

DESCRIPTION OF *KELLERIA REDUCTA* SP. NOV. (COPEPODA,  
CYCLOPOIDA, KELLERIIDAE) FROM A BRACKISH SYSTEM IN  
NORTHWESTERN MEXICO

BY

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ABSTRACT

Specimens of an unknown species of the monotypic family Kelleriidae Humes & Boxshall, 1996 were found in sediment samples taken during a number of sampling campaigns in two brackish systems in southern Sinaloa (northwestern Mexico). The species, herein described as *Kelleria reducta* sp. nov., shows some similarities with *K. propinqua* (T. Scott, 1894) from the Gulf of Guinea, but they can be separated by the armature formula of the female maxilliped and the relative length of the accompanying setae on the male maxillipedal claw. An amendment to Humes & Stock's (1973) key to the species of *Kelleria* is presented.

RESUMEN

Cierto número de especímenes de una especie desconocida de la familia monotípica Kelleriidae Humes & Boxshall, 1996 fueron encontrados en muestras de sedimentos tomadas durante el desarrollo de campañas de muestreo en dos sistemas salobres del sur de Sinaloa (noroeste de México). La especie, descrita aquí como *Kelleria reducta* sp. nov., mostró algunas semejanzas con *K. propinqua* (T. Scott, 1894) del Golfo de Guinea, pero pueden ser separadas en base a la fórmula de setas y espinas del maxilípido de la hembra y en base también a la longitud relativa de las setas accesorias de la garra del maxilípido del macho. Se presenta una enmienda a la clave para las especies de *Kelleria* propuesta por Humes & Stock (1973).

INTRODUCTION

Gurney (1927) described the genus *Kelleria* Gurney, 1927 (allocated to the Cyclopoidea, Lichomolgidae by Gurney (1927)) to accommodate *K. regalis* Gurney, 1927 and *K. purpurocincta* Gurney, 1927, collected in 1924 during the Cambridge

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Expedition to the Suez Canal. Gurney (1927) also reallocated two other species, *Pseudanthessius propinquus* T. Scott, 1894 (formerly placed in the Corycaeidae by T. Scott (1894)) and *P. pectinatus* A. Scott, 1909 (placed in the Lichomolgidae by A. Scott (1909)) to his newly described genus as *K. propinqua* (T. Scott, 1894) and *K. pectinata* (A. Scott, 1909). Huys & Boxshall (1991) recognized the Cyclopoida and Poecilostomatoida as two different lineages, giving the poecilostome families full order rank. Five years later, Humes & Boxshall (1996), following Huys & Boxshall's (1991) scheme, instituted the poecilostomatoid family Kelleriidae Humes & Boxshall, 1996, based mainly on the primitive state of the female maxilliped (with four elements in a well developed endopodal segment), to accommodate the genus *Kelleria*. *Kelleria vaga* Kim, 2000 was the only species added since 1973. Later, after analysing the published evidence about the relationships between Cyclopoida and Poecilostomatoida, Boxshall (in Boxshall & Halsey, 2004: 41) found Huys & Boxshall's (1991) scheme to be wrong, since "the Cyclopoida as recognised in Huys & Boxshall (1991) is probably paraphyletic, since the poecilostome families . . . almost certainly originated from within the Cyclopoida" (Boxshall & Halsey, 2004: 41), and treated the former Poecilostomatoida as a lineage within the Cyclopoida. This view is adopted in the present study.

During a short term project on the meiofauna from two brackish systems in southern Sinaloa, some specimens of an unknown species of *Kelleria* were found in sediment samples. The present study deals with the description of this new species, *K. reducta* sp. nov. Also, an updated key to the species of the genus is given.

#### MATERIAL AND METHODS

Triplicate sediment samples for meiofauna analyses were taken during a number of sampling campaigns in two brackish systems in southern Sinaloa (El Verde estuary and Urías system) during 2005. Sediment samples were sieved through 500  $\mu\text{m}$  and 40  $\mu\text{m}$  sieves and benthic copepods were separated from the rest of the meiofauna using a stereomicroscope with a magnification of 40 $\times$ . Specimens were stored in 70% ethanol prior to further investigation. Observations and drawings were made from whole and dissected specimens mounted in lactophenol at 1000 $\times$  using a Leica compound microscope equipped with phase contrast and a drawing tube. The type material was deposited in the Copepoda collection of the Instituto de Ciencias del Mar y Limnología, Mazatlán Marine Station. The terminology proposed by Huys & Boxshall (1991) for the general description, and the classification by Boxshall & Halsey (2004) were adopted.

Abbreviations used in the text and tables are: CIII, third copepodite; CIV, fourth copepodite; CV, fifth copepodite; P1-P6, first to sixth swimming legs; Exp, exopod; Enp, endopod; P1 (P2-P4) Exp (Enp) 1 (2, 3) denotes the proximal (middle, distal) exopodal (endopodal) segment of P1, P2, P3, or P4.

## DESCRIPTIVE PART

## CYCLOPOIDA Burmeister, 1834

## KELLERIIDAE Humes &amp; Boxshall, 1996

*Kelleria* Gurney, 1927***Kelleria reducta* sp. nov. (figs. 1-7)**

Type material. — One female holotype (EMUCOP-060605-07), one male allotype (EMUCOP-060605-06), five female (EMUCOP-060605-01, EMUCOP-060605-02, EMUCOP-060605-03, EMUCOP-060605-04, EMUCOP-090205-01) and two male (EMUCOP-060605-05, EMUCOP-090205-02) dissected paratypes, three females, two males, one CIII and one CV (EMUCOP-060605-08), one CIV (EMUCOP-060605-09), two females (EMUCOP-060605-10), eight females, one male, one CV, one CIV, three CIII (EMUCOP-070605-01), three males (EMUCOP-070605-02), one CV (EMUCOP-090205-03) and one female (EMUCOP-090205-04) paratypes preserved in alcohol. Collected 8 April 2005, 6 and 7 June 2005, 9 February 2005 (stn. 2, 3, 4, 5, 6, 8, 9, S. Gómez, unpubl. data); dissolved oxygen content, 1.66 mgO<sub>2</sub>/l-8.85 mgO<sub>2</sub>/l; biochemical oxygen demand BOD<sub>5</sub>, 2.17 mgO<sub>2</sub>/l-8.21 mgO<sub>2</sub>/l; sand, 99.3%-44%; silt, 0.27%-12%; clay, 44%-0.24%; sediment temperature, 20.4°C-29.5°C; bottom water salinity, 20‰-28‰; organic matter content 2.32%C-3.03%C; coll. F. E. Vargas-Arriaga, F. N. Morales-Serna, and S. Gómez.

Type locality. — El Verde estuary, Sinaloa state, Mexico (23°25'30"N 106°33'30"W).

Other material examined from other sites. — One dissected female (EMUCOP-080205-01), and one CV (EMUCOP-080205-02), three females (EMUCOP-080205-03, EMUCOP-080205-04, EMUCOP-021205-02), three males, 3 CIV, two CV, 5 CIII (EMUCOP-080405-01) and one CV (EMUCOP-021205-01) preserved in alcohol. Collected in the Urías system (23°11'06"N 106°25'06"W) (stn. 2, 3, 4, 5, 7, S. Gómez, unpubl. data); 8 February 2005, 8 April 2005, 2 December 2005; dissolved oxygen content, 2.89 mgO<sub>2</sub>/l-5.15 mgO<sub>2</sub>/l; biochemical oxygen demand BOD<sub>5</sub>, 0.81 mgO<sub>2</sub>/l-2.34 mgO<sub>2</sub>/l; sand, 99.5%-89.4%; silt, 0.19%-6.06%; clay, 4.55%-0.16%; sediment temperature, 21.0°C-23.4°C; bottom water salinity, 37‰-39‰; organic matter content 3.23%C-3.76%C; coll. F. N. Morales-Serna, F. E. Vargas-Arriaga, and S. Gómez.

Etymology. — The specific name alludes to the very small accessory seta on the male maxillipedal claw. It is an adjective agreeing in gender with the (feminine) generic name.

Description of female. — Body cyclopoid (fig. 1A). Total body length ranging from 990 μm to 1100 μm (mean = 1050 μm; *n* = 12). With podoplean tagmosis. Prosome with a few sensilla dorsally; tapering posteriorly. First pedigerous somite (P1-bearing somite) free. First urosomite (P5-bearing somite) about 2 times as wide as long; second and third urosomites completely fused dorsally and ventrally (genital double-somite), slightly tapering posteriorly; with paired genital apertures dorsolaterally on proximal part of genital somite (figs. 1A, 2A, 3A); fourth and fifth urosomites and anal somite about as wide as long, the latter with rounded anal operculum. Caudal rami (figs. 2A, B, 3A, B) about 3 times as long as wide, with six setae; all setae plumose except for setae II and VII; seta II located laterally halfway along outer margin, shorter than seta III, the latter as in fig. 3B and arising

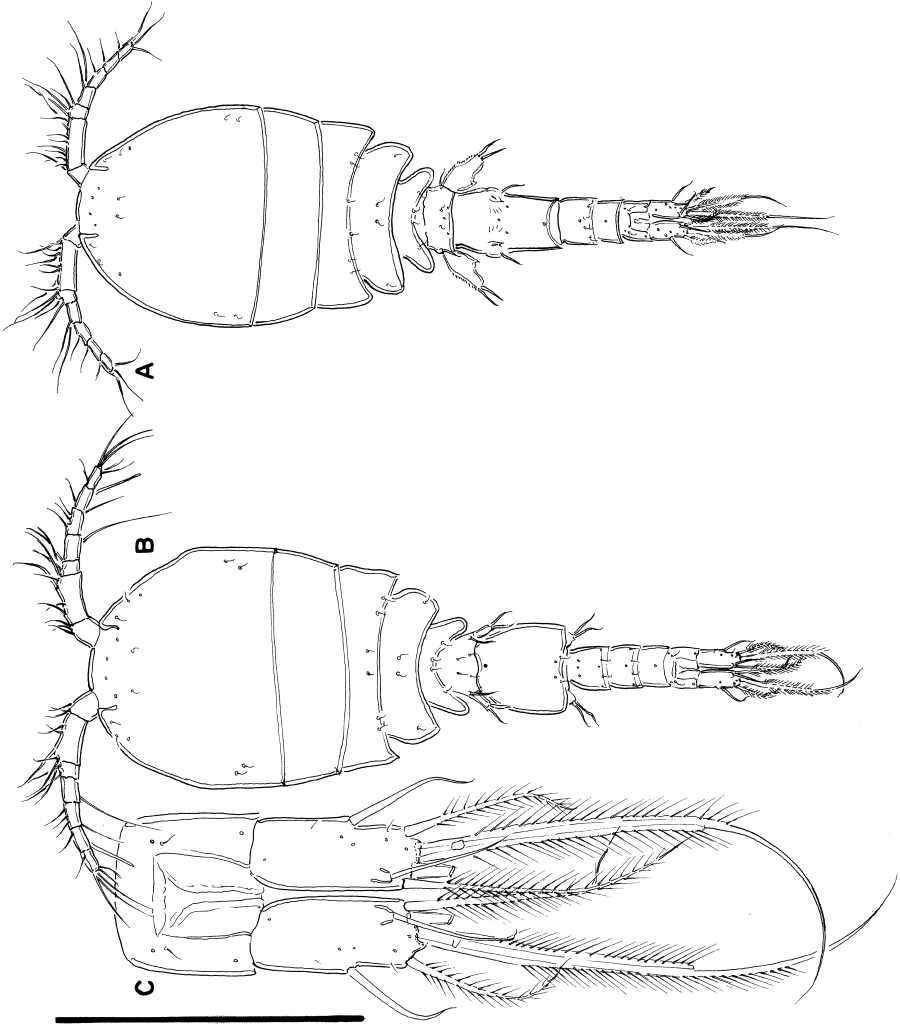


Fig. 1. *Kelleria reducta* sp. nov. A, female anal somite and caudal rami, dorsal. Scale bar: A, 500  $\mu$ m; B, 400  $\mu$ m; C, 100  $\mu$ m.

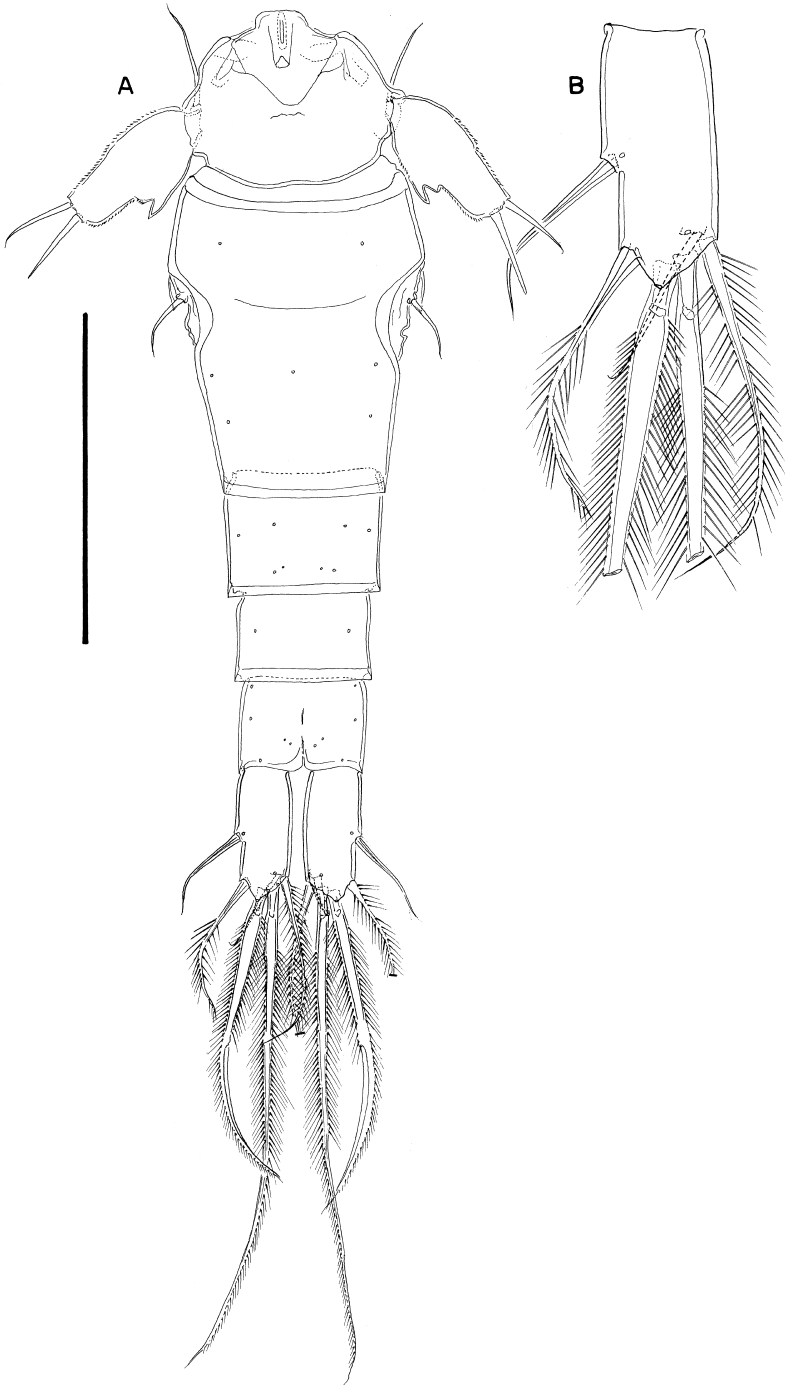


Fig. 2. *Kelleria reducta* sp. nov. Female. A, urosome, ventral; B, right caudal ramus, ventral. Scale bar: A, 200  $\mu$ m; B, 100  $\mu$ m.

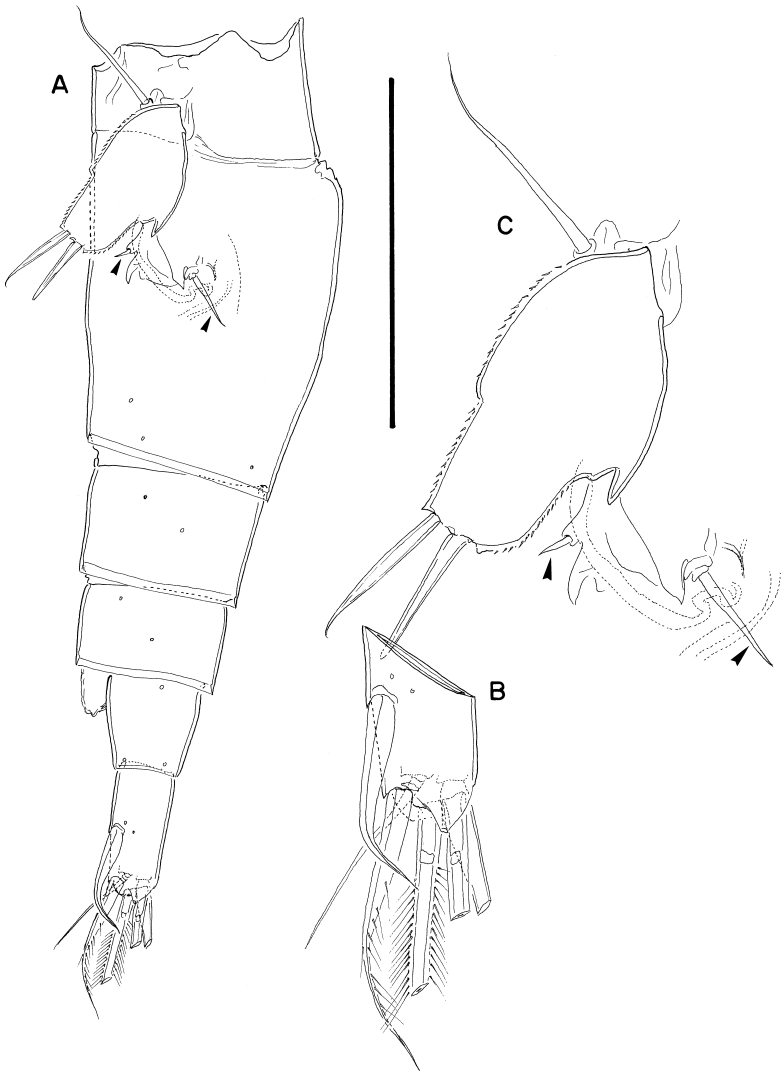


Fig. 3. *Kelleria reducta* sp. nov. Female. A, urosome, lateral; B, distal part of right caudal ramus, lateral; C, P5 and P6, lateral. Scale bar: A, 200  $\mu\text{m}$ ; B, 100  $\mu\text{m}$ ; C, 100  $\mu\text{m}$ .

on distal outer corner; ornamentation and shape of seta IV as figured, shorter than seta V; seta VI longer than seta III, arising in distal inner corner; seta VII located dorsally close to inner margin.

Antennule (fig. 4A) seven-segmented; segments 1 and 3 slightly wider than long; segment 2 longest, about 3 times as long as wide; segment 4 about 1.5 times as long as wide; segments 5, 6, and 7 about 2 times as long as wide. Armature formula as follows: 1-(4), 2-(13), 3-(6), 4-(3), 5-(4+ae), 6-(2+ae), 7-(7+ae).



Fig. 4. *Kellieria reducta* sp. nov. Female. A, antennule; B, antenna (apical claws arrowed); C, mandible; D, maxillule; E, maxilla; F, maxilliped. Scale bar: A, B, F, 200  $\mu\text{m}$ ; C-E, 100  $\mu\text{m}$ .

Antenna (fig. 4B) four-segmented. Coxobasis with one seta. Endopod three-segmented; segment 1 about 2.5 times as long as wide, with one seta subdistally; segment 2 the shortest, slightly longer than wide, with geniculate, setiform claw and two setae (proximal one shorter); segment 3 about 4 times as long as wide, with three subdistal setae, and two strong claws and one seta apically.

Mandible (fig. 4C). Proximal notch weakly defined. Main blade broad basally, with tapering lash distally; with inner row of strong spinules; with a longitudinal row of very robust teeth along outer margin of lash, with the first two teeth more than twice as long as the rest; with small outer spinules close to base of first two teeth of lash.

Maxillule (fig. 4D). A single lobe with one subapical, bare element and three distal, bipinnate spines (innermost the smallest).

Maxilla (fig. 4E) with large unarmed syncoxa. Basis with one smooth seta and one inner strong and bipinnate spine; distally armed with six unequal teeth as figured.

Maxilliped (fig. 4F, G) three-segmented; syncoxa large, unarmed; basis with two bipinnate spines, proximal one shorter; endopodal segment (see fig. 4G) with two bipinnate spines, one long seta, and one bare, claw-like element.

P1 (fig. 5A). Coxa with well developed inner plumose seta. Basis of P1 without setules on distal inner corner; with outer slender seta. Rami three-segmented; first exopodal segment without, second one with inner seta, third exopodal segment with three outer spines, one apical spine, and four inner setae; first and second endopodal segments with one inner seta, third endopodal segment with six setae/spines.

P2 (fig. 5B-D). Coxa as in P1. Basis with setules on distal inner corner; with outer slender seta. Rami three-segmented; first exopodal segment without, second one with inner seta, third exopodal segment with three outer spines, one apical spine, and five inner setae; first endopodal segment with one inner seta, second segment with two inner setae, third endopodal segment with six setae/spines.

P3 (fig. 6A). Coxa and basis as in P1. Rami three-segmented; first exopodal segment without, second one with inner seta, third exopodal segment with three outer spines, one apical spine, and five inner setae; first endopodal segment with one inner seta, second segment with two inner setae, third endopodal segment with five setae/spines.

P4 (fig. 6B). Inner seta of coxa bare and small. Basis as in previous legs. Exopod three-segmented; first segment without, second segment with one inner seta, third segment with two outer spines (with eight setae/spines in all). Endopod one-segmented; with small outer notch in proximal third; with one inner proximal seta and two apical spines (outermost shorter).

Armature formula of P1-P4 as in table I.



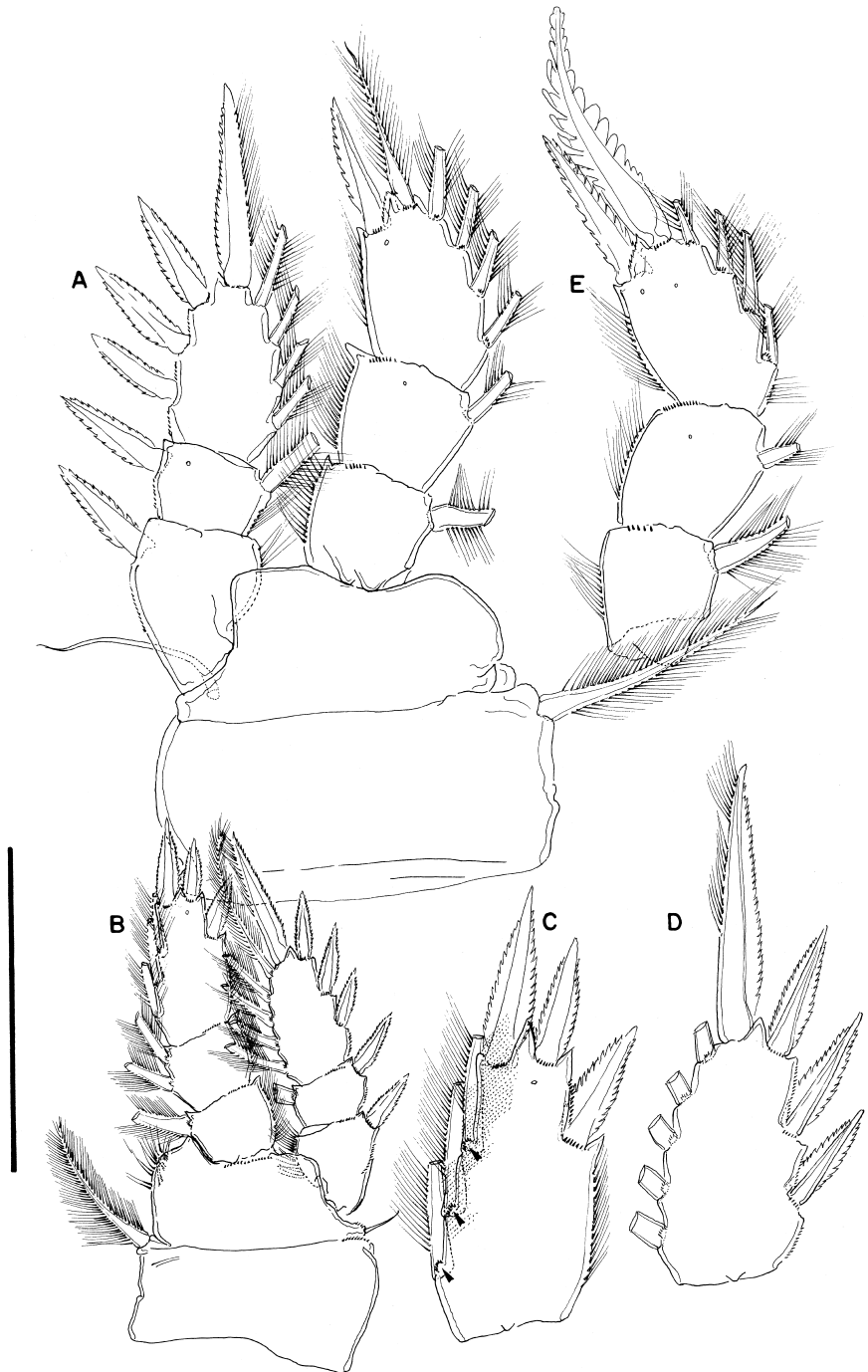


Fig. 5. *Kelleria reducta* sp. nov. A, female P1; B, female P2; C, female P2 third endopodal segment; D, female P2 third exopodal segment; E, male P1 endopod. Scale bar: A, C-E, 100  $\mu\text{m}$ ; B, 200  $\mu\text{m}$ .



Fig. 6. *Kelleria reducta* sp. nov. A, female P3; B, female P4; C, male P5; D, male P5 (another view); E, male P2 endopod; F, male P6. Scale bar: A, B, 200  $\mu\text{m}$ ; C, D, F, 50  $\mu\text{m}$ ; E, 100  $\mu\text{m}$ .

TABLE I  
Armature formula of female P1-P4 of *Kelleria reducta* sp. nov.

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

P5 (figs. 2A, 3A, C) with basal seta on surface of somite; free exopodal segment oval, ornamented with minute spinules along outer margin and along distal half of inner margin; with pointed process halfway inner margin; with small notch halfway outer margin; armed with two apical elements.

P6 (figs. 2A, 3A, C) represented by two setae (one of these very small) laterally on genital opercula.

Description of male. — Body (fig. 1B) as in female except for genital double-somite and second urosomite (the latter visibly larger in male). Total body length ranging from 850  $\mu\text{m}$  to 930  $\mu\text{m}$  (mean = 894  $\mu\text{m}$ ;  $n = 9$ ). Caudal rami (fig. 1C) as in female.

Antennule, antenna, mandible, and maxillule (not shown) as in female.

Maxilla (fig. 7A). General shape as in female, except for sexually dimorphic inner spine of basis and comparatively more slender surface seta.

Maxilliped (fig. 7B) sexually dimorphic; three-segmented; syncoxa large, unarmed; basis with two setae and ornamented with spinules along inner margin; endopodal segment small, unarmed; with long terminal claw accompanied by one anterior and one posterior accessory seta (one of these very small, arrowed in fig. 7B).

P1 as in female except for dimorphic apical spine of Enp3 (fig. 5E).

P2 as in female except for apparently dimorphic outer apical spine (fig. 6E).

P3-P4 (not shown) as in female.

P5 (fig. 6C, D) with basal seta arising from somite; free exopodal segment oval, with one spine and one seta apically.

P6 (fig. 6F) represented by two setae.

Remarks. — Humes & Boxshall (1996) created the poecilostomatoid family Kelleriidae to accommodate the genus *Kelleria*. The family was erected mainly based on the primitive state of the female maxilliped (with four elements on a well developed endopodal segment). After analysing the published evidence about the relationships between Cyclopoida and Poecilostomatoida, Boxshall & Halsey (2004) decided to consider the Poecilostomatoida as a lineage (i.e., the poecilostome families (Boxshall & Halsey, 2004: 41)) within the Cyclopoida. At present, there are ten valid species of *Kelleria* (not 11 as in Boxshall & Halsey,



Fig. 7. *Kelleria reducta* sp. nov. Male. A, maxilla; B, maxilliped (two setae of basis and small accompanying seta of endopodal claw arrowed). Scale bar: A, 100  $\mu\text{m}$ ; B, 143  $\mu\text{m}$ .

2004). Humes & Boxshall (1996) also erroneously recognized ten species, even though no species were added to the genus since Humes & Stock's (1973) revision (see also Kim, 2000). With the description of *K. reducta* sp. nov., the number of valid species is raised to 11. These are: *K. regalis*, *K. andamanensis* Sewell, 1949, *K. australiensis* Bayly, 1971, *K. camortensis* Sewell, 1949, *K. gradata* Stock, 1967, *K. pectinata*, *K. propinqua*, *K. purpurocincta*, *K. rubimaculata* Krishnaswamy, 1952, *K. vaga*, and *K. reducta* sp. nov.

*Kelleria reducta* sp. nov. keys out at *K. propinqua* in Humes & Stock's (1973) key, except for the presence of two mediobasal teeth on the mandibular blade that are much larger than the others in *K. reducta* sp. nov. (instead of only one tooth being much larger than the others in *K. propinqua*). According to T. Scott's (1894, pl. 13 figs. 49-56, pl. 14 figs. 1-4) description and illustrations of *K. propinqua*, some other differences were observed: (a) third segment of female maxilliped with two long setae and two spines laterally and one spine apically in *K. propinqua*, three lateral spines and one apical seta in *K. reducta* sp. nov.; (b) basis of maxilliped unarmed in *K. propinqua* (though this could be a misinterpretation), with two setae in *K. reducta* sp. nov.; (c) with one claw (one of the claws could have been masked by the other in T. Scott's (1894) dissection) and five setae on the last segment of the antenna in *K. propinqua*, with two curved claws and five setae in *K. reducta* sp.

nov.; (d) with two long accompanying setae on the male maxillipedal claw in *K. propinqua*, but with one long and one very small seta in *K. reducta* sp. nov.

Given the present knowledge of the genus, Humes & Stock's (1973) key to the species of *Kelleria* is amended as follows:

KEY TO THE SPECIES OF THE GENUS *KELLERIA*

1. Proximal spine on second segment of maxilliped with a large lateral spinule producing a bifid appearance ..... 2
  - This spine regularly pectinate or plumose, without such a spinule ..... 3
2. Body length not less than 1.25 mm, average 1.3 mm .....
  - ..... *K. regalis* Gurney, 1927
  - Body length 0.7 mm ..... *K. rubimaculata* Krishnaswamy, 1952
3. Medial margin of leg 5 with one or two pointed processes ..... 4
  - Medial margin of leg 5 with an obtuse swelling or straight ..... 7
4. Medial margin of leg 5 with one pointed process ..... 5
  - Medial margin of leg 5 with two pointed processes .....
    - ..... *K. australiensis* Bayly, 1971
5. Mediobasal tooth of mandibular blade not oversized .....
  - ..... *K. purpurocincta* Gurney, 1927
  - With one or two mediobasal teeth of mandibular blade much larger than the others ..... 6
6. With one mediobasal teeth of mandibular blade much larger than the others, maxillipedal claw with two long accompanying setae .....
  - ..... *K. propinqua* (T. Scott, 1894)
  - With two mediobasal teeth of mandibular blade much larger than the others, maxillipedal claw with one long and one reduced accompanying seta .....
    - ..... *K. reducta* sp. nov.
7. Medial teeth of lash of second maxilla graded in size, with five or six teeth in all .....
  - ..... *K. gradata* Stock, 1967
  - Medial teeth of lash of second maxilla irregular in size (long and short teeth mixed), with seven to 10 teeth in all ..... 8
8. Basal spine of second segment of maxilliped unilaterally pectinate ..... 9
  - Basal spine of second segment of maxilliped bilaterally with barbules ..... 10
9. Free segment of leg 5 about 5 times as long as wide .....
  - ..... *K. andamanensis* Sewell, 1949
  - Free segment of leg 5 about 3 times as long as wide .....
    - ..... *K. pectinata* (A. Scott, 1909)
10. Caudal rami 2.75 times longer than wide, with two subequal apical setae on the free exopodal segment of P5 .....
  - ..... *K. camortensis* Sewell, 1949
  - Caudal rami 4.76 times longer than wide, with one spine and one seta apically on the free exopodal segment of P5 ..... *K. vaga* Kim, 2000

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