

NEW RECORDS AND TAXONOMIC REEXAMINATION OF THE GENUS *KELLERIA* (COPEPODA, POECILOSTOMATOIDA, LICHOMOLGIDAE) FROM INDONESIAN WATERS

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ABSTRACT

Taxonomy and distribution were studied on the species of the family Lichomolgidae recently collected from 4 sites in Indonesian waters. Three species were recorded, including Kellera pectinata (A. Scott, 1909) has been recorded previously from Indonesian waters, and Kellera australiensis Bayly, 1971 and Kellera regalis Gurney, 1927 were new records for the area. The distribution of these species in Indonesian waters and other regions in the world is compiled and discussed.

Key words: *kellera, lichomolgidae, poecilostomatoida, copepoda, Indonesia, taxonomy*

INTRODUCTION

Only a few studies on the taxonomy and biogeography of Indonesian poecilostomatoid copepods, chiefly the family Lichomolgidae has been carried out previously. Brady's (1883) papers are the first report dealing with Indonesian copepods collected from a few stations in Buru Sea, Banda Sea and Celebes Sea. Collections of copepods have also been reported from other expeditions such as Valdivia (1898) from the Indian Ocean side of western Sumatra, and Snellius (1929) from Buru-Ambon Islands. Scott (1909) dealt with copepods including some species of Poecilostomatoida in Indonesian waters using the samples collected during the Siboga Expedition (1899–1900). Additional species of copepods from Indonesian waters were reported by Cleve (1901) from Bali and Bangka Straits, Carl (1907) from Ambon Bay, Früchtl (1924) from Aru Islands, and Delsman (1939, 1949) from Jakarta Bay and Sunda Strait. However, there has been no comprehensive study on the Indonesian poecilostomatoid copepods so far.

The species of the genus *Kellera* Gurney, 1927 are free-living crustacean in intertidal burrows or associated with crinoids. Currently, the literature indicates 11 known species, *K. andamanensis* Sewell, 1949; *K. australiensis* Bayly, 1971; *K. camortensis* Sewell, 1949; *K. fucicola* (Scott, 1894); *K. graduata* Stock, 1967; *K. gurneyi* Sewell, 1949; *K. pectinata* (Scott, 1949); *K. propinqua* (Scott, 1894); *K. purpurocinta* Gurney, 1927; *K. regalis* Gurney, 1927; and *K. rubimaculata* Khrisnaswamy, 1952 as widely accepted taxa world wide. In Indonesian waters, hitherto, only one species, *K. pectinata* was described by Scott (1909) from a single female collected in surface tow from the Bali Sea as *Pseudanthessius pectinatus*. In the present study three

species of *Kellera*, *K. pectinata*, *K. australiensis*, and *K. regalis* are described and illustrated based on specimens collected in coastal waters of Java and Lembah Strait, Bitung, North Celebes.

This paper deals with redescription and illustration of all species collected. It provides a key for their identification, and a discussion on their geographic distribution.

MATERIAL AND METHODS

The present samples were obtained from 4 sites (Figure 1) during 1993–2003. All stations were located near the coast. Samples were collected by surface or vertical hauls (from 5 m, 10 m, and 20 m depth to the surface) of conical plankton nets (0.10 mm and 0.33 mm mesh size, 0.35 m and 0.45 m mouth diameter, respectively) at day- and nighttime. The samples were fixed and preserved in 5% buffered formaldehyde/sea water solution. As far as possible, the specimens were identified to the species level by dissection and examination with a camera lucida.

Abbreviations used in the text to describe morphological features are: A1, antennule; A2, antenna; Ms1–Ms6, metasomal somites 1–6; P1–P6, swimming legs 1–6; Ur1–Ur6, urosomal somites 1–6; CR, caudal rami; Re, exopod; Ri, endopod; Se, outer spine; Si, inner spine; St, terminal spine.

DESCRIPTIONS

Genus *Kellera* Gurney, 1927

Diagnosis. Body cyclopiform. Urosome in female 5 somites, and 6 somites in male. CR with 6 setae. Rostrum rounded posteroventrally. A1 7-segmented, in female with

the armature 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete; in male with 4, 13 + 2 aesthetes, 6, 3 + 1 aesthete, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. A2 4-segmented, with formula 1, 1, I + 2, and II + 5, the claws being slender and setiform. Labrum with a deep indentation, bearing on its convex side a patch of spinules followed by a row of conspicuous spiniform teeth which grade into small spinules on the lash and on its concave side a row of stout spines; lash moderately long. Paragnath a small lobe with hairlike spinules. Maxillule with 4 elements, maxilla 2-segmented, with usual lichomolgid components but the lash short and stout, forming an angle with the segment and bearing irregularly sized spines; the element next to the lash a strongly barbed spine. Maxilliped in the female 3-segmented, with the proximal seta on the 2nd segment bearing 1 or 2 spinules on its proximal margin, and with the small 3rd segment having 4 elements; in the male 4-segmented (assuming that their proximal part of the claw represents a 4 segments).

P1-P4 with 3-segmented rami except for Ri of P4 II, I, 5. Ri of P4 with the formula II, 1. Armature similar in both sexes except for Ri of P1 in male where 3rd segment is I, I, 4 instead of I, 5 as in the female. P5 with a free segment bearing 2 terminal elements. P6 in female represent by 2 setae and spiniform process near the area of attachment of each egg sac; in male by a posteroventral flap on the genital segment bearing 2 setae.

Kelleria australiensis Bayly, 1971

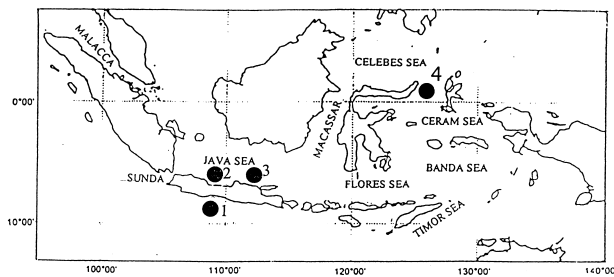


Figure 1. Map of Indonesian waters showing the study sites 1–4. Notes: 1 = Cilacap; 2 = off Tegal; 3 = off Surabaya; 4 = Lembeh Strait

Kelleria australiensis Bayly, 1971: 111–116, 2 figs (Type locality: brackish waters, Victoria, Australia); Humes and Stock, 1973: 186; Bayly, 1975: 46, Table 1; Arnott and Kinnon, 1981: 284–286, fig. 4.

Kelleria queenslandica, Hailstone *et al.*, 1978: 119

Material examined. Five females (1.20–1.25 mm), 3 males (0.98–1.01 mm) collected from Cilacap Bay by

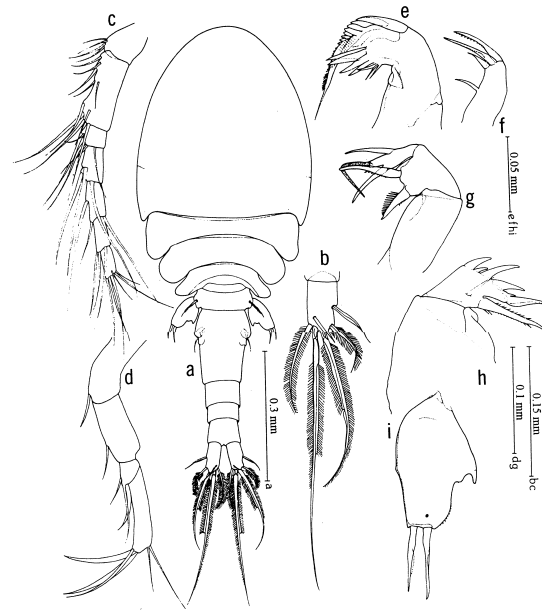


Figure 2. *Kelleria australiensis* Bayly, 1971. Female. a, whole animal, dorsal view; b, right CR, dorsal view; c, antennule; d, antenna; e, mandible; f, maxillule; g, maxilla; h, maxilliped; i, 5th leg.

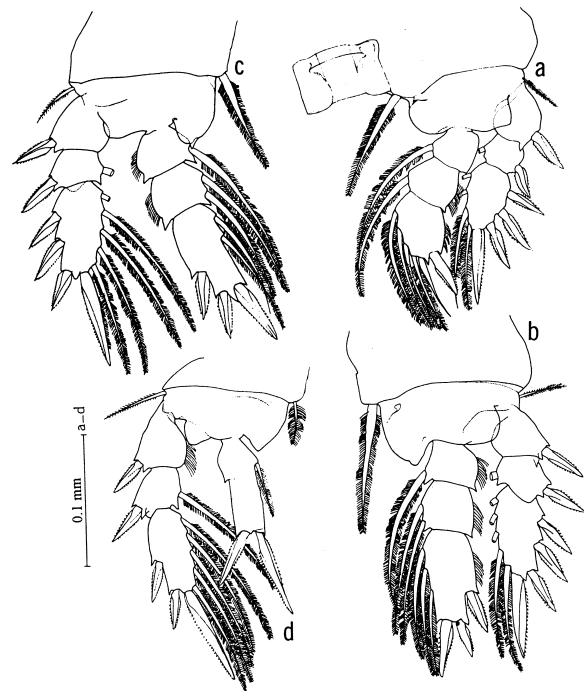


Figure 3. *Kelleria australiensis* Bayly, 1971. Female. a–d, 1st 4th legs.

surface tow of a 0.33 mm mesh plankton net tows at day- and nighttime on 19 May 1993.

Female. Prosome about 1.65 times as long as maximum width, and about 1.5 times as long as urosome excluding caudal setae. CR about 2.5 times as long as maximum width.

Large genital somite of urosome expanded laterally about two-fifths of length from proximal end. Area of attachment of egg sac bearing moderately long seta (with sharp spine present at base) on lateral margin, and group of 3 spines and 2 papillae on dorsal surface. Three postgenital segments naked. CR with 6 setae, characteristics of genus, and terminating in small rounded flange on ventral surface. Two inner of 4 terminal setae on CR reduced in width and with same arrangement of hairs. Oval egg sacs extending to distal end of preanal somite of urosome and containing greater number of eggs.

A1 7-segmented, not reaching distal end of Ms1 when folded backwards. Armature of A1 with setal formula 4, 13 (5 + 8), 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Terminal segment of 4 segmented A1 with 2 claws and 5 setae, and 1 of 3 elements on segment 3 forming claw. Outer margins of 2nd and 4th segments with row of very small spinules.

A2 4-segmented, ending in 2 claws and 4 setae. Mandible with 18 spines along outer margin, these spines gradually smaller distally, terminating in spike-like process with fine secondary hair-like processes, cluster of about 8 spines present on concave or inner margin. Mandible with small cluster of long hairs or spinules on convex margin.

Maxillule small, unsegmented, terminating in 3 spines, outer one with secondary process, and 1 median blunt-spur along concave side. Maxilla 2-segmented, distal segment with 5 large and 2 small spines and 1 seta. Maxilliped 3-segmented, 2nd segment with 2 large spines, 1st spine serrated, 2nd spine longer than 1st one, serration on inner margin; distal segment with 4 setae (2 on anterior edge, 1 on posterior edge and 1 long slender terminal seta).

P1-P4 with following armature (spine in Roman and seta in Arabic numerals); Ri I, I, 4-2-0; I, 2, 3-2-1; I, 2, 2-2-1; I-2-0 (or I, 0-2-0), and Re 0, I, 4-2-2; 0, I, 5-2-2; 0, I, 5-2-2; 0, I, 5-2-1, respectively. Ri of P4 usually 1-segmented, but with suture between point of insertion of seta and inner process giving apparent 2-segmented condition, with 2 terminal spines denticulated on both margin, shorter outer spine also possessing bifid tip. Inner distal corner of Ri produced into sharp projection. P5, 1-segmented, twice as long as wide, with 2 lobes on inner margin, proximal lobe longer and pointed in dorsal view, adjacent slightly more distal lobe with serrated border. Both margins of segment also serrated distally. Two terminal setae present, inner one stronger and blunt at tip.

Male. General appearance as in female. A1 similar to that of female but 3 aesthetes added, 2 on 2nd segment and 1 on 4th segment. Urosome consisted of 6 somites, Ur2 much

enlarged, longer than Ur3 and Ur4 combined. Maxilla differs than female in most spine with larger accessory spines along proximal half of distal edge. Maxilliped 3-segmented, prehensile, distal segment modified into long curved claw with seta proximally, 2nd segment with elongated with swathe of spines restricted to elongates area facing claw, about half length of claw, 2 setae present on inner margin of 2nd segment.

P1-P4 similar to female but some sexual dimorphism evident for endopods of P1 and P2. Ri of P1 strongly geniculate between 2nd and 3rd segments, and distalmost of 5 setae on 3rd segment in female replaced by large spine with obtuse lateral spinules. Third segment on Ri of P2 with atypical outer terminal spine naked except for 2 or 3 small proximal denticles. P5 single elongated segment bearing terminal spine and seta; shorter inner spine denticulated along outer margin. P6 present on expanded genital segment, consisting of posteroventral flap armed with 2 naked setae and small spiniform process.

Remarks. The present species resembles *K. australiensis* Bayly in general appearance, but it is distinguishable from the latter by the combination of mouthparts, the segmentation of antennule and antenna and the form of 5th legs.

Kelleria regalis Gurney, 1927

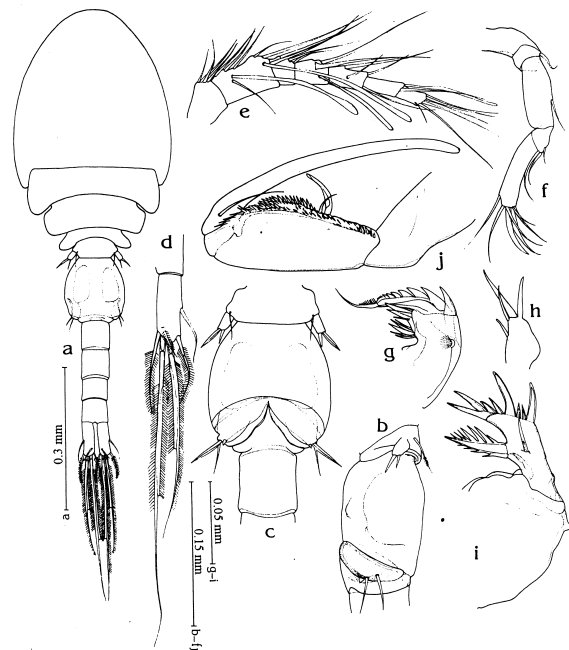


Figure 4. *Kelleria australiensis* Bayly, 1971. Male. A, whole animal, dorsal view; b, genital complex, lateral view; c, genital complex, ventral view; d, right CR; e, antennule; f, antenna; g, mandible; h, maxillule; i, maxilla; j, maxilliped.

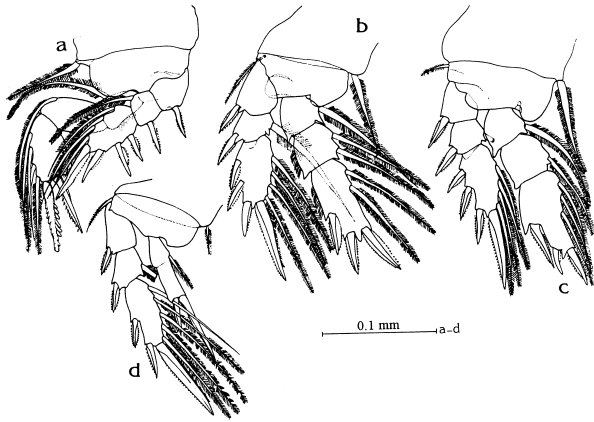


Figure 5. *Kelleria australiensis* Bayly, 1971. Male. A–d, 1st 4th legs.

Kelleria regalis Gurney, 1927: 471–474, figs. 116–117 (Type locality: Suez Canal); Marques, 1961: 47, pls. 1c–f, 2a; Humes and Ho, 1969a: 221–225, figs. 1–30; Humes and Ho, 1973: 186, fig. 105a–f. *Kelleria* sp. Bayly, 1983.

Material examined. Two females (1.09 mm) collected from off Surabaya, east Java by surface tow of a 0.33 mm mesh plankton net at day and nighttime on 9 June 1994.

Female. Prosome moderately slender, a little thickened dorsoventrally, and a slender elongated urosome. Urosome composed of 5 somites, genital complex elongated, in dorsal view somewhat expanded on its anterior two-fifths and narrower with nearly parallel sides on its posterior three-fifths. Egg sacs located laterally on the anterior expanded portion of segment. Ur2 longer than Ur3 and Ur4 combined; anal segment has a row of minute spinules posteriorly along dorsolateral and ventrolateral margins. CR moderately elongated, twice as long as wide, outer seta long and naked, other setae have lateral spinules. A1 7-segmented, not reaching distal end of Ms1, with armature 4, 13 (5 + 8), 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete, 2nd segment the longest. A2 4-segmented, distal segment with 2 claws and 4 setae. Mandible with about 13 various in shape of teeth along outer margin, proximal teeth long as rounded to minute serrations distally, ending in long spine-like process with hair-like accessory; inner margin with 8 fine spines. Maxillule small, unsegmented, with 3 apical spines and 1 inner blunt spur on middle. Maxilla 2-segmented, distal segment with 4 long and 3 small spines, and 1 seta, distal spine armed with 9 anterior and 6 posterior secondary spines. Maxilliped 3-segmented, 2nd segment with 2 large spines, proximal spine with large lateral spinule not bifid at apex, 2nd segment with large spinule medially; 3rd (distal) segment with 4 spines (3 at apex and 1 (the longest) on posterior edge).

P1–P4 with following armature (spines in Roman and setae in Arabic numerals); Ri I-0, I-0, II-II-4; I-1, I-0, I-1; II-II-5; I-0, I-1; II-II-5; I-0, I-1; I-II-5 and Re 0-1; 0-1; 0-II-4; 0-1; 0-2; I-II-3; 0-1, 0-2, I-II-2; 0-II-1, respectively. P4, proximal 1/3 with accessory small spine, between accessory and seta without suture. P5 unsegmented, twice as long as wide, with 2 lobes on middle inner margin, distal lobe much longer and larger than proximal one, outer margin with accessory small spine, and 2 unequal apical spines, inner one longest. P6 is probably represented by the 2 setae near the attachment of each egg sac.

No male was found in the present samples.

Remarks. The present female 5th legs resembles with the abnormal form of 5th legs of *K. regalis* Gurney, 1927 figured by Humes & Ho (1969: 221–229, pl. 4, fig. 21). In having 2 lobes on inner margin of the 5th legs, but it is distinguished from the latter by the proportional lengths of prosome and urosome, and the combination characters of the mouthparts.

Kelleria pectinata (Scott, 1909)

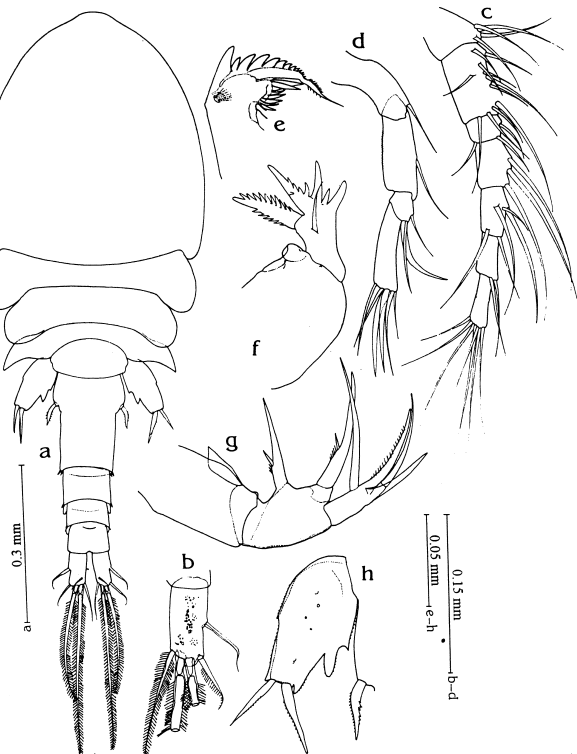


Figure 6. *Kelleria regalis* Gurney, 1927. Female. a, whole animal, dorsal view; b, ringed CR, dorsal view; c, antennule; d, antenna; e, mandible; f, maxilla; g, maxilliped; h, 5th leg.

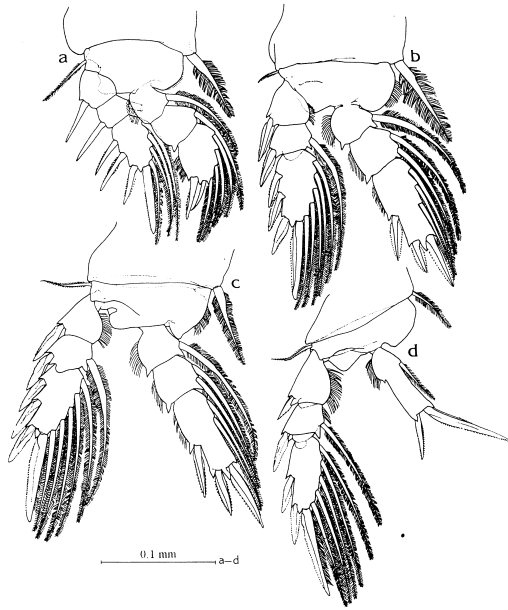


Figure 7. *Kelleria regalis* Gurney, 1971. Female. a–d, 1st–4th legs.

Pseudhantessius pectinatus A. Scott, 1909: 268–269, pl. 68, figs. 21–27 (Type locality: Bali Sea 8°0.3'S 116°59'E).

Kelleria pectinata, Humes and Ho, 1969a: 225–228, figs. 31–53; Humes and Ho, 1973: 186.

Material examined. Two females (1.30 mm) collected off Tegal, Central Java by surface tow of 0.1 mm mesh plankton net at night on 3 June 1994.

Female. The body elongated and narrow. Ratio of length to width of prosome 1.6 : 1. Proportional lengths of prosome and urosome 4 : 3. Cephalon rounded anteriorly. Posterolateral ends of Ms4 narrow and rounded; distal end of Ms5 considerably expanded. Urosome composed of 4 somites, Ur1 long, as long as Ur2, Ur3 and Ur4 combined, proximal end of somite expanded, distal end slightly contracted. Ur2 1.5 times as long as Ur3; anal somite longer than Ur3. CR rather short and ovate, as long as Ur2, with 2 outer and 3 apical setae.

A1 moderately long, 7-segmented, 2nd segment with 3 long slender spines and 4 setae, 2 inner spines are shorter than outer spine and fringed on external margin with short hairs. Mandible, apex is stylet-shape, basal portion very broad and with coarse denticles at upper margin. Maxillule rather stout, with 2 marginal setae and 2 apical setae. Maxilla produced into a short stout blunt stylet, which terminating in a stout spine, upper margin armed with 6 moderately stout teeth. Inner margin of apical segment furnished near base with strong and fine tooth. Maxilliped 3-segmented, upper margin of 2nd segment armed with 2 very stout spines. Outer margin of proximal spine armed with 11 moderately long and slender spines. Distal spine with fringe of short hairs

on inner margin; 3rd segment short, terminating in 1 long, stout and curved claw and 2 short spines.

P1–P3 with 3-segmented rami; P4 with 3-segmented Re and 1-segmented Ri. P5 slender and elongated, with a slight inner proximal expansion, 3,5 times as long as maximum width, outer terminal element is setiform and naked.

No male was found in the present samples.

Remarks

The female of this species resembles *K. propinqua* (Scott, 1894), but it is distinguished from the latter by the form of 2nd pair of maxilliped, proximal spine on 2nd segment of *K. propinqua* without fringe of long spinules, and the long apical claw on 3rd segment.

Results and Discussion

A total of 3 species of *Kelleria* were identified in the present study. *K. pectinata* has been recorded from Indonesian waters by previous expedition report, while 2 others species, *K. australiensis* and *K. regalis* are new records for the area. The occurrence, geographic ranges, and habitats of all the recorded species are listed in Table 1. One species, *K. regalis* belongs to the Indo-Pacific species, while 2 others species, *K. australiensis* and *K. pectinata* have recorded only from the Australian and Indonesian waters, respectively. *K. australiensis* was considered to be endemic to the Australian waters before this study, and *K. pectinata* has been recorded to be endemic species for Indonesian waters.

Table 1. Table 1. List of the species of *Kelleria* recorded in the present study, their sampling sites and their previous records in Indonesian waters, neighbouring areas and the major oceans. % = present records, % = previous records, Nr = new records, previous records from A = Indonesian waters, B = Australian waters, C = China Seas, I, P, At = Indian, Pacific and Atlantic Oceans, N = neritic.

No.	Species	Sites				Neighbour. areas			Remarks
		1	2	3	4	A	B	C	
1.	<i>Kelleria australiensis</i>	○			○	Nr	●		N
2.	<i>Kelleria pectinata</i>		○			●			N
3.	<i>Kelleria regalis</i>			○		Nr			I-P N

Based on their horizontal distribution and habitats, copepods are divided into 5 species groups: oceanic, neritic-oceanic, neritic, estuarine-neritic, and estuarine (Park, 1970; Kim, 1986; Madhupratap and Haridas, 1986). According to these groups, all of the recorded species are

classified as neritic species. *K. regalis* and *K. pectinata* were only recorded from Java Sea (off Tegal and off Surabaya), while the remain species, *K. australiensis* recorded from Cilacap Bay (the mangrove estuary facing the Indian Ocean) and Lembah Strait, Bitung, North Celebes.

Taxonomy and distribution remarks

The genus *Kelleria* Gurney, 1927 consists of 11 known species. In Indonesian waters, hitherto, only one species, *K. pectinata* was recorded. This species described as *Pseudhantessius pectinatus* by Scott (1909) based on a single female specimen found in Bali Sea. Although it is impossible to learn the exact nature of certain structures from Scott's (1909) description and figures, the similarities with the present specimens have led me to conclude that my material from off Tegal (Site 2) represent *K. pectinata*. Among striking similarities in the female are: the form of the antennule and its terminal elements, the nature of the mandible, and the armature of the maxilliped, especially on the last segment. The female described by Scott (1909) was a little longer (1.35 mm) than the present specimens. His description and figures of the genital somite, the CR, and the 5th legs, though rather cursory, suggest resemblances with my material. His figure of the maxilla, shows a somewhat different number and arrangement of the spines on the short lash. Since variation in these spines exist in *Kelleria* it is very possible that Scott's (1909) description of the spines in his single female may represent individual variation.

K. australiensis described for the first time from brackish waters Victoria, Australia. This species was found from Sites 1 and 4 (Cilacap Bay and Lembah Strait). Thwin (1972) in his unpublished thesis description of *K. queenslandica* from the Brisbane River estuary, compared his material with Bayly's (1971) description of *K. australiensis* and listed 11 points difference. However, many of the differences concerned relatively minor details on less structures, whereas the main features of the mandible, maxilla, and maxilliped were the same.

K. regalis established by Gurney (1927) from the Suez Canal. These species were found from Site 3 (off Surabaya). Humes and Ho (1969) found this species from Madagascar. Bayly (1975) described *Kelleria* sp. nov. based on specimens collected from Australian waters. It should be noted that Bayly's (1975) species of *Kelleria* was incorrectly referred to as *Kelleria* sp. nov. Examination of the material by Arnott and McKinnon (1981) showed that this species was, in fact, *K. regalis*, and the species were structurally more similar to

Gurney's (1927) Suez Canal specimens than those from Madagascar (see, discussion in Humes & Ho, 1969: 225).

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