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Two new species of *Kelleria* (Copepoda, Poecilostomatoida, Kelleriidae) from Shikoku, Japan

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Abstract: Two new poecilostomatoid copepod species, *Kelleria japonica* **n. sp.** and *K. pararegalis* **n. sp.**, belonging to the family Kelleriidae are described from an eelgrass bed on the southwest coast of Shikoku Island, western Japan. The family is new to the fauna of Japan. *Kelleria japonica* is similar to four congeners by having a bilobed medial process on the female leg 5, but distinguished from them by a combination of features in some of the following appendages, the caudal ramus and the terminal spines of the maxilla in both female and male, the female leg 5, and the male legs 1 and 2. *Kelleria pararegalis* is most similar to *K. regalis*, described from the Suez Canal, but differs from the latter in the body length in both female and male, the medial process on the first segment of the maxilliped and the inner apical spine of leg 5 in the female, and the outer apical spine of the leg 2 endopod in the male.

Key words: *Kelleria*, new species, poecilostomatoid copepod, taxonomy

Introduction

The poecilostomatoid copepods of the family Kelleriidae Humes & Boxshall, 1996 live in loose associations with other marine animals (Boxshall & Hasley 2004). The family currently consists of the single genus *Kelleria* Gurney, 1927 and 19 valid species (Walter & Boxshall 2015, Kim 2014). Four species of the genus have been recorded from Korea (Kim 2000, 2006), but there has been no record from neighboring Japan. In 2008 we found two species of *Kelleria* in plankton samples collected from an eelgrass bed on the southwest coast of Shikoku Island, Japan. These species are described herein with remarks on morphological differences among similar species. Discussion is made on species diversity of the genus and a new diagnostic character for distinction of *Kelleria* species.

Materials and Methods

The present specimens were collected from an eelgrass (*Zostera japonica* Aschers. & Graebn.) bed in a shallow (<1 m deep) subtidal zone (32°57′48″N, 132°32′57″E) located at a river mouth of a small inlet on the southwest coast of Shikoku Island, western Japan, at the low tides on 17 and 31 August 2008. The sampling was done by walking to the eelgrass bed and then gently swinging a plankton net (0.1-mm mesh opening) just above or among the leaves. The samples were fixed in 5% formalin immediately after sampling. Temperature and salinity of the bottom water at the collection site were measured with a handy digital thermometer (SS-31A, Sekisui) and handy salinity meter (PAL-06S, Atago).

Examination and dissection were done in lactophenol or glycerin. Detailed examination of appendages, measurements, and drawings were done under a differential interference microscope (Nikon Eclipse E600) with a drawing tube and an ocular micrometer. The body length was measured from the tip of the forehead to the distal end of the caudal ramus and the prosome length was measured along the midline in dorsal view. The type specimens, mounted on glass slides using glycerin and preserved in ethanol, have been deposited in the National Museum of Nature and Science, Tokyo (NSMT). Morphological terminology generally follows Huys & Boxshall (1991).

Results

Environment of sampling site and contents of the samples

Temperature and salinity just above the bottom at the

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sampling site were 31.5°C and 28 on 17 August, and 29.4°C and 21 on 31 August, respectively. The samples contained a substantial amount of bottom sediments such as mud, sand, and eelgrass fragments. The dominant zooplankton were *Acartia tsuensis* Ito, 1956, followed by the cyclopoid *Oithona davisae* Ferrari & Orsi, 1984 in the sample on 17 August and *A. sinjiensis* Mori, 1940 on 31 August.

Description

Order Poecilostomatoida Kabata, 1979
Family Kelleriidae Humes & Boxshall, 1996
Genus *Kelleria* Gurney, 1927

Kelleria japonica n. sp. (Figs. 1–3)

Material examined. Female holotype (NSMT Cr-24307) dissected and mounted on three glass slides, one dissected male allotype (NSMT Cr-24308) mounted on five glass slides, and four females and two male paratypes, of which two dissected females are mounted on each of two glass slides (NSMT Cr-24309) and other undissected individuals are preserved in ethanol (NSMT Cr-24310).

Female. Body (Fig. 1A) length 1.09–1.13 mm (holotype 1.09 mm). Prosome 0.68 mm long, about 1.7 times as long as maximum width and about 1.7 times as long as urosome. Cephalosome separated from first pedigerous somite with weak suture. Urosomal somites (Fig. 1B) without ornamentation on distal margins. Genital double somite about 1.2 times longer than wide. Caudal ramus (Fig. 1C) length about 2.2 times width; distal half of inner and outer terminal setae without setules along lateral and medial sides, respectively; anterolateral and dorsal setae naked; other setae normally plumose.

Antennule (Fig. 1D) 7-segmented; setal formula: 4, 13, 6, 3, 4+1 aesthetasc (ae), 2+1 ae, 7+1 ae. Antenna (Fig. 1E) 4-segmented, with 1, 1, 3, 7 setae on each segment; third segment with 2 thick distal setae; fourth segment with 2 thick claw-like spiniform and 5 thin setae on distal end. Mandible (Fig. 1F) with several spines medially and 17–18 blunt teeth along lateral margin; terminal lash curved at distal 1/3, bearing long setules along proximal half, sinuate distally. Maxillule (Fig. 1G) with short naked spine on medial margin and 3 terminal spines, inner spine of them short, and middle and outer spines subequal. Maxilla (Fig. 1H) 2-segmented; second segment with naked short seta on posterior surface, bipinnate thick spine medially, and 6 thick naked terminal spines, second and fifth (=penultimate) spines of them about half as long as 2 middle spines. Maxilliped (Fig. 1I) 3-segmented; second segment with 2 strongly bipinnate thick spines; third segment with 4 spines, apical one of them strongly curved.

Legs 1–4 (Fig. 2A–D) with setal formula as follows:

	coxa	basis	exopod			endopod		
			1	2	3	1	2	3
Leg 1	0-1	1-0	I-0	I-1	III, I, 4	0-1	0-1	I, 5
Leg 2	0-1	1-0	I-0	I-1	II, II, 5	0-1	0-2	I, II, 3
Leg 3	0-1	1-0	I-0	I-1	II, II, 5	0-1	0-2	I, II, 2
Leg 4	0-1	1-0	I-0	I-1	II, I, 5	II, 1		

Distal seta on third endopodal segment of leg 1 (Fig. 2A) conspicuously thicker than proximal setae (Fig. 2A). Inner apical spine on third endopodal segment of leg 2 (Fig. 2B) about 1.5 times longer than outer spine (Fig. 2B). One-segmented endopod of leg 4 (Fig. 2D) with notch at 1/3 length of lateral margin; inner apical spine about 1.3 times longer than outer spine. Leg 5 (Fig. 2E) free segment with weak notch at distal 2/5 length of lateral margin and bilobed process at 2/5 of medial margin; proximal lobe (=lobe more distant from segment axis) acute and more produced than distal lobe; medial margin distal to process and distal half of lateral margin finely serrate; outer terminal seta strongly curved at distal end; inner spine naked, straight and as long as outer seta. Leg 6 (Fig. 2F) represented by 2 setae and small prominence in genital area.

Male. Body (Fig. 3A) length 0.92–1.00 mm (allotype 0.92 mm). Prosome 0.68 mm long, about 1.6 times as long as maximum width and about 1.2 times as long as urosome. Genital somite (Fig. 3B) widest near posterior end. Caudal ramus (Fig. 3C) length 2.6 times width.

Antennule with setal formula 4, 13+2 ae, 6, 3+1 ae, 4+1 ae, 2+1 ae, 7+1 ae. Mandible (Fig. 3D) terminal lash not inclined against blade, bearing short setules along proximal 1/4, sinuate distally. Maxillule (Fig. 3D) with 3 terminal spines, middle one of them unipinnate and longest. Maxilla (Fig. 3E) second segment with 8 spines terminally; first, fourth and eighth (distalmost) spines of them much longer than others; inner thick spine more strongly bipinnate than in female. Maxilliped (Fig. 3F) 4-segmented; first segment unarmed; second segment with 2 unequal sinuate setae at proximal 1/4 of medial margin, and strong spinules on entire medial margin; third segment unarmed and indistinctly separated from fourth segment; fourth segment forming terminal claw, weakly curved, with strongly curved seta near base.

Leg 1 (Fig. 3G) basis without lateral seta; third endopodal segment with 2 apical spines and 4 medial setae; inner apical spine 1.6 times as long as outer spine and 1.3 times as long as segment, with round teeth along distal 2/3. Leg 2 (Fig. 3H) third endopodal segment with subequal 2 apical spines, outer one slightly sinuate; inner spine 0.41 times as long as segment. Leg 5 (Fig. 3B) free segment smaller than in female and without medial process. Leg 6 (Fig. 3B) represented by 2 setae and 1 spinule on genital flap. Other morphologies as in female except for usual sexual dimorphisms.

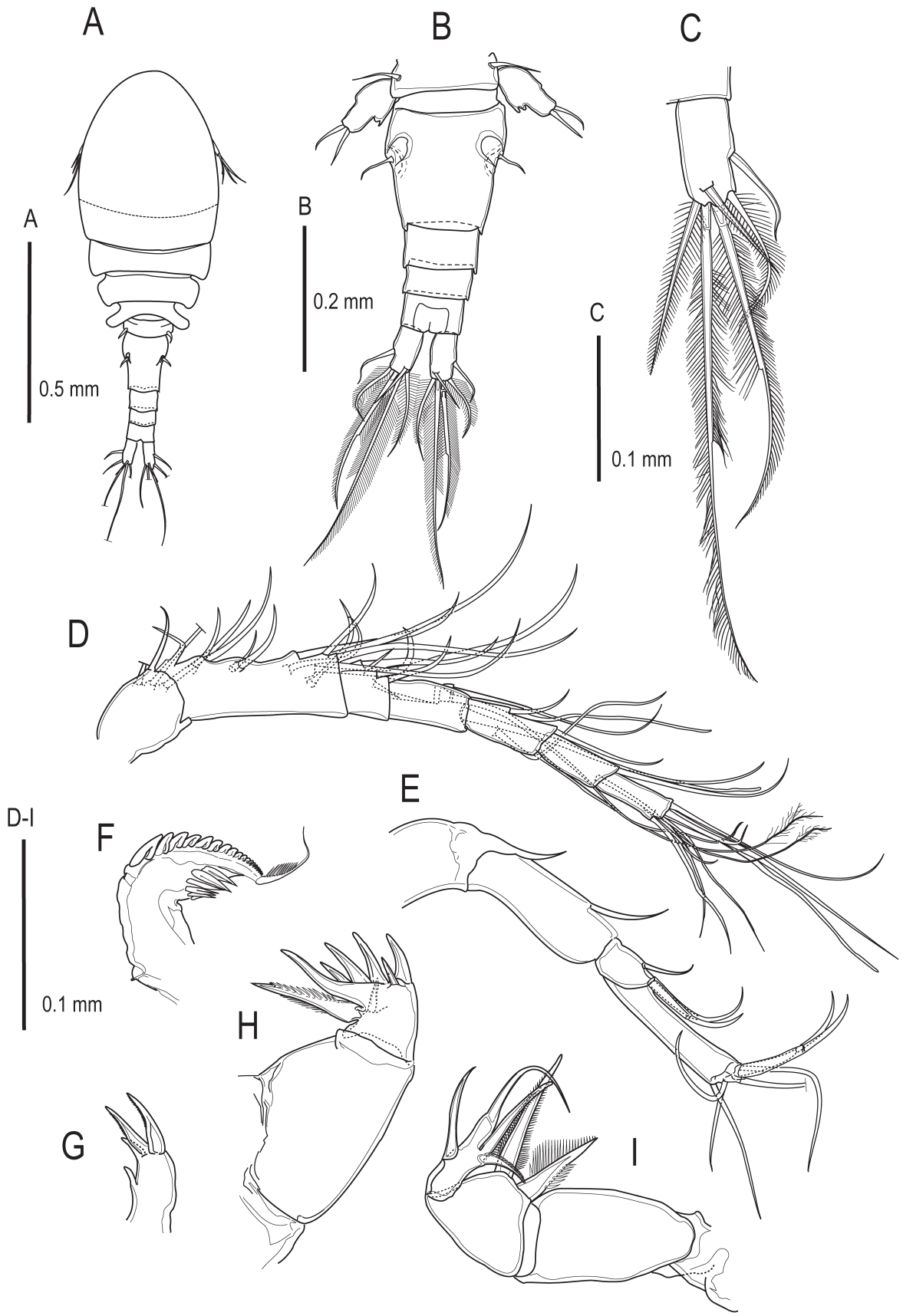

Fig. 1. *Kelleria japonica* **n. sp.** Female. A, habitus; B, urosome; C, right caudal ramus; D, left antennule; E, antenna; F, mandible; G, maxillule; H, maxilla, frontal view; I, maxilliped. A–C, F–I, holotype; D, E, paratype.

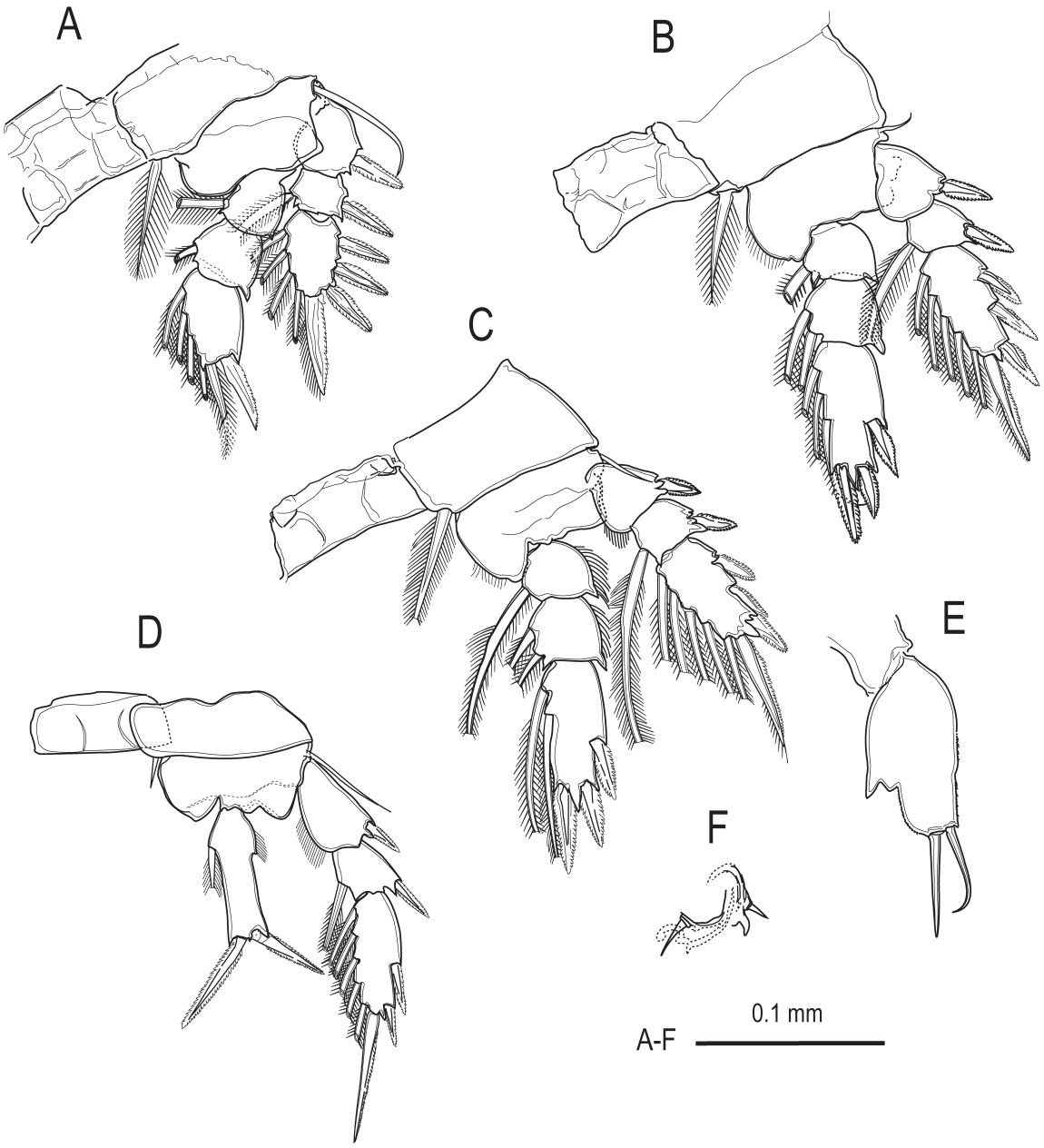

Fig. 2. *Kelleria japonica* **n. sp.** Female. A, leg 1; B, leg 2; C, leg 3; D, leg 4; E, free segment of leg 5; F, leg 6. A–E, holotype; F, paratype.

Etymology. Named for the first species of the family Kelleriidae from Japan.

Remarks. Among the 19 valid species of *Kelleria* (Walter & Boxshall 2015, Kim 2014), *K japonica* n. sp. is most similar to the following four species by having a bilobed process on the medial margin of the female leg 5: *K. australiensis* Bayly, 1971 from a brackish lake in southern Australia (Bayky 1971), *K. indonesiana* Mulyadi, 2009 from shallow coastal waters in Indonesia (Mulyadi 2009), *K. purpurocincta* Gurney, 1927 from a littoral zone in the Suez Canal (Gurney 1927), and *K. reducta* Gómez, 2006 from brackish waters of the Pacific coast of Mexico (Gómez 2006). Morphological differences among these species are listed in Table 1. The redescription of *K. australiensis* by Arnott & McKinnon (1981) based on specimens from the same sample used for the original description by Bayly (1971) is referred to along with the original descriptions of these species. Morphological differences between the present species and the four congeners are observed in the caudal ramus and the terminal spines of the maxilla in both female and male, the outer apical seta and the free segment of leg 5 in female, and the apical spines of the endopods of legs 1 and 2 in the male. It was also noted that the male leg 2 of *K. indonesiana* was mistakenly described by Mulyadi (2009) as leg 3. The present new species is distinguishable from each of these four species by a combination of at least four char-

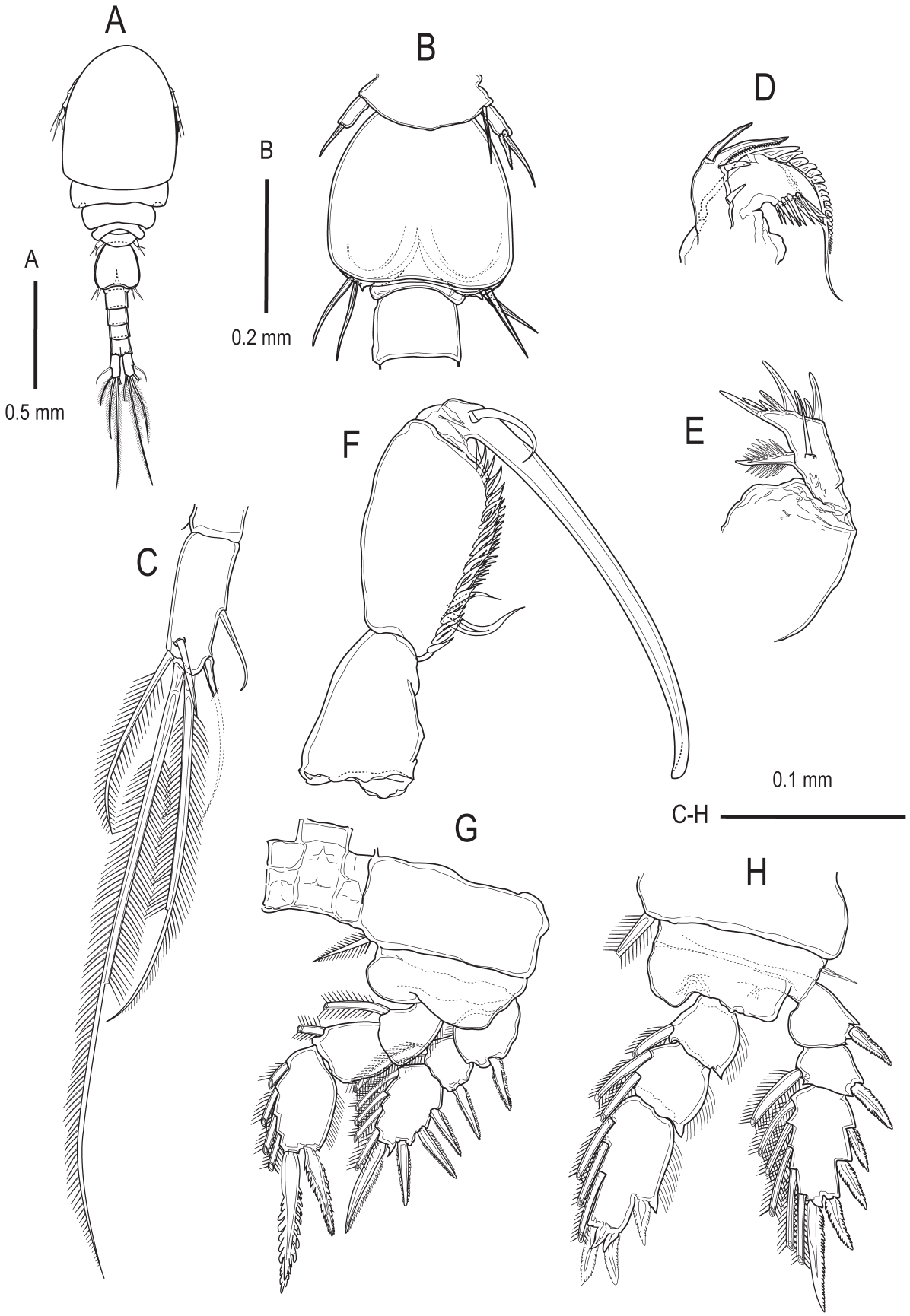

Fig. 3. *Kelleria japonica* **n. sp.** Male (allotype). A, habitus; B, first to third urosomal somites with legs 5 and 6; C, caudal ramus, dorsal view; D, mandible and maxillule, caudal view; E, maxilla, caudal view; F, maxilliped; G, leg 1; H, leg 2.

Table 1. Comparison of morphologies of *Kelleria japonica* **n. sp.** with the congeners which have bilobed medial process on the female leg 5. Morphologies apparently different from the new species are given in bold face.

	K. australiensis	*K. indonesiana*	*K. purpurocincta*	*K. reducta*	*K. japonica* n. sp.
Reference	Bayly (1971), Arnott & McKinnon (1981)	Mulyadi (2009)	Gurney (1927)	Gómez (2006)	present study
Locality	Victoria, Australia	Java, Indonesia	Suez Canal, Egypt	Sinaloa, Mexico	Shikoku, Japan
Female					
Body length	1.23 mm	1.15–1.20 mm	1.14 mm	0.99–1.10 mm	1.09–1.13 mm
Caudal ramus L/W	ca. 2.5	ca. 2 (†2.0)	†**ca. 3.0**	ca 3 (†2.2)	ca. 2.2
Maxilla 5th terminal spine	†**rudimentary or absent**	†**rudimentary**	(not described)	†**rudimentary**	ca 1/2 of 4th spine
Leg 5 free segment					
outer apical seta	†curved	†**straight**	†**almost straight**	†curved at distal end	curved
proximal medial process	†acute	†**blunt**	†**blunt**	†acute	acute
distal medail process	†well produced, *†**serrate**	†moderately produced, not serrate	†moderately produced, not serrate	†**weakly produced**, not serrate	well produced, not serrate
Male					
Body length	1.01 mm	0.89–1.01 mm	0.7–0.93 mm	0.85–0.93 mm	0.92–1.00 mm
Caudal ramus L/W	*†2.8	†2.7	†**ca. 3.7**	†2.5	2.6
Maxilla terminal spine					
spine number	†**6**	†8	†**11**	†6	8
relative lengths of penultimate (P) and distal most (D) spines	*P << D	†**P = D**	†**P = D**	*P << D	P << D
Leg 1 endopod, ratio of inner/outer apical spines	†,*1.5	†**1.1**	(not described)	†1.5	1.6
Leg 2 endopod, ratio of apical inner spine/segment	†,*0.43	†,****0.64**	†0.37	†0.46	0.41

†according to the figures in the references.
*based on Arnott & McKinnon (1981).
**based on fig. 5c of Mulyadi (2009), who mistook leg 2 for leg 3.

acters denoted in bold face in Table 1. Morphologies of the caudal ramus and spines of the legs are generally important diagnostic characters separating species of copepods. Their geographical distributions, which are widely removed from each other, also supports the conclusion that these are distinct species, because wide geographical ranges in estuarine copepods spanning oceans and/or continents is unlikely for estuarine species according to current opinions of copepod taxonomy and zoogeography (e.g. Ueda & Nagai 2005, 2009), except for in the case of populations introduced by human activities.

Kelleria pararegalis n. sp. (Figs. 4–6)

Material examined. Female holotype (NSMT Cr-24311) dissected and mounted on six glass slides, one dissected male allotype (NSMT Cr-24312) mounted on five glass slides, and two undissected female and two undissected male paratypes (NSMT Cr-24313) in ethanol.

Female. Body (Fig. 4A) length 1.15–1.23 mm (holotype 1.23 mm), moderately broad; prosome 1.5 times as long as width and about 1.3 times as long as urosome. Cephalothorax with weak dorsal suture between cephalosome and first pedigerous somite. Genital double somite (Fig. 4B) about 1.6 times as long as wide. Urosomal somites without ornamentation on distal margins. Caudal ramus (Fig. 4C) length 2.9 times width; proximal half of inner terminal seta normally setulose on both sides, and distal half naked on lateral side and with short setules on medial side; distal 1/3 of outer terminal seta naked medially.

Antennule (Fig. 4D) 7-segmented; setal formula: 4, 13, 6, 3, 4+1 ae, 2+1 ae, 7+1 ae. Antenna (Fig. 4E) 4-segmented with 2 thick claw-like spiniform and 5 thin distal setae on fourth segment. Mandible (Fig. 4F) with 9 strong, slightly blunt spines along medial margin, tuft of small spinules on lateral corner, and about 12 blunt teeth along distolateral margin; terminal lash slightly curved, serrate along lateral (ventral) side. Maxillule (Fig. 4G) with short spine at distal 1/5 along medial margin and 3 thick spines terminally; 2 outer terminal spines unipinnate and middle one longest. Maxilla (Fig. 4H) large basal segment with pointed attenuation at distomedial corner; second segment with 7 terminal spines; first, third, and seventh (=distalmost) terminal spines largest, second spine middle sized, and other 3 spines small; seventh spine straight. Maxilli-

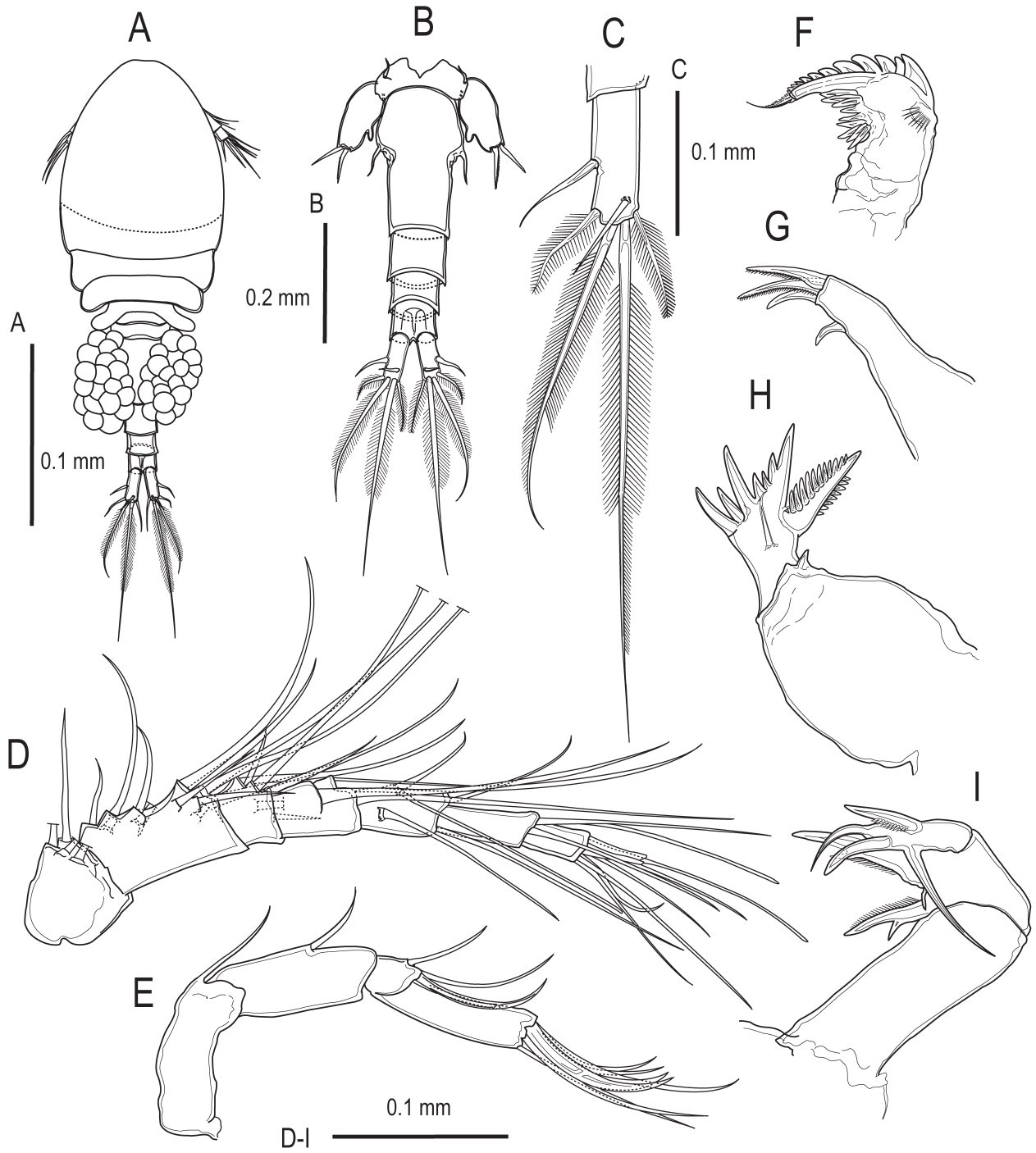

Fig. 4. *Kelleria pararegalis* **n. sp.** Female (holotype). A, habitus; B, urosome with leg 5; C, left caudal ramus; D, right antennule; E, antenna; F, mandible; G, maxillule; H, maxilla; I, maxilliped.

ped (Fig. 4I) first segment unarmed, without process along medial margin; second segment medially with 2 thick spines each on proximal and distal corner, both of them bearing spiniform attenuation at mid length; third segment with 4 spines, unipinnate one at mid length of lateral (ventral) margin, strongly curved apical one, and two on medial (dorsal) margin; proximal one on medial margin naked, very long, and directed dorsalward.

Leg1–4 (Fig. 5A–D) with setae formula as follows:

	coxa	basis	exopod			endopod		
			1	2	3	1	2	3
Leg 1	0-1	1-0	I-0	I-1	III, I, 4	0-1	0-1	I, 5
Leg 2	0-1	1-0	I-0	I-1	II, II, 5	0-1	0-2	I, II, 3
Leg 3	0-1	1-0	I-0	I-1	II, II, 5	0-1	0-2	I, II, 2
Leg 4	0-1	1-0	I-0	I-1	I, II, 5	II, 1		

Leg 4 (Fig. 5D) endopod with inner seta extending to distal end of segment; lateral margin proximal to notch somewhat roundly produced. Leg 5 free segment (Fig. 5E) with lateral and medial margins finely serrate; lateral margin weakly notched at mid length; medial margin with projection at distal 2/5; medial process broad (almost as long as base width), with blunt tip; inner terminal spine serrate only along lateral side, length subequal to outer spine and 0.5 times segment; outer terminal spine naked.

Male. Body (Fig. 6A) length 0.98–0.99 mm (allotype 0.99 mm); prosome 1.5 times as long as width and 1.2 times as long as urosome. Genital somite (Fig. 6B) as long as width. Caudal ramus (Fig. 6C) length 3.3 times width; distal half of inner terminal seta naked on both sides.

Antennule (Fig. 6A) setal formula: 4, 13+2 ae, 6, 3+1 ae, 4+1 ae, 2+1 ae, 7+1 ae; aesthetascs longer than setae. Mandible (Fig. 6D) with 6–7 acute spines along medial margin, about 10 blunt teeth along distolateral margin, second one of them much smaller than first one. Maxilla (Fig. 6F) first segment without acute distomedial corner; second segment with 8 terminal spines; first, fourth, seventh and eighth (=distalmost) terminal spines about 2 times longer than other 4 spines. Maxilliped (Fig. 6G) 4-segmented; first segment without notch in distal part; second segment with sinuate seta on proximal surface, normal seta at proximal 1/3 of medial margin, and strong spinules on entire medial margin; fourth segment forming terminal claw, weakly curved, with seta near base.

Leg 1 (Fig. 6H) basis without lateral seta; third endopodal segment with 2 apical spines and 4 medial setae; inner apical spine 1.3 times as long as outer spine and 1.2 times as long as segment, with round teeth along distal 2/3; outer spine unipinnate with normal teeth along medial margin. Leg 2 (Fig. 6I) third endopodal segment with 2 apical spines, outer naked and slightly sinuate; inner spine slightly longer than outer spine and 0.4 times as long as segment. Leg 5 (Fig. 6B) free segment smaller than in female and without medial projection. Other morphologies

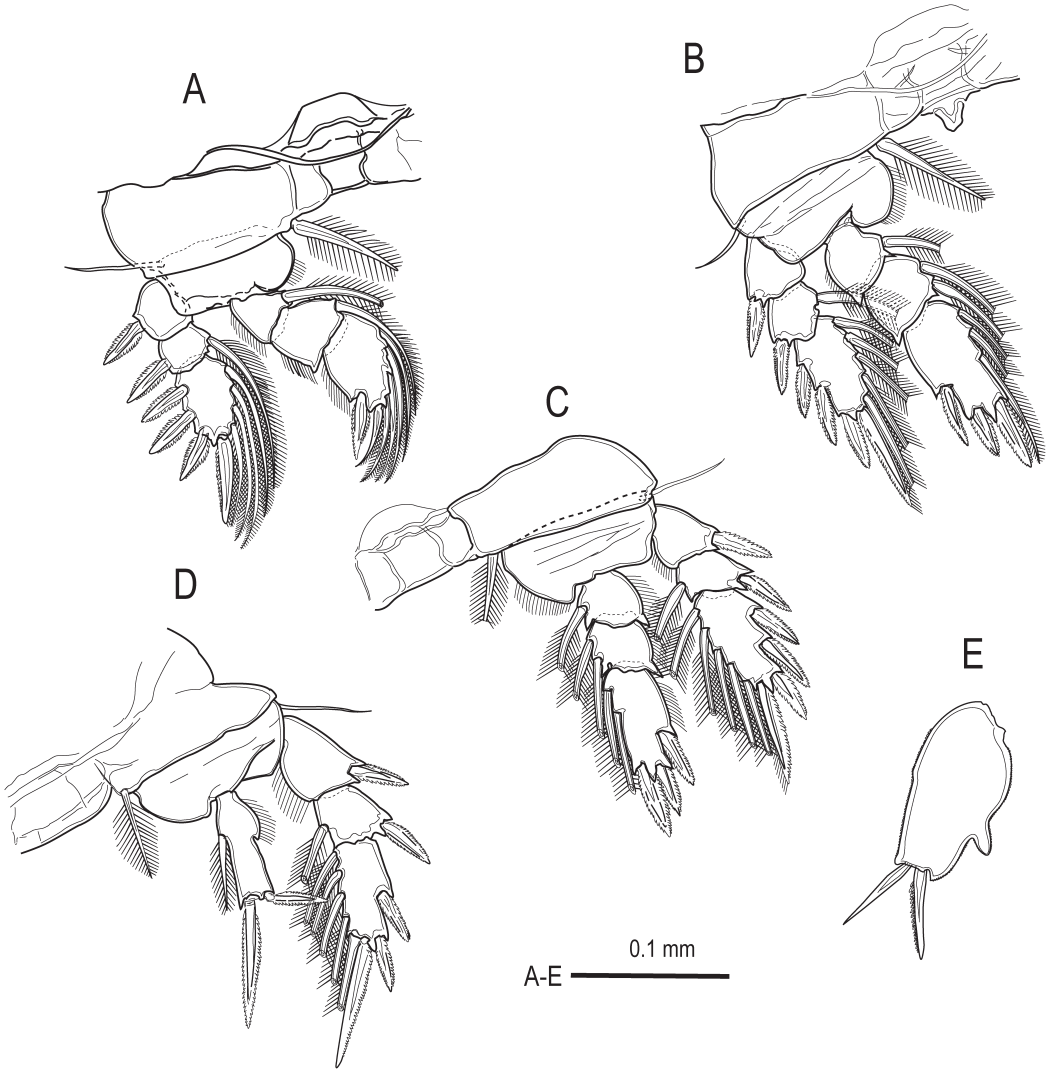

Fig. 5. *Kelleria pararegalis* **n. sp.** Female (holotype). A, leg 1; B, leg 2; C, leg 3; D, leg 4; E, free segment of leg 5.

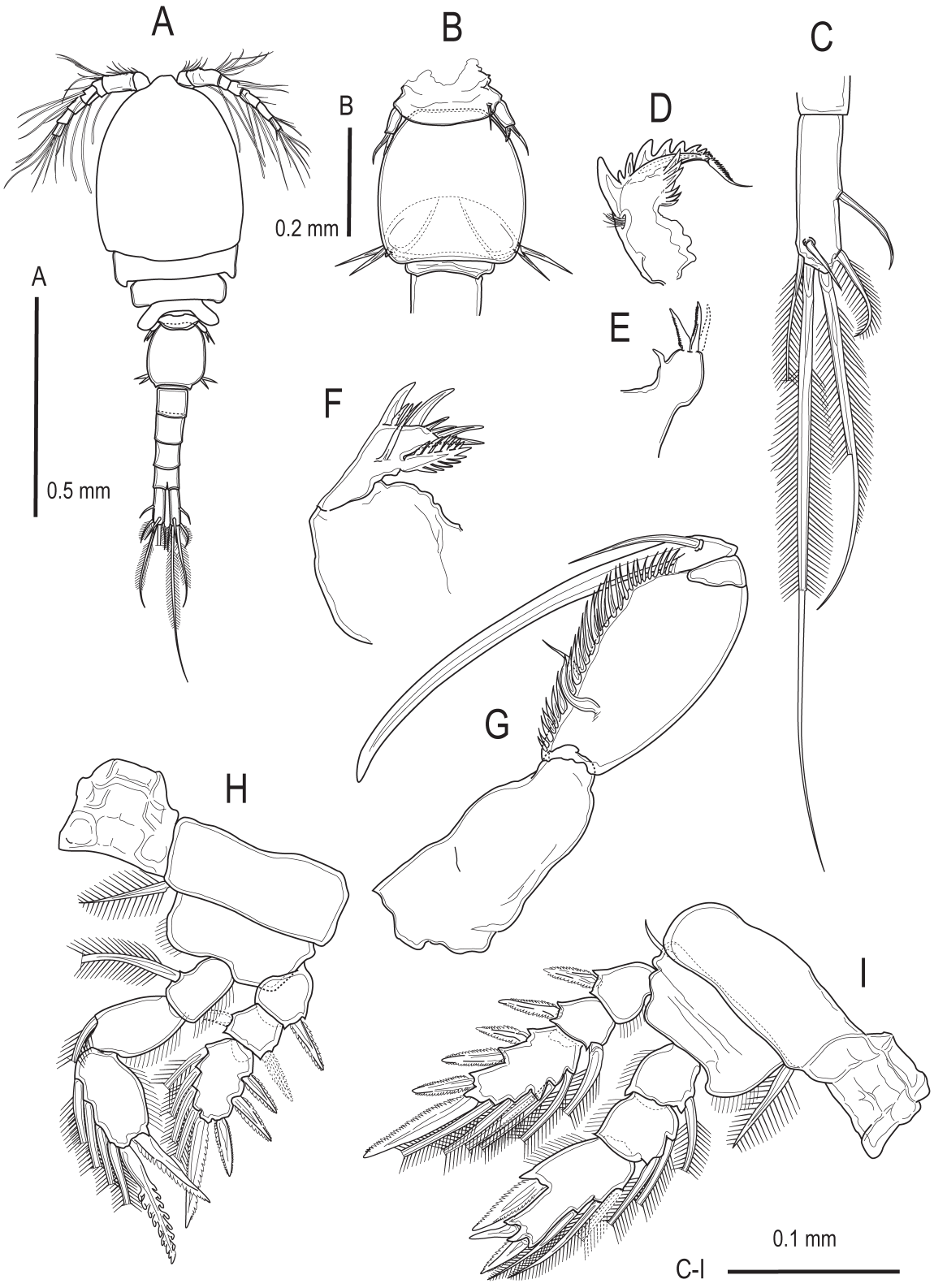

Fig. 6. *Kelleria pararegalis* **n. sp.** Male (allotype). A, habitus; B, first and second urosomal somites with legs 5 and 6; C, right caudal ramus; D, mandible; E, maxillule, outermost terminal spine missing; F, maxilla; G, maxilliped; H, leg 1; I, leg 2.

as in female except for usual sexual dimorphisms.

Etymology. The specific epithet "*pararegalis*" is a compound word of "*para*", a prefix meaning "resembling" in Latin, and "*regalis*", because of its close morphological resemblance to *Kelleria regalis* Gurney, 1927.

Remarks. Of the known species of *Kelleria*, *K. javaensis*

Mulyadi, 2009 and *K. regalis* most resemble *K. pararegalis* n. sp. in having a unilobed prominent medial process on the female leg 5. However, *K. javaensis*, which was described based only on female specimens (Mulyadi 2009), is readily distinguishable from the present species in having a much shorter caudal ramus (twice as long as wide) than in the present species (2.9 times longer than wide) and with leg 5 having an acute notch proximal to the medial process (the notch is absent in the present species). *Kelleria regalis* was first described from a brackish lake in the Suez Canal, Egypt by Gurney (1927), and subsequently from Madagascar by Humes & Ho (1969), who also examined Gurney's (1927) syntype female and male specimens for comparisons. According to Humes & Ho (1969), there are "rather minor differences" between their specimens and the syntypes, i.e. the syntypes have larger bodies, a longer caudal ramus, and a longer inner apical spine on the female leg 5 (Table 2). However, these differences are considered not "minor" but rather critical for distinguishing the species, because recent taxonomic studies using molecular analyses have revealed that speciation without or with minor morphological differences is common in estuarine copepods (e.g. Lee & Frost 2002, Caudill & Bucklin 2004, Chen & Hare 2008, Sakaguchi & Ueda 2010, Ueda et al. 2011, 2015). Thus the possibility cannot be ruled out that the species described as *K. regalis* from Madagascar by Humes & Ho might be a distinct species, although this awaits confirmation by molecular genetic analyses.

The present species is distinguishable from *K. regalis* sensu stricto (s. str.) from the Suez Canal by the smaller body in both the female and male, absence of pointed medial process on the first segment of the female maxilliped, subequal apical spines of the female leg 5, and slightly sinuate endopodal outer apical spine of the male leg 2, and from *K. regalis* sensu Humes & Ho (1969) by the longer caudal ramus in both sexes and the absence of a pointed medial process on the first segment of the female maxilliped (Table 2). In addition, the shape of the free segment of the female leg 5 appears different among the species. Based on the figures by Gurney (1927) and Humes & Ho (1969), the medial process of leg 5 in their descriptions is much more slender than that of the present species, and the tip of the process is acute in *K. regalis* s. str. in contrast to a blunt tip in *K. regalis* sensu Humes & Ho (1969) and the present species. The lateral notch of leg 5 is obvious only in *K. regalis* s. str. However, material-based comparison is necessary to determine whether the shape of leg 5 can be a diagnostic character for species, because figures could vary depending on the angle of leg 5 when it was drawn; both Gurney (1927) and Humes & Ho (1969) illustrated the female leg 5 without dissection from the body.

Discussion

The genus *Kelleria* has never before been recorded from Japanese waters, despite the fact that the planktonic copepod fauna has been rather well studied in Japan. This is probably because they seldom appear in plankton samples and because there have been few copepod taxonomic studies that have paid attention to species associated with benthic invertebrates in Japan. One of us (HU) carried out intensive surveys on planktonic copepod faunas

Table 2. Comparison of morphologies of *Kelleria pararegalis* **n. sp.** with closely related *K. regalis*. Expressions cited from the references are in brackets. Morphologies apparently different from the new species are given in bold face.

	K. regalis sensu stricto	*K. regalis* sensu Humes & Ho (1969)	*K. pararegalis* n. sp.
Reference	Gurney (1927)	Humes & Ho (1969)	present study
Locality	Suez Canal, Egypt	Nosy Bé, Madagascar	Shikoku, Japan
Female			
Body length	**1.45 mm**	1.25–1.37 mm	1.23 mm
Caudal ramus L/W	ca. 3	**2.3**	2.9
Maxilliped first segment, pointed medial process	†**present**	**present**	absent
Leg 5 free segment			
medial process	[spinous] †**acute tip**, †**slender**	†blunt tip, †**slender**	blunt tip, broad
lateral notch	†**obvious**	†weak	weak
inner apical spine length	†**1.5 (*1.53) to outer spine, †0.8 to segment**	1.0 to outer spine, †0.7 to segment	1.0 to outer spine, 0.5 to segment
Male			
Body length	**1.35 mm (*1.32 mm)**	1.00–1.09 mm	0.99 mm
Caudal ramus L/W	†ca. 3.1	[similar to female] †2.7	3.3
Leg 2 endopod outer apical spine	**not sinuate**	**not sinuate**	slightly sinuate

†according to the figures in the references.
*based on Humes & Ho (1969).

in various estuaries throughout western Japan, including the present site; partial results from these surveys on estuarine calanoid copepods were published by Sakaguchi et al. (2011). *Kelleria* was not found in any of these samples even though the conditions of some estuaries were similar to those of the present site, i.e., low salinity (21–28) and dominance of the estuarine calanoid *Acartia tsuensis*. This suggests that *Kelleria* is not often collected by usual plankton sampling methods. The occurrence of the present two species in our plankton samples is probably due to towing of the net in an eelgrass bed, as *K. australiensis* was also collected by Bayly (1971) (see Table 3).

Twenty-one *Kelleria* species, including the present new species, have been described in 15 studies from throughout the temperate and tropical zone, except for in South America (Table 3). Most species are probably endemic to their type localities. It is notable that about half of these species are described together with other congeners from the same sampling site or region. The wide geographical range of the genus but high endemicity of the species and frequent occurrence of more than one species in the same region imply that the genus is not yet fully characterized. It is expected that many more species will be discovered if appropriate sampling, such as weed washing and collection from invertebrate burrows, is performed in unexplored regions.

Distal halves of the inner and outer terminal caudal setae of the present two new species are devoid of setules on the medial, lateral, or both sides. This setulation pattern of the caudal setae showed no intraspecific variation and no significant sexual dimorphism, but differed between the two species. That is, the distal half of the inner terminal seta of *Kelleria japonica* is normally setulose on its medial side, whereas in *K. pararegalis* setules on the same part are apparently shorter than those on the proximal half of the seta in the female and are absent in the male. Ornamentation of the terminal caudal setae similar to *K. japonica* was seen in the closely allied species *K. indonesiana* illustrated by Mulyadi (2009), but he simultaneously described *K. javaensis* and *K. pectinata* Mulyadi, 2009 as having the setae with different ornamentation, being setulose on both sides throughout the seta length. Thus, the ornamentation of the terminal caudal setae can be proposed

Table 3. List of of *Kelleria* species with type localities and ecology or sampling method.

Species	Type locality	Ecology or sampling method	Author
Africa			
K. propinquus	Guinea	net tow (surface)	Scott (1894)
K. pectinata	Kenya	net tow (surface)	Scott (1909)
K. regalis	Egypt	bottom sediments or weed washings	Gurney (1927)
K. purpurocincta	Egypt	bottom sediments or weed washings	Gurney (1927)
K. multiovigera	Madagascar	associated with a sponge	Kim (2009)
West Asia			
K. gradata	Eilat, Israel	associated with a crinoid	Stock (1967)
South Asia			
K. andamanensis	Andaman Islands	net tow (surface)	Sewell (1949)
K. camortensis	Nicobar Islands	weed washings	Sewell (1949)
K. rubimaculata	Madras, India	not described	Krishnaswamy (1952)
K. vasfera	Thailand	invertebrate burrows	Kim (2014)
Southeast Asia			
K. indonesiana	Java, Indonesia	net tow (surface)	Mulyadi (2009)
K. javaensis	Java, Indonesia	net tow (surface)	Mulyadi (2009)
East Asia			
K. vega	west coast of Korea	intertidal mud flat	Kim (2000)
K. grandisetiger	Jeju Island, Korea	invertebrate burrows	Kim (2006)
K. portiviva	Jeju Island, Korea	invertebrate burrows	Kim (2006)
K. undecidentata	Jeju Island, Korea	invertebrate burrows	Kim (2006)
K. japonica n. sp.	Shikoku, Japan	net tow (eel grass bed)	present study
K. pararegalis n. sp.	Shikoku, Japan	net tow (eel grass bed)	present study
Australia			
K. australiensis	Victoria	net tow (brushed through weed and touched bottom)	Bayly (1971)
K. corioensis	Corio Bay	net tow (oblique from bottom)	Arnott & McKinnon (1981)
North America			
K. reducta	Mexico	bottom sediment	Gómez (2006)

to be a useful diagnostic character for distinction of *Kelleria* species, and should be paid attention to in future species identifications and descriptions. The importance of the ornamentation of the terminal caudal setae as a diagnostic character has already been recognized for *Halicyclops* species (Rocha 1984, Ueda & Nagai 2009).

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