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NEW RECORDS AND TAXONOMIC REEXAMINATION OF THE GENUS *CENTROPAGES* (COPEPODA: CALANOIDA), WITH NOTES ON THEIR GEOGRAPHIC DISTRIBUTION IN INDONESIAN WATERS

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ABSTRACT. - Very few studies on the taxonomy and biogeography of the genus *Centropages* from Indonesian waters have been carried out. The present paper deals with relevant information on the description and illustration of seven species of *Centropages* collected from 15 stations in Indonesian waters. Four out of five previously known species, i.e., *C. calaninus* (Dana, 1849); *C. furcatus* (Dana, 1849); *C. gracilis* (Dana, 1849); *C. orsini* Giesbrecht, 1896; except *C. elongatus* Giesbrecht, 1896, have been recorded. Three species i.e., *C. brevifurcus* Shen & Lee, 1963; *C. sinensis* Chen & Zhang, 1965; and *C. tenuiremis* Thompson & Scott, 1903, are new records for the area.

KEYWORDS. - New records, genus, *Centropages*, Calanoida, Copepoda, Indonesia, taxonomy, biogeography.

INTRODUCTION

The species of the genus *Centropages* Kroyer, 1849, are surface-living forms, and most of them are widely distributed in warm waters. Some of the species are primarily neritic, others are oceanic. Contributions by Giesbrecht (1892, 1895), Thompson & Scott (1903), Sewell (1912, 1914, 1932) and Mori (1937) provide the frame work for the genus and its taxa in the region under consideration. Currently, the literature indicates 23 nominal species as widely accepted taxa world-wide.

In Indonesian waters, hitherto five species of *Centropages* have been reported (Cleve, 1901; Carl, 1907; A. Scott, 1909; Delsman, 1939). The species thus recorded are: *C. calaninus* (Dana, 1849); *C. furcatus* (Dana, 1849); *C. gracilis* (Dana, 1849); *C. orsini* Giesbrecht, 1896; and *C. elongatus* Giesbrecht, 1896. All of these, except *C. elongatus* have been encountered

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in this study, while 3 other species, i.e., *C. brevifurcus* Shen & Lee, 1963; *C. sinensis* Chen & Zhang, 1965; and *C. tenuiremis* Thompson & Scott, 1903, represent new records for Indonesian waters.

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. A overview of all the nominal species (both valid species and synonyms) hitherto described from the world oceans, has also been included.

MATERIAL AND METHODS

The present plankton samples, many of which were kindly provided by collections of the Research and Development Centre of Oceanology, Indonesian Institute of Sciences (LIPI), were collected at 15 stations in Indonesian waters during 1985-1995 (Fig. 1; Table 1). All stations except that in the Flores Sea were located near the coast. Sampling was done by surface and vertical hauls (from 10 m, 100 m or 200 m deep to the surface) with plankton nets (0.1 mm and 0.33 mm mesh size; 0.35 m and 0.45 m diameter mouth aperture) at day- and nighttime.

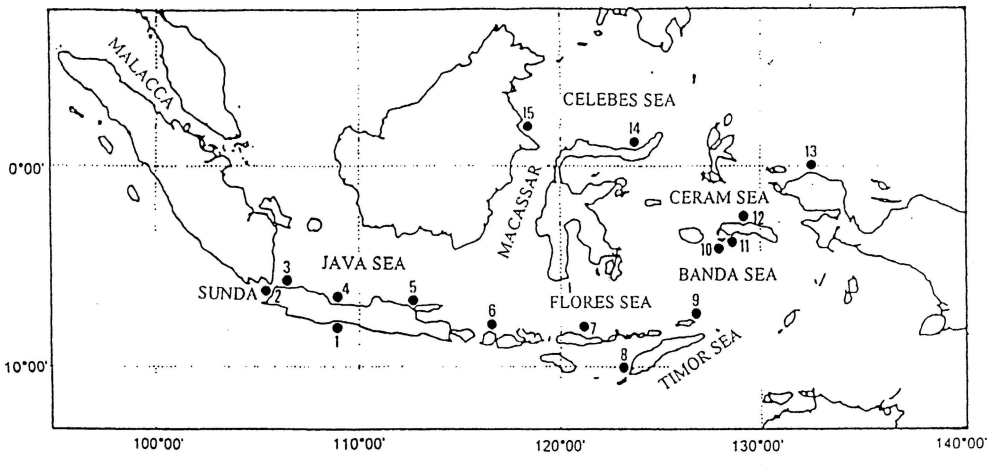

Fig. 1. Map of Indonesian waters and sampling sites.

Abbreviations used in the text to describe morphological features are: A1 = antennule, A2 = antenna, Ms1-Ms5 = metasomal somites 1-5, P1-P5 = swimming legs 1-5, Ur1-Ur5 = urosomal somites 1-5, CR = caudal rami, B1-B2 = basipods 1-2, Re = exopod, Ri = endopod, St = terminal spine, Se = outer spine, Si = inner spine.

Key to the species of *Centropages* in Indonesian water

Female

1. Posterolateral ends of Ms5 pointed 2
- Posterolateral ends of Ms5 rounded 7

2. Posterolateral ends of Ms5 with accessory spines ..... *C. furcatus*
- Posterolateral ends of Ms5 without accessory spines 3

3. Spine-like process of Re2 of P5 extending beyond distal end of Re3 ..... *C. elongatus*
- Spine-like process of Re2 of P5 not extending beyond distal end of Re3 4

4. Ur1 with ventral spine-like process ..... *C. tenuiremis*
- Ur1 without any processes 5

5. Posterolateral ends of Ms5 and Ur1 symmetrical ..... *C. orsini*
- Posterolateral ends of Ms5 and Ur1 asymmetrical 6

6. Distal end of Ur1 with knob-like process on right margin ..... *C. brevifurcus*
- Distal end of Ur1 without knob-like process on right margin ..... *C. sinensis*

7. Ur1 with spinules on right lateral margin, CR symmetrical ..... *C. gracilis*
- Ur1 without spinules on right lateral margin, CR asymmetrical ..... *C. calaninus*

Male

1. Posterolateral ends of Ms5 pointed 2
- Posterolateral ends of Ms5 rounded 6

2. Posterolateral ends of Ms5 with accessory spines on inner side ..... *C. furcatus*
- Posterolateral ends of Ms5 without accessory spines on inner side 3

3. Outer spine of Re2 of P4 asymmetrical, right side longer than left ..... *C. tenuiremis*
- Outer spine of Re2 of P4 symmetrical 4

4. Third outer spine of Re3 of P4 symmetrical 5
- Third outer spine of Re3 of P4 asymmetrical, right side hook-like ..... *C. sinensis*

5. Terminal spine of Re3 of right P5 longer than "thumb" ..... *C. orsini*
- Terminal spine of Re3 of right P5 shorter than "thumb" ..... *C. brevifurcus*

6. Terminal spine of Re3 of right P5 sharply bent ..... *C. calaninus*
- Terminal spine of Re3 of right P5 smoothly curved 7

7. Terminal spine of Re3 of right P5 with an inner triangular process ..... *C. gracilis*
- Terminal spine of Re3 of right P5 without inner triangular process ..... *C. elongatus*

DESCRIPTIONS

Centropages brevifurcus Shen & Lee, 1963

(Fig. 2)

Centropages brevifurcus Shen & Lee, 1963: 593, figs. 11-14; Chen & Zhang, 1965: 127; Chen, 1986: 524.

Material examined. - Ten females (1.27-1.38 mm), 10 males (1.10-1.16 mm) collected off Tegal, Central Java by surface tow of 0.33 mm mesh plankton net at night on 3 Jun.1994.

Female. - Cephalosome narrowed anteriorly with rounded projection posteriorly. Rostrum biramous with short filaments. Cephalon and Ms1 separated; Ms4 and Ms5 separated, posterolateral ends produced into asymmetrical acute process on left side; right side produced into acute and curved process, each armed with 2 short spines situated rather toward ventral side. In lateral view, posterolateral ends of Ms5 trifurcate.

Table 1. Sampling sites, dates and number of samples in Indonesian waters.

Sites	Position	Date	Depth of hauls	Number of stations	Number of samples
1. Cilacap Bay, Central Java	07°40'S 109°00'E	19 May 1993	10 m	9	76
		6 June 1994			12
2. Off Labuan, West Java	06°10'S 106°00'E	11 May 1993	15 m	6	34
		18 June 1994			72
3. Jakarta Bay-Seribu Islands	06°00'S 106°45'E	1-2 June 1994	25 m	3	48
4. Off Tegal, Central Java	06°40'S 109°10'E	3-4 June 1994	10 m	5	71
5. Off Surabaya, East Java	07°10'S 109°10'E	8-9 June 1994	10 m	3	64
6. Sumbawa Sea	08°40'S 112°45'E	4 September 1993*	100 m	2	3
7. Flores Sea	07°29'S 121°05'E	15 February 1985*	200 m	2	3
8. Kupang Sea	10°20'S 123°00'E	15 December 1994*	100 m	2	3
9. Banda Sea	07°39'S 126°50'E	29 July 1992*	100 m	2	3
10. Ambon Bay	03°40'S 128°10'E	18 July, 12 Dec. 1993+	25 m	6	10
		13-14 March 1995			91
11. Haruku Strait	03°40'S 128°00'E	2 August 1983*	100 m	1	3
12. Ceram Sea	03°16'S 129°00'E	23 July 1991	100 m	3	3
13. Sorong Sea	00°20'S 132°10'E	25 January 1995*	100 m	3	3
14. Off North Celebes	01°30'N 124°10'E	6/9 October 1994*	100 m	3	3
15. Derawan Strait, Borneo	02°12'N 118°17'E	22 October 1994*	100 m	3	3

Notes : * samples obtained from collection of LIPI
+ samples provided by Mr. T. Sidabutar

Genital complex widest part of Ur, asymmetrical, 1.5 times as long as Ur3, anterolateral swelling armed with spinules that extend to dorsal and ventral surfaces, right margin with distolateral knob-like process. Ur2, asymmetrical, right margin with knob-like process medially. Anal somite almost symmetrical, expanded posteriorly, as long as CR. CR symmetrical, divergent, 1.4 times as long as wide, with 5 plumose and 1 small setae on each side.

A1 22-segmented, reaching distal end of Ms5 when folded backwards. Number and relative lengths of basal segments not easily determined, apparently several segments fused together to form 2nd segment, segments 8 and 9, and 24 and 25 partially fused.

P1-P4 resemble those of *C. tripinosa* in general structure, but B1 with a process. B2 of P1 with 1 distolateral seta. P5 symmetrical, with 2 basal segments, 3 exopodal and 3 endopodal segments. B1 with 1 distolateral spine; B2 with small outer seta; Re2 with inner spine-like process, longer than the segment itself, serrated and swollen at apex; Ri as long as Re1 and Re2 combined, inner margin of Re1 with 1 rounded process on distal end.

Male. - Prosome similar to female, posterolateral ends of Ms5 sharply pointed, symmetrical; each armed with 2 spinules situated rather toward ventral side. In lateral view, posterolateral ends of Ms5 trifurcate.

Genital somite short, slightly asymmetrical, left side slightly produced posterolaterally, as long as Ur4. Ur2 longest; anal somite very short; CR as in female.

Right A1 geniculate, 23-segmented, anterior margin of segment 17 with row of teeth arising from proximal to distal end, somewhat longer than the segment, and extending over proximal part of segment 18. Segment 18 with double rows of teeth, covering almost whole length of segment and produced as knee-like process. Fused segments 19-21 with double rows of

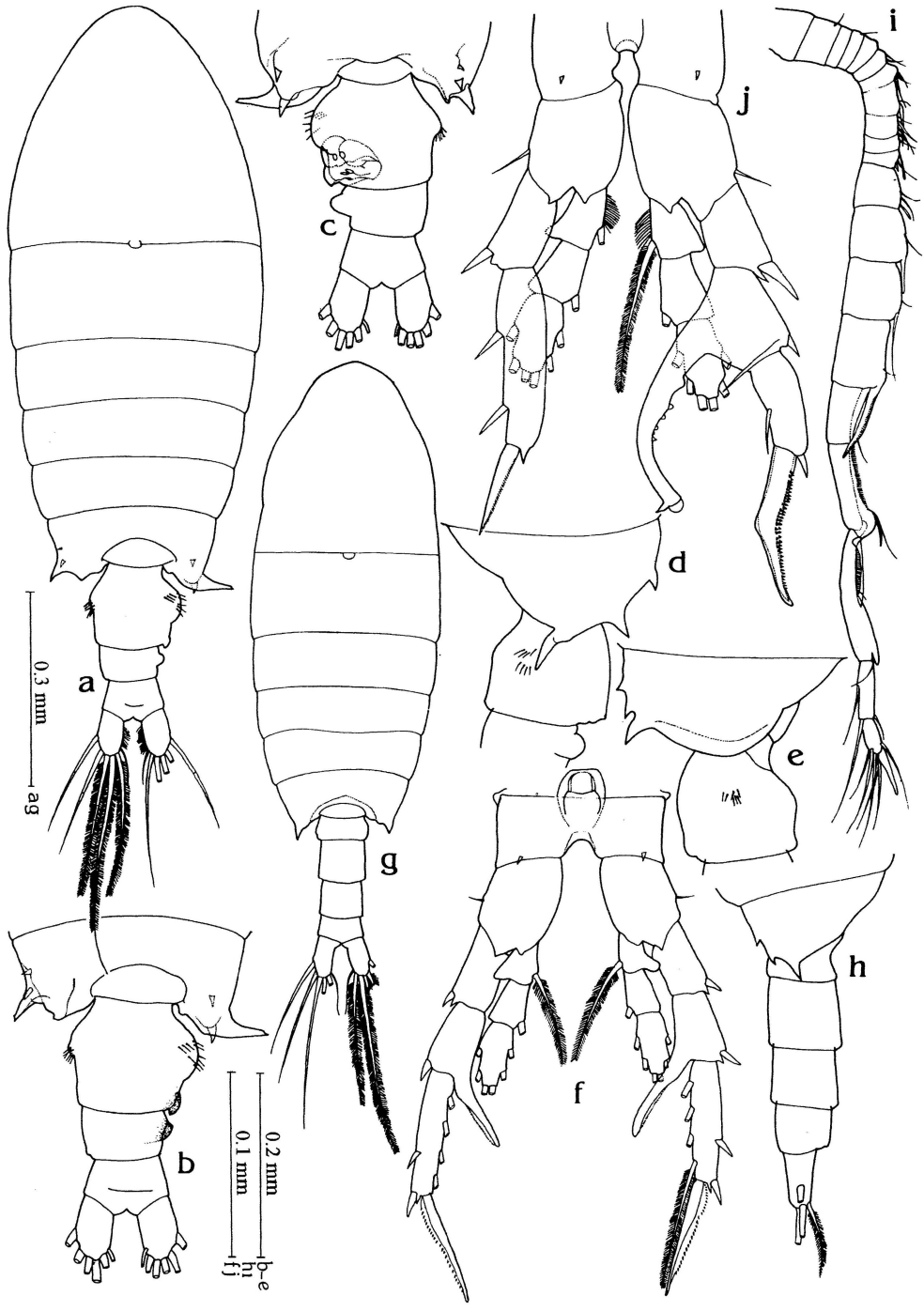

Fig. 2. *Centropages brevifurcus*, female. a, whole animal, dorsal view; b, Ms5 and urosome, dorsal view; c, Ms5 and urosome, ventral view; d-e, Ms5 and genital complex, lateral view; f, 5th legs; male. g, whole animal, dorsal view; h, Ms5 and urosome, lateral view; i, right antennule; j, 5th legs.

teeth on proximal half to 2/3 of length, this segment prolonged distally in a short spur-like process; segment 22 as long as segment 17; segment 23 terminating in spine-like process, 1.5 times the length of the segment, with 6 terminal setae.

Other appendages, except P5, as in female. P5, asymmetrical, right leg with 2 basal segments, 3 exopodal and 3 endopodal segments. B1 with 1 small spine; B2 with outer seta distally; Re2 with 1 outer spine and 1 long spine, prolonged laterally over inner part of the segment and 2 subequal inner spines; inner spine-like process ("thumb") of Re2 curved inwards, terminating in 1 knob-like process and 1 outer acute spine, inner margin with many denticles. Terminal spine of Re3 (claw) with 1 inner seta medially, 1 outer spine and 1 terminal spine with double rows of spinules on outer margin. Left leg with 2 exopodal segments, Re1 with 1 outer spine; Re2 with 2 outer spine and 1 terminal spine. Right and left endopods of P5 very similar to those of the female.

Remarks. - The female of *C. brevifurcus* is easily identifiable by the asymmetrical posterolateral ends of Ms5, right side produced into acute and curved process, anterolateral swelling of genital complex armed with spinules, and Ur2 with medial knob on right margin. The male is identifiable by the trifurcation of the Ms5 corner (visible in lateral view), the segment 23 of the geniculate antennule terminating in spine-like process, and the form of P5.

The present specimens differs from Shen & Lee (1963) description as follows: in the female, (1) the right corner of Ms5 strongly curved outward; (2) in lateral view, posterolateral ends of Ms5 trifurcate; and (3) the right margin of Ur2 with a knob-like process. In the male, (1) in lateral view, the posterolateral ends of Ms5 trifurcate; (2) the armature of the geniculate antennule and the form of P5.

Distribution. - *Centropages brevifurcus* was described by Shen & Lee (1963) based on specimens from Chiekong estuary, Kwangtung Province, South China. So far only known from China waters.

Centropages calaninus (Dana, 1849)

(Fig. 3)

Cyclopsina calanina Dana, 1849: 25.
Hemicalanus calaninus Dana, 1852: 1105, pl. 78.
Centropages calaninus (Dana), Giesbrecht, 1892: 305, pls. 17, 18, 38; Giesbrecht & Schmeil, 1898: 58; A. Scott, 1909: 112; Mori, 1937: 61-62, pl. 30, figs. 4-7; Farran, 1936: Dakin & Colefax, 1940: Wilson, 1942; 1950: 186; Tanaka, 1963: 8; Grice, 1964: 220, pl. 23, figs. 13-18.

Material examined. - Two females (1.90 mm), 1 male (1.70 mm) collected from Ambon Bay by surface tow of 0.33 mm mesh plankton net at night on 22 Dec.1993.

Female. - Posterolateral ends of Ms5 rounded. Prosome 2.5 times as long as urosome. Genital complex somewhat swollen and symmetrical; Ur3 more than twice length of Ur2, with small ventral lamella near distal end; CR asymmetrical, right ramus longer and thicker than left one. A1 24-segmented, reaching distal end of CR by the last 2 segments when folded backwards. P1, Re2 with small notch on outer margin. P5, inner spine-like process of Re2 longer than Re3.

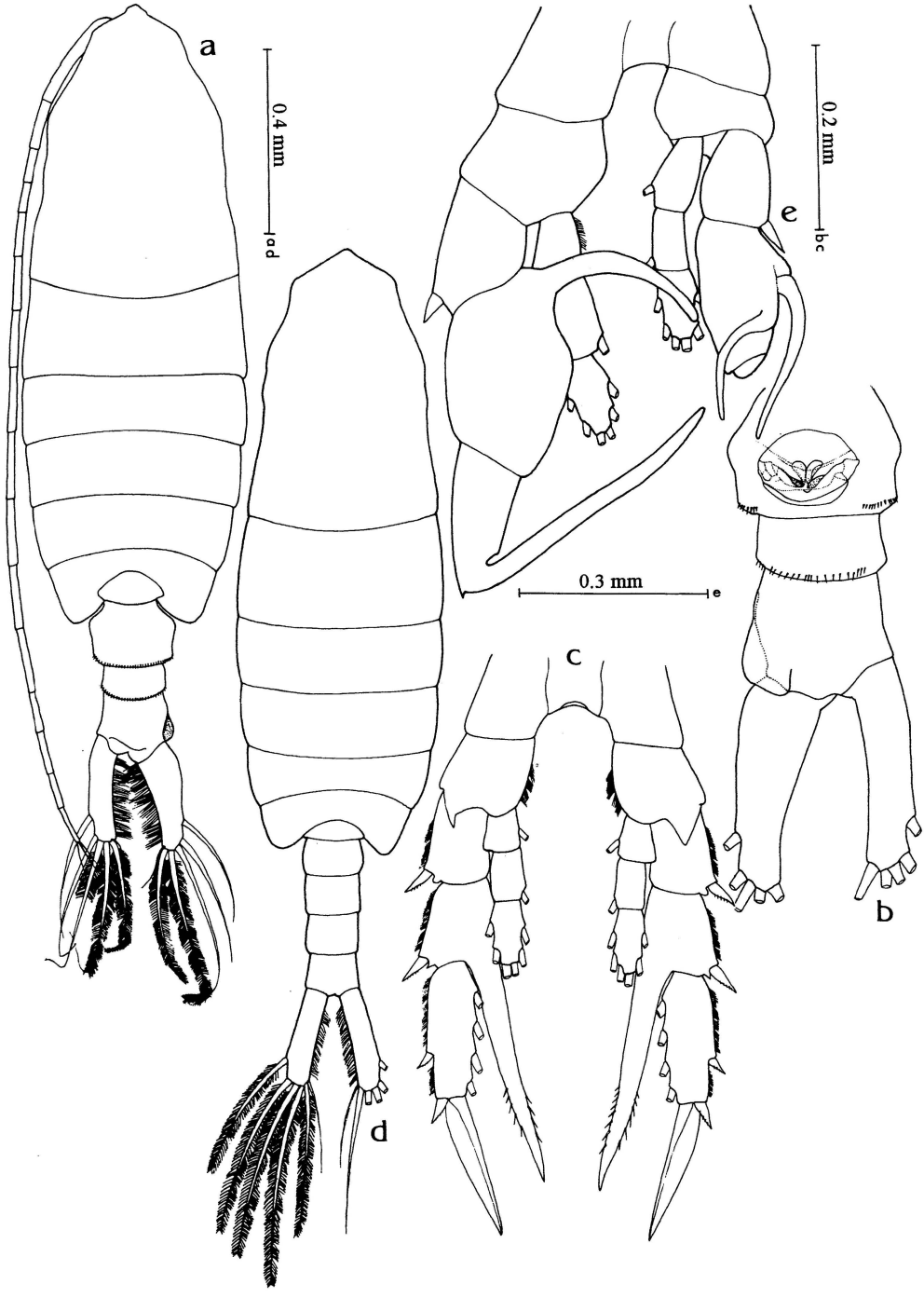

Fig. 3. *Centropages calaninus*, female. a, whole animal, dorsal view; b, urosome, ventral view; c, 5th legs; male. d, whole animal, dorsal view; e, 5th legs.

Male. - Prosome and urosome asymmetrical. Posterolateral ends of Ms5 rounded. Right A1, segments 19-21 shorter than those of *C. gracilis*. P5, right leg, terminal spine of Re2 longer than "thumb", sharply bent inwards. Left leg, Re2 (terminal segment) with 2 finely serrated plates at apex.

Remarks. - The female is identifiable by the small ventral knob on Ur3 and the long spine-like process on the Re2 of P5. The male is identifiable by the form of P5, especially the long and bent terminal claw of the chela.

Distribution. - An Indo-Pacific warm water epiplanktonic form. Indian Ocean records include Sewell, 1947; Krishnaswamy, 1953; De Decker & Mombeck, 1964; and Saraswathy, 1967. Oriental Pacific: Mori, 1937; Wilson, 1950; Yamazi, 1958a; Brodsky, 1962; Tanaka, 1963; central Pacific: Wilson, 1950; Chiba et al., 1955; Grice, 1962; Australasian region: off New South wales coast (Dakin & Colefax, 1940); Great Barrier Reef waters (Farran, 1936), Moreton Bay (Greenwood, 1977).

Indo-Malaysian region. - Eastern Indonesian waters (Cleve, 1901; A. Scott, 1909), otherwise cf. Wilson (1950), and Wickstead (1961).

Centropages furcatus (Dana, 1849)

(Fig. 4)

Catopia furcata Dana, 1849: 25; 1852: 1173-1174, pl. 79, fig. 1a-d.
Centropages furcatus (Dana), Cleve, 1900: 52; Thompson & Scott, 1903: 246; A. Scott, 1909: 113; Wolfenden, 1911: 356; Farran, 1929: 255; 1937: 108; Sewell, 1932: 229; Mori, 1937: 63-64, pl. 32, figs. 1-2; Wilson, 1942: 177; 1950: 186-187; Tanaka, 1963: 9; Chen et al., 1964: 95-96, fig. 43a-h; Gonzales & Bowman, 1965: 247-248; Zhang et al., 1984: 244, fig. 164F-I.
Centropages furcatus var. Carl, 1907: 8, 16, pl. 1, figs. 6-7.
Centropages furcatus var. *carli* Früchtl, 1923: 452, 1924: 45.

Material examined. - Ten females (1.60-1.70 mm), 10 males (1.55-1.70 mm) collected off Labuan, West Java by surface tow of 0.33 mm mesh plankton net at night on 18 June 1994.

Female. - Body narrowly elongated with truncate frontal portion. Posterolateral ends of Ms5 produced symmetrically into long spiniform process with 1 accessory spine on inner side. Genital complex produced into triangular lobes on either side and into a rounded ventral lobe on the right side; Ur2 very short; Ur3 asymmetrical, twice as long as Ur2. CR relatively slender, asymmetrical, right ramus slightly longer and wider than the left one.

A1 24-segmented, reaching distal end of anal somite when folded backwards; anterior margin of segment 1, 2, and 5 produced into 1 sharp teeth. P1-P4 as in the other species of the genus. P5, inner spine-like process of Re2 straight and stout, reaching middle of Re3.

Male. - Posterolateral ends of Ms5 asymmetrical, left side more protruded than right. Ur5 well developed, as long as Ur3; CR 3 times as long as Ur5. Right A1 geniculate, anterior margin of segments 15-16 with very small row of teeth.

P4, Re2 with long outer spine. P5 asymmetrical, right leg, Re2 with spinal process ("thumb") as long as terminal claw; Re3 with 2 teeth on its proximal part. Left leg, Re2 with spinal process at apex and 2 spines near distal end.

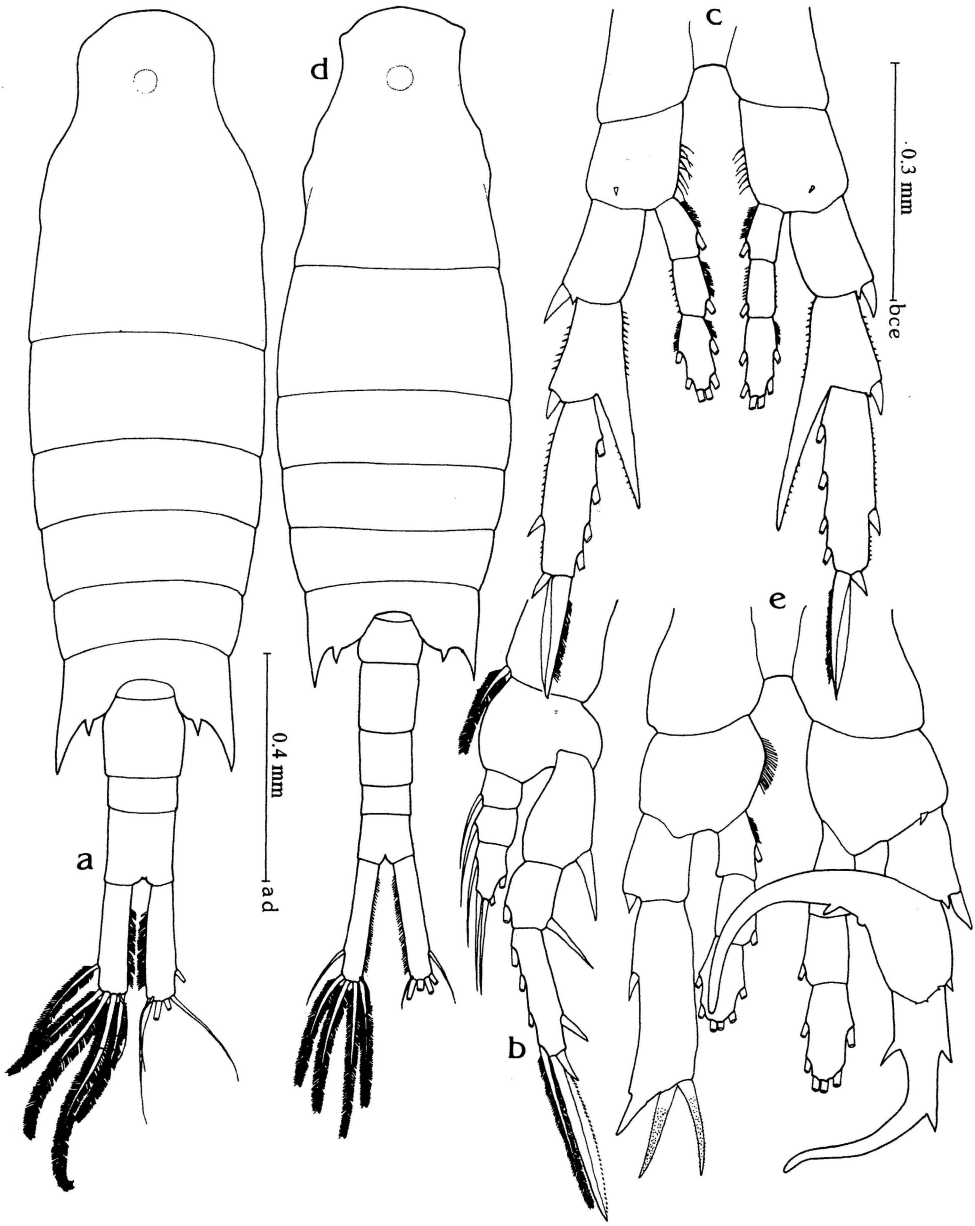

Fig. 4. *Centropages furcatus*, female. a, whole animal, dorsal view; b, 1st legs; c, 5th legs; male. d, whole animal, dorsal view; e, 5th legs.

Remarks. - *Centropages furcatus* is easily identifiable by the slender body, the spiniform prolongations of the posterolateral ends of Ms5, and the very short Ur2 in the female. The form of P5 of both sexes is also characteristic. A variety of the male was described by Carl (1907) from Ambon Bay, and has subsequently been recorded from the Aru Islands by Früchtl (1923) and the Indian Ocean by Sewell (1932).

Distribution. - It is the most widely distributed species of the genus, common in tropical and subtropical areas of the world oceans and often occurring in large numbers (Sewell, 1932; Vervoort, 1963, 1965; Tanaka, 1963; Gonzales & Bowman, 1965). Recorded from the northwestern Pacific by Mori (1937), Tanaka (1953, 1963), Brodsky (1962), and the central Pacific by Wilson (1950).

Australasian region.- Great Barrier Reef waters (Farran, 1936), off the southern coast of Australia (Dakin & Colefax, 1933, 1940), Brisbane River mouth (Bayly, 1965a), Moreton Bay (Greenwood, 1977).

Indo-Malaysian region.- Frequently recorded throughout as noted by Cleve (1901), A. Scott (1909), Wolfenden (1905), Delsman (1939), Wickstead (1961), and Fleminger (1963).

Centropages gracilis (Dana, 1849)

(Fig. 5)

Hemicalanus gracilis Dana, 1849: 1108, pl. 78.
Centropages gracilis (Dana), Giesbrecht, 1892: 305, pl. 17, figs. 31, 32, 46, figs. 4, 13; Giesbrecht & Schmeil, 1898: 57; A. Scott, 1909: 114; Mori, 1937: 62, pl. 30, figs. 8-11; Sewell, 1947: 163; Tanaka, 1963; Grice, 1964: 218, pl. 23, figs. 1-12; Zhang et al., 1989: 244.

Material examined. - Two females (1.85 mm), 5 males (1.75-1.80 mm) collected from Derawan Strait, East Borneo by vertical haul of 0.33 mm mesh plankton net from 100 m to surface at night on 22 October 1994.

Female. - Posterolateral ends of Ms5 rounded. Genital complex with spinules on lateral margin of right side; Ur2 with distinct knob-like projection on lateral margins, surface of each knob covered with fine short spinules, ventral surface bearing a rounded process; CR symmetrical, about 3 times as long as wide.

A1 reaching distal end of CR by the last 5 segments when folded backwards. P5 slightly asymmetrical, inner spine-like process of Re2 nearly straight, stout and almost as long as Re3, inner spine of Re2 of left leg slightly longer than right.

Male. - Ms4 very short. CR about 4 times as long as wide. Left A1 reaching distal end of CR by the last 3 segments when folded backwards, middle part of right A1 slender.

P5, right leg with terminal claw longer than "thumb" and with 1 triangular process on inner margin.

Remarks. - The female of *C. gracilis* is easily identifiable by the lateral marginal spinules on Ur2, and the short inner spine of Re2 of left P5. The male is identifiable by the triangular process on the inner margin of the terminal claw of right P5, which is absent in other species of the genus.

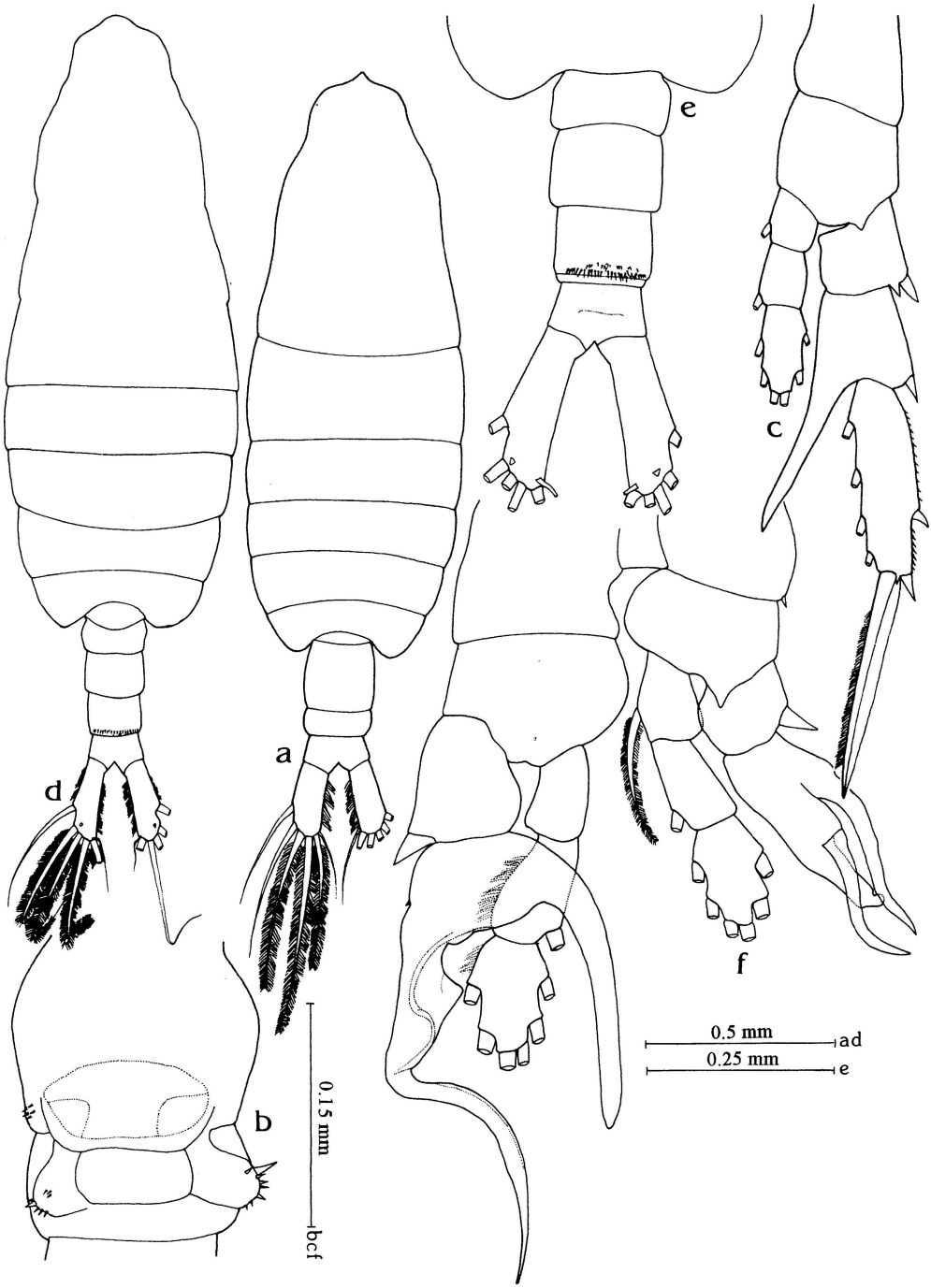

Fig. 5. *Centropages gracilis*, female. a, whole animal, dorsal view; b, genital complex, ventral view; c, 5th leg; male. d, whole animal, dorsal view; e, Ms5 and urosome, dorsal view; f, 5th legs.

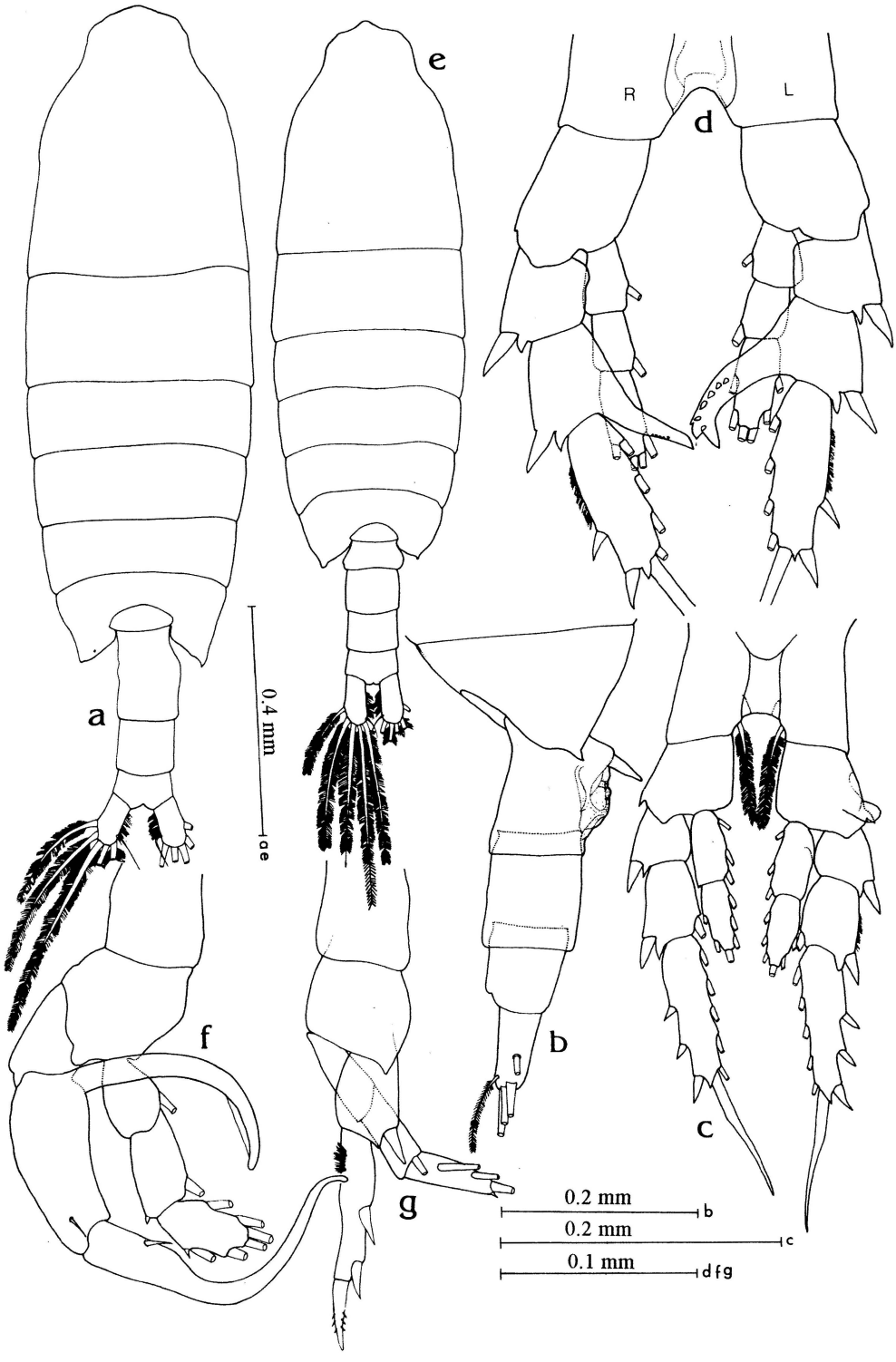

Fig. 6. *Centropages orsini*, female. a, whole animal, dorsal view; b, Ms5 and urosome, lateral view; c, 4th legs,; d, 5th legs; male. e, whole animal, dorsal view; f, right 5th leg; g, left 5th leg.

Centropages orsini Giesbrecht, 1889
(Fig. 6)

Centropages orsini Giesbrecht, 1889: 305, pls. 17, 18, 38; Giesbrecht & Schmeil, 1898: 57; A. Scott, 1909: 115; Sewell, 1911: 315; 1914: 221: 1932: 230; 1947: 163; Farran, 1936: 109: Mori, 1937: 60, pl. 29, figs. 1-7; Wilson, 1950: 187-188; Tanaka, 1963: 9: De Decker & Mombeck,1964: 11; Saraswathy, 1967: 78; Greenwood, 1977: 63, fig. 5c, d.

Material examined. - Ten females (1.40-1.60 mm), 10 males (1.25-1.30 mm) collected off Labuan, West Java by surface tow of 0.33 mm mesh plankton net at night on 18 Jun.1994.

Female. - Posterolateral ends of Ms5 pointed. Genital complex symmetrical, with 1 ventral spine; CR twice as long as wide with 5 plumose and 1 small setae. A1 24-segmented reaching distal end of CR when folded backwards.

P1-P4 with 2 basal, 3 exopodal, and 2 endopodal segments. P5 slightly asymmetrical, inner spine-like process of Re2 short and stout, beset with small spinules, not reaching to distal end of Re3.

Male. - Posterolateral ends of Ms5 slightly asymmetrical, pointed, left side longer than right one. CR as in female. A1, left side 24-segmented, extends to middle CR; right side, with anterior margin of segments 15 and 16 with 1 weak process.

P5, right leg, "thumb" of chela shorter than terminal claw; left leg with 2 exopodal segments, Re2 projecting into 1 long spine terminally.

Remarks. - *Centropages orsini* mostly resembles *C. kroyeri*, but is distinguished from the latter by the form of P5 of both sexes. The inner spine-like process of Re2 is short and stout, it is beset with spinules. In *C. kroyeri* the projection is comparatively slender and it is without spinules. The terminal claw of the male right P5 is longer than the "thumb". In *C. kroyeri* the "thumb" is longer than the terminal claw.

Distribution. - Indo-West Pacific in warm waters; Gulf of Aden and Red Sea (Giesbrecht, 1892), northern Indian Ocean (Wolfenden, 1905; Sewell, 1947; Saraswathy, 1967), southern Indian Ocean (Brady, 1915; De Decker & Mombeck, 1964), Pacific (Mori, 1937; Yamazi, 1958a; Tanaka, 1963; A. Scott, 1909).

Centropages sinensis Chen & Zhang, 1965
(Fig. 7)

Centropages sinensis Chen & Zhang, 1963: 126-127, pl. 26, figs. 1-7; Zhang et al., 1989: 243.

Material examined. - Ten females (1.40-1.42 mm), 10 males (1.25-1.30 mm) collected off Tegal, Central Java by surface tow of 0.33 mm mesh plankton net at night on 3 June 1994.

Female. - Cephalosome robust. Cephalon and Ms1 fused; Ms4 and Ms5 separated, posterolateral ends asymmetrical, right side pointed, left side rounded. Rostral filaments slender. Genital complex asymmetrical, broadest, right side swollen provided with numerous denticles, anal somite shortest. CR asymmetrical, left ramus slightly longer than right. A1 24-segmented, reaching distal end of Ms5 when folded backwards.

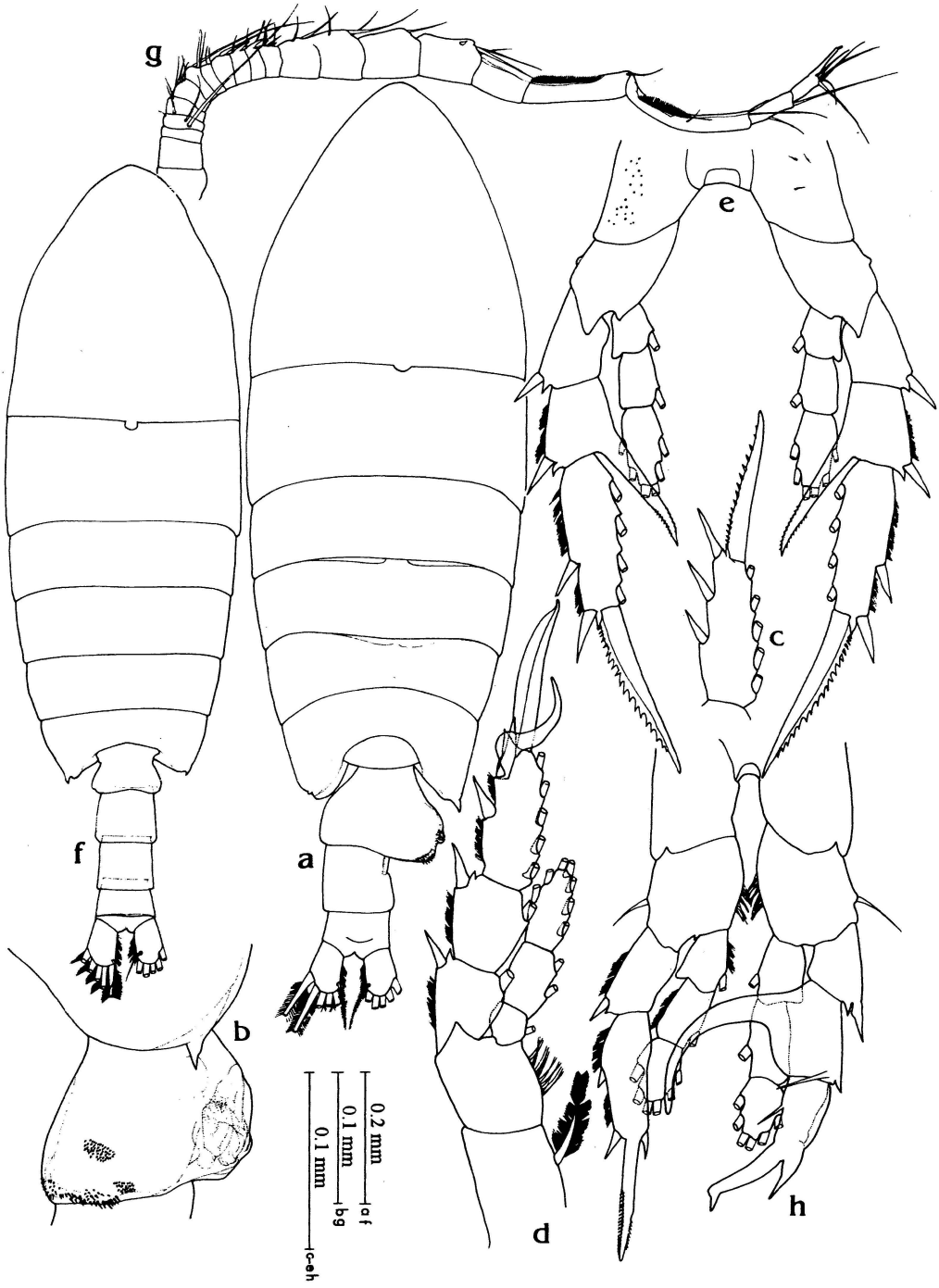

Fig. 7. *Centropages sinensis*, female. a, whole animal, dorsal view; b, Ms5 and genital complex, lateral view; c, distal segment of left 4th leg; d, right 4th leg; e, 5th legs; male. f, whole animal, dorsal view; g, right antennule; h, 5th legs.

P2-P4 similar to other species of the genus; P5 asymmetrical, distal 1/3rd of inner spine of Re2 denticulated on both margins, longer than Re1 and Re2 combined, but shorter than Re3.

Male. - Cephalosome similar to female, posterolateral ends of Ms5 small and almost symmetrical. Urosome, Ur2 longest. Right A1 geniculate, anterior margin of segment 17 with rows of denticles from proximal to 1/3 from distal end; segment 18 with short row of denticles; distal segment armed with long, spur-like process.

P1-P4 of left side longer than those of right side. Se2 of Re2 of right P4 longer than that of left P4; Se3 of right Re3 hook-like and curved outwards, outer marginal denticles of apical spine smaller than those of the left side. P5 asymmetrical, left leg, Re 2-segmented, Re2 longer than Re1; right leg, Re 3-segmented, Re2 broadest, ventral margin of its inner spine on both sides, apical spine strong and smooth its distal portion curved outwards.

Remarks. - So far this species was only known from the China Sea, commonly found in the coastal waters of the Gulf of Hangchow and in the Chou-San Archipelagoes during summer and autumn (Chen & Zhang, 1965).

Centropages tenuiremis Thompson & Scott, 1903
(Fig. 8)

Centropages tenuiremis Thompson & Scott, 1903: 247, pl. 1, figs. 14-18; Chen et al., 1964: 91, fig.40a-h; Chen & Zhang, 1965, pl. 25, figs. 1-6; Chen et al., 1989: 224, fig. 164.
Centropages arabicus Cleve, 1903: 371, pl. 16, figs. 1-9, pl. 17, fig. 1.
Centropages kroyeri (male), Mori, 1929: 174, pl. 6, figs. 4-7.
Centropages orsini (female), Mori, 1929: 174, pl. 6, figs. 2-3.
Centropages yamadai Mori, 1937: 59, pl. 28, figs. 7-12; Tanaka, 1963: 11, fig. 153a-c.

Material examined. - Five females (1.95-2.00 mm), 5 males (1.75-1.80 mm) collected off Tegal, Central Java by surface tow of 0.33 mm mesh plankton net at night on 3 Jun.1994.

Female. - Cephalon rather protruded. Posterolateral ends of Ms5 produced into symmetrical, long, spinal process. Genital complex asymmetrical, left side with 2 swelling, separated by constriction, ventral surface with 1 hook-like process; Ur3 (anal somite) very short; CR 3 times as long as wide, outermost seta short and pointed, the outer 4 setae thickened proximally.

A1 24-segmented, reaching distal end of CR by the last 2 segments when folded backwards.

P1-P4 as in rest of genus. P5 asymmetrical, right leg with 2 exopodal and 3 endopodal segments, inner margin of fused segment Re1-Re2 with 1 stout spinal process, extending backwards, and bearing fine teeth. Ri2 with hairs on posterior surface. Left leg with 3 exopodal and 3 endopodal segments, inner spinal process on Re2 naked and shorter than the segment, posterior surface of Ri2 naked.

Male. - Posterolateral ends of Ms5 produced into short spinal process. Urosome composed of 5 somites, symmetrical, CR as in female. Right A1 geniculate, anterior margin of segment 18 with denticulated ridge. P1-P3 as in female. P4, right Re2 longer than the left one, third outer spine of Re3 symmetrical. P5, right leg, Re 3-segmented, a spinal process stretching from middle part of inner margin of Re2 to form a chela with Re3, "thumb" of chela shorter than terminal claw (Re3).

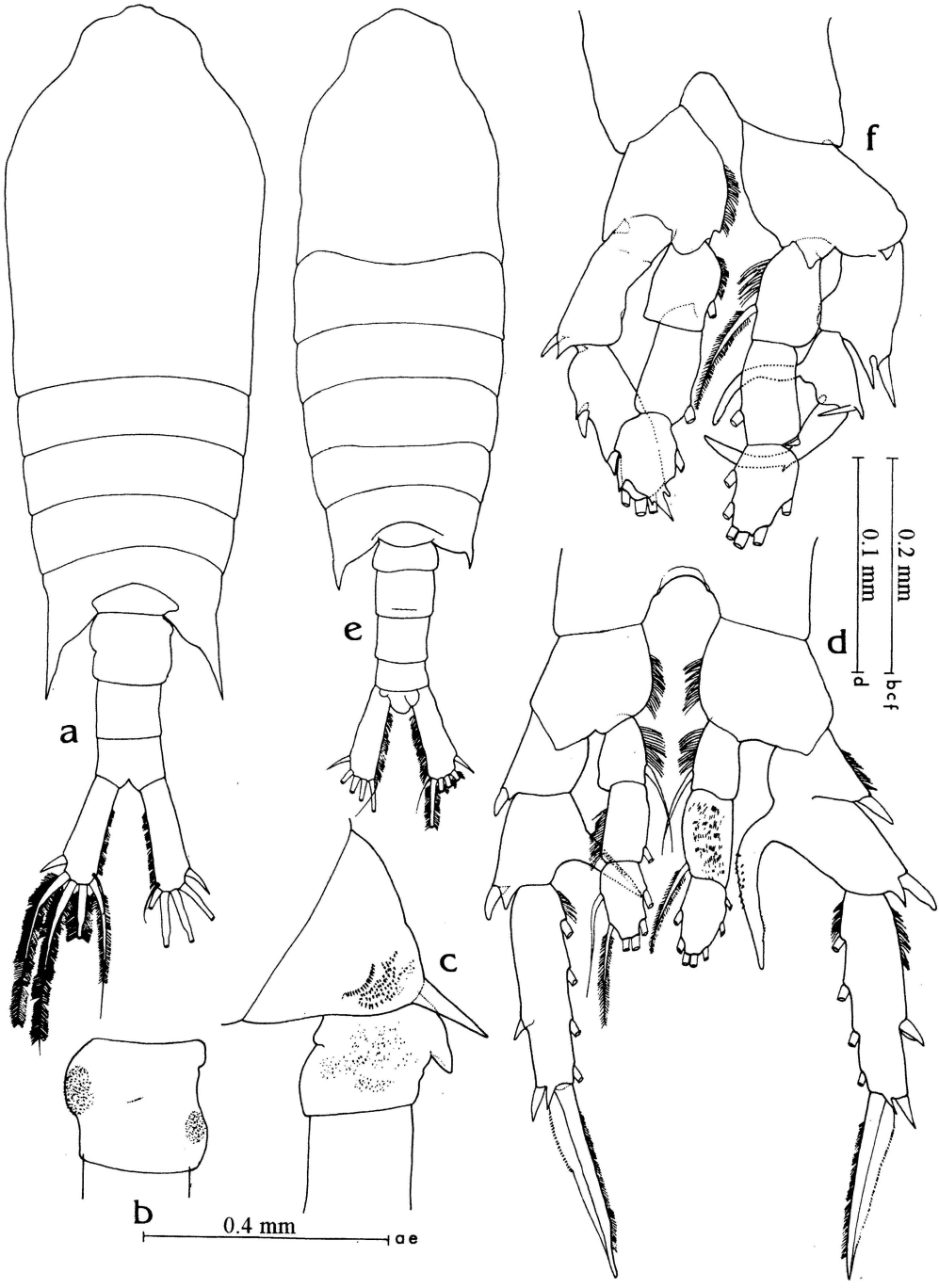

Fig. 8. *Centropages tenuiremis*, female. a, whole animal, dorsal view; b, genital complex, dorsal view; c, Ms5 and genital complex, lateral view; d, 5th legs; male. e, whole animal, dorsal view; f, 5th legs.

Remarks. - This is an estuarine and coastal species, occurring in large numbers in epipelagic neritic waters of the Java Sea during the dry season, but absent in eastern Indonesian waters during the present study.

Distribution. - Ceylon Pearl Banks (Thompson & Scott, 1903), China Seas (Chen et al., 1964; Chen & Zhang, 1965; Zhang et al., 1989), Korea and warm waters of Japan (Mori, 1929, 1937; Tanaka, 1963).

Australasian region.- No records.

GENERAL REMARKS

The genus *Centropages* Kroyer, 1849 consists of surface living forms, almost all of which are widely distributed in warm waters. Some of the species (*C. furcatus, C. sinensis*) are primarily neritic while others (*C. calaninus, C. gracilis*) are oceanic.

All the species previously recorded from the area, except *C. elongatus*, have been found in the present study. Besides three species, i.e., *C. brevifurcus*, *C. sinensis*, and *C. tenuiremis*, have been newly recorded from Indonesian waters. *C. furcatus* and *C. orsini* occurring almost on all locations (Table 2). *C. furcatus* is known as a circumglobal species, commonly found in the Indian and Pacific Oceans, and extending into the tropical Atlantic Ocean, off Brazil (Bjornborg, 1963) and Puerto Rico (Gonzales & Bowman, 1965). It was also found to be common in Indonesian waters and always co-occurred with *C. orsini*. *C. orsini* is apparently restricted to the Indian and Pacific Oceans (Madhupratap & Haridas, 1986).

Centropages calaninus and *C. gracilis* are frequent in oceanic waters of the Indo-Pacific, but are restricted in eastern Indonesian waters to limited numbers, whereas *C. brevifurcus* and *C. sinensis* appear to be neritic and endemic to the China Seas and extend into the Java Sea, although *C. sinensis* was only recorded inside the estuarine off Tegal, Central Java (Table 2).

Table 2. Species list of the genus *Centropages* 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, A = Indonesian waters, B = Malaysian waters, C = China Seas, D = Japanese waters, I = Indian Ocean, P = Pacific Ocean, At = Atlantic Ocean.

Species	Sites															Indo-Australasian				Oceans		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	B	C	D	I	P	At
C. brevifurcus	○			○	○											nr		•				
C. calaninus										○					○	•		•	•	•	•	
C furcatus	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	•	•	•	•	•	•	•
C. gracilis							○					○		○	○	•	•		•	•	•	
C. orsini	○	○	○	○	○	○				○						•		•	•	•	•	
C. sinensis				○												nr		•				
C. tenuiremis		○	○	○	○											nr		•		•	•	

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