schnack and Schnack, 2009) and they were also of importance for constructing and/or revising the subgroups within the speciose genus *Triconia* (Böttger-Schnack and Machida, 2011). Within the *conifera*-subgroup, the proportional lengths of P4 endopodal spines, in particular the length ratio of the distal spine to the outer subdistal spine now shows some additional pattern not hitherto noted: 1) both spines about equal in length: *T. conifera*, *T. furcula*, *T. hirsuta*, and *T. inflexa*; 2) distal spine longer than outer subdistal one: *T. antarctica*, *T. borealis*, *T. canadensis*, *T. derivata*, *T. quadrata*, *T. rufa*, and *T. redacta*; and 3) distal spine slightly or distinctly shorter than outer subdistal spine one: *T. pararedacta* and *T. thoresoni*. The additional character states might prove to be useful for classifying and grouping of new species within the *conifera*-subgroup in the future.

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